J Ornithol (2006) 147: Suppl 1 1–297
DOI 10.1007/s10336-006-0093-1

ABSTRACTS

Plenaries

Adkins-Regan E

Hormones and the development of sex differences in behavior

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Birds are diverse in their degree of sexual dimorphism in behavior as well as morphology. Some are quite monomorphic behaviorally, while others have striking sex-specific behaviors such as male displays or vocalizations. Much attention has been paid to the evolutionary origins and selective pressures responsible for this diversity. A necessary complement to an understanding of the ultimate causes of dimorphism is the discovery of the proximate endocrine and other physiological mechanisms that lead to its development and adult expression. Experiments with Japanese Quail (*Coturnix japonica*), a precocial species with male-specific crowing and strutting, have shown that some of the sex differences are produced by hormonal dimorphism in adulthood (activational effects), whereas others are produced by permanent actions of sex steroids early in development, during the embryonic period (organizational effects). Experiments with Zebra Finches (*Taeniopygia guttata*), an altricial species, have revealed organizational effects on singing and mating that occur after hatching, during the nestling period. In both species, organizational effects are due primarily to estrogens, not androgens. The overall pattern of organization differs between the two species in interesting ways. Thus, early treatment with estrogen feminizes crowing in male quail but masculinizes singing in female Zebra Finches. Dimorphic behavior also includes mate preferences and choices, where the behavior itself is not necessarily dimorphic but the targets to which it is directed are. Experiments with both species suggest that sex differences motivating birds to mate or pair are produced by organizational rather than activational hormone actions. Zebra Finches are socially monogamous and form permanent pair bonds. Both sexes are motivated to pair, and pairing interest and success are expressed through monomorphic affiliative behavior such as clumping, mutual preening, and spending time in a nest together. Young juveniles direct this behavior toward family members. As they approach sexual maturity, the targets for the behavior shift from the family to potential pairing partners. What is the role of sex steroid hormones, if any, in adult pair bonding? Is it involved in the developmental shift in the target individuals for affiliative behavior? Although many species of birds form pair bonds, little is known about their physiological mechanisms. Experiments with adult Zebra Finches have shown that interfering with sex steroid actions has no effect on pairing interest or success in either males or females. Such a lack of significant involvement of sex hormones in adult pair formation may be widespread in other species that pair permanently, even when not actively breeding. Regulation of adult pairing by sex hormones is more likely to occur in species that pair seasonally, but even then indirect evidence suggests that high levels of sex steroids are not always necessary for continued maintenance of the pair relationship throughout the breeding season. The concept of hormonal organization, and the results of the experiments with Japanese Quail and Zebra Finches, raise a number of interesting questions, such as: (1) what other hormones and neurochemicals might be involved in mechanisms for pair bonding in continuously paired species, (2) what kinds of evolutionary changes in development have given rise to species differences in the degree of sexual dimorphism, and (3) what is the phylogeny of the major patterns of hormonal organization in birds? Supported by the National Science Foundation, U.S.A.

Bezzel E

Birds in Germany: Some insights after nearly two centuries of comprehensive bird recording by birdwatchers and ornithologists

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The breeding bird fauna of Germany forms a representative sample of the bird fauna of the temperate zone of the western palearctic region. According to atlases of breeding birds at the end of the 20th century, the breeding ranges of species in Germany match those in surrounding areas. Germany has no endemic species. Of species found on more grid units than expected, those of forest and farmland dominate; and those that are sparser and rarer are birds of oligotrophic open land and wetlands. The present differences in the ranges of species between Germany and adjacent parts of Europe seem to be determined more by available habitat than by zoogeographic gradients. Population sizes vary similarly. According to data in the BirdLife/EBCC European Bird Database, those breeding species that are abundant in Germany are similarly abundant in adjacent countries as well. Only several very rare species show different patterns; but there is no species that is rare in continental Europe yet common in Germany. In the middle of the 19th century, the well-known German ornithologist Johann Friedrich Naumann published a detailed review in which he bewails the decline of birds in central Germany. As a result of fifty years of birdwatching and experience in professional bird trapping for food, he saw "modern" practices of increased farming and human persecution as the main causes for alarming decreases. Thirty years later, Karl Theodor Liebe published a list, according to which more species had declined than increased in Thuringia, particularly the larger non-passerines, due mainly to human exploitation of forests and open land. So there is a reliable history of the German bird fauna from before the Industrial Revolution in the second half of the 19th century, an event that marks the beginning of the change which has affected so many bird habitats up to the present. Detailed local and regional bird reports have existed since that time, giving insight into the dynamics of species diversity in central Europe. More than a hundred years ago, the relative number of records indicating negative trends or extinction in local or regional populations per time unit seem to have been higher than during the 20th century. In the 20th century, rather more regional species seem to have increased than declined. This may be due to prior preoccupation with recording species that were declining or disappearing locally; but it is surely also a result of successful efforts in protecting threatened and rare species nowadays. For some of the larger areas of Germany, published data and documented birdwatching over periods of differing socio-economic and technical conditions enable reconstruction of the number of species breeding annually over a long period through the 20th century. In Bavaria, the number of species breeding annually has increased by seven percent over the last hundred years, and the number breeding per decade by eight percent. This small but nevertheless surprising increase is contradictory to the findings of some local studies, and has to be interpreted carefully because the present situation may be masked by several influences. The increase is unlikely to reflect more bird recording activity in recent decades, but may well result from conservation efforts. Though the balance between new and lost breeders is positive over the last hundred years, it has still fallen in the last three decades. The number of introduced species increased from less than one percent in the first decade of the 20th century to nearly eight percent in the last. Moreover, the balance between new and lost species is related to the size of the area involved indicating a species-area relationship. The decline in common and widespread species within the last decades has involved populations in smaller rather than larger areas. Thus in Bavaria, where the overall trend per decade is positive, turnover in species in smaller areas tends to be negative: species diversity reacts more sensitively at local than regional scales. A hundred years ago, birdwatchers and ornithologists in Germany focused on describing the situation rather than documenting the dynamics. So a huge amount of collected data was often published in detailed reports or lists. These irreplaceable historical sources not only provide information on the distribution of species but also such seasonal events as the arrival or departure of well-known migrants. The first seasonal records of migrants at the beginning of the 20th century compared with data collected a hundred years later indicate considerable changes in migratory behavior in some species.

Blondel J

The story of Mediterranean Blue Tits: How to cope with heterogeneous and rapidly changing environments

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A basic problem in evolutionary biology concerns the adaptation of populations to environments that are heterogeneous and change rapidly. Mediterranean landscapes are highly dynamic ecological systems with mosaics of habitats that are dominated by either deciduous or evergreen trees, such as the patches of oakwoods with variable proportions of deciduous Downy Oak (*Quercus humilis*) or evergreen Holm oak (*Q. ilex*). The particular oak habitat type determines the timing of the leafing of trees in spring and, hence, the development of leaf-eating caterpillars which are the preferred prey of the Blue Tits (*Parus caeruleus*). The leaves of deciduous oaks develop one month earlier than those of evergreen oaks and, therefore, provide food for caterpillars one month earlier. Because 100% of the foliage of deciduous oak is renewed each year in contrast to only 30% of the foliage of evergreen oaks, the abundance of caterpillars is much lower in evergreen than deciduous forests. A large number of habitat types has been studied in two landscapes of southern France, one of which is on the mainland where deciduous oaks are more common and the other on the island of Corsica where evergreen oaks dominate. Combined with experimental approaches, these study sites provided a wealth of data on phenological, morphological, genetic, behavioral and physiological responses of Blue Tits to the various habitat-specific features and constraints of the environments. The one-month difference in the phenology of oaks and associated invertebrates results in a corresponding one-month difference in the onset of breeding for those populations that best match the supply/demand ratio of food. Populations that settle in the less common oak forest in each landscape and miss the peak of food production, however, have much lower breeding success and produce fewer offspring of poorer quality. This local maladaptation was shown by minisatellite markers to result from gene swamping from rich to poor habitat patches, producing a source-sink population structure. Blue Tits breeding in the productive deciduous oak habitat patches start to breed earlier, lay more eggs, and produce more offspring of better quality than those that settle in evergreen oakwoods. They are also larger and heavier but cross-fostering experiments have shown that differences in environmental constraints result in adaptive differences in nestling growth and hematocrit values leading to environmentally-induced phenotypic plasticity. In evergreen oak habitats, various combinations of constraints, such as food shortage, parasite loads and high temperatures, create more variable and sometimes extremely poor breeding conditions for these late breeding birds. Parasites are especially harmful when food is scarce, and may reduce the heritability of size-related traits, thus limiting evolutionary responses to selection. Missing the peak of food production can be very costly and may have severe consequences on fitness and survival: doubly-labeled water experiments have shown that the metabolic effort of adults rearing chicks increases steeply as the time difference between breeding date and peak caterpillar productivity increases, which forces adults to work far beyond their sustainable limits. Radiotracking showed that parent tits in the poor evergreen habitats forage at much greater distances from their nest, but that the amount of food delivered to each chick is similar to that in deciduous oakwoods due to smaller number of chicks and a greater mean prey size. Foraging distances and searching time are longer for mismatched adults, with severe consequences for survival prospects. Inter-habitat phenotypic variation in life history traits is considerably higher on Corsica than on the mainland, providing a striking example of an adaptive response of suites of life history traits to habitat-specific selection regimes that operate on a scale that is much smaller than the scale of dispersal and potential gene flow. This difference between mainland and insular patterns is due to reduced dispersal in the island birds, which is part of the insular syndrome. Interestingly, weak genetic differentiation contrasted with large phenotypic variation in the populations on Corsica. Despite significant heritability of and selection for several traits, no significant change was found over time. A variety of factors may explain why traits may have considerable additive genetic variance and appear to be under directional selection and yet do not evolve. The study system illustrates an extreme case of habitat heterogeneity and divergent selection regimes at landscape scale for small passerines in temperate habitats. The most fascinating aspects of the story, with a cascade of consequences for life history, is the one-month difference in breeding time between populations, depending on the morphotype of oakwood chosen for breeding. Several experiments in the field and in aviaries have been devised to determine whether variation in their traits is a plastic phenotypic response or has resulted from genetic differentiation in response to local selection regimes. The observed variation in Mediterranean Blue Tits illustrates a large body of theoretical work, and supports the divergence-with-gene-flow model of speciation, whereby reproductive isolation can evolve between populations that are connected by gene flow whenever divergent selection is strong relative to gene flow. Wherever habitat heterogeneity is a mixture of very different habitat patches, the resulting reaction norm includes either local specialization, phenotypic plasticity, or local maladaptation depending on the size of the habitat patches relative to the average dispersal range of the organism.

du Plessis MA

Delayed dispersal and cooperative breeding in birds

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Cooperative breeding, a reproductive system in which more than a pair of individuals behave parentally towards young in a single nest or brood, has attracted significant attention over the past four decades. By the early nineties, signs of agreement among workers in the field seemed to draw the earlier excitement in the field to a close. More recently, however, several new lines of argument have reinvigorated the field, not the least of which have been the debates centered on the role of its evolution on ecology, life history and phylogeny. In order to understand the evolutionary basis of cooperative breeding, a framework involving the dissociation of two key questions has generally been used. First, why do birds delay dispersal, and second, given delayed dispersal, why do the large majority of philopatric birds provide care to offspring on the territory in which they live? I propose to focus largely on the first question, but with cursory reference to some of the current thinking on the second. As reproductive maturity is reached, an individual is faced with the decision to breed independently or delay breeding. In the latter case, there are three options: delay breeding by staying on the natal territory either as a helper or as a non-helper, or to leave the natal territory as a "floater". If the cost and likelihood of successful breeding vary spatially and temporally, individuals may delay dispersal and/or independent breeding in response to the following: the quality of the territory, the depressibility of key resources, the risks associated with dispersal, and/or, in unpredictably variable environments, the seasonal variation in territory quality. The dispersal threshold model suggests that delayed reproduction may in some instances ultimately yield higher lifetime reproductive success than breeding independently in territories of poor quality. Various constraints and opportunities affect our attempts to understand the relative importance of the above factors. First, measures of territory quality have been fraught with complications and generally the best that can be done is to control indirectly for their effects in demographic analyses. Secondly, when breeders allow offspring to remain on the parental territory, there is potential for competitive conflict for access to critical resources on the territory. It is therefore important to consider the nature of the critical resources in terms of their depressibility. Thirdly, it is difficult to quantify the risks associated with dispersal accurately. In this connection, some colonial species breed in circumstances where most individuals in the colony have access to nest sites and experience similar environmental conditions. Thus, colonial birds are not necessarily exposed to the risks commonly associated with dispersal, which has been suggested to have a strong influence on the reproductive decisions that territorial cooperatively breeding birds take. Fourthly, in unpredictable environments, the severity of environmental conditions during different breeding seasons vary greatly. This presents some non-breeders with the opportunity to base their reproductive strategies on seasonal variation in territory quality. While it is possible to identify constraints operating on individual cooperative breeders or to agree on shared life-history characteristics, it still cannot be predicted when species will adopt the strategy of staying at home or to float non-territorially as non-breeders. The absence of strong predictive capacity to explain the phenomenon of delayed dispersal is of concern, particularly given that similar ecological and life-history features are shared by a large majority of species that do not delay dispersal and/or breed cooperatively. A potentially fruitful approach could lie in the study of delayed dispersal and cooperative breeding among irregular cooperative breeders or those species that show extensive variability in degree of sociality.

Edwards S

Genomics and ornithology

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Like many areas in ornithology and ecology, new technological advances have allowed the avian genome to come into sharper focus. The recently completed draft chicken genome sequence is but a start. New initiatives, including complete sequencing of the Zebra Finch (*Taenopygia guttata*) genome, will accelerate the development of a truly comparative genomics of birds. We can already glimpse this comparative genomics through the few available multi-kilobase aligned nuclear genome comparisons among birds, chromosome painting studies, and also through large-scale bioinformatics analyses of avian and reptilian genomic DNA. These studies suggest that avian genomes will be very conserved in terms of their overall organization, synteny (order) of genes along the chromosome, genome content and rate of evolution, and may exhibit specific rules, such as a faster rate of sequence evolution on autosomes and on microchromosomes. But genomics has much more to offer ornithology than comparative genomics and phylogenetics. New studies employing macro-and micro- array analyses of expressed genes have begun to suggest, in broad outline, networks of ecologically relevant genes that help birds combat pathogens and whose regulation may undergo bouts of evolution during epizootic events. Such micro-array platforms may provide an avenue for examining gene expression differences in a variety of ecological contexts - between dominant and subordinate individuals, breeders and migrants in low- and high- quality habitats, and between phenotypically plastic behavioral and hormonal syndromes in social systems such as cooperative breeding. Large-scale expressed sequence tag (EST) surveys of brain transcripts in the Zebra Finches promise to provide resource for examining changes in brain structure and function during ontogeny and in response to song. Ultimately, with the advent of the first comparative maps of avian genomes, genomics will shine a bright light on the process of speciation itself. Avian genomics is still clearly in its infancy, and the challenge for an integrated ornithological genomics is to marry the considerable technical challenges of scaling up in our surveys of genomic variation with field studies of variation in behavior, ecology and physiology. Such cross-disciplinary efforts will help pinpoint those regions of the genome participating in adaptive change, and help predict phenotypic changes resulting from changes in DNA.

Greenwood JJD

Citizens, science and bird conservation

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Collaborative work by amateurs has made substantial contributions to ornithology and to bird conservation science, at least in some countries. In those countries, it has expanded the numbers of citizens who are well-informed and rationally concerned about environmental issues. Yet there is potentially much more that could be done, in terms of the topics investigated, the countries involved, and the numbers of people participating.

Haffer J

The development of ornithology in central Europe

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The first genuine ornithologist in Europe since Aristotle was the emperor Friedrich II of Hohenstaufen whose work on falconry, written before 1248, includes a general account of birds based largely on his personal observations. Other medieval workers on birds were Albertus Magnus, Thomas di Cantimpré and Konrad von Megenberg. Gilbertus Longolius (1544) and William Turner (1544) reported on some birds of the Rhine region. The Renaissance encyclopedist, Conrad Gesner (1555), compiled the total knowledge of European birds at the time, listing 182 species in alphabetical order. The first local vertebrate fauna was published by Caspar Schwenckfeld (1603) who included brief accounts of c. 150 species of birds. Several collections of unpublished bird paintings from the late 16th and the 17th centuries also represent valuable faunistic records. Two separate research traditions in Europe originated around 1700 from the work of John Ray (1627 to 1705) in England: research into the systematics of birds, and research into the field natural history of birds. The principal early representatives of the natural history tradition in Germany were Ferdinand Adam von Pernau and Johann H. Zorn who published the results of their important field studies during the first half of the 18th century. They worked under the concepts of physico-theology employing the teleological principle, and were the first truly significant researchers of the biology of European birds. The first German bird book with excellent folio color plates was that of Johann L. Frisch which appeared in 1733 to 1763. Around 1800, two detailed handbooks on the birds of Germany were published by J. M. Bechstein and by J. A. Naumann, respectively. The text of Bechstein is more extensive than that of Naumann, but the color plates in the latter, prepared by his son Johann Friedrich, are superior. The Golden Age of central European ornithology from 1820 to 1850 saw the appearance of the splendid works of Johann Friedrich Naumann, Christian Ludwig Brehm, and Friedrich Faber who established a sound basis for the study of birds in this region and beyond. During the second half of the 19th century, many European researchers turned their attention to exotic ornithology, because large bird collections were arriving in Europe then from many different parts of the world. During those decades, the study of central European birds made little progress, despite a major controversy over instinctive versus purposive behavior in birds which did not stimulate any field research. The influence of the Darwinian theory of evolution (1859) had little impact among central European ornithologists until the end of the 19th century. From the 1920s onward, central European ornithology changed rapidly, and general biological studies began to take precedence over earlier systematic-faunistic work: the Stresemann revolution. This paradigm change had a worldwide impact, and it was soon recognized that the bird is a well-suited subject for studies into the problems of functional morphology, physiology, behavior and orientation in animals.

Merton DV

The Kakapo: some highlights and lessons from five decades of applied conservation

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The Kakapo (*Strigops habroptilus*) is a giant, flightless, nocturnal parrot endemic to New Zealand, in the monotypic subfamily Strigopinae. It is the largest parrot, adults weighing <4.0 kg. The kakapo has combinations of features not shared by any other bird and is unique amongst parrots in having a "lek" mating system. Its origin and relationships with other parrots are obscure and distant, and it is one of the last surviving members of a unique avian-herbivore/plant system that disappeared with the extinction of the moas. The Kakapo was well-adapted to ground mammal-free conditions in prehistoric New Zealand, but proved pathetically vulnerable to predation by introduced mammalian carnivores. By the 1990s it had declined to extinction throughout its natural range and was critically endangered. It survives today on three off-shore islands to which it was relocated in 1975 for its protection. Attempts to avert its extinction were first made in the late 1890s when the New Zealand government transferred ~375 birds to islands in Dusky Sound, Fiordland. Stoats reached the islands soon after, and the venture failed. Fifty years were to elapse before a further conservation attempt was made. In the late 1950s and 1960s, ~10 birds were located within Fiordland's Milford catchment and an attempt was made to establish a captive population. All nevertheless proved to be male, and most died within a few months. A third attempt to save the species was launched in 1974 and continues to the present time. Using a range of “close-order management” techniques on free-living birds, effort is now directed at maximizing survival of naturally produced eggs and young, increasing breeding frequency and managing genetic diversity in order to improve low fertility and hatchability. Techniques include manipulation of the breeding population to optimize genetic diversity; inter-island transfer of breeding stock in order to capitalise on locally abundant foods that trigger breeding because Kakapo breed at two to five yearly intervals in synchrony with unusually heavy fruiting or seeding of certain native plants; support of breeding females through supplementary feeding; manipulation of female pre-breeding weights to increase the proportion of female young produced; artificial insemination to increase fertility and improve genetic representation; physical protection of nests; and intensive monitoring of nests throughout breeding coupled with intervention as necessary. A great deal has been learned during the course of the program – much of it relevant to other rescue and recovery programs. Since 1995, Kakapo numbers have increased by 68%; the global population now stands at 86 individuals.

Piersma T

Using the power of comparison to explain habitat use and migration strategies of waders worldwide

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Waders, or shorebirds, form an ecologically homogenous group of birds that, despite the homogeneity, show clear correlated contrasts in habitat use and migration distance between closely related species pairs. Within species, moreover, there is often distinct variation in breeding and wintering latitudes, that is, migration distance. I review such contrasts at different taxonomic levels, and evaluate what can be learnt from them about selective forces acting on habitat selection and the evolution of migration strategies in birds. The worldwide migration system of Red Knots (*Calidris canutus*) is one example. These sandpipers breed only on high arctic tundra but move south from their disjunct, circumpolar breeding areas to nonbreeding sites on the coasts of all continents except Antarctica, between latitudes 58° N and 53° S. Due to their specialized sensory capabilities, Red Knots generally eat hard-shelled prey found on intertidal, mostly soft, substrates. As a consequence, ecologically suitable coastal sites are few and far between, so they must routinely undertake flights of many thousands of kilometres. In contrast to predictions based on the low costs of living and thus the freedom to allocate nutrients to fuel storage, Red Knots at tropical intertidal sites have lower fuelling rates than birds at more southern or northern latitudes. This leads to more constrained annual schedules in the south temperate and tropical wintering populations. Whether this affects overall mortality rates or seasonal mortality patterns, with concomitant differences in selective regimes, will be discussed on the basis of new comparative demographic studies on Red Knots and Bar-tailed Godwits wintering at different latitudes.

Wanless S

Climate change and north-east Atlantic seabirds

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The coastal shelf seas around the north-east Atlantic are some of the most productive regions in the world. They are already at risk from a range of anthropogenic pressures, such as overfishing, development of wind and tidal energy schemes, and pollution; and the situation is currently being exacerbated by marked and rapid changes due to global warming. Seabirds are charismatic top predators in these systems, and are being caught increasingly in the crossfire between human exploitation and climate change. In conjunction with information on ocean climate, long-term data on seabird demography, phenology and diet are being used to predict the consequences of current and future climate change on seabird populations and to interpret the interspecific and regional differences that are apparent. These population level data are being complemented by detailed studies of individuals, using novel technology, that aim to identify important foraging areas and quantify foraging performance under a range of environmental conditions. I provide an overview of the current situation and highlight the species and regions that are most at risk.

Wiltschko W

Magnetoreception in birds: Two receptors for two different tasks

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The geomagnetic field is a reliable, omnipresent source of information for orientation: its vector provides directional information and can be used as a compass; and the spatial distribution of its intensity and/or inclination, with gradients running from the magnetic poles to the magnetic equator, can provide information on position as a component of the navigational "map". Furthermore, special magnetic conditions can indicate specific locations, where they may act as "triggers", eliciting specific responses. Behavioral evidence indicates that birds indeed use the geomagnetic field for all these purposes. For magneto-reception, two hypotheses are currently under consideration. The "magnetite-hypothesis" assumes receptors that are based on magnetic particles, as described from the upper beak and ectethmoid region in birds. The "radical-pair model" proposes magneto-reception based on the modification of chemical processes in photopigments in the eye, where the modifications depend on the alignment of pigment molecules in the ambient magnetic field. Behavioral tests with migratory birds provide evidence for both hypotheses. For the first, a short, strong magnetic pulse designed to affect magnetite particles led to a marked change in the prefered directions, thus indicating the involvement of magnetite-based receptors. At the same time, tests showed that birds require light from the blue-to-green part of the spectrum for migratory orientation, and that this orientation can be disrupted by HF-fields in the MHz-range, indicating the involvement of photopigments and a radical-pair mechanism. The test-design of the various studies and the specific responses of the birds, as well as electrophysiological studies, suggest that light-dependent radical-pair processes in the right eye mediate directional information for compass use, whereas magnetite-based mechanisms in the beak provide information on magnetic intensity used in the navigational "map" and for the "trigger" functions.

Symposia

Symposium S01: Avian personalities

Conveners: Claudio Carere, Belgium; Irene M. Pepperberg, USA

Drent PJ

Avian personalities: the Great Tit story

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Like many vertebrates, including humans, birds frequently cope with challenges in a changing environment to survive and reproduce. The best evolutionary solution will be that individuals are all flexible to be able to react in an optimal way to these challenges separately. In most species, however, neuro-endocrine and developmental constrains have resulted in genetically based variation in neuro-endocrine processes that determine variation in behavioural reactions towards mild challenges. As a consequence of structural pleiotropy a lot of behavioral reactions towards different challenges are correlated showing carry-over affects of particular traits (such as aggressiveness) into different contexts. So in an evolutionary context, selection will rather be on different optimal behavioral compromises, than on the optimality in each of the different challenges independently. This results in a variation of packages of behavioral reactions, resulting in lower plasticity on the individual level, referred to as coping strategies, behavioural syndromes and personality in humans. Under selection, these differences in behavior result in fitness differences in life history traits, which influences the reaction norms and cause modification in life-history traits. So selection on life-history traits is indirectly also selection on behavioural syndromes or personalities. Therefore variable environments and frequency dependent selection could not only cause coexistence of variation in life-history traits, but might also maintain variation in personalities.The Great Tit (*Parus major*) is the only wild animal species for which laboratory- and field- work is brought together, thereby integrating genetic, mechanistic and evolutionary aspects of personality. Here I show animal personality in this species, its ontogenetic background, and fitness differences under different circumstances which might contribute to the maintenance of personality-types in the wild.

Pepperberg I

Behavioral differences in Grey Parrots: Studies on cognition and communication

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Grey Parrots (*Psittacus erithacus*) have been shown to exhibit many complex cognitive and communicative abilities in a laboratory setting. Their successes evidently rely on two factors: an underlying neurological architecture that supports complex information processing, and training that enables them to express their capacities in ways measurable by human researchers. Individual differences can affect both factors; but the quality of the latter can be controled experimentally. Although training my parrots to communicate in English speech generally enables me to demonstrate their advanced cognitive capacities, occasionally such training has interfered with success in tasks requiring a specific type of complex information processing. For the same two parrots, I describe results for two different tasks. In one task, involving the ability to segment English speech sounds and demonstrate phonological awareness, communication training, as expected, enhanced success. In the other task, retrieval of an item suspended from a long string in order to demonstrate means-ends understanding, communication training unexpectedly inhibited success. Individual differences can therefore be expressed in ways that are not necessarily predictable and which encourage further experimentation.

Cockrem J

Corticosterone stress responses and avian personalities

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Stress responses are natural responses that help birds adjust to changes in their external or internal environment. They are characterized by activation of the adrenal axis and secretion of corticosterone. Corticosterone increases blood glucose concentrations, promotes changes in behavior and has a variety of other physiological actions. A feature of corticosterone responses is that they can vary markedly among individual birds. We have quantified individual variation in corticosterone responses in Adelie Penguins (*Pygoscelis adeliae*) in Antarctica, and Great Tits (*Parus major*), Japanese Quail (*Coturnix japonica*) and chickens (*Gallus gallus*), and have found that the responses of individual birds are generally repeatable. It is thus likely that there is a genetic basis for this variation, although this has so far been demonstrated only in the Japanese Quail. Behavioral measures of fear in quail but not in penguins were related to corticosterone responses, with quail selected for low or high corticosterone responses showing differences in a range of behavioral and physiological characteristics. These differences are similar to those in Great Tits considered to have different coping styles or personalities. Birds with proactive coping styles are likely to be more successful in a relatively constant environment whereas the more cautious style of reactive animals may be more successful in a changing environment. There is no optimal coping style or corticosterone response for all situations. The relative proportions of individuals with each coping style will differ between populations of the same species and between species of birds. This could in turn have ramifications for species that experience habitat changes as consequences of global warming, where the ability of populations and species to adapt to such changes is influenced by the proportions of individuals with each coping style.

Stöwe M, Kotrschal K

Personality determines whether social context facilitates or delays exploration in Common Ravens

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The presence of conspecifics tends to encourage object exploration and learning. Factors such as individual personality and social relationships, however, may also modulate approaches to novel objects in such circumstances. We examined individual consistency in exploratory behavior over development in Common Ravens (*Corvus corax*), as well as the effects of social context on it. We confronted 11 hand-raised ravens individually at three and six months of age with novel objects, and also tested them in different dyadic combinations at six months. Individuals were consistent over development and contexts, alone and social, in their response to a variety of novel objects. We defined individuals as “fast” and “slow” explorers on the basis of their latency of approach when tested alone. Whether social context hastened or delayed approach to novel objects depended on the coping style of an individual. In “fast” birds, the presence of a conspecific delayed the approach to novel objects. In “slow” birds, in contrast, approach was hastened in dyads. The more socio-positive (sitting in close proximity) the behavior in a dyad, the faster the second bird followed the first in approaching novel objects. Even so, individual personality seems to be the main determinant of exploratory behavior in social contexts.

van Oers K[1], Drent PJ[2], Kempenaers B[1]

Personality and promiscuity in the Great Tit

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Why females engage in extra-pair matings is a central issue in a dynamic debate. It is generally assumed that in doing so, they obtain genetic benefits for their offspring. Two types of mechanisms have been proposed in explanation: the ‘good genes’ and the ‘compatible genes’ hypotheses. In both cases, personality may play a role, as female Great Tits (*Parus major*) of a given personality vary in fitness benefits according to male mate. Since advantages of personality type are dependent on environmental circumstances, females, independently of their own personality, need to choose those genes which give their offspring the best chances of recruitment in good and bad conditions. In this study, we examined the relationship between extra-pair paternity and personality. Blood samples of adult birds were collected between autumn 2002 and summer 2005, and samples of 478 juveniles from 58 nests, and 331 from 43 nests were collected during the breeding seasons of 2003 and 2004 respectively. Parentage was assessed by genetic screening of microsatellite markers specific to Great Tits. In our study, we found no evidence for the ‘good genes’ hypothesis. Males that had extra-pair young were not heavier or larger than the males they cuckolded; and extra-pair young were not heavier than within-pair young. However, we found that extra-pair offspring were more frequent in the broods of some pair combinations than others. In other words, broods of assortative pair combinations had a higher chances of including extra-pair offspring than dissassortative pairs. These extra-pair offspring were of males that had personalities different from those of the mated males. Such results suggest that pairs which are more alike in behavior seem to be less compatible, perhaps meaning that Great Tit females which engage in extra-pair copulations choose males with genes that are better matched than those of their own partners to improve the fitness of offspring.

S02: New insights into the sense of smell in birds: from foraging behavior to individual recognition

Conveners: Francesco Bonadonna, France; Gabrielle Nevitt, USA

Wenzel BM

Avian olfaction: then and now

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Avian olfaction has been a small but persistent research topic for the last half century. For an entire symposium to be devoted to it testifies to growing understanding of its importance in avian behavior, physiology and ecology. Without Bang's early papers describing the anatomy of the olfactory cavity along with the development of olfactory mucosa in several avian species, or his and Cobb's measurements of the olfactory bulb in over 100 species, avian olfaction as a serious research topic might have had little appeal. It seems appropriate, therefore, to dedicate this symposium to the late Betsy G. Bang. Beginning in the early 1960s, my laboratory studied the neuroanatomy and neurophysiology of the avian olfactory system as well as behavioral effects of olfactory stimuli. Over the years, other laboratories have taken up these topics, and by now a good body of research has been produced, most on behavioral aspects of olfaction. This emphasis is an essential contribution to avian biology because the ultimate question for avian olfaction is how birds use their olfactory systems.

Nevitt G

The odor world of sub-Antarctic Procellariiform seabirds

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Procellariiform seabirds (the petrels, albatrosses and shearwaters) have among the largest olfactory bulbs of any bird. Though often overlooked by seabird ecologists, this observation suggests that variation in the ability to smell is relevant to understanding how members of this group interact with the environment in a variety of ways. Procellariifom seabirds are unique in that they spend nearly all their lives at sea foraging for patchily-distributed prey resources; they are tied to land only to breed and rear offspring. My presentation will explore how different procellariiform seabirds use olfaction to forage and to relocate their nest sites in the colony. Our approach has been to integrate sensory data collected from empirical studies with detailed knowledge of diet, foraging ecology, and atmospheric chemistry to build a conceptual model for how birds use odors to locate prey and navigate back to colony sites. This work has focused on Southern ocean species assemblages. Our results suggest that (1) procellariiform seabirds use odor landscapes at different spatial scales, and that (2) different species can utilize distinct sensory strategies for locating prey patches and nest sites. In parallel, we are beginning to investigate how olfactory behaviors develop even before fledglings leave the nest. These and other studies have opened the door to an intriguing new area of sensory ecology with respect to the use of personal odors in individual recognition.

Gagliardo A[1], Odetti F[1], Savini M[1], Ioalè P[1], Pecchia T[2], Vallortigara G[2]

Olfactory lateralization in homing Rock Doves

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It has been shown that homing pigeons (Rock Doves, *Columba livia*) rely on olfactory cues to navigate from unfamiliar locations. The integrity of the olfactory system, from the olfactory mucosa to the piriform cortex in the brain, is in fact a necessary condition for navigation over unfamiliar areas. Recent studies show that there is also a functional asymmetry in the piriform cortex in its involvement in the use of the olfactory navigational map, the left piriform cortex being dominant. To further investigate lateralization of the olfactory system in relation to navigation, we performed an experiment comparing performance in pigeons released with either the left or the right nostril plugged. Contrary to expectations, orientation was impaired initially in those birds with the right nostril plugged, evidently resulting from the projection of olfactory bulbs ipsilaterally to the piriform cortex. Even so, both groups with plugged nostrils performed more poorly than control pigeons in their homing. The observed asymmetry favoring the right nostril could be due to contralateral projections from the olfactory bulbs to the *globus pallidum* in the brain, a structure involved in motor responses.

Hagelin JC

Social behavior and odor function of a tangerine-scented seabird

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The Crested Auklet (*Aethia cristatella*), a monogamous seabird, exhibits a seasonally elevated, tangerine-like scent that is associated with a striking courtship display. During the “ruff-sniff,” birds rub their beaks repeatedly in the scented nape of a display partner, in a manner that provides a conspicuous behavioral mechanism for odor transmission and the potential for scent assessment during intra- or intersexual selection. Over three years of field and captive experiments, we have examined how Crested Auklets respond to their unusual scent, and how odor relates to social behavior. Wild birds placed in a T-maze preferentially oriented toward the scent of conspecific plumage and toward a synthetic mixture of the seasonally-elevated chemical components. Both sexes also approached artificially scented models (round skins) of male auklets more closely than unscented controls of either sex. Scent alone did not, however, elevate the display frequency of approaching birds. In the field it is difficult to follow the social behavior of specific individuals in a colony of 100,000+ birds. However, in captivity, we can more easily follow odor profiles of individuals over time and relate odor concentration to social status. In a captive population (n=11) two key components of feather scent (cis-4-decenal and decanal) and a plumage ornament (crest length) were significant predictors of social rank. Both chemical compounds showed a positive relationship with male social status, and are consistent with field data indicating that odor may be more emphasized in males. Odor within the population also exhibited a significant decline in concentration over the course of the breeding season. The pattern of scent loss suggests that odor behaves similarly to other secondary sexual traits (crests, orange beak plates, auricular plumes) and may serve as an olfactory ornament.

VanBuskirk R[1], Nevitt G[2]

The developmental environment of tube-nosed seabirds and the evolution of their foraging behavior

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The evolutionary origins of foraging behavior in tube-nosed seabirds (Procellariiformes) are poorly understood. Moreover, proximate factors affecting their foraging ecology, such as the influence of developmental environment on sensory systems, have yet to be addressed. Here we apply comparative methods based on current procellariiform phylogenies to identify associations between sensory modalities and the developmental environment that may underlie the evolution of complex foraging behavior. We postulate that, for burrow-nesting species, smell is likely to dominate the sensory world of the developing chick. For on-ground-nesting species, in contrast, chicks receive exposure to a range of visual, auditory and olfactory cues. We employ maximum likelihood algorithms to test models of correlated trait evolution between nesting habit and olfactory foraging style, and to reconstruct the ancestral states of these characters when coded as binary states. Our results suggest that nesting behavior has evolved in conjunction with foraging style. Based on this analysis, we propose that nesting on the surface was a life history innovation that opened up a new developmental environment with profound effects on the foraging ecology of tube-nosed seabirds.

S03: Emerging issues in cooperative breeding research

Conveners: Jeff Walters, USA; Jan Komdeur, The Netherlands

Hatchwell BJ, Sharp SP

Kin selection and recognition mechanisms in avian societies

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Helpers in cooperative breeding systems are generally considered to be making the best of a bad job when constrained from independent breeding. The fitness benefits of helping that outweigh the costs of caring for non-descendant offspring can be described as direct (enhanced current or future reproduction by the helper) or indirect (the kin-selected benefit of increasing the productivity of relatives); the relative importance of these sources of fitness has been the subject of extensive debate since the inception of long-term studies on cooperative breeders. The aims of this paper are to quantify the fitness consequences of cooperation in the Long-tailed Tit (*Aegithalos caudatus*) and to determine the mechanism through which kin-directed cooperative behavior is achieved. First, we show that kin-selected fitness benefits represent a substantial component of inclusive fitness in this species, and the sole source of fitness for many individuals; we also consider the conditions necessary for kin-directed behavior to evolve and the life history and demographic traits that create the potential for kin selection to operate. Second, we show by observation and experiment that learned vocal recognition cues and a simple rule of thumb provide the basis for kin discrimination in this species. However, this recognition rule may not permit fine discrimination among kin of varying relatedness. Finally, we discuss the implications of kin selection and recognition mechanisms for variation in the contribution of helpers to brood care among cooperative breeding systems.

Ekman J

The group living route to cooperative breeding

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Cooperative breeding is defined by three or birds attending a nest. In breeding families, retained offspring usually act as the extra birds. Group-living in cooperatively breeding families has been ascribed to a unique process where the offspring should forego dispersal for constraints on opportunities for independent breeding and where group cohesion is maintained by retained offspring providing alloparental care. Yet, the route to cooperative breeding families is a sequential process. Philopatric offspring remain with their parents, and in this respect cooperatively breeding families form no exception to general group living. A growing body of data shows that the offspring can stay without providing help-at-the-nest suggesting that alloparental care may be an emergent property of group living. Group living can be decoupled from constraints on independent breeding and being non-breeding either as 'floater' or in a group outside the natal territory is the alternative to philopatry. To remain in the family and be able to act as an alloparenting extra-bird the offspring must resist the temptation to leave. Then parental tolerance providing the offspring with access to resources that they will be denied elsewhere is likely to be a cornerstone of a kin association selecting for delayed dispersal in cooperative breeders. It is only after that dispersal has been delayed that there is a potential for inclusive fitness gains from kin cooperation providing the evolutionary impetus for evolution of alloparental care. Selection for delayed dispersal seems required to maintain alloparental care in species where cooperative breeding is an inherited ancestral trait. Behavioral plasticity in species from lineages where delayed dispersal and cooperative breeding has deep historical roots suggests that the phylogenetic bias may reflect a design-driven response to current selection rather than evolutionary inertia.

Eguchi K[1], Yamaguchi N[2], Ueda K[2], Takagi M[3], Nagata H[4], Noske R[5]

Social structure and helping behavior in the Grey-crowned Babbler

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A study of cooperative breeding in the Grey-crowned Babbler (*Pomatostomus temporalis*) was conducted near Darwin, Australia, during 2002 - 2004. The mean size of 14-22 territorial groups over three years was 4.21, 3.85 and 4.59 respectively, most groups comprising single monogamous pairs with 1 - 7 auxiliary birds. We found no floaters. Sex ratio was almost unity in each of the 3 years. Auxiliaries included philopatric offspring, immigrating juveniles and immigrating sexually mature birds. Adult females moved more frequently between groups than males and often obtained breeding status in forwarding territories. Clutch size was 1-4 eggs (mode 2), and joint-nesting was observed. Pairs without helpers never produced fledglings, and members were often doomed to separate, suggesting that this species is an obligate cooperative breeder. However, for groups with helpers, there was no significant correlation between the number of fledglings and that of helpers. Breeding females incubated exclusively. Although most members of groups provisioned chicks, there was high variance in the contributions of members, some birds giving no help at all. Total provisioning rate was higher in larger than smaller groups, but the difference was not significant. All members of each group slept in a communal roost at night and foraged together by day. Because solitary birds may suffer low temperatures at night, food shortage, and harassment from groups, selection in this species should favour individuals joining established groups. Small groups need to recruit helpers for self-maintenance and to enhance reproductive success. Under such situations, breeding groups comprise both kin and non-kin helpers, and, therefore, fitness benefits and the reasons for joining groups must vary among auxiliaries.

McDonald PG[1], Kazem AJN[2], Clarke MF[3], Wright J[2]

Altruistic acts as indicators of quality in a cooperative breeder: Are helpers-at-the-nest 'showing off'?

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Explanations of why helpers incur the costs of altruistic acts have typically centered upon fitness benefits associated with kin selection. However, an alternative explanation is that altruistic acts may be signals used to impress third parties, from which benefits are derived. The propositions of the two main 'signaling' hypotheses are that helping may act as (1) an indicator of quality and improve breeding opportunities ('social-prestige'), and/or as (2) a means of securing group membership and associated benefits ('pay-to-stay'). We examined helping behavior in the light of these expectations in colonies of the cooperatively-breeding Bell Miner (*Manorina melanophrys*), for which levels of relatedness between individuals had been genetically determined. In this species, the majority of helpers are male, often assisting concurrently at multiple nests. Helpers are typically related to the breeding pair that they assist, as predicted by kin selection. High turnover of breeders, nevertheless, means that older attendants tend to be unrelated to the broods they aid, suggesting alternative functions of helping. During provisioning, furthermore, individually distinct calls are given by helpers, potentially allowing conspecifics to monitor individual helping effort. We recorded provisioning by helpers at nests before, during and after a potential audience (either breeding male or female) had been removed for several hours. For a subset of observations, we also simulated the auditory presence of the removed bird by playing back its provisioning calls. Preliminary analyses indicate that playback provoked greater helper feeding rates than did removal of the breeding female alone, consistent with a form of 'prestige' signaling. Experimental work is ongoing to provide the first critical test of these ideas outside of humans.

Rubenstein D

Kin selection, extra-pair paternity, and mechanisms of reproductive suppression in the plural cooperatively-breeding Superb Starling

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To understand why avian cooperative breeding systems have evolved, both the reasons why subordinates act as helpers and the mechanisms underlying this reproductive suppression need to be known. I studied the plural-breeding Superb Starling (*Lamprotornis superbus*) which lives in groups of 10-35 individuals on a group territory with 2-5 breeding pairs that nest separately and are supported by helpers of both sexes. I combined behavioral observations, microsatellite studies of parentage and relatedness, and analyses of sex and stress hormones to understand why helping has evolved and how reproductive roles are governed. Direct reproductive benefits for helpers appeared to be low. There was no evidence of brood parasitism by females. Extra-pair fertilizations by males accounted for less than fifteen percent of all offspring, and only five percent of these were fathered by helpers. In contrast, the indirect benefits of helping appeared to be high for both sexes, and kin selection probably explains helping behavior. Since direct fitness benefits for helpers are low and helpers often aid non-kin, I examined the mechanisms underlying reproductive suppression. I tested four hypotheses involving the developmental, environmental, and social factors that may govern breeding roles. Although one-year-old males never bred socially and had lower levels of testosterone than older birds, they did secure some extra-pair fertilizations, suggesting that they were physiologically capable of breeding. Moreover, although some two-year-old males did breed, most did not, even though unpaired, unrelated females were present. Contrasting predictions from the reproductive inhibition and social suppression hypotheses were also tested to determine which of environmental and social stress influenced reproductive roles the most. Social factors appeared to play an important part in governing reproductive roles, particularly in years when environmental conditions were extreme.

S04: Male and female contributions to biparental care

Conveners: Keith Hamer, UK; Douglas Mock, USA

Székely T

Sexual conflict over parental care

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Should parents cooperate to raise young, or abandon their mate and seek a new partner? Parental care is costly, so each parent often does better by shifting the hard work of raising young entirely to their mate. Surprisingly, however, biparental care is common among many avian taxa. I explore the fundamental reasons of parental cooperation: limited mating opportunities and the demands of the offspring for care. Recent comparative phylogenetic analyses and field experiments are used to test why parents cooperate to raise their young in some bird species, but in others abandon their brood and seek out new mates.

Hamer K

Sex differences in contributions to biparental care: does size matter?

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About 90% of bird species have biparental care, with both sexes contributing to the provision of food for offspring. Male and female parents need not, however, contribute equally to food provisioning, and sexual conflict over how much each individual contributes is inescapable except under true monogamy. Sexual differences in foraging behavior and food provisioning rates of offspring have been recorded in a number of socially monogamous but sexually size dimorphic species, and these differences are usually ascribed to the influence of body size on foraging efficiency and competitive ability. Recent evidence, however, has indicated that differences between males and females in foraging and food provisioning behavior can occur in the absence of sexual size dimorphism, although the reasons for this occurrence are unclear. Here I explore this phenomenon using data from my research group and research partners for different species of seabirds, a group in which biparental care is universal. I examine differences between males and females in foraging locations, dive depths and behavior at sea, and I compare the responses of males and females to solicitation for food by their offspring. Results are then discussed in the context of parent-parent and parent-offspring conflict and collaboration, and the evolution of reversed sexual size dimorphism.

McNamara J[1], Houston A[1], Barta Z[2]

When should females prefer to raise young with low quality males?

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Understanding the interactions between males and females over parental care is complicated because of various feedbacks. We present a model in which males vary in quality. The value of offspring depends on both the quality of a male and its level of care. Level of care will depend on its opportunity for further matings, which depends, in turn, on its attractiveness. The attractiveness of a male thus depends not only on its quality, but also on the level of care that it will provide. These components cannot be considered in isolation. In the absence of extra pair copulations (EPCs), we analyse circumstances in which a female should prefer to raise young with a low quality male because of its capacity to provide better care than a high quality male. When EPCs are possible, there is the extra complication that parental input from the social partner will be affected by paternity. We identify circumstances in which a female should prefer to raise young with a low quality male while giving EPCs to high quality males, despite potential constraints on the level of care from the social partner.

Laaksonen T[1], Lessells K[2]

Maternal effects as mediators of sexual conflict over parental care

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Evolutionary theory predicts that male and female parents have different optima in the investment they make in their offspring, as it would advantage one parent if the other were to bear a greater share of total parental investment. This sexual conflict arises from a trade-off between parental investment and future reproductive success, and the fact that the parents do not share the same genetic interests because they are not related. Very little is known about the ways in which one parent can make the other to work relatively more. For the female, one such way could lie in manipulating the behavior of offspring. Recent research indicates that hormone levels in developing eggs affect the subsequent begging behavior of chicks, which in turn affects parental feeding response. This offers females a chance to manipulate the parental investment of male partners by altering the level of hormones in the eggs. We present results of an experimental test of this novel idea in a wild Pied Flycatcher (*Ficedula hypoleuca*) population. We broke the environmental and genotypic links between offspring and parents experimentally through cross-fostering the eggs. One egg per brood was sampled for hormones. Data will be presented showing how much of the variation in relative parental investment by each sex is explained by pre-hatching hormonal levels in the young. These results add to our understanding of the ways in which birds may manipulate the parental investement of their partner.

Kabat A[1], Phillips R[2], Croxall J[2], Woakes A[1], Butler P[1]

Parental foraging proficiency: The key to successful fledging in the Black-browed Albatross?

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Rates of successful fledging vary greatly within species despite similar environmental constraints. Some long-lived species of seabirds improve breeding ability with increasing age and effort, or with differences in body size, fat or protein reserves. Even then, some pairs consistently fledge chicks more successfully than others. The underlying reasons for this disparity, as well as the extent to which phenotypic or genotypic influences affect fledging success, remain unclear. Much of this variation may nevertheless be determined by parental capacity to provide adequate food for nestling growth, a capacity reflective of foraging proficiency as only females above a minimum threshold in condition attempt to breed. The present investigation uses heart rate loggers on free-ranging Black-browed Albatrosses (*Thalassarche melanophrys*) to estimate field metabolic rate for determining why some breeding pairs are more successful than others. By careful selection of 24 breeding pairs of similar age and with known reproductive histories (12 successful, 12 unsuccessful), this study examines how energetic constraints and parental investment affect fledging success. Metabolic and effort data were used to calculate indices of foraging proficiency for assessing the variation in parental provisioning to chicks, as well as the partitioning of paternal and maternal investment. The study also examines the extent to which foraging proficiency underpins variation in long-term breeding performance and variability in chick growth rates. This is contrasted with growth and overall condition at fledging, as presumably those chicks in better condition will have greater survival prospects, thereby providing an overall estimate of fitness of both breeding pairs and their offspring.

S05: Flexibility in mating signals and mate choice: ultimate and proximate bases

Conveners: Keith Sockman, USA; Elizabeth MacDougall-Shackleton, Canada

MacDougall-Shackleton E[1], Clinchy M[2], Zanette L[1], Neff B[1], Wingfield JC[3], Boonstra R[4]

Environmental quality, physiological stress and female mating strategies in Song Sparrows

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Ecological factors such as food availability and predator pressure that affect reproduction and survival likely also affect life-history traits such as mating strategies. We conducted a 2 x 2, manipulative food addition plus natural predator reduction experiment on Song Sparrows (*Melospiza melodia*) that demonstrated: interactive food and predator effects on egg production, nest survival and annual reproductive success, as well as food and predator effects on the stress physiology of parents. Here we report the effects on extrapair paternity. Extrapair paternity was more frequent the more challenging the environment. Correspondingly, females producing extrapair offspring appeared more stressed since they had elevated corticosterone, significantly higher plasma glucose and elevated free fatty acid levels, and were significantly more anaemic, than females producing only within-pair young. There were no significant physiological differences between males with full paternity and cuckolded males, nor were there significant differences in size or symmetry between extrapair and within-pair nestling brood-mates. Conceivably, females may be using extrapair mating to diversify their offspring and so hedge their bets in challenging circumstances. We suggest our results highlight the importance of understanding both the ecological and physiological context in which extrapair paternity occurs.

Sockman K

Neural orchestration of mate-choice plasticity

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Females choose among prospective mates based on signals that may reflect male quality. In several songbird species, females prefer males with longer or more complex songs over those with shorter or simpler songs. Because constraints on the male can compromise his song quality, this female preference may ultimately be based on information that song contains about environmental hardship experienced by the male. Females can adjust their choice behavior according to the prevalence of preferred song, presumably because environmental variation is likely to influence the availability of preferred phenotypes. But how this choice-plasticity is orchestrated by the brain is just beginning to be unraveled. Studies using induction of the immediate early gene ZENK as an indicator of neuronal activity have revealed that the caudomedial mesopallium (CMM) and caudomedial nidopallium (NCM) of the female auditory forebrain are sensitive to song quality and respond proportionally to the strength of the female's mate-choice behavior. In European Starlings (*Sturnus vulgaris*), long songs are preferred by females and induce higher ZENK induction in the CMM and NCM compared to short songs. Experimentally reducing the prevalence of long songs reduces this forebrain sensitivity to song length, raising the possibility that the songbird auditory telencephalon integrates social information that enables the female to adjust her mate-choice threshold according to the availability of the preferred phenotype. In some songbird species, the noradrenergic system modulates song-induced auditory forebrain activity and mate-choice behavior, suggesting a possible role for this system in mediating the effects of social information on forebrain and behavioral sensitivity to song quality. The presence of such a system that can adjust its sensitivity to preferred traits based on the prevalence of those traits would seem beneficial when the availability of preferred mates varies.

Patricelli GL[1], Uy JAC[2], Borgia G[3]

Interactive signaling during mate choice in the Satin Bowerbird: an experimental test using robotic females

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Sexual selection in many species involves communication during mate choice, as males display secondary sex traits to assessing females. Male display traits are generally assumed to remain constant throughout the mate choice process, but this may not be so. Male success may rely on not only the production of attractive traits but also on the ability to modify them in response to female signals. In a field experiment using robotic females, we show that such interactive signaling occurs during mate choice in the Satin Bowerbird (*Ptilonorhynchus violaceus*). Males with higher-intensity displays are preferred as mates, but intense displays can frighten females early in the mate choice process. As females assess potential mates, they signal the intensity of display that they will accept, which increases as the process of choice progresses. Males that modulate display intensity effectively in response to female signals and startle females less often improve their courtship success. Sexual selection for intense displays in males, which can threaten females in one context and attract them in another, may facilitate the evolution of interactive signaling between the sexes, favoring females that signal acceptable levels of display intensity and males that modify their displays in response. Our results suggest that interactive signaling is important for effective courtship in Satin Bowerbirds and may have a more significant role in shaping the outcome of sexual selection than has been recognized.

Hauber ME[1], Woolley SMN[2], Theunissen FE[3]

Learning, memory, and mate choice: Early experience and neuronal discrimination of songs by female Zebra Finches

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Songbirds, unlike most other vertebrates, show a remarkable ability to recognise and imitate sounds and are ideal for the study of the neuronal bases of vocal communication. Despite the role that female choice plays in shaping the evolution of male sexual displays, little is known about the auditory processing of acoustic cues by female songbirds, especially in those species where females do not sing. In female Zebra Finches (*Taeniopygia guttata*), behavioral preferences for conspecific song develop in the absence of tutoring, but discrimination between songs can also be altered in females raised by heterospecific Bengalese Finches (*Lonchura striata*). Here we demonstrate the same duality of the ontogenetic paths of neuronal response selectivity in the auditory forebrain areas of female Zebra Finches. Single unit neurophysiological recordings showed consistently higher mean spike rates for Zebra Finch songs compared to rates for Bengalese Finch and Black-throated Finch (*Poephilia cincta*) songs in control females reared by Zebra Finches. In contrast, spike rates for Bengalese Finch songs were similar to rates for Zebra Finch songs and higher than for Parson Finch songs in females reared by Bengalese Finches. These results set the stage for future work concerning the mechanism of neuronal discrimination of song and the limited plasticity of auditory filters and perceptual templates in female songbirds.

Catchpole C[1], Spencer K[2], Buchanan K[3], Leitner S[1], Goldsmith A[2]

The developmental stress hypothesis, song, neural development and mate choice in birds

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Although there is now general agreement that the complex songs of male birds have evolved through sexual selection, there remains the question of how song complexity has become an honest indicator of male quality in female choice. The developmental stress hypothesis has recently been proposed as one possible answer. Birds learn their songs in their first year when the song control pathway in the brain is still developing. If young males are subjected to some form of stress, such as food shortage or disease, then individuals of lower quality may have to divert resources away from systems such as the developing brain. Only superior quality males can afford to pay the additional costs of developing the song control pathway, and thus adult song complexity may become an honest indicator of male quality. In the Zebra Finch (*Taeniopygia guttata*), we found that nestlings subjected to both nutritional stress and direct administration of the stress hormone, corticosterone, developed less complex songs as adults than controls. We also found that in both experimental groups the main song control nucleus in the brain (HVC) was smaller. Tested female Zebra Finches were able to discriminate between stressed and non-stressed songs as well, showing significant preferences for the latter. Recently we have infected juvenile canaries with the malaria parasite and also followed their song and brain development. We found that infected males developed simpler songs as adults, and also developed a smaller HVC in the brain. This last experiment not only supports the developmental stress hypothesis, but also has implications for the Hamilton-Zuk hypothesis of parasite-mediated sexual selection, mate choice and the development of bird songs.

S06: Information and power: how are conflicts at the nest resolved?

Conveners: Rebecca Kilner, UK; Hugh Drummond, Mexico

Kilner R

The use and abuse of information in conflict resolution at the nest

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Evolutionary conflicts of interest within the family arise when family members disagree over the optimal division of parental investment. In theory, conflicts should be commonplace, yet evidence of their existence in nature is scarce. One theoretical explanation is that the conflicts have long since been resolved, and this conceals the original disparity in parental investment optima between the different parties. Here I will consider the significance of information control in resolving conflicts of interest at the nest. Recent work on passerine species suggests that parents and offspring can both control information about the costs and benefits associated with parental care. For example, offspring might choose to advertize information about the benefits they stand to gain from parental investment with their begging display. Parents may signal the quality of care on offer after hatching to their young, through differential hormonal deposition in each egg.

Drummond H

Aggression in avian broods: from lethal violence to rotating roles

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While avian brood-mates generally compete for resources by begging and scrambling for food, in some avian species it is feasible and economically advantageous for brood-mates to use physical violence and other forms of agonism. Self-feeding precocial chicks scramble for food that is dispersed and use aggressive exclusion and pursuit for food that is concentrated in space. Parentally fed altricial and semiprecocial chicks establish relationships of aggressive dominance to compete for food that is concentrated at or near the outlet – the parental mouth. Relationships of aggressive dominance vary from ritualized “aggression-submission” in the Blue-footed Booby (*Sula nebouxii*), with distinct aggressive and submissive roles for each individual, to “aggression-aggression” in the Brown Booby (*S. leucogaster*), in which the subordinate individual does not assume a submissive role, and culminate in the extraordinary “rotating dominance” of the Crested Ibis (*Niponia nippon*), in which brood-mates take turns as attacker and submissive victim. The nature of the aggressive dominance relationship seems to depend on two ultimate factors: the cost of subordination, and the degree to which brood-mates are confined together. Brood hierarchies develop in precocial chicks mostly on the basis of ranking fights, individual recognition and learned pairwise relationships; those in altricial chicks develop mostly through conditioning of general agonistic tendencies, assessment and ongoing age-based inequalities. Rank in broods of altricial chicks secures enhanced access to limited resources and improved survival during the nestling period, but may be of limited importance after fledging; rank in broods of precocial chicks probably confers benefits in feeding competition and may also boost rank and competitiveness in adult life.

Hillström L[1], Gieg J[2], Lyon R[2]

Siblicidal behavior in relation to food availability in the Cattle Egret: An experimental test of the food amount hypothesis

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By starting incubation before clutch completion, parents in altricial species often induce a sibling hierarchy to facilitate brood reduction. In species that practice siblicide, this is termed siblicidal brood reduction. Parental investment theory predicts that siblicide manifests conflict behavior. The food amount hypothesis (FAH) maintains that sibling aggression should be related to the amount of food that parents deliver to the nest. Although there have been some observational studies supporting this hypothesis, very few experimental studies have yet tested the FAH under field conditions. Field work was carried out at a colony of Cattle Egrets (*Bubulcus ibis*) in Oklahoma, USA. Nests were monitored from a blind during incubation and hatching until days 20-25 post-hatch. Nests with 3 eggs and 3 (a, b and c) chicks hatched were randomized in a triplet, so that each was subject to one of the following three treatments: (1) b-chick fed every second day starting from day 5 after hatching of a-chick, (2) c-chick fed every second day as for b-chick, and (3) chicks in a control nest shamfed. The feeding of chicks started on day 5 and ended on day 15 post-hatch. Chicks were fed at the nest with small pieces of mice, representing the average value of daily metabolizable energy (DME) for a chick per day. In support of the FAH, there was a significant negative correlation between parental feeding rate and fighting rate between siblings ($p<0.05$). In most cases, it was the last-hatched c-chick that was killed. There was also individual variation in feeding behavior, some parents allocating food differentially to c-chicks. When senior chicks were sleeping, the parent would reurgitate (spared) food to the still hungry c-chick, perhaps indicating that parent-offspring conflict is solved by feeding junior offspring when sibling fighting is quiescent.

Nager R

Chicks are not equal competitors: The influence of egg quality on sibling rivalry

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Families are characterized by distinct competitive asymmetries. Usually they are thought to result from asynchronous hatching, where the oldest sibling is also the largest and has a clear power advantage. Hatching asynchrony results mainly from the commencing of incubation before clutch completion, which is under parental control. However, parents also produce offspring that may differ in their inherent quality through differential resource deposition in the eggs with respect to laying order. Differential resource deposition is related to environmental conditions during laying, and has well-documented effects on offspring phenotype. Parents can then use information on the expected future quality of their young to manage rivalry among them so as to maximise reproductive success. The functional significance of competitive asymmetries among siblings with respect to egg quality is still poorly understood. Here I focus on competitive asymmetries due to inherent differences between siblings, and the consequences of direct manipulation of these asymmetries on parental provisioning. Competitive asymmetries are manipulated by hatching eggs in an order different from their laying. In Lesser Black-backed Gulls (*Larus fuscus*), last-laid eggs were made to hatch first and vice versa through swapping eggs between clutches. Chick begging and agonistic behavior was not only influenced by hatching order but also laying order. Changes in interactions among siblings had a significant effect on parental provisioning effort. Similar experiments in Black-legged Kittiwakes (*Rissa tridactyla*) also reveal influences from laying order on among-sibling behavior and had a significant effect on fledging success. Both species thus provide evidence that parental control of competitive asymmetries at the egg production stage may fine-tune sibling scramble competition during the nestling stage, with consequences for subsequent parental effort and reproductive success.

Quillfeldt P, Masello JF

Sex-differences in growth and begging, and their physiological basis

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Mass differences between the sexes of dimorphic bird species often appear early in nestling development. But how do parents in sexually dimorphic species gauge how much to feed a chick? Do chicks of the heavier sex beg more? We summarize available information, and compare data from two species of procellariiform seabirds: Cory's Shearwater (*Calonectris diomedea*), a species in which adult and nestling males are heavier than respective females, and Thin-billed Prion (*Pachyptila belcheri*), a sexually monomorphic species. Petrels are especially suitable for studies of signaling at the nest, because they have an obligate brood size of one, and thus the potentially confounding effects of sibling competition are excluded. In order to understand the physiological basis of sex differences in behavior and growth, we further present and review data of sex-specific differences in nestling hormones, and propose future directions for study.

S07: Responses of birds to (over)fishing

Conveners: Bruno Ens, The Netherlands; Bob Furness, UK

Furness R

Responses of seabirds to prey depletion

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Harvesting reduces fish stocks, though it may increase production so that the age/size structure of a fish population may shift in a way that influences its quality as food for dependent predators such as seabirds. Life history theory predicts that seabirds will respond first to reduction in food abundance by changes in behavior or breeding effort, buffering adult survival. Empirical data show some support for this but also sometimes indicate a trade-off in which survival of breeding seabirds may be reduced by food shortage. The sensitivity of adult seabird survival rates may be a feature of the detailed ecology of particular species, and may be affected by ecological conditions such as the possibilities for switching prey. Fishery managers may set a lower limit biomass to protect fish stock recruitment, often at about 20% of predicted unfished stock biomass. In some cases, this may be too low a threshold to protect seabirds dependent on the fish stock. Seabirds show correlations in breeding success with fish stock biomass that indicate minimum densities of food required. These are orders of magnitude more than the consumption by seabird populations, so that a simple bioenergetics estimate of food requirement fails to account for seabird food needs. Threshold prey density also varies tremendously among seabird species, and is clearly a function of the detailed ecology of each species. It is possible to predict which species will be most sensitive to declines in food supply. Sensitive species may be sentinels of the 'health' of the marine ecosystem. For example, in the North Sea, breeding success of the Black-legged Kittiwake (*Rissa tridactyla*) is particularly sensitive to abundance and quality of sandeels.

Seabird communities may nevertheless be affected by a variety of interactions prompted by changes in fisheries; maintaining food fish levels may not alone be sufficient where communities have altered in composition over decades of fishing, as in the North Sea.

Ens BJ[1], Rappoldt K[2]

Modeling the response of birds to (over)fishing

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The immobility of shellfish, and their occurrence in intertidal areas that are relatively easy to sample, has proven a major advantage in the study of the impact of fisheries on top seabird predators that depend on the same prey targeted by fishermen. It has allowed for the development, the calibration and the validation of models describing (1) how the size and the distribution of the shellfish stock determine the distribution and the number of shellfish-eating birds that can survive, (2) the impact of the fishery and predation by the birds on the distribution and the stock of shellfish. Fishery managers are inclined to think that fishery will not harm the birds wintering in an estuary, if they leave a shellfish stock that is roughly equal to the total food consumption of the birds present at the start of the winter. The modeling studies make clear that this physiological food requirement does not suffice for the birds. A proper policy of food reservation is based on the ecological food requirement, which is several times higher than the physiological food requirement. It takes account of the fact that for a variety of reasons, the birds can only harvest a fraction of the total food supply. Shellfish lose mass during winter and die of other reasons than bird predation or fishery. Furthermore, the birds cannot feed profitably on shellfish that are too small or occur in densities that are too low. Birds nevertheless interfere at high bird densities and this puts a limit to the exploitation of the best feeding areas. It will be investigated whether these conclusions may also apply to systems that are less easily studied empirically.

Lorentsen S-H[1], Grémillet D[2], Sjøtun K[3]

Great Cormorant foraging activity concomitant with kelp harvesting

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Kelps (*Laminaria spp.*) form large underwater forests extending from just below low tide to depths of 30 m in coastal temperate seas. These forests are important as nursery grounds for juvenile fish, and important habitats for top marine food-chain consumers such as fish and seabirds whose distribution is often tightly linked to them. Kelps are harvested in a number of parts of the world, yet little is known of the effects that this harvesting has on fish and seabird populations. Accordingly, the foraging activity of Great Cormorants (*Phalacrocorax carbo carbo*) was investigated in kelp beds outside central Norway during 2001-2003, in un-harvested and harvested areas of different age. The occurrence of juvenile fish was also counted in the same areas at the same time. Cormorants equipped with radio transmitters revealed that the birds foraged more often in kelp-forested areas than would be expected from the extent of such areas. 85% of diet consisted of gadid (Gadidae spp.) fish, which are often found in hard-bottom, kelp-forested areas; the mean length of fish caught was 16.5 cm (range 2-55 cm). Kelp harvesting reduced the abundance of juvenile gadid fish (<15 cm) by 75-80%, an effect that persisted for at least one year. In response, the cormorants altered their foraging behavior to compensate.

Crawford RJM[1], Dundee BL[2]

Managing the responses of four seabirds to large changes in the abundance of sardine and anchovy in the Benguela upwelling system

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The Benguela upwelling system off south-western Africa supports large populations of sardine (*Sardinops sagax*) and anchovy (*Engraulis encrasicolus*) that are harvested intensively by purse-seine fisheries and which are also the main prey of four endemic seabirds: African Penguin (*Spheniscus demersus*), Cape Gannet (*Morus capensis*), Cape Cormorant (*Phalacrocorax capensis*) and the nominate race of the Swift Tern (*Sterna b. bergii*). Over the period of operation of the fisheries, there have been large, long-term changes in fish abundance that have had massive impacts on the seabird populations. Following the collapse of the northern Benguela stock of sardine, for example, the populations of penguins and gannets in that region declined by 85% and 93%, respectively. Although natural, regime-scale variability in fish populations is an on-going hazard, fishing has the potential to alter this variability further, for example by prolonging and deepening troughs in fish abundance. International agreements and national legislation expect fishing policy to take cognisance of the needs of dependent species. In the Benguela system, efforts take account of the food requirements of seabirds have included consideration of target populations for seabirds and long-term (15-25 years) monitoring of seabird parameters, with a view to developing an empirical relationships between seabirds and their prey that would enable the linking of sustainable management models for both. This contribution will describe responses of the four seabirds to the observed shifts in the abundance, distribution and species composition of their prey resources. It will also canvass the use such information towards achieving target populations for seabirds.

Frederiksen M

Causes of seabird declines are complex: Kittiwakes, climate and fisheries in the North Sea

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Predatory seabirds can be adversely affected by human activities in several potentially interacting ways. Thus impacts from industrial fisheries competing for shared prey and marine environmental change can together exacerbate population declines. In the North Sea, Black-legged Kittiwakes (*Rissa tridactyla*) have declined by >50% since 1990, a period during which a Lesser Sandeel (*Ammodytes marinus*) fishery was active and profound oceanographic changes occurred. I collected demographic data on the Isle of May, southeast Scotland, from 1986 to 2002, examined changes over time and correlations between population parameters, the local sandeel fishery and environmental factors, and incorporated the results in a population model. Breeding success and adult survival were low when the sandeel fishery was active between 1991-1998, and both also correlated negatively with winter sea temperature, with a one-year lag for breeding success. Modeling showed that the observed changes in population parameters could explain the change in population growth rate from +8% year-1 in the late 1980s to -11% year-1 in the late 1990s. Stochastic modeling indicated that the population was unlikely to increase while the fishery was active or sea temperature rose, and that population decline would continue if both occurred. Sandeel recruitment is reduced in warm winters, which probably explains the temperature effects on kittiwake survival and breeding success. The fishery also had a strong negative effect on demographic performance, although the mechanism is unclear as kittiwakes and fishermen target sandeels of different ages. This study shows that adequate monitoring of the effects of fisheries and environmental change on seabird populations needs to include survival as well as breeding success, and that multiple factors may act simultaneously. None should be assessed in isolation.

S08: Birds as Indicators of Environmental Change

Conveners: David Noble, UK; Michel Louette, Belgium

Gregory RD[1], van Strien A[2], Vorisek P[3]

Using birds as indicators of environmental change in Europe

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In 2002 world leaders pledged 'a significant reduction in the rate of biodiversity loss by 2010' and these commitments have been echoed at regional and national levels. Meeting such commitments requires a way of measuring progress towards the targets and concerted conservation action to improve the status of species and their habitats. Measurement alone poses a considerable challenge because biodiversity trend information is often sparse and patchy in its coverage of species and ecosystems, and synthesis is rare. Delivering conservation action on a sufficient scale and with sufficient intensity to bring about change is a massive challenge. Here we use European birds as an example to show how workable environmental indicators can be constructed at national and continental scales, and show how they can then be interpreted. We have developed statistical methods to create national and supranational multi-species indices and indicators based on data from national annual land bird surveys in Europe. The resulting indicators show, for example, that common farmland birds have declined steeply across Europe over the last three decades. Evidence from elsewhere suggests that agricultural intensification is the prime driver of biodiversity decline on farmed land. We argue that, with some care, wild bird indicators of this kind can often provide a useful proxy for ecosystem health and trends in other elements of biodiversity. The purpose of such indices is to communicate with and aid decision makers in reviewing and formulating environmental policies. The indicators we describe have been adopted by national governments in Europe and by the European Union. Our work provides a template for other taxa, habitats and regions, and provides a step towards fully representative biodiversity indicators.

Sontag W[1], Louette M[2]

The potential of particular starlings (Sturnidae) as indicators of habitat change

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The some 110 species of starlings and mynas, Sturnidae, are a highly successful group. Although many depend on trees, many also adapt well to open habitats. Several predominantly open country species have been introduced successfully; and some have been brisk intruders, affecting native birds. Their success in extending range seems to be connected to an ability to accept habitats modified by humans. Thus habitat use in a typical open country myna (*Acridotheres tristis*) and a forest myna (*Gracula religiosa*) were investigated in primary and secondary habitats in the Comoro Islands, where *Acridotheres tristis* is introduced, and in Thailand where both species are native. The landscape of the four Comoro Islands has been affected by man to a variable extent. *A. tristis* was found not only in such open environments as degraded mosaic habitat and tree plantations, but in isolated and main forests as well. Secondary habitats were preferred, and the myna is a good indicator of degradation here, forest habitat types that it never entered in its native Thailand. In contrast, *Gracula religiosa* was readily found in primary forests in Thailand, but its distribution was heterogeneous. It tended to prefer sites characterized by large trees, open forest and with open areas nearby. Though clearly dependent on trees, *G. religiosa* may use a much wider spectrum of forest types than other forest-living birds. Additional observations of other starlings in Thailand also suggest that they have potential to use a wide ecological niche, and that there is marked plasticity in habitat use by particular species, making them good indicators of rapid habitat change.

Fuentes EE, Olsen J

The ecology of raptor communities as an indicator of habitat quality

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Indicator species of habitat quality are a useful tool for biodiversity managers nowadays. Studies using such indicators, however, are often limited to presence/absence or abundance data of a few species, and rarely include more complex ecological information. Here we argue that ecological studies of raptor assemblages are good indicators of habitat quality, with wider applications than studies incorporating only presence or abundance data. Since 2002, we have been carrying out a long-term study on the ecology of the raptor assemblage in the Canberra region, southeast Australia. We found 11 of the 12 regional raptors breeding inside the city limits, something unusual in large urban centres that are commonly inhabited by few species. As a whole, the assemblage showed high reproductive success in comparison with other areas and years, though this was not true for all species. Our study of hunting behavior revealed little dietary overlap and use of a broad prey base. Nor was diet dominated by one or two superabundant prey species, indicating the availability of a complex animal community ranging from macropodids to parrots and from turtles to insects; such a community constitutes what could be called a resource "umbrella" for the raptors. Concerning nesting substrates, trees of native *Eucalyptus* were the main sites used, but cliffs and exotic conifers, mostly *Pinus radiata*, were also important. The species nested in a wide range of habitat types, segregating themselves evenly through the landscape. Changes in raptor density, breeding success, habitat use and hunting behavior could thus be used to detect and monitor fluctuations in habitat quality.

Rönkä MTH[1], Saari L[2], Lehikoinen EA[1], Suomela J[3]

Environmental changes and population trends in breeding waterfowl in the northern Baltic Sea

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Seabirds are an important component of marine ecosystems, usually as predators at the top of the food chain. They are regarded as good indicators of environmental changes, and may help to fill gaps in our knowledge of marine ecosystems under stress. Most studies until now, however, have only documented changes in seabird populations without going on to connect them with environmental circumstances. We modeled the impact of eutrophication, winter severity, weather conditions during breeding and water salinity on breeding populations of ten species of waterfowl in the Archipelago Sea off southwestern Finland, using generalized linear models and the program TRIM (TRends and Indices in Monitoring data). This is the first attempt to show quantitatively the connection between changes in waterfowl populations and several simultaneous environmental events. The Goldeneye (*Bucephala clangula*), Eurasian Coot *Fulica atra*) and Velvet Scoter (*Melanitta fusca*) declined with increasing eutrophication. The Goldeneye, coot, Mallard (*Anas platyrhynchos*), Mute Swan (*Cygnus olor*) and Common Eider (*Somateria mollissima*) were most vulnerable to winter severity. We did not find evidence for impacts of weather on breeding, or of water salinity on population trends. Our results suggest that eutrophication and severe winters, in particular, impact negatively on waterfowl populations in north temperate seas. In order to understand changes in seabird populations, there is a need for long-term environmental data, as well as data on population dynamics, such as breeding success and recruitment. More also needs to be learnt about the dynamics of marine ecosystems and the interactions between seabirds, their food resources and the environment.

Burfield I[1], Butchart S[2], Nagy S[1], van Bommel F[1]

Developing indicators for monitoring trends in the status of threatened birds in Europe

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In 2002, world leaders pledged to significantly reduce the rate of biodiversity loss by 2010. Across Europe and the EU25, governments set an even more ambitious target to halt biodiversity loss altogether by 2010. To measure progress towards these goals, the Convention on Biological Diversity proposed a number of indicators for immediate testing. One of these involves monitoring trends in the status of threatened species. At a global level, BirdLife International, as part of the Red List Consortium, has led the development of Red List Indices (RLIs) to meet this need. Using data from the *IUCN Red List of Threatened Species*, RLIs show overall changes in the threat status or relative extinction risk of representative sets of species over time. RLIs can be calculated for any complete set of species for which Red List assessments have been carried out at least twice. To date, global RLIs have been developed for birds for 1988–2004 and for amphibians for 1980–2004. RLIs are a very useful indicator of biodiversity loss at global scale, because their high geographical representativeness compensates for relatively coarse temporal resolution. At the scale of Europe or the EU25, however, considerably more information is available on population trends in a higher proportion of threatened birds. There are also relatively few globally threatened birds in Europe, so RLI trends are driven by fewer species and thus less robust. Consequently, BirdLife International has been exploring other potential indicators of trends in threatened birds in Europe, using data from *Birds in Europe*. These include RLIs based on assessments of regional extinction risk, and indices based on population trends in threatened species. This paper evaluates the relative strengths of such approaches, and describes the improvements in monitoring schemes needed to support them.

S09: New tools and concepts in avian conservation genetics

Conveners: Gernot Segelbacher, Germany; Jacob Höglund, Sweden

Piertney S

Avian conservation genetics in the era of genomics

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The central tenet of conservation genetics is the maintenance of genetic diversity. High levels of genetic diversity minimise levels of inbreeding depression in individuals, and maximise the evolutionary potential of populations. Traditionally, levels of genetic diversity in natural populations have been surveyed from neutral markers, such as microsatellite length polymorphisms, that have minimal adaptive or functional value. It is unclear to what extent neutral proxies accurately reflect levels of ecologically meaningful genetic variation at functional genes that will have direct impact on individual fitness and adaptive potential in a changing environment. Conservation effort aimed at maintaining adaptively important genetic diversity in natural populations must be underpinned both by an understanding of the molecular mechanisms that determine fitness-related traits, and also how such diversity will vary in response to the changing demographic structure and diverse selection pressures inherent in natural populations. The advent of genomics has yielded powerful new approaches for elucidating the genetic basis of adaptation and fitness in non-model species, and determining the spatio-temporal dynamics of fitness-related genes in natural populations. Here I highlight some of the genomics tools that have been used to define adaptive genetic diversity in avian species, ranging from the isolation and characterisation of candidate gene regions likely to directly impact individual fitness, to genome-wide scans directed to determine multi-locus responses to specific selection regimes. Specific examples, primarily from my own work on grouse, are used to illustrate the utility of the various approaches in a conservation context.

Keller L

Genetic consequences of small population size in birds

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The insight that genetic processes can lead to unusual patterns in small populations is at least 240 years old. But to what extent these genetic processes affect naturally small populations of birds has only been the subject of close attention in the past 30 or so years. I will first summarize what we know about one particular genetic process, inbreeding depression. Data from birds make it clear that severe inbreeding depression can occur in nature even in isolated island populations. Furthermore, I will present data that show that the degree of inbreeding depression can be strongly affected by the environmental conditions to which the birds are exposed. However, while evidence is accumulating that the magnitude of inbreeding depression in natural animal populations can be substantially modified by environmental conditions, I will argue that inbreeding depression is not necessarily always most pronounced when environmental conditions are poorest. I will put the results obtained form birds into a larger context and ask what we really know about inbreeding depression in the wild and what we currently fail to understand. Finally, I will touch on some of the other genetic processes and ask how they affect small populations.

Segelbacher G

Genetic diversity in bird populations - what do we learn for conservation?

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Population fragmentation and isolation have extremely detrimental effects both on the fitness and viability of extant populations, and also on the evolutionary potential of species. Population genetic structure is predicted to impact on population persistence and long-term survival wherever small and isolated populations run the risk of extinction. Most studies that have attempted to monitor genetic diversity within and among threatened populations have used so-called neutral genetic markers to quantify variation. These markers are excellent for estimating effective population size, migration rates and other population genetic processes because, on the whole, they are not affected by selection and hence genetic variation in them is determined mainly by genetic drift. It is questionable, however, whether neutral genetic variation is a suitable proxy for the ecologically meaningful genetic variation required to maintain populations as viable entities capable of adapting to habitat and environmental change. I use Hazel Grouse (*Bonasa bonasia*) as a model system to investigate how lowered genetic variability in populations is affected by both population size and isolation, and to estimate the potential impact of both of these factors. I compare populations from within a continuous distribution (e.g. boreal landscape) with contiguous populations (e.g. Alps) and recently isolated populations to infer the effect of habitat fragmentation on genetic diversity. I also discuss whether heterozygosity is a useful indicator of population decline and will contrast these findings with results from markers under selection.

Robertson B, Meathrel C

Do sampling rigor and methodology affect the genetic differentiation of threatened populations and resultant conservation strategies? A case study using Australia's Pacific Gull

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When assessing the degree of genetic differentiation between separate species, geneticists, including those working on Northern Hemisphere gulls, are faced with such issues as degree of geographic separation and the potential for gene flow, especially in ring species complexes. As a consequence, few, if any, studies have examined the roles of sampling rigor (the number of samples per site) and technique (nuclear versus mitochondrial DNA sequencing, or a combination thereof) in evaluating differentiation among species and populations within species. Yet rigor and technique have potential to confound research outcomes and resultant conservation strategies. Australia’s only large endemic gull, the Pacific Gull (*Larus pacificus*), has a total population of only about 9000 birds which occur in five distinct, geographically isolated populations. As such, they are an ideal model with which to test statistical and methodological issues of within/between population variation in avian conservation genetics.

Jamieson IG, Grueber CE

Neutral DNA markers and their limitations in inferring inbreeding and kinship in endangered species with low genetic variation

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There has been an upsurge in the use of neutral molecular markers to infer levels of inbreeding and relatedness in wild populations of birds, and much has been made of their apparent usefulness for conservation research. However, few of these techniques have been tested on endangered species and fewer still on species with relatively low genetic variation. We tested for correlations between pedigree-based inbreeding coefficients (f) and marker-based heterozygosity in the highly endangered New Zealand Takahe (*Porphyrio hochstetteri*), and examined different approaches for comparing pedigree versus marker-based estimates of pair-wise relatedness. Although the pedigree data goes back seven generations and there is high variance in f, Takahe have relatively low levels of heterozygosity (0.33) and a low number of alleles per locus (2.1, n=9), both indicative of a severe bottleneck. We found no significant relationship between pedigree f and heterozygosity. The relationship between pedigree vs. marker-based estimates of kinship was weak and varied significantly depending on the software package used, with the best results obtained from an allele-sharing approach. The use of marker-based metrics to infer levels of inbreeding or kinship is not straight-forward, and will work well only when many, highly polymorphic markers are used. We therefore conclude that their use in conservation research, especially in endangered species with low genetic variation, will be relatively expensive and of potentially limited value.

S10: The status of the House Sparrow in the urban environment

Conveners: Jenny De Laet, Belgium; J. Denis Summers-Smith, UK

Summers-Smith D[1], De Laet J[2]

The status of the urban House Sparrow in the world

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The House Sparrow (*Passer domesticus*) is unique among wild birds in its close association with, indeed virtual dependence on, man, not only in the agricultural environment, where presumably this association first evolved, but also in built-up areas. It would be expected that, with man's dominance of the world, the future would be bright for the bird, but it is now becoming evident that this is not the case, particularly in the highly developed region of western Europe. The urban decline has been the subject of much speculation, but the reasons are not yet properly understood. This is an interesting ornithological question. This presentation aims to provide a summary of the present status of the House Sparrow in urban areas and identify those areas of research that will provide the necessary evidence to understand what is going on. Any significant change in the population of a species, particularly a dramatic decrease such as has occurred recently in urban House Sparrows in western Europe, is clearly worthy of scientific study. Application of the precautionary principle demands that we identify the reason(s) for the decline in built-up areas, the prime habitat for man, with the possibility that what is affecting House Sparrows now could have an impact on us in the future.

Peach W[1], Vincent K[2], Ockendon N[1], Orsman C[1], Noble D[3]

Environmental causes of the decline of urban House Sparrows: a review of the evidence

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There is good evidence that House Sparrow numbers have declined markedly in many urban-suburban areas across Europe during the past 20 years. London has experienced the largest sparrow decline of any UK city, counts falling by 66% in just six years (1995-2001). Despite much speculation there has until recently been little evidence relating to the potential environmental causes of these declines. Detailed studies of reproductive success in suburban Leicester indicate that high rates of chick starvation combined with low fledgling body mass (a good predictor of post-fledging survival) provide a plausible demographic mechanism for the large declines in local sparrow numbers. Chicks were more likely to starve if their diet included a relatively high proportion of vegetable material or a high proportion of ants, and were less likely to starve if their breeding localities contained relatively large areas of deciduous vegetation and grass, and relatively high densities of aphids. Fledgling body mass was lower in broods raised in highly urbanised localities (i.e. in areas having high levels of air pollution and lacking deciduous vegetation and grass). Thus, House Sparrow productivity in suburban Leicester appears to be limited by the effects of urbanisation on the availability of key chick invertebrate prey. In London we are testing the hypothesis that annual productivity and breeding densities of suburban House Sparrows are limited by the availability of invertebrate prey for chicks. Twenty-six breeding colonies are being provided with supplementary protein (mealworms) throughout the breeding season while paired control colonies remain unfed. Fledgling sparrows were significantly more abundant at fed colonies than un-fed colonies in 2005, but we will not know whether breeding densities have responded to supplementary feeding until April 2006. The experiment is planned to continue for two further breeding seasons.

Vincent K[1], Peach W[2], Fowler J[1]

The breeding biology and nestling diet of the House Sparrow in urban Britain

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We present findings of an investigation into the causes of population decline in House Sparrows (*Passer domesticus*) in urban Britain. New data are presented describing breeding biology and chick diet across an urban-rural gradient in Leicestershire. We found pronounced seasonal variation in nesting success, with low egg and chick failure rates early in the season but high rates of chick starvation during June and July. More young fledged from home ranges that included extensive areas of grass, deciduous shrubs and trees. Araneae, Homoptera, Diptera and Coleoptera accounted for 80% of all invertebrate remains found in nestling faecal samples, and were evidently main prey. Composition of chick diet changed during the season, with aphids becoming prominent in June, and spiders, ants and vegetable material increasingly common later in the season. Nestlings that died had been fed on a higher proportion of vegetable material and ants than those that went on to fledge, and broods with diets dominated by vegetable material suffered high rates of total failure. The number of young fledged from late broods was positively related to the abundance of aphids within 100m of the nest. Lack of suitable invertebrate prey appears to have been the cause limiting chick survival and reproduction in House Sparrows in our urban study area.

Vangestel C, Lens L

Fluctuating asymmetry and ptilochronology as phenotypic markers of food stress in the House Sparrow

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A steep decline in populations of urban House Sparrows (*Passer domesticus*) over recent decades is well substantiated. Apart from its interest as a biological phenomenon *per se*, the fall in numbers may reflect a widespread deterioration in the quality of urban environments, and as such, has attracted the attention of both ecologists and conservationists. To predict future population trends and take appropriate conservation action before they become irreversible, conservation biologists are in urgent need of effective stress indicators that could serve as early warning systems. With this in view, we performed food stress experiments on caged House Sparrows to evaluate the applicability of two potential phenotypic markers: fluctuating asymmetry (deviation from perfect symmetry in bilateral traits, FA) and ptilochronology (dimensions of growth bars in avian feathers). To manipulate intake rates of food, individual sparrows were provided with commercial aviary food supplemented with different proportions of inert, non-digestible components. Levels of FA and growth bar widths of left and right second outermost tail feathers were compared between treatment and control groups. In addition, both phenotypic markers were examined in series of museum specimens collected during the 1980s, before the onset of widespread population decline. This allowed us to compare historical patterns of FA and ptilochronology with current patterns, in areas that have and have not suffered marked population declines.

Seitz J

Three hundred years of persecution of House Sparrows in Germany

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Modernization of agriculture, economic development and human population increase after the end of the Thirty Years War caused authorities in many parts of Germany to decree the abatement of so- called pest animals. Edicts against House Sparrows (*Passer domesticus)* are first known from before 1700, and many were issued in the first half of the 18th century in different parts of Germany. Farmers were then given targets of sparrow heads to be delivered in proportion to the size of used farmland or pay a fine. Famous German ornithologists around the turn of the 19th century - J. A. Naumann, J. M. Bechstein and J. F. Blumenbach - nonetheless argued against the eradication of sparrows. Naumann drew attention to the devastation of many other songbirds killed in the course of the measures. C. L. Gloger, the pioneer of bird protection in Germany, emphasized the value of House Sparrows in controlling insect plagues. The pros and cons of the persecution were discussed intensively then. Decrees began to be abolished in many areas by the mid 19th century either because they had been ignored or had caused farmers to conserve local enclaves of sparrows to ensure that targets of heads could be met. But the decrees were subsequently reintroduced for agricultural reasons around the beginning of the 20th century. Surprisingly, such famous ornithologists and conservationists as Ernst Hartert and Graf Berlepsch joined in the war against sparrows, supporting a general view that sparrows were competitors of so-called useful songbirds. After the Second World War, sparrows were poisoned in large numbers. In Lower Saxony, where a destruction method with poisoned grain had been developed, more than 200,000 sparrows were killed in the winter of 1950/51, as well as other songbirds. Only in the last forty has the persecution of sparrows finally ceased in Germany. It is suggested that such a long history of persecution has had a significant impact on the populations of House Sparrows there today.

S11: The effectiveness of agri-environment schemes for farmland birds

Conveners: Juliet Vickery, UK; David Kleijn, The Netherlands

Kleijn D

Ecological effects of agri-environment schemes on birds in different European countries

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Agri-environment schemes are an increasingly important tool for the maintenance and restoration of farmland bird populations in Europe, but their exact effects are poorly known. We evaluated the effects of agri-environment schemes on densities of breeding birds in Germany, Spain, Switzerland, the Netherlands and Great Britain. In each country we compared settlement densities on 42 paired sites, one with an agri-environment scheme, the other conventionally managed. Birds were surveyed using a territory mapping approach at two spatial scales: the field scale, varying in size between countries, and the 12.5 ha plot scale. The abundance of observed birds, but not of territory-holding birds, was significantly higher at the field scale only in Switzerland and Germany. In Spain, birds preferentially bred on fields with agri-environment schemes at both spatial scales, but the total number of observed individuals was not significantly enhanced on sites with agri-environment schemes. In the Netherlands, more territories were observed at the 12.5-ha plot scale but not at the field scale. Red data book species occurred in considerable densities in Spain, the Netherlands and Britain but only in Spain did agri-environment schemes lead to significant effects. The results suggest that agri-environment schemes provide moderate benefits to farmland birds in most of the countries. With the exception of Spain, however, they failed to enhance the species most threatened by modern agriculture. The response of individual species or functional groups is analyzed in a number of countries to gain more insight in the mechanisms behind the observed responses, and to produce recommendations to improve the effectiveness of agri-environment schemes.

Evans A[1], Green R[2]

An example of a two-tiered agri-environment scheme designed to deliver effectively the ecological requirements of both localised and widespread bird species

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Intensification of agricultural practices over the last 50 years has resulted in the impoverishment of the wildlife resource associated with lowland farmland across much of Western Europe. This is perhaps best documented in birds. In England, populations of 15 species associated with lowland farmland have fallen by between 50% and 100%. Several species have become rare and localised. Others, formerly abundant and ubiquitous remain relatively common and widespread, but nonetheless in need of conservation action. Agri-environment schemes are widely held as a solution to this generic problem. The efficacy of any scheme in recovering the population of a given species will depend upon deployment of effective prescriptive management in the right place. We argued that a two-tiered approach is required in the design of any scheme, to cope with the requirements of both localised and widespread species. We illustrate this by using case studies of two ground-nesting bird species, Stone-curlew (*Burhinus oedicnemus*) and Skylark (*Alauda arvensis*), which share a common cause of decline but for which the prescriptive management and the means of deployment differ radically.

Kahlert J, Clausen P, Hounisen JP, Petersen IK

Response of breeding waders to agri-environmental schemes may be obscured by effects of predation, existing hydrology, and previous cultivation

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The initiation of agri-environmental schemes (AES) to create more bird-friendly habitats for breeding waders may not show expected benefits in all situations. We show this with results from a long-term study of breeding waders on 469 permanent grass fields in the Danish Wadden Sea, where an AES scheme has been developed gradually since 2002. We had expected that more waders would be attracted by improved retention of water during the breeding period. Nevertheless, overall numbers of breeding pairs did not change, even though Northern Lapwings (*Vanellus vanellus*), Black-tailed Godwits (*Limosa limosa*), and Common Redshanks (*Tringa totanus*) were brought to water in fields. From 2004, research was widened to identify factors constraining the positive effects that had been anticipated. We found that many of the fields in the core breeding area were already prone to high water retention, even before AES initiation. Furthermore, some AES fields had been cultivated previously, attracting fewer birds than both AES and non-AES fields which had never been cultivated. The results suggest that the interplay between ground water retention and previous farming history are important determinants of habitat choice for breeding waders in developed landscapes. These factors are likely to vary significantly, even at fine-grained, local scales. In addition, we found that wader-friendly habitat management could be affected by predators, especially foxes, living in the same landscape. This emphasises the need for thorough analysis of local population processes and the nature of the habitat before initiation of an AES, so that the goals defined are realistic and the benefits expected achieved.

Díaz M, Concepción ED, Baquero R

Influence of landscape structure on the effectiveness of agri-environment schemes

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Recent work has suggested that loss of biodiversity in European farmed landscapes could be attributed to landscape simplification rather than impoverishment of environmental conditions within fields. Moreover, the failure of agri-environment (AG) schemes to recover diversity could partially be due to reduced recolonisation rates and/or lack of source populations in simpler landscapes. We analyse whether species richness and the effectiveness of AG schemes (i.e., increase in species richness between paired fields with and without schemes) are influenced by landscape traits at the scales of (1) fields and (2) the surrounding landscape. Selected landscape metrics were measured at the two scales: size and shape of focal fields and types of boundaries (field scale), and land cover type, length of three types of boundaries and measures of landscape structure in 500 m circular buffers around field centres (landscape scale). Landscape metrics were summarized by means of three Principal Component Analyses (PCAs), one for field-scale metrics and two for landscape-scale metrics; of the latter, one PCA estimated landscape connectivity and the other the diversity and types of land use. Preliminary results, with detailed measurement of three study areas in Spain differing in landscape complexity (amount of natural vegetation interspersed within fields), led us to propose a non-linear model for the effects of landscape, including threshold values of landscape complexity and saturation effects on both species richness and effectiveness of AG schemes. We here test the generality of this model at a European scale, using data from comparable study areas located in other European countries. Comparability between countries was ensured by common sampling designs within the V Framework project: 'Evaluating current European agri-environment schemes to quantify and improve nature conservation efforts in agricultural landscapes' (EASY).

Birrer S[1], Spaar R[1], Kohli L[1], Spiess M[1], Herzog F[2]

Why has the Swiss agri-environmental scheme such a low impact on farmland specialist birds?

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Agricultural production is intensive in the Swiss lowlands, where about half of farmland bird species are on the Red List. A nation-wide agri-environmental scheme was launched in 1993 to improve biodiversity on farmland. To qualify for subsidies, farmers had to set aside at least 7% of their farmland as "ecological compensation areas" (ECA); these areas are managed for conservation purposes. The Swiss Ornithological Institute evaluated the effects of the scheme - and ECA was increased on a national scale to 8.8% of farmland in 2004. Despite the increase, there is still no positive impact on specialized farmland birds: the national Swiss Bird Index, 1990-2004, shows a continuing decline. Common and widely distributed farmland species, however, are now stable or even increasing. On a local scale, Yellowhammer (*Emberiza citrinella*), Common Redstart (*Phoenicurus phoenicurus*) and Linnet (*Carduelis cannabina*) include ECAs preferentially in their territories. We attribute the meager impact of the scheme to the poor quality of three quarters of ECAs. Quality is considered as "adequate" for farmland birds, if, for example, grassland in or near orchards is cultivated at low intensity, providing a good supply of invertebrates. Merely 27% of orchards fulfill this criterion. In various test-regions, we demonstrated a clear positive effect of high quality ECA on regional farmland bird populations. To achieve high quality in ECAs it is essential to provide a competent advisory service to farmers and to obtain close co-operation from nature conservationists, governmental agencies and farmers. A new Swiss scheme was launched in 2000 with the aim of improving the quality of ECAs and of connecting them in networks. Farmers gain additional subsidies if they take part in regional programs to improve ecological conditions for specified target species. The new scheme allows for implementation of specific conservation measures for threatened farmland species. Examples will be presented.

S12: Avian conservation in the tropics: a global perspective

Conveners: Kimberly Smith, USA; Navjot Sodhi, Singapore

Sodhi N[1], Smith K[2]

Conservation of tropical birds: mission possible

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Worldwide habitat loss, fragmentation and degradation are operating on a massive scale, and are accelerating. Many scientific studies have shown or predicted that such habitat destruction will have dire consequences for the future of global biodiversity. Habitat loss in the tropics especially is unprecedented, which is of particular concern because it is in the tropics that the greatest diversity and centres of endemism are to be found. We first report on the local extinctions of tropical birds, and then review the current state of tropical birds and highlight the areas and countries with high numbers of threatened bird species. To conclude, we discuss the options for tangible conservation of tropical birds.

Garnett S[1], Brook BW[2], Crowley G[3]

Extinction risks for tropical forest birds

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Tropical forests support some of the world's richest centres of species diversity and endemism, yet these biomes are now dangerously imperilled by anthropogenic change, including deforestation and habitat degradation, overexploitation, global climate change, and the invasion of alien predators and competitors. If we are to avert or at least mitigate catastrophic loss of species in these areas, it is vital to understand the direct and indirect effects of these agents of threat. Moreover, provision of a robust theoretical and empirical underpinning for the relationship between evolved characteristics (life-history traits and ecological preferences) and extinction risk may provide a general theory of the extinction process useful for conservation management. Forest birds provide some of the best quantitative data on the rate and selectivity of the extinctions in tropical regions, and their autecology is better known than most other taxonomic groups, making them ideal candidates for the tropical application and testing of extinction theory and viability models. I show how direct population, habitat and threat data, in combination various lines of surrogate information, can be used to develop a broad predictive framework for extinction vulnerability of tropical birds using generalized linear mixed modelling and multi-model inference from an *a priori* set of population dynamics simulations. Case studies, including the Sulewesi maleo, are provided. The results emphasise an important disconnection between the proximate processes that dominate the fate of small bird populations on the edge of extinction and the ultimate and often broad-scale anthropogenic drivers that are causing once abundant tropical species to decline.

Collar N

An overview of bird conservation in Asia

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Astonishing levels of pressure, unlike anywhere else on earth, are being placed on natural habitats in Asia, most notably forests and wetlands, through the exceptionally high levels of human population region-wide, and the strong drive of competing nations for economic growth. Yet levels of investment in conservation, sustainable use of resources and biological understanding are lower than in many other regions. Consequently, the situation in Asia is relatively bleak. More bird species are threatened with extinction compared with other regions, while in many parts of Asia, agricultural landscapes have been reduced to birdless deserts through the intensification of farming (including widespread use of strong pesticides) and the heavy exploitation of birds (both for food and pets), so that relatively widespread, common species have become rare and isolated in reserves (which are themselves often compromised by lack of funds and staff). Asian ornithology is rather weakly and patchily developed, with some generally very small birdwatching clubs and few more serious scientific bodies. Responsibility for initiating and funding conservation work lies in the hands of "BINGOs" (big international non-governmental organisations).

Githiru M[1], Ndanganga PK[2], Thompson H[2]

Some challenges facing bird conservation in Africa

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Bird conservation remains low on the agenda in Sub-Saharan Africa whereas, overall, things are getting worse. Why is this the case when interest, reflected for example in the number of young ornithologists, seems to be growing? For some sites and species, there is a genuine lack of data required to back calls for conservation action. BirdLife International (BI) has collated and synthesized the data available for effective conservation planning, leading to the production of Action Plans for globally threatened birds and the regional Important Bird Areas (IBA) directory. Yet, even when the data exist, there is often a failure to provide pragmatic solutions. BI endeavours to surmount this in their African Partnership for Sustainable Biodiversity Action initiative that involves formulation of National IBA Conservation Strategies and formation of Site Support Groups. Additional problems include: (i) the deeply entrenched short-term 'project approach' that lacks the continuity for building-up into some form of policy; (ii) habitual absence of conservationists in public arenas where ideas and policies are formed; and (iii) (erroneous) negative attitudes towards locals for their perceived role in conservation problems. They present three key challenges: (i) while short-term projects are valuable for building scientific evidence, triggering initial interest and conservation actions, they should have an in-built mechanism enabling them to develop into policy-influencing instruments at local and national scales; (ii) with sound alternatives, conservationists must vigorously infuse their agenda into other sectors of society; (iii) conservation messages should be linked directly to everyday living and human wellbeing. The few places in Africa where some of these challenges are being tackled in some form require development and replication. Lastly, besides integrated research, conservation education and advocacy, emphasis needs to be placed on Protected Areas as the cornerstones for fostering conservation actions.

Garcia-Moreno J[1], Clay R[2]

Developments in bird conservation in the neotropical region

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Habitat loss remains the major cause of threat to birds in the neotropics, over and above such other impacts as the live bird trade, nest robbing, invasive species, and, in the case of seabirds, fishery bycatch. Nevertheless, the region has benefited from a surge in avian research over the last decade, many of the studies using modern techniques to analyze a variety of data, ecological, molecular and physiological. These studies have improved general understanding of the taxonomic status of many forms, their ecology and conservation needs. Using this information, the bird watching community can contribute further to the gathering of information in support of conservation efforts, but needs mobilizing. So capacity building has become a key issue. The Important Bird Areas (IBAs) approach promoted by BirdLife International is a core component in our strategy for defining Key Biodiversity Areas, through which Conservation International is attempting to broaden the definition of the IBA concept. As part of the strategy for identifying such areas, account is now being taken of migratory and large-range birds and their need for large-scale biodiversity corridors.

S13: Detecting ecological traps: avian and human perspectives

Conveners: Marc-André Villard, Canada; Tomas Pärt, Sweden

Pärt T[1], Villard M-A[2]

Ecological traps: Avian and human perspectives

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Ecological traps are poor quality habitats that are preferred by individuals. From a human perspective, ecological traps mislead standard indicators of habitat quality. From an avian perspective, such a non-adaptive and non-ideal choice of habitat may have detrimental effects on individual fitness and long-term population persistence. For conservation purposes, it is therefore critical to identify, or at least determine the probability of detecting ecological trap habitats. First, we briefly review the standard methods of identifying high quality habitats and their reliability in terms of habitat-specific reproduction and productivity. Secondly, we review studies of ecological traps and their potential causes. We find only a minority of cases showing true ecological traps, whereas many studies suggest non-ideal habitat selection, such as a poorer choice than expected from ideal habitat selection decision rules. Third, we show long-term demographic data on breeding habitat selection in northern wheatears (*Oenanthe oenanthe*) in Swedish farmland to illustrate the complexity of habitat selection decisions causing ecological traps. Specifically, we show that the degree of non-ideal habitat selection depends on a partly stochastic determinant of reproductive success and on the cues used by individuals when assessing habitats. We conclude that there is an urgent need to elucidate the ecological contexts producing ecological traps and non-ideal habitat selection.

Lens L

New unconventional methods of estimating habitat quality: strengths and weaknesses

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Given the worldwide loss, deterioration and fragmentation of natural habitats due to anthropogenic activity, ecologists are increasingly challenged to identify populations under threat before their demographic and/or genetic properties are irreversibly affected. Traditional indicators of habitat quality, such as density and age structure, or individual quality, such as survival and reproductive success, are often cumbersome to measure, and populations may go extinct before appropriate datasets can be collected. More recently, ecologists have started to explore the suitability of presumed phenotypic markers of environmental quality and stress that do not require repeated captures and are easy to measure. I discuss two such markers: growth bar dimension in feathers and left-right asymmetry in bilateral symmetrical traits. Both methods are first described from a conceptual perspective. Their potential strenghts and weaknesses for the study of ecological traps are then illustrated with examples from ongoing case studies on a temperate zone species, the House Sparrow (*Passer domesticus*) and a suite of Afrotropical bird species that inhabit a critically-endangered biodiversity hotspot in south-east Kenya.

Roos S

Habitat quality and ecological traps when prey species avoid predators

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Increased predation risk has often been identified as a cause of ecological traps, partly because many generalist predators gather opportunistically in increased numbers near human settlement or in recently modified habitats. Studies suggest that although songbirds may prefer some modified habitats, the density of generalist predators, especially of egg- and nestling- preying corvids, can transform them into ecological traps. I investigated habitat preference and reproduction in one such songbird, the Red-backed Shrike (*Lanius collurio*), in relation to corvid density over nine years. In this period, corvid abundance increased dramatically, especially close to human settlement. Results show that Red-backed Shrike nests were often depredated and that the risk of predation was positively related to corvid abundance. As Red-backed Shrikes have a strong preference for breeding in shrub-rich grasslands, and many grasslands in the study area were located close to human settlement, it might be expected that some Red-backed Shrikes bred close to a corvid territory. This, however, is not the case because Red-backed Shrikes intentionally avoid nesting close to the corvid territories. Thus, the between-year variation in spatial distribution of corvids in conjunction with the avoidance behavior of shrikes effected a strong between-year variation in abundance and spatial distribution in the shrikes. The results suggest that ecological traps created by elevated levels of predation are less likely to happen in species with an evolutionary history of predator avoidance. It therefore seems likely that site-specific density and reproductive success in such species in one year may be poor indicators of habitat quality over a longer time frame.

Rodenhouse NL[1], Sillett TS[2], Holmes RT[3]

Multiple interacting anthropogenic factors create ecological traps in space and time

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The ecological trap concept developed from the simple observation that humans were changing avian habitats in ways that could not have occurred during the evolutionary history of the organisms affected. Often the trap is created by a single strong driving factor, such as the destruction of nests by agricultural operations. Most avian habitats today, however, are being affected by humans in multiple ways. As a consequence, it may be necessary, in some settings, to consider combinations of interacting anthropogenic changes affecting habitat quality as ecological traps. As an example, we use our long-term studies of Black-throated Blue Warblers (*Dendroica caerulescens*) and simple population models to examine how climate warming and beech bark disease within the Hubbard Brook Experimental Forest are generating two types of ecological traps: a habitat trap and a density trap. The habitat trap is created as climate warming reduces food availability in an otherwise suitable habitat at low and mid elevations in northern hardwood forest. Beech bark disease then exacerbates the trap by reducing the amount of suitable habitat available for breeding. The density trap results because first-year breeders recruit to the highest elevation allowed by spring weather, but are limited in moving upslope by the fixed transition zone to spruce-fir forest. Consequently, there is a concentration of breeding pairs at high elevation below the transition zone in warm springs; and reduced annual fecundity is associated with high population density. These findings lead us to conclude that it will be necessary to understand the potentially multiple interacting anthropogenic drivers creating ecological traps in order to assess and mitigate their effects.

Mänd R, Tilgar V, Lõhmus A, Leivits A

Providing nest boxes for birds: Does habitat matter?

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Nest boxes are a popular management tool to increase nest site availability for hole-nesting birds, but the biological consequences of their provision in different habitats have been studied little. In our study area, nest boxes for small passerines were set up in deciduous and coniferous woods. Great Tits (*Parus major*) preferred deciduous habitat for breeding, as judged by higher nest box occupation, earlier egg-laying and larger clutches and eggs. In coniferous habitat, however, more and heavier young fledged per nest, and the return rate of both fledglings and adults was higher. We propose two mutually non-exclusive explanations, both related to the maladaptive outcome of the provision of nest boxes: (1) in preferred habitat, nest boxes caused a supra-optimal breeding density leading to an ecological trap, and (2) boxes drastically improved the non-preferred habitat, but birds were unable to exploit it fully. Not only should the provision of high numbers of artificial nest sites in preferred habitat be undertaken with care, but improvement of less favourable habitat by removing critical constraints may sometimes be preferable.

S14: The effect of climate change on avian population dynamics

Conveners: Marcel E.Visser, The Netherlands ; Marcel M. Lambrechts, France

Sæther B-E

Climatic impacts on avian population dynamics: processes and some general patterns

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A large number of studies over recent years have now demonstrated convincingly that expected changes in climate will affect avian population dynamics strongly. Here I review some studies in which intraspecific differences in the quantitative contribution of climate variation to temporal changes in the size of bird populations has been estimated. A general pattern that seems to emerge is that regional variation in the effects of large scale climate phenomena, such as the North-Atlantic Oscillation, and in local climate, is often large. Based on a generalization of the Moran effect for the influence of environmental covariation on population synchrony, I argue further that the spatial scaling of local climatic effects on population dynamics strongly influences the spatial synchrony in population fluctuations over larger distances. An important pattern to emerge is that such climatically-induced synchronic fluctuations in climate have a spatial scaling that is far less than the spatial scaling of climate variables that affect local dynamics. This suggests that the expected large-scale changes in climate may have much larger impacts on avian population dynamics than previously realized.

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Selecting the most relevant climate indices to identify and predict climate impacts on bird population

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There is now wide agreement within the scientific community that global change in climate is ongoing. A major challenge for ecologists now is the development of models to predict future changes in species ranges and extinction risks under various climate scenarios. An important step is the identification of the climatic factors that drive the variation of vital rates in natural populations, and which could be used as indices of climate forcing in models designed to predict the future ranges of species. Individuals in natural populations are directly exposed to variation in local climate, and such variation depends to a large extent on atmospheric and oceanic circulation at the global scale. The resulting large-scale patterns are captured by teleconnection indices such as the North Atlantic Oscillation and El Niño Southern Oscillation. These indices are increasingly used in ecological studies as integrative proxies of climate. In our contribution, we ask which type of climate indices (local- vs. large- scale) is the most relevant to address the ecological impacts of climate change on birds. We first address potential advantages and drawbacks of both types of indices with case studies of seabird and landbird populations. We then present a meta-analysis that synthesizes findings from studies where influences of climate on demographic parameters of birds have been addressed. To conclude, we explain differences among study cases in the fraction of variation in demographic parameters accounted for by climate indices. We relate the fraction of variation explained to the type of climate index applied to the demographic parameter under study, the type of habitat occupied and life-history strategy.

Nevoux M, Barbraud C

Do demographic responses to climate change depend on life history strategies?

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Life history theory postulates that individuals face a major trade-off in the allocation of resources between reproduction and survival. It is also thought that many trade-offs appear only under restricting conditions. In the context of global climate change, a growing number of ecological consequences are now being reported for a huge range of species and habitats. Thus, if climatic change is a potential source of perturbation affecting the nature of trade-offs, assessment of the response of different demographic strategies should help in understanding better both the populational and evolutionary consequences of future climatic change. From that aspect, we compared two distinct avian populations. On a “slow-fast” gradient of life histories, the White Stork (*Ciconia ciconia*) and Black-browed Albatross (*Thalassarche melanophrys*) are both long-lived species that nevertheless use contrasting demographic tactics. Although they live in very different habitats, both are also known to be sensitive to fluctuations in climate. We used long-term demographic data sets based on individual birds to try to link local as well as global climatic fluctuations to inter-annual fluctuations of such demographic parameters as survival rate, breeding performance and recruitment rate. The strong relation found between demography and climate in both species demonstrates that present climate change seems to be having a very significant impact on avian population dynamics. As predicted, responses to climatic variation appear to depend on the life-history strategy adopted by individuals, affecting stork and albatross in different ways.

Maclean IMD, Austin GE, Rehfisch MM

Are responses to climate change temperature dependent? Population changes in over-wintering migratory shorebirds.

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Europe hosts internationally important numbers of over-wintering migratory birds such as waders. Given the degree to which waterbird numbers are used as criteria for designating sites for conservation, and current concerns about global warming, it is important to establish whether changes in the sizes of local populations of these species are driven by climate change. Using data collected from over 3,000 sites and spanning more than 30 years, we present the first pan-European study to examine this link. Our results demonstrate that even small-scale site-level changes in population size have been correlated with changes in temperature. The relationship is most marked in colder areas, suggesting that responses to climate change are temperature dependent and thus may not be uniform in time and space. The underlying mechanisms causing such changes are discussed with particular reference to the relative importance of population shifts versus demographic processes.

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Population level consequences of temporally variable climate change in Black Grouse

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Changes in patterns of large-scale climate may disrupt the match between the proximate cues and ultimate selection factors in the timing of breeding in numerous ways. The consequences thereof on the dynamics and size of natural populations, as well as the underlying mechanisms, nevertheless often remain unidentified. Here we present a novel scenario, where temporal differences in patterns of regional climate change have disrupted the breeding phenology of the Black Grouse (*Tetrao tetrix*). Due to increased spring temperatures, both onset of egg-laying and hatching have advanced over the past 40 years. Because early summer conditions have not changed, however, post hatching weather conditions have become more adverse. As a consequence, bad years have got worse and more frequent, while good years have not got any better. Providing evidence that conditions in early life are critical to chick survival, we argue that chicks are increasingly hatching too early and consequently suffer higher mortality. This may well explain the severe long-term decline in reproductive success, and ultimately the decline in population size, in Black Grouse. We further modeled the impact of asymmetric climate change on population dynamics, and show that this mismatch may also account for the observed qualitative changes in the long-term dynamics, such as the loss of cyclicity, of Finnish Black Grouse populations.

S15: Birds and their use of varied landscapes: insights for integrated conservation planning

Conveners: Richard Loyn, Australia; Lucia Severinghaus, Taiwan

Bennett A, Radford J

Landscape planning for conservation: how do birds respond landscape pattern?

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Research on the status of birds in modified landscapes has been dominated by studies of individual landscape elements, particularly wooded patches. Attributes of patches (size, shape, vegetation, condition, temporal isolation) frequently influence species assemblages within the focal patch. Landscape context, including connectivity with other habitats and the types of adjacent and regional land-uses, also influence species either by affecting within-patch processes or the capacity of birds to move through the landscape. Such research has informed land management in many useful ways. However, for managers to plan at the scale of landscapes or regions, they also require understanding of how emergent properties of landscapes affect biota. By changing the grain of investigation, from patch to land mosaic, new insights can be gained into the importance of landscape-level properties such as total extent of habitat, diversity of land-uses, and spatial configuration of landscape elements. We use a case study from Victoria, Australia, to highlight responses of woodland birds to the properties of 100 km2 land mosaics in an agricultural region. For most species, incidence was most strongly influenced by total extent of wooded cover; measures of spatial configuration, physical environment and land use were also significant for some species. Univariate analyses of species' incidence in relation to the extent of wooded cover showed that incidence generally declined with decreasing cover, but that different forms of response (e.g. linear, curvilinear, asymptotic, and threshold responses) were shown by different species. These results highlight the complex ways in which birds respond to landscape patterns and the challenge for integrated conservation planning.

Mac Nally R

It won''t happen overnight! Time-lags in rebuilding variegated landscapes

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Many native bird species in production landscapes of south-eastern Australia are demonstrably declining, and loss of native vegetation is the major cause. Our biodiversity management objectives must be to increase the probabilities of persistence of species that should occur in the landscape. To do so, there needs to be extensive amounts of new plantings. However, we are conscious that: (1) new plantings in the impoverished soils of southern Australia will take many decades to mature, but will offer suitable habitats for different species over the course of that maturation process; and (2) much existing vegetation is senescent or will be in a few decades'' time. Recent landscape rebuilding models do not explicitly consider maturation time-lags. However, these lags in habitat maturation may create "“bottlenecks"” at future times (e.g. in 50 years) that might prevent some species from persisting in whole landscapes, even though such landscapes may be much more suitable in 100 years' time than now. There are several critical issues: (1) species differ in habitat needs and even one species may require different kinds of habitats for foraging and for breeding; (2) landscapes must be conceived, and managed, as spatial and temporal mosaics to allow for persistence of the full set of species that should occupy them, meaning that senescing and replanted habitats may need to be juxtaposed; and (3) in some particularly problematic landscapes, some highly productive agricultural lands may need to be dedicated to habitat provision because maturation can be fast-tracked in fertile, well-watered locations. The problem is a complex one of scheduling and placement, and its optimization presents major theoretical and analytical challenges.

Mönkkönen M[1], Rajasärkkä A[2]

Forest landscape structure and bird communities in northern Finnish reserves vs adjacent areas in Russia

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Populations of forest birds have changed drastically in northern Finland over the past few decades. These changes have been attributed to intensive, large-scale forest management and harvesting since the late 1940s, which have embedded patches of remnant old-growth forest in a matrix of young regenerating stands. In adjacent areas of the Russian Karelia, old-growth forests still dominate forest landscapes, thus providing a comparative testing ground for assessing the effect and role of forest landscape structure on bird assemblages in northern Europe. Accordingly, we carried out comparative censuses of breeding birds in 103 old-growth forest reserves in Finland, and in the Kostamuksha, Viena and Paanajärvi reserves of Russian Karelia to address the question of how assemblages of breeding birds are affected by forest landscape structure within and around forest reserves. The results indicate that forest reserves close to Russian source areas contained more species and individuals of old forest-associated birds than areas further west. Different species showed different responses to forest landscape structure but, by and large, our results emphasized the importance of the Russian Karelian forests in maintaining bird species diversity and abundance in the fragmented forest landscapes of Finland. The results have clear implications for the planning of forest reserve networks, and their surroundings, at the landscape level.

Strewe R

The importance of altitudinal migration in frugivorous birds on the Pacific slope of the Colombian Andes

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Biogeographic studies on the geographic distribution and area dynamics of tanagers (Thraupidae) were conducted over two years within the Endemic Bird Area Chocó on the Pacific slope of the Andes in Colombia. Tanagers were selected as the target study group because they comprise a characteristic element of the avifauna of the Chocó, occur across all altitudinal zones on the west Andes and include a high proportion of endemics. The studies were carried out across a wide altitudinal range between 400-3200 m asl, thereby covering humid lowland, submontane and montane forest, and extended over two years, including an El Niño event. Results revealed that a considerable proportion of the submontane and montane forest tanager fauna migrates altitudinally. Most of the migrants are frugivores or nectarivores, and therefore important for maintenance of the vegetation ecosystems across altitudes through pollination and seed dispersal. Analysis of geographical distribution and altitudinal movements in the tanagers enabled identification of conservation priorities, stressing the importance of conserving a full altitudinal range of habitat types which are needed by different species at different times, and pinpointing the 600-1800 m asl submontane zone as a crucial center of avian diversity. Present conservation strategies and nature reserves, regrettably, are inadequate for the sustainable protection of the regional bird fauna, particularly its endemic species.

Chan S-F, Severinghaus L, Lee C-K

The effect of rice field fragmentation on wintering waterbirds at landscape level

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Rice fields are a common feature of landscapes in Asia. In Yilan County, northeast Taiwan, rice fields are cultivated in spring and summer and then left to fallow through autumn and winter, when they serve as important wetland habitat for wintering waterbirds. With increasing urbanization, the area under rice has been declining and that which remains has become dissected increasingly by roads. Our study investigated the relationship between changes in the wintering waterbird community on the rice fields and the pattern of urbanization and other changes in the landscape. Wintering waterbirds were censused on sample plots in rice fields averaging 15 ha. From their geometric centers, we quantified land use within three radii of 0.5km, 1km, and 5km using satellite imagery or aerial photographs, to examine the relationships between relative proportions of different types of land use and the species richness, abundance, and community structure of waterbirds. At the 1km scale, both species richness and bird numbers were correlated negatively with the area under buildings and rank grass, but positively with that under fish ponds. The distribution of egrets was not affected by land use. Ducks were associated mostly with fish ponds. Population sizes of waders, especially the most abundant - Pacific Golden Plover (*Pluvialis fulva*), Kentish Plover (*Charadrius alexandrinus*), and Dunlin (*Calidris alpina*) - varied with the proportion of rice field in each 1 km circle. Results from the different scales of analysis will be compared to elucidate the response of waterbirds to mosaic patterns in the landscape.

S16: Demographic mechanisms of population changes at large spatial scales

Conveners: Fernando Spina, Italy; Stephen Baillie, UK

Nichols JD[1], Runge MC[1], Johnson FA[2], Williams BK[3]

Adaptive harvest management of North American waterfowl populations – recent successes and future prospects

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The history of North American waterfowl harvest management has been characterized by attempts to use population monitoring data to make informed harvest management decisions. Early attempts can be characterized as intuitive decision processes, and later efforts were guided increasingly by population models and associated predictions. In 1995, a formal adaptive management process was implemented, and annual decisions about duck harvest regulations in the United States are still based on this process. This formal decision process is designed to deal appropriately with the various forms of uncertainty that characterize management decisions, environmental uncertainty, structural uncertainty, partial controllability and partial observability. The key components of the process are (1) objectives, (2) potential management actions, (3) model(s) of population response to management actions, (4) credibility measures for these models, and (5) a monitoring program. The operation of this iterative process is described, and a brief history of a decade of its use is presented. Future challenges range from social and political issues such as appropriate objectives and management actions, to technical issues such as multispecies management, geographic allocation of harvest, and incorporation of actions that include habitat acquisition and management.

Baillie SR

Studying population processes at different spatial scales using standardized mist-netting

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Since the launch of the Constant Effort Ringing programme in the United Kingdom in 1981, similar projects have developed rapidly in other countries. Some 14 Constant Effort Ringing schemes are now operating in Europe while the Monitoring Avian Productivity and Survival Programme cover much of North America. Fortunately nearly all of these programmes follow very similar protocols and thus provide comparable data on trends in population size, productivity and survival. Such data can be used to develop integrated models of population dynamics, either alone or in combination with data from other sources. Furthermore, the rapidly developing availability of Bayesian techniques for integrated analyses of population dynamics offers the prospect of gaining more robust conclusions by combining data on different demographic processes within a single statistical analysis. This paper will review how data from these programmes can be used to examine population processes operating at scales ranging from sites to continents. Understanding how avian population processes operate at different spatial scales is of considerable applied importance for addressing the impacts of large-scale environmental change on bird populations.

Schaub M[1], Ullrich B[2], Knötzsch G[3], Albrecht P[4], Meisser C[5]

Spatial extent and the dynamics of four local little owl populations

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Because individuals disperse between local populations, the demographic mechanisms underpinning local population growth depend on the size of the spatial range of such populations. As spatial range becomes larger, the importance of mortality and recruitment to population growth is enhanced and of immigration and emigration reduced. Emigration and immigration can be considered as edge effects, the importance of which is scale-dependent. If inferences about the demographic causes underlying population change are to be obtained, the spatial range of the focus population has to be taken into account. However, often only a single population is studied, and the effect of the spatial scale is difficult to assess. Here we present a demographic analysis of four different populations of the Little Owl (*Athene noctua*) that differ in their spatial ranges. We estimated local survival, recruitment and immigration in each population and assessed the contribution of different demographic parameters to population growth by life table response experiments. We show that the impact of immigration and local recruitment to local population growth depends very much on the spatial range of the population. The relationship between the sizes of the study areas and demographic rates allowed us to obtain a rough estimate of the spatial range needed by a population without immigration, that is, the minimal size for self-sustainability.

Nagata H

Estimating species occurrence from a national survey of the natural environment in Japan

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National surveys of the natural environment (NSNE) have been conducted in Japan since 1973 by the Environment Agency (1973-2000) and Ministry of Environment (2001-). Breeding bird censuses, however, have been completed only twice, in 1978 and 1998-2002. These censuses cover less than 5% of the total area of Japan. In order to document distributional changes, I developed species occurrence models, using as my base habitat, meteorological and topographical data provided by the Biodiversity Center and Geographical Survey Institute of Japan. All parameters have a resolution of about 1 km^2. I developed suitable habitat models for breeding birds at different spatial scales from GIS data sets, such as the 50 m DEM and 1:50,000 vegetation map. Two different types of parameters - climate and topography, and land-cover types - were used for the habitat model. I also used presence/absence data to develop models of bird species occurrence from recent breeding bird censuses compiled by the National Survey on the Natural Environment, Japan. Occurrence models were developed for 77 species of land birds within the Kanto district. The accuracy of each model was highly variable, though given models were statistically significant. Occurrences of summer visitors and forest species were better explained by elevation and vegetation type within a 1 km^2 mesh than resident/nomadic species and those occurring in open habitat. Accuracy of the models was negatively correlated with body mass, because home range size increases with mass.

Brotons L[1], Sierdsema H[2], Newson S[3], Jiguet F[4], Gregory R[5]

Spatial modeling of large-scale bird monitoring data: Towards pan-european quantitative distribution maps

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Regional and national long-term monitoring programs currently provide cost-effective information for identifying population change at large spatial scales. These have been implemented now for birds in most European countries using representative and well-designed sampling strategies. Bird monitoring programs provide us with convenient spatial data that have the potential to feed habitat suitability and geo-statistical models to create maps showing spatial and temporal patterns in species distribution and abundance. These approaches lead to a convergence between strict mapping attempts (i.e. bird atlases), and the results obtained from monitoring programs. A recent initiative has been launched by the European Bird Census Council (EBCC) with the objective of using large-scale bird data from established long-term monitoring programs to generate pan-European bird maps. Two main types of maps may be produced at first from this initiative: (1) distribution maps showing spatial variability in species abundance, and (2) trend maps showing spatial variability in changes of species abundance. Both pathways appear promising and we present preliminary tests aimed at dealing with homogenization of abundance data between countries, evaluation of habitat modeling across regions, and the suitability of environmental data available. A pilot study conducted on a number of different European monitoring schemes produced the first tentative, pan-European abundance maps for indicator farmland bird species. The results show potential for producing large scale abundance and trend maps at a pan-European scale, and help to identify the main constraints expected in the road ahead. Maps are easy to produce, intuitive and appealing. As the maps are expected to be used extensively in policy making, special effort should be allocated to justifying the methodologies used in different applications, including limitations and orientation for data interpretation.

S17: From trend analysis to population alert

Conveners: Mark Rehfisch, UK; Ruud Foppen, The Netherlands

Underhill L

Developments in trend analysis for waterbirds

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Econometricians have developed a variety of approaches to economic time series data. The "Market Model" provides an approach used to analyse the relationship between the index for a stock market as a whole and the individual shares that compose that index. These methods decompose the "risk" of a share into "market" and "unique" risk. The same approach can be applied to waterbirds; the counts of waterbirds of a species at sites are analogous to the "share prices", and the trend index for the species derived from these counts is analogous to the "market index". The outputs from this analysis then provide a measure of the extent to which fluctuations of a species at a site relate to factors unique to the site rather than to changes in the overall trend index. The "unique" factors can be used to set "alerts" for sites. One important difference between an enonomic time series, such as share prices, and ecological time series, such as counts of waterbirds at wetlands, is that the amount of "error" in the latter is much larger, and the data analysis methods need to be adapted to take this difference into account. Econometricians have also developed concepts of "portfolio theory", which consider approaches to constructing a portfolio of shares which has a level of risk acceptable to the investor. I explore the extent to which these ideas are transferable to the development of sets of sites at which the risk, defined in terms of variability of total numbers of birds present, is at an appropriate level. The paper will be illustrated using wader count data for British estuaries.

Austin G, Rehfisch M

Waterbird alerts in the UK

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The Wetland Birds Survey has been monitoring wintering waterbirds in the UK for over four decades. In recent years our Waterbirds Alerts System has been developed to provide a standardised method of identifying the direction and magnitude of changes in numbers at a variety of spatial and temporal scales. Thus changes in numbers, derived from a smoothed trend generated by fitting a generalized additive model to the count data, are assessed over short, medium and long time-frames (5,10 and 25 years), and categorised according to their magnitude and direction. Major changes in the numbers of a species (declines equal to 25% or more over the time-frame being considered) trigger the issuing of an Alert. Species trends are considered nationally (Great Britain, England, Scotland, Wales and Northern Ireland) and for sites for which waterbirds are designated features (e.g. Special Protection Areas, Sites of Special Scientific Interest). For designated sites, generalized linear models are then used to determine whether site trends follow wider scale patterns in order to assess whether they are most likely being driven by wide scale or local factors and so help to focus attention on where to seek possible explanations for changes in bird numbers. Alerts are advisory and must be subject to interpretation. They are intended as a means to trigger and direct research and inform subsequent conservation efforts if required.

Noble DG, Baillie SR, Joys A

Raising alerts for terrestrial breeding birds in the United Kingdom

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Conservation policy makers need clear and up-to-date information on which populations are declining and on the magnitude of declines. We describe the system that we have developed to raise such alerts for terrestrial breeding birds in the UK. This incorporates rigorous analyses of population trends, assessment of statistical error, simple change thresholds and methods for flagging information that may be unreliable. Estimates of long-term trends from bird population monitoring schemes are often difficult to interpret due to short-term population fluctuations and statistical error. Our preferred method is to fit generalized additive models, incorporating site effects and a non-parametric trend, directly to the census data. Bootstrapped confidence intervals show the precision of trends and change measures. Changes over specified time intervals are then compared with 25% and 50% decline thresholds. Warnings are given if change measures may be unreliable due to unrepresentative data or small samples. We discuss ways in which these methods might be developed further, noting that there is a trade-off between the desirability of retaining comparability with past alerts and the benefits of using the most up-to-date analytical methods. More parsimonious trend analysis methods might be developed if site effects could be replaced by spatially explicit models with fewer parameters. A Bayesian approach, yielding the probability that a long-term change is below or above some threshold, might be more useful than a traditional frequentist estimate of the change and its confidence limits.

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Detecting flexible trends in bird populations

The longer the time-series is, the lower the relevance of linear trend analysis. Therefore, flexible trend analysis is being used in an increasing number of (bird) monitoring programmes, varying from simple moving averages to complex smoothing techniques like generalized linear modelling (GAM). An easy to apply alternative are structural time-series models as computerized in the TrendSpotter software. The main advantage of this programme is that it does not only calculate confidence limits to trend estimates but also to the differences between the trend estimate of the last year in the time-series and each previous year. In the Dutch Waterbird Survey the programme enables us to test the significance of population changes since each year in the time-series, which facilitates the calculation of population alerts considerably. The confidence limits of trend estimates permit the easy testing of deviations from population thresholds like the favourable conservation status of the EU Bird Directive. Other applications are the analysis of population dynamics of birds affected by climatic change and trend analysis of species aggregates.

Sierdsema H[1], Brotons L[2], Newson S[3], Jiguet F[4], Gregory R[5]

The next step in population alerts: Assessing changes in distribution and abundance from count survey data

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Population alerts are based mostly on numerical changes observed in population numbers. Over the last decade, Europe has become increasingly covered by modern monitoring schemes, making it possible to assess trends over wide regions and raise population alerts from local to continental scales. The calculated indices, however, give limited information about changes in distribution, let alone changes in patterns of abundance. Although repeated bird atlases do provide information about changes in distribution, they are generally uninformative on changes in abundance. Another problem associated with atlases is the considerable time-span between successive compilations, often ranging from 20-30 years. As monitoring projects often cover representative portions of countries and typically collect count data on a continuous basis, they are the most likely source of information for documenting continual shifts in distribution. In this paper we show how monitoring data can help in gaining insight into changes in distribution and abundance. We demonstrate how European abundance maps created from monitoring farmland birds, a group of species that show long-term continent-wide declines, can be used in population alerts. The combination of these maps with indices of population change and changes in distribution and abundance may offer a convenient tool to better understand large-scale population dynamics and for preserving bird populations.

S18: Integrated ecological studies of diseases and parasites in birds

Conveners: André Dhondt, USA; Heinz Richner, Switzerland

Richner H

Ecological studies of ectoparasites

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Ectoparasites are common in most bird species and have been a major force in the shaping of avian life histories. Bird-ectoparasite interactions are the result of a long-standing co-evolutionary history where both the hosts and the parasites have developed sophisticated strategies and counterstrategies. As a consequence, both the harm that may arise from parasites and the hosts' responses are not readily apparent purely from observations. It requires experimentation at ecological and temporal scales that are relevant for the studied species. This will be first illustrated by a brief review of relevant studies, and by a case study analysis of long-term experiments on the Great Tit. Second, many ectoparasite species are nest-based hematophageous arthropods and thus directly affect the nestlings, but indirectly also the parents via their responses to the parasite-modulated conditions. Maternal responses transferred via the egg to the offspring include modulation of immunoglobulins, hormones, and potentially also carotenoids. Experiments show that the maternal responses greatly enhance offspring survival and reproductive performance, but also point to the trade-offs involved in strategic parasite control.

Dhondt A, Hochachka WM

Integrated ecological studies of diseases in birds: some examples

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In the last 20 years a large number of new or (re)emerging diseases have appeared around the world, also in bird populations. Examples include avian influenza, West Nile virus, and mycoplasmal conjunctivitis. These diseases have had major effects on bird populations, and in some cases on humans too. Thus ornithologists are being faced with the need to provide knowledge and guidance in preventing or managing outbreaks of these diseases. However, in most cases there is a lack of basic but fundamentally important ecological and behavioral knowledge about the host, the pathogen, the disease, pathogen transmission, causes of variation in disease expression among infected individuals, or vector competence and dynamics. In this talk, we will give examples of how an integrated, multidisciplinary approach is essential for generation of a detailed understanding of the host(s)-pathogen system. In our experience, veterinarians, epidemiologists, and ecologists have very different perceptions of and ask very different questions from the same system. Using the knowledge and perspective of researchers from multiple fields is the most efficient route to generating a detailed mechanistic understanding of host-disease dynamics, which is necessary to generate models of these dynamics.

Perez-Tris J

Implications of cryptic diversity in avian malaria parasites

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Malaria parasites, protozoans of the genera *Plasmodium* and *Haemoproteus*, have long been used as models in studies of bird-parasite interactions. So far, some 200 morphologically distinct species of avian malaria parasites have been described. These organisms, nevertheless, seem to be much more diverse, as suggested by recent genetic studies which raise the number of parasite lineages to the order of thousands. Suddenly, we are faced with the problem of birds being infected by complex communities of blood parasites, which probably include members with, *inter alia*, different host specificity, transmission rates, and virulence. Identifying ecologically diverse parasites will help to understand the interactions between such parasites and their bird hosts. Here I summarize an ongoing research program investigating the implications of genetic diversity in avian malaria parasites, showing that elucidation of cryptic parasite diversity is important in ecology, evolution and conservation of birds. Avian parasites that are morphologically identical can differ greatly in the use they make of their hosts. As examples, some parasites are host specialists and some are generalists, and there are parasites that take advantage of bird migratory movements to disperse among host populations while others are adapted to seasonal transmission and geographical restriction. Cryptic parasite diversity is crucial for understanding the role of immune mechanisms such as the MHC in parasite resistance. Moreover, conservation programs involved in habitat management and re-introductions can only benefit from a detailed knowledge of actual parasite diversity in different habitats or in different host populations. In summary, the analysis of genetic diversity of blood parasites is a growing field in ornithology, and can be expected to contribute greatly to our understanding of bird-parasite interactions.

Barta Z[1], Feró O[1], Houston AI[2], McNamara JM[2]

Optimal immunity over the annual cycle in non-migratory birds

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Having an efficient immune system is highly beneficial in a world teeming with parasites. The maintenance of such a system is, however, costly because it requires resources that could be used for other purposes. Investing resources in reproduction or molt could lower the optimal level of immune defence. On the other hand, a high level of defence might be a prerequisite for successful breeding and molting. So it is not obvious how the optimal level of immunity should vary over the year. Here we use an optimal annual routine model of the behavior of non-migratory birds to investigate the optimal level of immune defence over the annual cycle. In our model, decisions depend on the time of year and a set of state variables that include energy reserves, breeding status, experience, quality of the primary flight feathers and condition of the immune system; explicit density dependence in the food supply is also incorporated. We use the model to investigate how the optimal level of immune defence should change over the year, and how seasonality in the chance of parasite infection influences the optimal level and annual behavior.

Bouliner T[1], McCoy KD[2], Staszewski V[1], Tveraa T[4]

The seabirds-tick-*Borrelia* system as a model for addressing ecological questions of epidemiological relevance: Host specialization, maternal transfer of antibodies and the dynamics of vector borne diseases

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Most seabirds are long-lived and breed in colonies where large populations of ectoparasites can accumulate. We illustrate how these characteristics make them useful models for addressing evolutionary and ecological questions of strong epidemiological relevance. Using a population genetic approach, we found that the seabird tick *Ixodes uriae*, known to parasitize more than 50 seabird species in both hemispheres and vector of Lyme disease bacteria (*Borrelia burgdoferi* sensu lato), actually comprises several host races with race-specific levels of gene flow. This could directly affect the dynamics of the Lyme disease bacteria at large geographic scales. Using an immunological approach, we moreover showed that females of the Black-legged Kittiwake (*Rissa tridactyla*) can transmit antibodies against Lyme disease bacteria to their young via egg yolk as a function of the local prevalence of the tick vector. This maternally-induced response could be adaptive, and could affect the transmission dynamics of the bacterium. Ongoing field and laboratory studies are addressing the functional role of maternally transferred antibodies and the factors affecting the dynamics of immunity against Lyme disease bacteria strains. The findings obtained here are of direct relevance not only for the epidemiology of vector born diseases, but also for basic understanding of the evolutionary ecology of host-parasite interactions.

S19: Macroecology

Conveners: Carsten Rahbek, Denmark; Katrin Böhning-Gaese, Germany

Ricklefs R

Time, space, and the origin of macroecological patterns

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Although the contemporary ecological template exerts a strong influence on local patterns of population abundance and species diversity, a variety of processes, including the movement of individuals, coevolutionary relationships, and the production of new species, produce regional patterns at a variety of scales. This talk will focus on patterns of population density, species abundance/distribution relationships, and species diversity. Emphasis will be placed on matching the scales of patterns and processes, and on analytical approaches to understanding the origin of macroecological patterns.

Böhning-Gaese K, Griebeler EM, Schaefer H-C

Extending macroecology beyond patterns in abundance, distribution and species richness

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In its widest definition, macroecology seeks to understand patterns in and determinants of the broad-scale distribution of life across the planet. In the past, much macroecological research has focused simply on describing macroecological patterns; and the factors explored most frequently were abundance, distribution and species richness. A drawback from this approach has been that the understanding of underlying processes has lagged behind the description of patterns. One reason for this is that abundance, distribution and species richness are shaped by a particularly wide variety of factors, both intrinsic to the organisms as well as extrinsic, and contemporary as well as historical. A solution might be to broaden research to cover a wider variety of factors, such as life-history traits, habitat choice or behavioral traits. Macroecological patterns can be found, for example, in the clutch size of birds, in the habitat distribution of species and in the percentage of migrants in bird communities. By including them in research, many of the factors and processes driving the patterns might then be more easily understood. That this approach is fruitful is demonstrated in a study of latitudinal gradients in clutch size. By using a combination of individual-based evolutionary simulation models and empirical tests, the determinants and processes shaping spatial patterns in clutch size have become rather clear. A central result of this study is its demonstration that contemporary, ecological factors (climatic variability) have to act in combination with evolutionary factors (selection of life-history traits in the face of trade-offs) to produce the observed patterns. The corollary is that analyses focusing solely on environmental factors or only on evolutionary processes can be expected to yield misleading results.

Fjeldså J[1], Bowie RCK[2]

Diversification of African sunbirds (Nectariniidae) in space and time: Linking ecological and historical processes

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Pattern and process of diversification since the upper Tertiary was investigated by linking together a well-resolved phylogeny and species distributions for the more than 80 species of African sunbirds, Nectariniidae. Species richness patterns show very high numbers of species in montane areas and upland savannas. Phylogenetically old species occur mainly in the Guineo-Congolean rainforest, but some are very widespread. In contrast, the highlands have been the principal centers of radiation in the more recent past. Contemporary environmental factors explain well the richness patterns in widespread species, but not the aggregations of endemic species in certain highlands. The presence of several old relict species in areas with aggregates of recently evolved species suggest that a major factor driving the speciation process has been population persistence in sites of stable and predictable conditions in a continent characterized by high climatic instability.

Storch D

Linking biodiversity patterns to spatial distributions of species: Scaling patterns in continental avifaunas derived from the structure and dynamics of species distribution

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Patterns in species richness are inevitably linked to patterns in the spatial distribution of species, as the number of coexisting species is given by the number of overlapping geographic ranges. Attempts to relate both classes of macroecological patterns are nevertheless rare. Using bird distribution data from several continents and several spatial scales, I show that two major biodiversity patterns, the species-area relationship and species-energy relationship, can be derived using simple assumptions concerning relationships of probability of occurrence to area and energy availability. The shape and slope of the species-area curve can predicted using only the information of species range size distribution and the assumption that species distributions are aggregated on all spatial scales. The species-energy relationship can be accurately predicted using a simple dynamic model assuming that probability of occurrence increases proportionally with energy availability. These simple assumptions are sufficient also for the prediction of the interactive effect of area and available energy on species richness. The emergence of biodiversity patterns in birds can be thus modeled without assumptions concerning interspecific interactions or any sort of biotic saturation which is assumed in neutral models of biodiversity based on zero-sum dynamics, and can be therefore attributed to the spatial dynamics of mutually independent species ranges, i.e., to the autecology of individual species. These models, however, do not provide any mechanism that generates observed range size distribution, and it is possible that interspecific interactions can play a role here. Moreover, it is not clear why probability of occurrence for species increases with available energy. It seems that instead of increasing total abundances, environmental energy elevates habitat heterogeneity, and the species-energy relationship is thus mediated bnergye

(climatic and microclimatic differences) or active (feather waxes, free fatty acids on the brood patch or microbial inocula) processes

because there is invariably more than one possible partner available on the day that a mate-seeker arrives. For the Common Tern (*Sterna hirundo*), a long-lived and long-distance migrant with a brief window of time for annual reproduction in northern Europe, I attempt to shed light on the ways how first-time-breeders start reproduction and with which mates. Arrival dates within a season may be scattered over a period of several weeks or even months. From 1994-2003, pairings of several hundred individually known recruits were analyzed by means of transponder-based identification and compared with those of experienced colony members. First-time breeders are inexperienced and young compared to established breeders. They are late in arrival and in egg laying, and so under greater time constraints than older conspecifics. Their lack of breeding experience and/or age itself are key components in explaining why they reproduce more poorly than older, experienced individuals. As expected, the degree of experience in the mate of a first-time breeder played a major role in individual reproductive output, and was found an important factor in influencing how natal recruits start breeding. The paper will show how recruits manage to obtain experienced mates, how such first-time breeders are characterized, and what the causes of frequent divorce are after the year of recruitment.

S23: Natural holes: the missing dimension in understanding hole-nester ecology

Conveners: Tomasz Wesolowski, Poland; Kathy Martin, Canada

Wesolowski T

Lessons from long-term hole nester studies in a primeval temperate forest

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Secondary hole nesters (SHN) are birds that are critically dependent on holes for nesting and roosting. The absence of holes renders habitat uninhabitable for them; and in man managed woods, their populations are known to increase with the provision of nest boxes, suggesting that SHNs are limited by shortage of holes and must compete for them. Thirty years of observations in the last fragments of primeval temperate forest in lowland Europe, in the Bialowieza National Park in east Poland, are used to test this assumption. They show, that in these conditions: (1) SHNs do not face a shortage of holes,(2) competition for nest sites is of minor importance, (3) woodpeckers are not keystone species for the SHN assemblage - most SHN species rely on holes of other origin, and (4) the SHNs hole requirements appear to be shaped by the necessity to simultaneously avoid nest predation and nest flooding - the two most important nest mortality factors. The Bialowieza situation seems to be characteristic of primeval forest conditions in general.

Martin K, Drever M

Resource flow in secondary hole nester communities in old mixed forests

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Hole nester species live in hierarchically-structured communities termed ‘Nest Webs’ that interact through the creation of and competition for nesting and roosting holes. Many secondary hole nester (SHN) populations are considered to be limited by hole availability, with fierce competition for this scarce critical resource. However, in older forests in natural conditions, inter- and intra-specific interactions among SHN species in the community are complex (competition, facilitation, predation), multi-factorial (nest sites, cover, foraging, food storage), and multi-scale (local, regional, continental). Hole supply can vary with rates of excavation and hole loss, number and abundance of excavator species, competitor densities, as well as conditions of nesting trees and forest stands. In old mixed coniferous-deciduous forests of western Canada, *Colaptes auratus*, the keystone excavator, and 8 other excavating species provided a range of sizes and quality of holes for SHNs, whereas 12% of 1252 SHN nesting attempts were in natural holes. Hole supply may be reduced if some excavators reuse holes, and when densities of competitors increase. Hole quality may vary when SHNs nest near hole-nesting competitors (squirrels, raptors) and excavators that may potentially prey on SHN adults and young. Continental or regional level processes alter relative hole availability by influencing the density of competitors (e.g., *Sturnus vulgaris*) or excavators. Outbreaks of forest insects or warm winters may allow increased densities of resident or migrant SHNs, with resultant increased demand for holes. SHNs must also compete with non-hole nesting resident species for food and predator avoidance. Thus, hole supply is only one of several critical ecological and environmental factors that influence SHN populations. In old forest systems, food supply, predation and environmental conditions may limit SHN densities such that hole availability is not the dominant resource constraint.

Bai M-L, Mühlenberg M

Nest site use of hole-nesting birds in a natural boreal forest in Mongolia

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Tree holes and the nests of hole-nesting birds were surveyed in a natural boreal forest in West Khentey, Mongolia. We investigated (1) hole abundance in natural forests, (2) the importance of different tree species and different types of holes for hole-nesting birds, and (3) interactive relationships among hole-nesting birds. Nest-web analysis was applied to link the three main components of the study: bird species, nest holes and hole trees. Hole density in the study area averaged 30/ha. Most holes were located in birch (*Betula platyphylla*), but poplar (*Populus laurifolia*) was the most hole-rich tree species relative to abundance. Branch holes were occupied over-proportionally by secondary hole nesters; they used woodpecker holes in proportion to their availability, and holes excavated by the Willow Tit (*Parus montanus*) less often. Apart from the probably irreplaceable function of the Black Woodpecker (*Dryocopus martius*) in producing large holes, woodpeckers do not play a keystone role for the hole-nesting community. Birch, which often hosted excavating species and provided most of the branch holes, is nevertheless of fundamental importance. Were birch to be replaced by hole-poor tree species, such as spruce (*Picea*), the numbers of branch holes would fall by approximately 80%. This, in fact, is a real prospect due to the current program of converting large tracts of boreal and hemiboreal forest into conifer plantations in Mongolia.

Severinghaus L

Cavity competition and breeding success in the Elegant Scops Owl of Lanyu Island

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The Elegant Scops Owl is the largest predator in the forests of Lanyu, a subtropical island in the western Pacific. Endemic to the island, the local breeding form (*Otus elegans botelensis*) is severely restricted in its breeding by limited nest sites, due to high population density and the shortage of suitable cavities. There are no cavity-making birds or mammals on Lanyu. The only human disturbance to the forests comes from traditional aboriginal cultivation and wood harvesting. I have studied reproduction in the scops owls of Lanyu and followed their use of nest cavities since 1986. Starting in 2000, I selected a 10-hectare plot and, with the help of a field team, examined the cavity conditions in 86 trees with a trunk diameter breast height greater than 38 cm. We found cavities in 67 of the trees. To create a cavity database for these trees, we measured every cavity with an entrance wider than 10 cm, recording depth, width, height, dryness, flatness of the floor, and horizontal and vertical orientation of the entrance. 317 cavities were so measured. As well, we recorded the height of the cavity above ground, its position on the tree, and other tree characteristics. When a cavity ceased to be used by owls, or when a previously unused cavity became useful to owls, its characteristics were measured again to document cavity change. Results showed that owls selected cavities that were large enough in size, dry, above a certain height from the ground, and relatively flat bottomed. Similarly dimensioned nest boxes that I provided were not always occupied. Analyses are underway to determine the relationship between cavity quality, intensity of competition for cavities, and breeding success in the owls.

Blanc LA, Walters JR

Hole-nesting community dynamics of the fire-maintained longleaf pine ecosystem, southeast USA

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Fire-maintained longleaf pine forests in the southeastern United States are dominated by living pine and are relatively snag-poor; yet hole-nesting birds comprise a major component of this ecosystem. The Red-cockaded Woodpecker (*Picoides borealis*), endemic to the region, is the only North American excavator of cavities in living pine and thus has potential to heavily influence hole-nesting community structure in these forests. The goals of this study then were to describe the community structure of hole-nesting birds in longleaf pine forest, determine the critical nesting resources in the ecosystem, and identify the role played by the Red-cockaded Woodpecker in their provision. From 2002 to 2005, we measured relative abundance, nest resource availability and use, and nesting success for 14 species of hole-nesting birds on the northwestern Florida panhandle. Based on correlated data, the hole-nesting community was partitioned into two ‘species webs’, one associated strongly with pine snags and the other with hardwood snags. Visualizing the hole-nesting community as ‘webs’ enabled us to examine potential interdependencies among species, identify critical components in the system, and predict how community structure would shift if or when these components were removed. For example, in forests where large pine snags are harvested, we could predict that parts of the ‘pine web’ would compress, causing a shift in nest-site selection by some species to existing cavities in living pine. Such web compression may result in increased usurping of Red-cockaded Woodpecker cavities and thus growing conflict among hole-nesting species in the system. A better understanding of how community webs are structured will improve efforts to manage forests for the healthy coexistence of many primary and secondary hole-nesters.

S24: The physiology of life histories: comparing tropical and temperate zone birds

Conveners: Martin Wikelski, USA; Jeff Brawn, USA

Wikelski M, Hau M

Do physiological traits limit the diversification of avian life histories?

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Most of the variance in avian life-history spreads along a slow–fast continuum, with low reproductive rate, slow development and long life span at one end and the opposite traits at the other end. In general, alternative combinations of life history variables are absent, indicating that the diversification of life history is constrained. However, the exact mechanisms underlying these constraints are largely unknown. Here we review what physiological mechanisms could control avian life history diversification. We attempt to integrate data on endocrine, metabolic, immune and behavioral (activity) processes to understand avian life history diversity along environmental gradients. We present data from a multi-species comparison of birds that either live in tropical or temperate-zone habitats where life histories often differ remarkably. We discuss this ‘physiology-life history’ approach as a top-down analysis for reaching an understanding of biological organization from genes to physiology to behavior to life history.

Brawn J

What do we really know about the demography of tropical birds?

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The avifaunas of tropical latitudes are speciose, ecologically diverse, and relatively unstudied. As more is discovered, it is clear that long standing assumptions about the ecology and life histories of tropical birds are sometimes questionable. For example, tropical birds may not have life spans that are systematically longer than their temperate-zone counterparts, but they do have notably small clutch sizes. Rates of nest loss are indeed high owing to predation, but they can vary among species and over time. In this talk I will report some findings of over 30 years research on the population biology and life histories of lowland forest birds in Panama. Results from Panama and other studies in the neo- and paleotropics indicate that "tropical birds" have very diverse life histories that often defy generalization and complicate comparative analyses. Characterizing and understanding this variation is critical for the conservation of birds at tropical latitudes.

Canoine V

Seasonal endocrine modulation of aggressive behavior: Comparing temperate and tropical birds

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In birds, sexual and aggressive behaviors are generally regulated by the androgen testosterone (T) and/or its estrogenic metabolites. In species that breed in temperate zones, seasonal variation in aggressive and reproductive behavior is correlated with large fluctuations in plasma T. In contrast, tropical species that are aggressive year-round but breed seasonally have low plasma levels of T throughout the year, with little seasonal variation. Therefore, tropical species may have evolved mechanisms for controlling aggressive behavior that differ from those in temperate species. Here I compare seasonal differences in the hormonal modulation of aggressive behavior between the temperate European Stonechat (*Saxicola torquata rubicola*) and the tropical Spotted Antbird (*Hylophylax n. naevioides*). The Spotted Antbird is a typical tropical species that breeds seasonally and holds territory year-round. European Stonechats are exceptional among temperate birds because they defend both a breeding and wintering territory. Thus, these two species are aggressive in both reproductive and non-reproductive contexts. Their aggressive behavior in relation to physiological and neuroendocrinological parameters will be discussed, and I then compare the results of my own work with previous studies in a review of general differences in the regulation of aggression between temperate and tropical birds.

Lee K[1], Klasing K[2], Wikelski M[1]

Ecological and phylogenetic correlates of immune defense indices in tropical birds

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Immune defense strategies are intricately linked to the ecology, physiology, life history and evolutionary history of the host. We measured several indices of standing immune defenses, including natural antibodies, complement activity, and bacterial killing ability of whole blood, and the energetic costs of inducing an inflammatory response, in more than sixty tropical bird species. From this, we present broad-scale comparative analyses exploring the major ecological and phylogenetic correlates of variation in these immune defense measures.

Wingfield JC

Endocrine response to social challenges in northern and southern hemisphere populations of the crowned sparrows, *Zonotrichia* (Emberizidae)

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There is now extensive evidence that male-male interactions over territories and receptive mates can modulate secretion of testosterone. Furthermore, the pattern of response, or whether an individual responds at all, has been related to mating system. This pattern now appears to be found in most vertebrate taxa. How these patterns vary in relation to diverse habitats, however, is less well known. Field investigations of several taxa of closely related emberizines, the crowned sparrows (*Zonotrichia*), which occur from the arctic tundra of Alaska to Tierra Del Fuego at the southern tip of South America, show a tremendous variation in altitudinal and latitudinal range, particularly in North America. At high latitudes at the limits of their distribution, breeding seasons are brief and circulating testosterone levels are not socially modulated. Far northern males of *Zonotrichia* actually become insensitive to the behavioral effects of testosterone, possibly as a mechanism for maintaining paternal care. At mid-latitudes, most, but not all, males exhibit social modulation of testosterone secretion, especially in response to experimental challenges. In contrast, populations of the Rufous-collared Sparrow (*Zonotrichia capensis*) in Central and South America show a fixed pattern of testosterone secretion that is not socially modulated. Such variation in pattern and degree of social modulation appears to be independent of mating system and thus offers an ideal opportunity for comparing populations to determine the ecological basis of this variation, evolution of these patterns and the mechanisms underlying them.

S25: Advances in molecular systematics and phylogeography of neotropical birds

Conveners: Cristina Miyaki, Brazil; John Bates, USA

Aleixo A

Gene trees, landscape evolution, and geology: towards a modern synthesis of Amazonian historical biogeography?

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As the number of phylogeographic studies on Amazonian birds increases, previous interpretations of Amazonian historical biogeography are being replaced by spatially and temporally different scenarios. At the same time, recent research has improved significantly our understanding of Amazonian geological history during the Tertiary and Quaternary, two periods critical for the recent diversification of the Amazonian avifauna. The notion that geologically older and more stable areas of Amazonia - such as the Brazilian and Guianan shields - functioned as "species-pumps", and that geologically recent and less stable areas - such as the western Amazonian lowlands - mostly captured part of the diversity generated nearby, has been supported by a recent phylogeographic study focusing on a species complex of the genus *Xiphorhynchus* (Dendrocolaptidae).

Here, I review 13 additional molecular datasets published between 1999 and 2006 to assess whether this historical scenario can be extended to other lineages of Amazonian birds. The reviewed datasets indicated, *inter alia*, a clear dichotomy in the diversification histories of species associated with seasonally flooded and upland forests. Many "core" lineages of upland species found nowadays in western Amazonia are clearly associated with more basal lineages from the Brazilian and Guianan shields, and the Andes, indicating a more recent history in this geologically dynamic region. On the other hand, lineages associated with seasonally flooded forests seem to have an ancient history in western Amazonia, apparently expanding over the geologically more stable areas only recently. Another evolutionary process differing between upland and seasonally flooded forest species is rate of cladogenesis, which is much slower in the latter group. When interpreted together, all reviewed studies provide evidence that geology and landscape evolution are tightly linked with the timing and mode of differentiation of Amazonian birds.

Bates JM

Understanding and interpreting the comparative patterns of genetic diversity and the evolution of Neotropical birds

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Molecular data offer great opportunities for understanding the evolutionary history of Amazonia. However, a variety of recent generalizations about genetic structure in Amazonian birds misrepresent patterns of avian genetic diversity in the region. I compare and contrast available data on genetic diversity in Amazonian birds with birds from adjacent regions, the Cerrado and the Andes. Several important points can be made from these data. First, Amazonia is not a museum comprised only of old lineages. Amazonia has many lineages that demonstrate comparatively recent evolutionary diversification. Statements about largely old, non-evolving, Amazonian lineages appear to result from interpretations of diversity based on the Biological Species Concept, but they have also resulted from mis-interpretation of genetic data demonstrating that divergences in many lineages of Amazonian birds pre-date the Pleistocene. Of the three regions, the avifauna of the Cerrado appears the most distinct in that it appears to have comparatively low levels of structure for the taxa analyzed. Comparative data between regions are still far from substantial, but the initial patterns appear to illustrate important differences in the evolutionary history of the regions.

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Major evolutionary patterns and higher-level systematics in tyrant flycatchers, cotingas, manakins and their allies (Tyrannida)

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The precise taxonomic limits of major groups in the Tyrannida - cotingas, manakins, tityrines and tyrant flycatchers - as well as the systematic relationships within these groups, remain unclear despite the growing understanding of passerine evolution over the last 15 years. An analysis of DNA sequence data obtained from two nuclear exons, three introns, and one mitochondrial gene from these groups has now produced well-supported hypotheses about the earliest evolution within the Tyrannida. The subfamilies Cotinginae, Piprinae (excluding *Piprites*), Tityrinae, Tyranninae (excluding *Platyrinchus*), and Pipromorphinae of Sibley and Monroe (1990) were all found to be reciprocally monophyletic. Clades corresponding to traditional groups suggests that the tyrant flycatchers (Tyranninae plus Pipromorphinae of Sibley and Monroe 1990) are monophyletic. Furthermore, Tityrinae, *Oxyruncus*, *Piprites*, Pipromorphinae and Tyranninae form a well-supported clade.

Ribas C[1], Miyaki C[2]

Patterns of diversification and comparative biogeography in five genera of neotropical parrots

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The neotropical region is characterized by high species diversity and distinctive patterns of endemism. Yet its biogeographical history, especially the climatic and geological influences on the diversification of its biota, remains poorly known despite the abundance of hypotheses explaining patterns of distribution. Molecular phylogenies of neotropical groups offer direct insight into the complex biogeographical history of the region. Here phylogenies for five genera of neotropical parrots were reconstructed using mitochondrial DNA sequences from the cytochrome b, ND2, rDNA 12S and rDNA 16S genes, and the control region. The phylogenies were compared both spatially and temporally to determine (1) historical relationships among areas, (2) common historical events effecting cladogenesis, and (3) the frequency of those events. Well-resolved phylogenetic reconstructions were recovered for the genera *Pyrrhura*, *Gypopsitta*, *Pionopsitta*, *Pionus* and *Brotogeris*, and for a monophyletic group of species belonging to *Aratinga*. With the exception of *Gypopsitta*, Amazonian taxa in each genus were not monophyletic: Atlantic Forest and Central American taxa were often sister to Amazonian taxa. Divergence times were not compressed into a particular time period, but did reveal a pattern of recent diversification between eastern Amazonian and Atlantic forest taxa. Diversification in all genera occurred mainly during the last six million years, and seems to have been influenced by geological and paleoclimatic events such as the uplift of the Andes and isolation and contact between Amazonian, Atlantic and Central American forests. Support by FAPESP, CAPES, CNPq, AMNH.

Tello JG

Understanding neotropical diversification: Implications from phylogenetic patterns in four avian lineages

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Neotropical forests harbor the highest biotic diversity on earth. Although several hypotheses have been proposed to explain the origin of such diversity, most have been put forward in the absence of phylogenetic data. Studies of distribution and patterns of endemism in several organisms have also identified centers of endemism in the region. Yet the historical patterns of taxon differentiation, and the spatial and temporal congruence of these patterns, are just beginning to be investigated. In this study, phylogenetic analyses using molecular data and species distributions were used to uncover area relationships for four co-distributed lineages: the flycatcher genera *Platyrinchus* and *Tolmomyias* (Tyrannidae), and two non-sister clades previously included in the antbird genus *Cercomacra* (Thamnophilidae). These lineages belong to two of the most speciose avian families in the neotropics; thus their patterns of diversification are potentially representative of the evolutionary history of much of the neotropical avifauna. Four mitochondrial genes and one nuclear intron were used to recover phylogenetic relationships, information that provided the framework for reconstructing the biogeographic history of the lineages. The results revealed lineage origins that were both concordant and discordant spatially and temporally. Temporal discordance of spatial patterns was not expected, owing to the overall similarity among the distributions of the species. Such discordance, however, may be explained by the origin of distribution patterns under different scenarios, suggesting that the history of diversification in neotropical birds is complex and ongoing. Analyses such as this can be expected to provide insights into the evolutionary history of neotropical areas of endemism.

S26: New approaches, new data, and new findings in avian phylogenetics at and above the ordinal level

Conveners: Shannon Hackett, USA; Gerald Mayr, Germany

Harshman J[1], Braun EL[2], Braun MJ[3], Hackett SJ[4], Han K-L[5], Huddleston CJ[3], Kimball RT[2], Marks BD[5], Miglia KJ[6], Moore WA[6], Reddy S[1], Sheldon FH[6], Steadman D[7], Yuri T[3], Witt C[6]

Early Bird, an international collaboration in deep molecular phylogenetics of birds: Can four million bases resolve the tree?

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Early Bird is a project funded by the ATOL program of the U.S.A. National Science Foundation. It includes investigators at five institutions in the U.S.A. and in two extra-American groups. We have assembled a data set of 23,000 bases of nuclear DNA, with an emphasis on introns, for 200 species that span avian diversity. The purpose of the project is to resolve basal relationships within birds, especially within the Neoaves. We have been able to resolve many, though not all, interordinal relationships with high confidence. Both nucleotide and indel data have been useful.

Mayr G

The renaissance of avian paleontology and its bearing on the higher-level phylogeny of birds: are there missing links between modern higher-level taxa?

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Recent phylogenetic analyses of morphological and molecular data provide strong evidence for some previously undetected clades of morphologically very divergent modern avian groups. Within the past decades, moreover, avian paleontology has experienced a renaissance and the Paleogene fossil record of birds is approaching that of mammals in the number of recorded higher-level taxa. Yet there is still little mutual exchange between students of these different data, as molecular systematists are often unfamiliar with the fossil record of birds, while avian paleontologists have only recently started to interpret their fossils in the light of modern phylogenetic groupings. Here several fossil groups are presented that are considered missing links between extant higher avian groups, combining the derived characters of one taxon with the plesiomorphic traits of its sister group. These taxa have often been known for a long time, but the mosaic of character distribution displayed was hitherto interpreted as convergence and not evidence of relationship. Examples discussed include the Palaelodidae, an extinct stem group of flamingos which support the recently proposed sister-group relationship between flamingos and grebes, and the Plotopteridae that exhibit the highly derived wing morphology of penguins but also share derived characters with “pelecaniform” suloids (gannets, cormorants and allies).

Manegold A

Out of Australia? - The natural history of the oldest passeriform birds of Europe

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Recent phylogenetic analyses using molecular markers have led to the hypothesis that the three major extant lines of passeriform birds - New Zealand acanthisittids, other suboscines, and oscines - diverged in the southern hemisphere with the break-up of Gondwana during the late Cretaceous. The stem species of acanthisittids and suboscines arose on New Zealand and western Gondwana (South America), respectively, and the stem species of the oscines on the Australian continental plate. Passerines do not appear in the fossil record of the Northern Hemisphere until the early Oligocene, and only from the Miocene onwards are they abundant in certain fossil deposits. Owing to the alleged skeletal uniformity of these fossils, few attempts have been made to place them in a phylogenetic framework. The detection of new phylogenetically informative characters, however, now allows the assignment of certain skeletal elements of fossil passerines from Southern Germany to extant passeriform taxa, providing new insights into the composition of the Neogene avifauna. Most Northern Hemisphere Miocene passerines are assignable to the extant oscine infra-order Passerida, consistent with the "Out-of-Australia" hypothesis. Older fossils from the Oligocene, however, cannot be identified with any extant oscine taxon and probably belong outside the Eupasseres, the taxon comprising all extant oscines and suboscines. It is in that connection that earlier descriptions of a 'crown-group' of suboscines in the fossil record of Europe are discussed. A goal of this study is to contribute towards mutual exchange of phylogenetic hypotheses based on molecular and comprehensive morphological analyses of extant and fossil taxa. Whereas recent deep-lineage molecular analysis of the Passeriformes provides a phylogenetic framework in which to place passerine fossils, studies of the fossils themselves can provide a timescale for major evolutionary events in the natural history of perching birds.

van Tuinen M

Mode and tempo of evolution in aquatic birds inferred from Bayesian clocks and total evidence phylogenetics

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Birds display diverse adaptations to aquatic environments. Most lineages are distinct morphologically, and, as a result, a number have long been afforded ordinal status. In contrast, molecular evidence indicates extensive convergent and divergent evolution among them. New cladistic analyses of morphology corroborate some of the unexpected molecular phylogenetic findings. To compare and improve phylogenetic signal across datasets, I present a total evidence analysis based on several Bayesian partitioning and parsimony schemes, and enhance these data with molecular divergence times based on several clock methods. This approach continues to support a novel clade comprising the grebes, flamingos, hamerkop, shoebill and the pelicans, with the ibises and herons as a sister group to this larger clade. The analysis also finds strong support for a core pelecaniform clade comprising cormorants and gannets; but other phylogenetic relationships remain unclear. Molecular divergence time estimates indicate relatively young age for the diversification of nearly all waterbird lineages. These data support a labile convergent/divergent evolutionary mode in waterbird history.

Houde P[1], Fain MG[2]

Evaluation of the putative neoavian dichotomy, Metaves and Coronaves

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It has been widely anticipated that a tree of avian evolution would crystalize from comparative studies of DNA. While recent studies have clarified the monophyly of the Palaeognathae, Galloanserae, and Neoaves, relationships among the latter remain frustratingly vexing. Some even suggest that the issue might be intractable. We studied ß-fibrinogen intron 7 in the most taxonomically inclusive survey of DNA sequences of nonpasserine bird families and orders to date. These data, both alone and in combination with eleven other independently assorting loci, suggest that the Neoaves comprise two sister clades, Metaves and Coronaves. The two are distinguished by four insertion/deletions. They present ecological parallelisms comparable to those found between marsupial and placental mammals. Some members of the two putative clades, such as respective loons and grebes or respective swifts and swallows, have long been recognized as examples of convergent evolution, but it has not been appreciated that they might be parts of diverse parallel radiations. At least five orders of birds, including Pelecaniformes, Gruiformes, Charadriiformes, Ciconiiformes, and Cuculiformes, are suggested by these data to be polyphyletic, with component families in both radiations. Evolutionary theory predicts convergent adaptive radiations between animals of distinct lines of descent due to adaptation to similar conditions, particularly on different continents. Parallelism between marsupials and placentals was recognized early on from conspicuous differences in their reproductive biology and the largely Austral endemism of marsupials. In contrast, morphology has left few clues to the relationships of Metaves and Coronaves that have not been completely overwritten by convergence, and biogeography is a notoriously poor guide to avian relationships because of the inherent vagility of birds. This discovery warrants wholesale re-evaluation of the avian fossil record and of morphological characters used in avian classification.

S27: Molecular systematics and evolution

Conveners: Dorit Liebers-Helbig, Germany; Allan J. Baker, Canada

Baker A, Haddrath O

Rare genomic events as phylogenetic markers to help resolve the avian tree of life

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DNA sequences generated from a range of nuclear and mitochondrial DNA genes are accumulating rapidly, and have brought increased resolution to the Avian Tree of Life. Nevertheless, a huge problem still confronts avian systematists in deep time because the basal connections among ordinal clades of birds is proving to be refractory to even large sequence datasets of multiple genes. Additionally, many of the gene trees do not appear to recover species trees in some ancient clades. We have therefore isolated retroposons that insert uniquely in genomes in an attempt to resolve some of these vexing problems, as over one hundred thousand of these elements have been discovered in the chicken genome. In the Galliformes the rare insertion of these retroposons at major nodes in the phylogeny support the branching pattern derived with multiple DNA sequences, and thus completely corroborate the topology. In the Paleognathae, the gene trees derived separately from mitochondrial genes and nuclear genes are discordant, with the latter suggesting that tinamous are nested with ratites. However, retroposon insertions recover the same branching pattern as published previously from the analysis of mitochondrial DNA genome sequences, and therefore refute the nuclear gene topology. Although the isolation of retroposons and testing of their usefulness in phylogenetic inference have initially proved to be time-consuming, recent advances in detection methods and the increasing availability of the sequences of genomes of birds will expedite their use in resolving the Avian Tree of Life.

Sætre G-P

Sex, genes and speciation - the curious case of the *Ficedula* flycatchers

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When hybrids have low fitness, natural selection may reinforce prezygotic barriers to gene exchange, eventually leading to reproductive isolation. The old-world, black-and-white flycatchers of the genus *Ficedula* provide a rare but well-documented avian example of this speciation process. In areas where the Pied (*F. hypoleuca*) and Collared (*F. albicollis*) Flycatchers co-exist, a character displacement in male plumage characteristics, mediated by female choice for divergent traits, has occurred that reduces the frequency of mal-adaptive hybridization. Here I review ten years of investigations of the genetic basis for reinforcement in these birds. I present evidence that genes located on the Z-chromosome play a crucial role in the speciation process. Characters related to both post-zygotic isolation (hybrid fertility) and pre-zygotic isolation (male plumage characteristics and female mate preference rules) appear to be affected by Z-linked genes; Z-linked genes exhibit reduced intraspecific variation but increased rate of divergence between the species compared to autosomal genes, a pattern consistent with effects of recurrent selective sweeps. Theoretical investigations show that speciation by reinforcement is particularly powerful when linked genes on the sex chromosome control traits associated with pre- and post- zygotic isolation. This is partly due to reduced rates of recombination between sex-linked genes and partly because selection can act more effectively on such genes since recessive alleles are not masked by dominance in the heterogametic sex. I suggest that selection of traits associated with sex and reproduction has accentuated the rate of species divergence in these birds, and that sex-linkage of the relevant genes has facilitated the reinforcement process in sympatry. I briefly discuss the generality of these findings for other avian taxa.

Liebers-Helbig D[1], de Knijff P[2], Sternkopf V[3], Helbig AJ[3]

Evolution in the Herring Gull species group

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The circumstances under which sexually reproducing animals can speciate without geographical disjunction remain controversial. According to the ring species model, a reproductive barrier may arise through 'isolation-by-distance' when peripheral populations of a species meet after expanding around some uninhabitable barrier. The classical example given for such speciation is the Herring Gull (*Larus argentatus-fuscus-cachinnans*) complex with a circumpolar distribution in the northern hemisphere. Analysis of mtDNA variation among 21 gull taxa now reveals that members of the complex differentiated largely in allopatry, following multiple vicariance and long-distance colonization events, and not primarily through isolation-by-distance. Extant taxa are the result of a recent (late Pleistocene) radiation within which two ancestral lineages were originally separated in a North Atlantic and a continental Eurasian refugium. Contrary to the ring species model, we found no mitochondrial genetic evidence for a closure of the circumpolar ring through colonization of Europe by North American Herring Gulls. We have since included nuclear markers (AFLP & SNP genotyping, intron sequences) as an independent (biparentally inherited) source of genetic information to be compared with the mitochondrial (maternally inherited) phylogeography. These markers will also serve to test the apparent biphyletic origin of two species (*argentatus, hyperboreus*), as well as the unexpected position of *L. marinus* within instead of outside the complex. Concentrating on markers on the large sex (Z) chromosome, we hope to identify loci linked to post-zygotic isolation factors which should be the first to differentiate between incipient species and may bring us closer to an understanding of the molecular-genetic mechanisms of speciation.

Hochachka W, Lovette I

Phylogenetic niche conservatism and competition-structured local species assemblages in North American wood warblers, Parulidae

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Closely related species are likely to occupy similar niches, with the consequence that in sympatry they will settle in the same physical locations even though intense inter-specific competition may prevent much overlap in distribution. While local species assemblages today will be affected by processes of niche conservatism and inter-specific competition, the relative influences of these opposing processes have rarely been determined. We investigated this issue using a phylogeny of all North American wood warblers combined with detailed information on the local co-occurrence of species drawn from the North American Breeding Bird Survey (BBS) which provides information from local regions across much of the United States and Canada. Using these data, we were able to identify all species pairs that occurred on each BBS transect, and could thus co-occur at specific sites. For such potentially co-occurring species pairs, we calculated actual co-occurrence and looked for variation in co-occurrence as a function of phylogenetic distance between the species. Observed relationships between phylogenetic distance and co-occurrence were compared with null models of local co-occurrence. We found indications of pervasive niche conservatism, combined with evidence that local competition was only relaxed for a few species pairs that were very distantly related, to the extent that they used different foraging niches. Our results suggest that conventional perceptions, that North American wood-warblers are an adaptive radiation in which many species evolved substantial behavioral differences quickly to enable extensive coexistence, is incorrect. Instead, considerable evolutionary time appears to be required for high levels of spatial overlap to occur.

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Biogeography and phylogeny of the southeast Asian *Brachypteryx leucophrys - B. montana* complex (Turdidae)

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A phylogenetic analysis was carried out on the shortwings *Brachypteryx leucophrys* and *B. montana* from the southeast Asian mainland, Taiwan, Philippines and Indonesia to clarify the phylogeography of the group. The cytochrome b gene in mitochondrial DNA and the nuclear introns myoglobin and ODC were sequenced, and phylogenetic relationships then estimated by parsimony and Bayesian inference methods. Our study suggests that *leucophrys* and *montana* form a complex of several species involved in multiple invasions, originating on the southeast Asian mainland, then dispersing out to the Indonesian and Philippine archipelagos, only to reinvade the mainland and then disperse to Indonesia once more. The resulting pattern of dispersal bears some resemblances to those of "ring" species. The phylogenetic results also indicate that the shortwings crossed Wallace's Line between Bali and Lombok twice, both recently and a long time ago. Competition following secondary contact between early and late radiations has played an important role in shaping altitudinal distribution, the biogeographic impacts of which are discussed.

S28: Dispersal and gene flow in populations: linking molecular methods to direct observations

Conveners: Arie J. van Noordwijk, The Netherlands; Judith Rhymer, United States

Rhymer J

How to infer population structure from molecular data?

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Recent advances in the ability to generate and analyze DNA data have led to extensive use of population genetic data to illuminate population structure at scales from breeding pairs to species. At a larger scale, phylogeography examines overall population genetic structure in the context of the broad geographic distribution of a species. Landscape genetics is a newer discipline that explores how landscape and environmental features influence population genetic structure and dispersal rates at a finer scale. It is now possible to distinguish between contemporary and historical gene flow and dispersal using partial or fully Bayesian assignment tests, which probabilistically assign individuals to populations based on their multilocus genotypes. This approach can be used to determine how many genetically discrete populations occur without relying on prior definitions of population structure. Another analysis method uses either a maximum likelihood or Bayesian approach based on coalescent theory and jointly estimates varying population sizes and the magnitude and direction of gene flow among populations. Individual-based assignment tests can also be used to estimate the extent of natal and sex-biased dispersal. In addition to dispersal rates, analyses of genotypic data provide estimates of relatedness among individuals and the extent of reproductive success of resident individuals as well as of inter-demic migrants in metapopulations. DNA-based capture-recapture methods are now available that use an individual's DNA profile rather than standard tags to estimate survival, emigration rates and changes in population size. These newer, more powerful approaches allow researchers to infer much more from genetic data than was previously possible from standard population genetics methods.

van Noordwijk AJ

Measuring natal dispersal as distance-related recruitment rates

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Population structure is the final consequence of distances moved between site of hatching and site of reproduction. However, direct observations of individuals marked at their sites of hatching and breeding depend strongly on the distribution of observers in time and space. These effects have to be eliminated before the demographic behavior of the species studied can be established. Analyzing movements towards breeding sites rather than away from sites of hatching allows us to compare the number of birds moving a certain distance to the number of nestlings ringed at that distance. This is a simple and effective way of measuring the dispersal that actually occurs. Subdividing the dataset allows replication of estimates, the efficiency of which is demonstrated by low standard errors in recruitment rate. Replicate estimates, moreover, allow use of general linear models for analyzing the data and to test hypotheses about the relative importance of factors affecting dispersal behavior. So far, this method has been applied to only a few datasets, bringing, nevertheless, new insights into dispersal behavior; more applications will follow.

Korpimäki E, Thomson RL, Vasko V, Laaksonen T

Breeding dispersal of Eurasian Kestrels in a temporally varying environment

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Dispersal is a key life history trait linking individual behavior to population dynamics. However, studies on dispersal have been questionable because it is often not known how many individuals dispersed outside a restricted study area. We trapped Eurasian Kestrels (*Falco tinnunculus*) in two large areas (2000 km^2, 400 nest-boxes each) 50 km apart during 1985-2005. Annually >80% of breeding adults were ringed or re-trapped (a total of 2200 females and 1900 males). In addition, parent kestrels were ringed or re-trapped in six other areas at distances of 30-250 km. The main prey of kestrels are voles (*Microtus* spp.), the densities of which fluctuated in high amplitude (50-200-fold) three-year cycles. Female parents dispersed longer distances than males, and yearlings (1-yr-old) of both sexes dispersed longer distances than adults (+1-yr-old) between breeding attempts. Annual turnover of female parents was higher (70-100%) than that of males (50-95%). Annual turnover of males was higher at high than at low vole densities, when kestrel breeding density was also low (0.1 nest/km^2). When vole density in the spring was high, many males immigrated to the area, and kestrel densities were high (1.0 nest/km^2). The proportion of adult kestrels shifting nest-sites >5 km between successive years was higher at low than at high vole densities in the current spring. Our results indicate that temporal variation in environmental quality is a main determinant of kestrel breeding dispersal in Northern Europe.

Dias P

Gene flow, local adaptation and phylogeographic history in Mediterranean Blue Tits

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Adaptation in heterogeneous environments depends on the balance between gene flow and local selection pressures. Several study populations of Blue Tits (*Parus caeruleus*) living either on the island of Corsica or in northeastern Algeria, in two types of contrasting habitats, show different degrees of habitat-related differentiation in phenotypic traits, particularly breeding parameters. These may correlate with genetic differences. Accordingly, we used neutral molecular markers to test whether neutral genetic divergence, if any, corresponds with phenotypic divergence. Using mitochondrial DNA and microsatellite nuclear DNA loci, we analysed within-population diversity, between-population differentiation, and regional differentiation in Algerian vs. Corsican vs. mainland southern France populations. Based on preliminary analyses of mitochondrial DNA data, results are discussed in the context of both local adaptation and glacial history.

Hénaux V, Lebreton J-D

Potential and problems of capture-recapture analyses

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Since the landmark Cormack-Jolly-Seber model (1965) made it possible to separately estimate survival and capture probabilities based on capture-recapture data, capture-recapture methodology in the broad sense has evolved considerably. In particular, multistate models, in which individuals move between sites or, more generally, states (e.g. breeder and non-breeder), appear as a powerful tool for answering a variety of biological questions. They provide also a way of analysing mixtures of information such as live recaptures and dead recoveries. Altogether, multistate models are a powerful framework for modelling the fate of individual characterized by categorical attributes changing over time. In this context, age-dependent multistate models considering reproductive status (breeder *vs*. non-breeder) can help analysing recruitment, modelled as an age-dependent pattern of accession to reproduction. By combining adequately the various possibilities offered by multistate capture-recapture models, we develop here a multi-site recruitment model allowing to model and estimate separately the rate of accession to reproduction, natal dispersal, breeding dispersal, and permanent emigration out of the set of studied sites. We illustrate the potential of the approach with the example of the Danish Cormorant (*Phalacrocorax carbo*) population and discuss foreseeable developments.

S29: Causes of geographic variation in avian life-histories

Conveners: Wesley Hochachka, USA; Francisco Pulido, Germany

Cooper C[1], Hochachka W[1], Voss M[2], Dhondt A[1]

Thermal environment and physiological constraints on incubation as influences on geographic variation in clutch size

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Explaining patterns of variation in clutch size is one of the oldest and most fundamental topics in avian life history research, with particular emphasis on understanding latitudinal and seasonal variation in clutch size. Based on our research examining extrinsic selection pressures shaping latitudinal trends in clutch size, we used our data to make inferences about intrinsic constraints on clutch size variation. We study Eastern Bluebirds (*Sialia sialis*) across a twenty-degree latitudinal gradient, and have examined how individuals in different populations expressed various traits, such as incubation behavior, in response to environmental temperatures. Our analyses suggest that several trait-temperature relationships change with latitude. These local temperature adaptations may constrain how individuals respond to rapid changes in climate. While the current results are correlational, and need to be confirmed by manipulative experiments, we have been able to make some inferences about whether responses to local temperature variation are or are not entirely the result of phenotypic plasticity. The data presented in this talk illustrate the value of using large-scale monitoring data to create hypotheses concerning the importance of local genetic adaptations in life histories.

Coppack T

Using indoor experiments to determine the photoperiodic basis for variation in the timing of breeding, molt and migration

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Geographic variation in the timing of breeding, molt and migration of birds reflects adjustment of their annual cycle to regional differences in environmental conditions. Generally unknown, however, is whether phenotypic plasticity or genetic adaptation are the cause of observed variation among populations. Here, I review the underlying causes of latitudinal variation in the timing of breeding, molt and migration, reflected in the individual responses of passerine birds to the photoperiodic environment. Experiments with hand-raised birds from different populations kept under identical conditions suggest that the timing of life-cycle events is primarily endogenously controled. A single common-garden experiment has no neutral testing ground however. Thus, if birds breeding at high latitudes have evolved higher photoperiodic response thresholds than southern conspecifics, testing birds in an intermediate photoperiodic environment could lead to an exaggeration of phenotypic differences and so an overestimation of the genetically fixed endogenous component. While reciprocal transplantation may control for this problem, such an experimental design is generally logistically unfeasible. This has led to the study of population-specific reaction norms in split-brood experiments, in which full siblings are allocated to a range of different environments. Such studies have revealed an unexpectedly high degree of plasticity in response to photoperiodic variation. For example, some palearctic-African migrants (*Sylvia borin*, *Ficedula hypoleuca*) advance pre-nuptial moult, spring migratory activity and gonadal growth when kept in environments mimicking higher wintering latitudes. Thus, geographic variation in the timing of life-cycle events may well arise from plastic responses to the latitudinal photoperiodic gradient.

Lloyd P

Variation among reproductive life-history traits as a function of age-specific survival, and their net consequences for annual fecundity

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A central prediction of the evolutionary theory of life histories is that parental investment in reproduction should vary directly with the fitness value of current offspring, and inversely with the residual fitness value of adults, or adult survival. Investment in reproduction incorporates a number of life-history traits, including clutch size, egg size, re-nesting effort, and parental effort in offspring care at different stages of development. Past studies have tended to focus on clutch size as a sole measure of reproductive investment. Yet, other traits that are important components of reproductive investment may not covary positively with clutch size. To better elucidate environmental influences on life history traits through age-specific mortality risks, I examine the correspondence between a variety of reproductive life-history traits and variation in age-specific survival among a broad array of species from both south-temperate and north-temperate regions. I test the prediction that parental investment in individual components of reproductive effort varies as a complex trade-off between the fitness value of current offspring at their different stages of development, and the expectation of further reproduction. I further examine geographical variation in potential and realized annual fecundity as a life-history x environment interaction.

Petren K

A landscape genetic view of geographic variation in Darwin's Finches

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Immigration is an important consideration for interpreting phenotypic variation among populations. Field studies are essential for understanding life-history variation and local adaptation in birds. However field studies are limited spatially and temporally in their ability to quantify dispersal and immigration, especially when dispersal is infrequent. Furthermore, conventional reasoning suggests that even rare immigration can profoundly influence local population processes. Recently developed molecular tools and methods of inference now make it possible to estimate the magnitude and patterns of even rare immigration. I present several examples of how these approaches are applied and how inferences about immigration can fundamentally affect the interpretation of local processes. Darwin's finches are an excellent model system because the large numbers of discrete populations and species allows one to use a comparative approach. Results provide evidence for several processes that are assumed to occur rarely, but are difficult to quantify by other means, such as non-random dispersal, habitat selection and directionally-biased migration. These results present a challenge to conventional thinking about the random nature of dispersal, the constraining influence of gene flow, and the role of peripheral populations and their contribution toward future biodiversity.

Caro S[1], Balthazart J[1], Lambrechts M[2]

The proximate basis of adaptive micro-geographic variation in reproductive phenology in male and female Blue Tits

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The underlying proximate mechanisms involved in the expression of adaptive micro-geographic variation in reproductive traits remain poorly understood, mainly because neuro-endocrinological investigations are rarely combined with long-term field studies. Here we report results of a comparative multidisciplinary analysis of the reproductive phenology in two Corsican populations of Blue Tits (*Parus caeruleus ogliastrae*) exposed to extreme differences in food abundance. Females of the two populations differ by one month in their dates of egg laying in response to local resource-based selection pressures. In both female populations, recrudescence of the ovaries, reflected in the seasonal profiles of plasma VLDL (Very Low Density

Lipoproteins) and VTG (Vitellogenin), is linked closely with observed egg laying dates. In contrast, neither male population differs in the seasonal growth of the song control nuclei in the brain, nor do they differ in onset of gonad development, despite a one month difference in the peak values of plasma testosterone, gonadal size and song activity. In addition, quantitative genetics analyses show significant repeatability and heritability values in egg-laying dates for the females, whereas values do not differ significantly from zero in the males. We hypothesize that the adaptive differentiation in breeding dates in these two Blue Tit populations is sex-specific, with females under stronger local resource-based selection pressures than males.

S30: MHC in birds: genomic organization and evolutionary importance

Conveners: Ralph Tiedemann, Germany; Helena Westerdahl, Sweden

Tiedemann R, Pfautsch S

MHC evolution in ducks and allies

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While studies on variation in the Major Histocompatibility Complex (MHC) in mammals are routine, investigations of these important genes are still rather scarce in birds. Apart from the chicken, basic information as to the genomic organization and the number of loci involved are still mostly lacking, often comprimizing the distinction between alleles from orthologous versus paralogous loci. Here we summarize current knowledge on the genomic organization and evolution of the MHC in birds, with a particular focus on the MHC2-loci in ducks and allies. Apart from discussing the evolutionary forces acting on different regions of these loci, we also hint at the applicability of these loci as markers in studies on adaptive genetic variation in the wild.

Westerdahl H

Passerine MHC; genetic variation and disease resistance in the wild

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As an ecologist interested in natural selection, I consider that it is critical to investigate genes that are related to survival (or fitness) when searching for associations between genetic variation and phenotypic expression. The Major Histocompatibility Complex (MHC) plays an important role in vertebrates' specific immune defence against various pathogens. Compared with other coding genes the MHC genes exhibit extremely high levels of polymorphism. Their importance in the immune defence and high levels of polymorphism, make these genes ideal markers to study in an ecological perspective. Passerines have been the focal organism in a large number of long term monitoring studies. Recently, it has become possible to screen for genetic variation in the MHC genes of passerines. Earlier avian MHC studies have been conducted primarily in galliform birds, such as the chicken, which have a simple MHC structure. Passerines appear to have a greater number of MHC genes, some of which are non-functional. In this talk I will describe the general features of passerine MHC genes based on the DNA sequences published so far. I will also review the ecological results up to date concerning (1) an MHC-based female mate choice and (2) associations between MHC alleles and survival.

Arnaiz-Villena A, Zamora J, Moscoso J, Cachafeiro J-I

The evolution of the major histocompatibility gene complex in canaries diversifies on islands

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Phylogenetic relationships among wild canary species (*Serinus* spp.), a group of finches widespread in Africa and Eurasia, were studied using cytocrome b mitochondrial DNA sequences. Histocompatibility class I (MHC) genes were also sequenced and examined for mode of evolution across populations, revealing low variability as found previously in related South American siskins (*Carduelis* spp.). However, wild canaries from the western Canary Islands (*Serinus canaria*) diverged and varied much from other canary species in neighbouring Africa in their MHC genes. The hypothesis that isolation and inbreeding lead to diversification of polymorphic histocompatibility systems is supported by these data, which are discussed in the context of postulated pathogenesis (high variability) of autoimmune diseases linked to histocompatibility genes.

Viio T

Polymorphism and expression of MHC class II genes in a lekking bird, the Black Grouse

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The maintenance of genetic variation, especially in the MHC (Major Histocompatibility Complex), is thought to be particularly important in ensuring long-term survival in rare species. However, evidence that genetic variation at MHC loci in wild birds is related to fitness remains scarce, and more studies are needed. Black Grouse (*Tetrao tetrix*) is a Red-listed species in many countries, and is declining across Europe. Its ecology, moreover, has been studied intensively for over two decades, particularly in relation to sexual selection. Since males alone contribute "good" genes to the offspring, the male MHC genotype may be important in female mate choice. Here I present the first data on the MHC class II gene organization in the Black Grouse and its levels of polymorphism. To investigate its complexity, I used restriction fragment length polymorphism (RFLP). I also studied transcription using a RT-PCR approach. A single stranded conformational polymorphism (SSCP) method was developed as well to screen MHC class II diversity. I found at least three polymorphic loci in the gene complex, and at least two of these are expressed in the spleen of Black Grouse. I also investigated the inheritance of MHC genes from parents through offspring. In future studies I will explore the fitness consequences of MHC diversity in Black Grouse populations sampled in central Finland, and examine MHC diversity in a further four populations in Europe, two of which are from Fenno-Scandia, and are large and in contact with other populations. The other two populations are from the Netherlands and England, both small and isolated.

Comparison of MHC diversity with variation previously described in microsatellites is also envisaged.

Lindström K
Parasites, immunity and MHC diversity in the Small Ground Finch of the Galapagos
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In isolated island ecosystems, many common parasitic diseases can be absent. In such absence, potential hosts are unable to participate in the co-evolutionary arms race that takes place between parasite and host elsewhere. Thus, accidental introductions of common diseases can have disastrous consequences in island ecosystems. In this study I identified and quantified the number of avian parasites on in four study populations of Small Ground Finches (*Geospiza fuliginosa*) on the Galapagos islands, with the aim of examining how immunological defense strategies and MHC genotype frequencies co-varied with parasite abundance. I found that the abundance of several parasite species co-varied with island- and host-population size, parasites being generally more abundant in large host populations. I also found that the magnitude of three types of immune response co-varied with island size, and that in small, parasite-poor populations, defense strategy shifted towards larger investment in cell-mediated components of the immune response, coupled with reduced investment in specific antibody response and natural antibody production. This raises another question: do these immunological differences reflect underlying differences in the MHC genotype in the four study populations of the Small Ground Finch? Documented by Denaturing Gradient Gel Electrophoresis (DGGE), the genetic diversity in MHC class II genes within individuals and populations will be presented.

S31: Magnetic orientation and magnetoreception

Conveners: Roswitha Wiltschko, Germany; Susanne Åkesson, Sweden

Åkesson S
Behavioral evidence of magnetic orientation and navigation
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Many birds are adapted to cope with extreme navigation conditions on the wing during foraging or migration, and are able to return with very high precision to known sites important for their survival. Effort to reach these sites in time, and with sufficient fuel reserves, has led to strong selection for workable and trustable navigation mechanisms and compass senses. Today much evidence has accumulated about how birds and other animals use the global magnetic field for compass orientation and navigation. Many innovative approaches and different experimental paradigms have been applied to investigations of behavioral responses to various manipulations of the magnetic field in the laboratory and in the wild, resulting in increased understanding of the function of the inclination compass and of the navigatory sense using field intensity and compass information. There are, however, some interesting differences in the results from alternative experimental paradigms, resulting in strong support for magnetic compass use and magnetic navigation from laboratory experiments but less from free-roaming birds in the wild. In this paper, I discuss the outcome of various experimental paradigms, and compare the ways in which birds in different situations rely on magnetic field information for compass orientation and navigation.

Mora CV
Conditioning birds to magnetic stimuli
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Migratory birds and homing pigeons are able to find their way over great distances, even in unfamiliar territory. It is now well established that most birds have a magnetic compass for direction finding, but it is still unclear how they determine their position while navigating. Magnetic effects, such as solar storms and local magnetic anomalies, have provided indirect evidence that their "map" might utilize spatial information provided by the earth's magnetic field. However, numerous past attempts to condition birds to magnetic field stimuli failed to provide convincing results and this failure has been repeatedly used as an argument against the possibility of magnetic navigation in birds. Recent magnetic conditioning studies with a range of animals revealed that two experimental conditions, namely the use of a non-uniform magnetic stimulus and movement by the animal as part of the behavioral response, have to be fulfilled for magnetic conditioning to be successful. Based on these findings, four homing pigeons were trained to discriminate between the presence and absence of a "wave-shaped" magnetic field anomaly (peak intensity 189 microTesla) by choosing between two identical platforms located at opposite ends of an experimental tunnel. Choice of the correct platform was rewarded with food whereas incorrect choices were punished with a time penalty. The pigeons consistently performed above the chance level of 50%. This magnetic discrimination ability was then impaired by attachment of a magnet to the cere, local anaesthesia of the upper beak area, and bilateral section of the ophthalmic branch of the trigeminal nerve, but not of the olfactory nerve. These results demonstrate that magnetoreception occurs in the upper beak area of the pigeon and is most likely magnetite-based, a finding that is further supported by physiological studies. In addition, domesticated chickens were recently successfully conditioned to magnetic compass directions using a social reward.

Stapput K, Wiltschko R
Behavioral evidence for the Radical Pair Model of magnetoreception
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The Radical Pair Model assumes that magnetoreception for compass orientation is based on radical pair processes in the avian eyes. It predicts that magnetoreception is light-dependent and is disrupted by high frequency (HF) fields in the MHz range.

Disruptive effects depend on the alignment of the HF field with respect to the geomagnetic field. These predictions were tested with migratory birds, using orientation in a seasonally appropriate migratory direction as a criterion for whether or not the birds obtain directional information from the geomagnetic field. HF-fields disrupted orientation when they were presented at an angle, but not when they were presented parallel to the magnetic vector. HF fields of 1.315 MHz, the frequency that matches the energetic splitting induced by the local geomagnetic field, proved particularly effective, disrupting orientation at 10 times lower intensity than HF fields of 2.63 MHz. Tests under monochromatic light of various wavelengths revealed that magnetoreception required light from the blue-to-green part of the spectrum, whereas several species of migrants and homing pigeons were disoriented at wavelengths of greater than or equal to 590 nm. Normal migratory orientation was observed under low intensity monochromatic 424 nm blue, 502 nm turquoise and 565 nm green light. Under higher intensity monochromatic light, however, birds no longer preferred their migratory direction, but showed axial tendencies or unimodal preferences for odd directions. Similar tendencies were observed under bichromatic light that combined light from the blue-to-green part of the spectrum with 590 nm yellow light. These tendencies are not controlled by the inclination compass, nor are based on radical pair processes, but involve a different mechanism, the nature of which is still unclear.

Muheim R

Magnetic compass calibration: a single calibration reference derived from sunset/sunrise polarized light cues from the region of sky near the horizon?

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Migratory birds use multiple sources of compass information for orientation, including the geomagnetic field, the sun, skylight polarization patterns and stars. Previous analyses of cue conflict experiments suggest that during the premigratory season, celestial information is given the greatest salience and used to recalibrate the magnetic compass by both juvenile and adult birds. In contrast, during migration, a majority of experiments suggest that birds rely on the magnetic field as the primary source of compass information and use it to calibrate celestial compass cues. I suggest an alternative pattern, i.e. that birds exposed to the cue conflict with a view of the entire sunset sky tend to recalibrate the magnetic compass, regardless of whether the cue conflict occurred during the premigratory or migratory period. Birds exposed to the cue conflict in orientation funnels and registration cages that restricted their view of the region of sky near the horizon did not recalibrate the magnetic compass, but used the magnetic compass to calibrate the other celestial compass systems. This suggests that under natural conditions there may be a single calibration reference for all of the compass systems of migratory birds which is derived from sunset (sunrise) polarized light cues from the region of sky near the horizon. In cue-conflict experiments carried out during the migratory season, there was an asymmetry in the birds' response to magnetic fields shifted clockwise and counter clockwise relative to celestial cues. I discuss two possible explanations: (1) lateral asymmetry in the role of the right and left eye in mediating light-dependent magnetic compass orientation and (2) interference from the spectral and intensity distribution of skylight at sunset with the response of the light-dependent magnetic compass. This new theory is based on a review of existing cue conflict studies and will be experimentally tested during the coming migration season(s).

Dennis T

Initial flight alignment to geomagnetic intensity contours in homing pigeons

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Navigation by animals is presumed to require the use of a 'map' to determine position relative to a goal, and a 'compass' to set and maintain a course to the goal. Previous studies demonstrate that magnetic cues are involved in navigation during homing in pigeons and provide strong evidence for the existence of a magnetic compass. However, the role of magnetic cues in how animals determine their positions using their navigational map remains unclear. Here I show that the flight behavior of pigeons released at unfamiliar sites is associated significantly with the spatial structure of the geomagnetic field. I observed that the initial flight paths of pigeons were often aligned in directions parallel and/or perpendicular to contours of equal total intensity of the local geomagnetic field, a phenomenon not previously reported. Such "alignment" behavior indicates that birds can determine relative changes in the local value of magnetic total intensity, information that may be one of several pieces which pigeons use in their navigational map.

S32: Understanding the causes of recent changes in migratory behavior

Conveners: Timothy Coppack, Germany; Charles M. Francis, Canada

Francis CM

Changes in the timing of spring migration in relation to climate: phenotypic or genetic responses?

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Many species of birds in both Europe and North America have been shown to arrive earlier on the breeding grounds and/or to initiate nesting earlier in recent years, apparently in response to climate warming patterns. Such changes could be due to evolutionary shifts in endogenous rhythms, or in the interactions between annual rhythms and the environment. If individuals that migrate early have higher reproductive success, natural selection could lead to rapid evolution of migratory timing. Alternatively, observed changes could be due largely to phenotypic plasticity in migration behavior. Two lines of evidence suggest that much of the observed change in recent decades can be explained by phenotypic plasticity. First, annual fluctuations in temperature provide a better explanation of changes in arrival dates than a long-term trend; the reverse would be expected if responses were largely genetic, because evolutionary change operates across generations and hence with a multi-year time lag. Second, analyses of migration timing from a range of latitudes in eastern North America show that observed changes in migration timing can be largely explained by changes in the rate of migration across the continent. In warmer years, the time between arrival at southern latitudes and arrival at more northern latitudes is reduced. This suggests that birds are opportunistically accelerating their migration in warmer years, rather than advancing their departure times from the wintering grounds, as might be expected with a genetic shift. Such phenotypic plasticity has the benefit that birds can readily cope with the observed large annual fluctuations in climatic conditions. Nevertheless, if warming patterns continue, limits may be reached on the ability of birds to cope with change through flexibility in behavior. In this case, one might expect to see endogenous rhythms and/or reaction norms starting to experience evolutionary changes.

Pulido F

The mechanisms underlying recent phenotypic changes in the timing of bird migration

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The breeding and migration phenology of birds is one of the best studied and most sensitive biological indicators of recent climate change. For many bird species breeding in Europe and North America an overall trend for earlier breeding and advanced spring migration has been detected, yet the direction and rate of response has not been uniform among areas and species. One potential constraint on the adjustment of breeding times to temporal shifts in the availability of food is the rate of change in the timing of spring arrival. In many regions, recent changes in the timing of spring migration have been smaller in long-distance than in short-distance migrants, or resident species. This variability in the rate of phenotypic change among species differing in migration distance has been attributed to differences in the availability of environmental cues in winter that may be used to predict the progression of spring in the breeding areas, differences in phenotypic plasticity or the levels of genetic variation, and to differences in the complexity of selection regimes. Re-adjustment of arrival times to the altered environmental conditions in a population could be achieved by three basic mechanisms: microevolution, environmentally induced phenotypic change, and gene flow from populations adapted to the novel conditions, such as immigrants from warmer areas. Although the mechanisms underlying phenotypic changes need to be understood if the limits of adaptation are to be predicted, current knowledge is still limited as few studies have addressed this question in the past. Here I give an overview of approaches that may help us to identify the proximate causes of phenotypic change in migratory behavior and review studies that have investigated the mechanisms of adaptive phenotypic change in the wild.

Bell CP

Demographic trade-offs govern shifts in migratory behavior in response to climatic variation

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Prenuptial migration occurs at the point in the annual cycle when the survival benefits of remaining on wintering grounds are outweighed by the reproductive benefits of moving to breeding grounds. Climate change affects both dimensions of this trade-off, such that timing of pre-nuptial migration cannot be understood simply in terms of response to changes in optimal arrival time on breeding grounds. Accordingly, migratory species should be responsive to climatic trends on both breeding and wintering areas. Moreover, since timing of migration is critical to choice and viability of wintering sites, shifts in timing of migration should be accompanied by changes in breeding and wintering ranges. In sub-Saharan Africa, many songbirds that breed in northern Europe pass the winter in equatorial regions where they benefit from high availability of food just prior to a relatively late spring migration. Should their optimal arrival time in northern Europe advance, some species or populations might be expected to switch migration strategy to that favored by earlier migrating species from southern Europe, and to shift their wintering areas north as well, to the southern margin of the Sahara. On the other hand, if high levels of premigratory food are critical to migratory success, the birds may be unable to respond to the changing phenology of their breeding grounds. Wintering populations of some Arctic-breeding waders occur across a wide range of latitudes, and at some low latitude sites, improvements in food availability late in the wintering period appear critical for gaining sufficient energy reserves for pre-nuptial migration. Earlier optimal arrival on the breeding grounds could render such low latitude sites untenable, leading to a northward shift in wintering latitude. Competition with populations already using sites at those latitudes could then lead to a global decline in migratory bird populations.

Tøttrup AP[1], Thorup K[2], Coppack T[3], Rainio K[4], Lehikoinen E[4], Rahbek C[1]

Long-term phenological changes in spring migration through northern Europe: A comparative approach

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Migratory songbirds are changing the timing of their spring migration in response to climate warming. Single-site studies describe general trends towards earlier spring arrival in numerous species, yet there has been little focus on the causes and consequences of inter-specific variation. Most migratory songbirds in northern Europe share common breeding grounds, but they use different migration strategies and winter in different regions. Bird observatories and ringing stations in northern Europe have accumulated extensive phenological information throughout the period of recent climatic warming. Here we present a comparative approach to the study of long-term changes in spring arrival dates of northern European passerine migrants, covering data collected from 1976 to 1997 at three locations in the North Sea and Baltic region. We apply four measures of population arrival to characterize the arrival of entire populations, namely arrival date of the first individual and of the first 5%, 50% and 95% of the total spring passage complement. Phenological changes are compared inter-specifically, and variation between sites is related to local and broad-scale climatic indices. Species-specific differences in phenological response related to differences in life-history, habitat and feeding ecology are tested while controling for migration distance, wintering area, species-specific mean arrival time, density changes over time and phylogeny. The results improve knowledge of how climate change may affect migratory birds in the long term.

Barbraud C, Weimerskirch H

Antarctic avian phenology and climate change

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Whereas there is compelling evidence for climate-related advances in migration dates in the northern hemisphere, no such long-term time series exists for the southern hemisphere, particularly for Antarctic birds. Yet physical changes observed in Antarctica are some of the strongest signals of global warming, and it might be supposed that the phenology of birds should also be affected by them. Since 1950, the first arrival and laying dates of the nine seabird species breeding in Antarctica have been recorded by ornithologists wintering each year at the Dumont d'Urville station in Terre Adélie, Antarctica, generating the longest-term phenological data set available for Antarctic species. We investigated trends in arrival and laying dates from 1950 to 2004. Unexpectedly, we found that Antarctic seabirds now arrive at their colonies on average 9.1 days later and lay on average 2.1 days later than in the early 1950s. Using a proxy for the extent of sea ice, our analyses reveal that, following years of reduced sea ice, species arrived and laid later. A meta-analysis confirmed that the mean slope of arrival date against sea ice extent departed significantly from the null model of no change. We also found no significant relationship between phenological events and average air temperatures for the month preceding species-specific arrival and laying dates. Our results contrast with phenological changes observed in the northern hemisphere. The mechanisms underlying these differences are discussed with a particular emphasis on changes in sea ice extent and the duration of the sea ice season. Changes in migration and phenology could have considerable consequences for the ecology and conservation of Antarctic seabirds. Later nesting could be detrimental if juvenal survival is reduced by a shortened period separating fledging from winter, or if seabirds lose synchrony with the phenology of their food supplies.

S33: Migratory connectivity: biological significance and modern techniques

Conveners: Frank Moore, USA; Franz Bairlein, Germany

Drent RH[1], Eichhorn G[1], Van der Graaf S[1], Stahl J[2]

Migratory connectivity in Arctic Geese: Looking for the weakest link

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Breeding in the Arctic is a major challenge for a herbivore as the growing season of local forage suitable for geese is too short to fit in the entire nesting cycle. Arctic nesting geese thus fly in adequate provisions (protein and lipid stores in the body) to stretch the season. Accumulating these subsidies is essential at least in part not only for egg formation but also to support incubation which equates to a near-starvation phase for the female (the sole incubator). Arctic geese thus follow a mixed strategy of capital and income breeding, as has been confirmed by recent work with stable isotopes that help to trace origins of egg components and of the body stores. Our leading question is, where does this crucial accumulation of nutrients occur, and how reliable are these source areas from year to year ? An added complicatioin is that the window of opportunity for spring growth involves a trade-off between waiting for adequate biomass accumulation and missing the digestibility peak. The obvious climatological link between geography and timing of spring snowmelt and plant growth has given rise to the concept of a "Green Wave" regulating spring migration in geese. There is also the tantalizing perspective that repeated heavy grazing year after year at times critical for plant growth might enhance profitability for the harvesters (geese in this case) following the "Grazing Optimisation Syndrome". It is our aim to enumerate predictions from these theoretical concepts and test them for the Russian breeding Barnacle Goose (*Branta leucopsis*) where the dynamics of travel have been elucidated using year-round satellite telemetry with implanted transmitters and can be linked to local site use along the way. These findings will be related to current modelling exercises of body stores dynamics during spring migration of other goose species. Achieving understanding of spring accumulation of body stores is critical to predictive population management of Arctic breeding geese.

Hobson K

Establishing migratory connectivity and seasonal interactions using stable isotopes

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Measurements of naturally occurring stable isotopes of several elements (C,N,H,O,S) in avian tissues have vastly increased our capabilities to investigate migratory connectivity and seasonal interactions. This approach is based on three fundamental principles. First, that we know the nature of the isotopic landscapes or "isoscapes" that a are used by a migratory individuals and how these may vary in time. Secondly, we need to know the temporal window of integration of the isotopic signal in the avian tissue of choice. Finally, we need to know the way in which isotopic signals are infleuenced by other processes such as isotopic discrimination, elemental turnover, exercise including endurance flight and diet quality. Here, I will present an overview of these issues and discuss past successes and failures in the application of this technique in the Nearctic and Palearctic migratory systems. In particular, isotopic patterns for deuterium in precipitation will be presented and discussed for several continents. Other isoscape mapping related to recent breakthroughs in remote sensing and modelling of the distribution of C3 and C4 plants will be discussed, especially in relation to the African continent. Future prospects, especially in terms of other tools such as trace element analyses, use of stable isotopes of heavier elements, and the combinaiton of genetic and isotopic markers will be considered.

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Demographic and fitness consequences of migratory connectivity

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The habitats that migratory birds use at the opposite ends of their migratory range vary in quality. Occupation of high quality habitats at both ends should have considerable fitness benefits, and the reverse should apply for poor quality habitats, with important evolutionary implications. The rate of exchange of individuals between habitats of different quality can also influence demography and population dynamics. To address these issues at population scale, we used an intensive tracking study of color-marked Icelandic Black-tailed Godwits (*Limosa limosa*) and stable-isotopes to link habitats throughout the year. Currently undergoing population increase, these godwits have been expanding into poorer quality habitats on both wintering and breeding grounds. We found that the same individuals were likely to use either high or low quality habitats at both ends of the range. Such seasonal matching of habitats of parallel quality in summer and winter can severely affect individual fitness and key evolutionary processes, leading to considerable alteration of effective population size. The evolutionary, demographic and conservational implications of seasonal matching are discussed.

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Connecting the spots - influences on site use by migratory Pacific Flyway shorebirds

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Over the past 14 years, the Pacific Flyway Shorebird Migration Program has used radio telemetry to trace a clear picture of how Western Sandpipers (*Calidris mauri*) and other shorebirds (Dunlin, *C. alpina*, Long- and Short-billed Dowitchers *Limnodromus scolopaceus, L. griseus*) migrate from Mexico north to their breeding grounds in Alaska. During this period we tracked over 400 birds, many over distances spanning much of their spring migration route. Here we report on results from these studies, including one to be completed in the spring of 2006. We have found that, while individual birds can travel over 3,000 km in a single flight, the majority use a system of stopover sites within hundreds of kilometers of one another. Use of these sites is influenced by sex, date, origin of migration, and age. In 2004, we measured triglyceride levels in migrating Western Sandpipers from Mexico to Alaska as an index of fattening rate. We were able to show, first, that plasma triglyceride levels increased between winter and migration at San Francisco Bay. Secondly, we found that there was a near-linear increase in plasma triglyceride levels with increasing latitude through the spring migration period, from low levels in Mexico to progressively higher levels northwards to the Copper River Delta in Alaska. This suggests that birds fatten progressively as they move north and approach breeding grounds. At San Francisco Bay, length of stay of Western Sandpipers was negatively related to triglyceride levels ($P<0.10$). Differences among species in the use of stopover sites will also be discussed.

Strandberg R[1], Thorup K[2]

Autumn migration performance in long-distance migrating raptors: New insights from satellite telemetry

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The advantages and disadvantages of using satellite-based radio-telemetry compared to ringing data for elucidating migration performance are evaluated from comparison of ring recoveries in three long-distance migrating raptors with satellite-tracking results from the last ten years. Because of the expense involved in satellite-tracking compared to ringing, it is usual for only a few individuals from a geographically restricted area to be tracked. Even so, satellite-tracking can provide detailed information about the exact timing of migration, migration speed, migration directions, stopover sites and times, and detours, thereby overcoming many of the potential biases found in ring recoveries. Comparison of the results from these two methods revealed overall agreement in the geographical patterns of migration in Swedish populations of the three raptors which winter mainly in tropical West Africa: Osprey (*Pandion haliaetus*), Honey Buzzard (*Pernis apivorus*), and Marsh Harrier (*Circus aeruginosus*). Satellite-tracking, nevertheless, provided much more detailed information in Africa and revealed significant differences in the estimated timing of migration, which ringing recoveries had inferred as much later. We also compared dispersal patterns and estimated survival rates on a more qualitative scale. The implications of our findings for interpretation of migratory connectivity and the understanding of migration are discussed.

S34: Endocrine bases of reproduction: mechanisms and diversity

Conveners: Pierre Deviche, USA; Alistair Dawson, UK

Tsutsui K[1], Ubuka T[2], Yin H[1], Ukena K[1], Bentley G[2], Sharp P[3], Wingfield J[4]

Discovery of gonadotropin-inhibitory hormone in a domesticated bird, and its mode of action and functional significance

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Neuropeptide control of gonadotropin secretion at the level of the anterior pituitary gland occurs primarily through the stimulatory action of the hypothalamic decapeptide, gonadotropin-releasing hormone (GnRH) in vertebrates. Until recently, no neuropeptide that directly inhibits gonadotropin secretion had been identified. In 2000, we discovered a novel hypothalamic dodecapeptide that directly inhibits gonadotropin release in quail and termed it gonadotropin-inhibitory hormone (GnIH). A gonadotropin inhibitory system is an intriguing concept and provides an unprecedented opportunity to study the regulation of avian reproduction from an entirely novel angle. To elucidate the mode of action of GnIH, we have identified a novel G protein-coupled receptor for GnIH in quail. The receptor possessed seven transmembrane domains and bound specifically to GnIH in a concentration-dependent manner. The GnIH receptor was found to be expressed in the pituitary and several brain regions, including the hypothalamus. These results indicate that GnIH acts directly on the pituitary via a GnIH receptor to inhibit gonadotropin release. GnIH may also act on the hypothalamus to inhibit GnRH release, because GnIH fibers have been observed to contact GnRH cell bodies. To demonstrate the functional significance of GnIH and its potential role as a key neuropeptide involved in avian reproduction, we investigated GnIH actions on gonadal development and maintenance in quail. Chronic treatment with GnIH inhibited photoinduced testicular development and maintenance by decreasing gonadotropin synthesis and release. Melatonin is a key factor for involved in GnIH neural function, because quail GnIH neurons contain a melatonin receptor, and melatonin stimulates expression of GnIH mRNA and mature GnIH peptide in a dose-dependent manner. We conclude that GnIH is capable of transducing photoperiodic information via changes in the melatonin signal and so influences the reproductive axis of birds.

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Gonadotropin-inhibitory hormone in seasonally breeding songbirds: Form and function

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The discovery of GnIH in quail has opened a new perspective on the neuroendocrine control of reproductive physiology and behavior. Using highly photoperiodic passerine songbirds as our model system, we have identified GnIH cDNA and localized its transcript in two passerines: Gambel's White-crowned Sparrow (*Zonotrichia leucophrys gambelii*) and European Starlings (*Sturnus vulgaris*). There is a high degree of homology between galliform and passerine GnIH cDNA sequences and peptides. The distribution of GnIH peptide is also similar among the galliform and passerine species studied so far. GnIH precursor polypeptide is only produced in the paraventricular nucleus, yet GnIH-immunoreactive (-ir) fibers project to multiple brain areas, suggesting multiple physiological and behavioral functions. Using peripheral administration of GnIH in vivo we demonstrated rapid inhibition of LH release in laboratory and field experiments. Because of the widespread network of GnIH-ir fibers and fiber terminals throughout the central nervous system, we sought to determine the effects of central infusions of GnIH. Centrally-administered GnIH rapidly reduced circulating LH and significantly reduced the number of copulation solicitations performed in response to song playback, with no reduction of locomotor activity. Central infusion of rhodaminated GnIH elucidated putative GnIH binding sites in the median eminence close to GnRH-I fiber terminals, and in the midbrain on or close to GnRH-II neurons. Furthermore, there are putative GnIH binding sites in passeriform gonads, implicating GnIH in regulation of gonadal steroid production. These data demonstrate direct effects of GnIH upon reproductive physiology and behavior, possibly at multiple physiological levels and over different time-frames. Thus, the discovery of GnIH has unearthed a complex and interesting system for the regulation of avian reproductive biology.

Maney DL[1], Goode CT[1], Ball GF[2]

Transduction of a non-photic cue: From the auditory system to a neuroendocrine response?

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Decades of research have shown that exposure to such social signals as conspecific song enhances reproductive function in birds. How such social signals are processed by the brain, and particularly how these signals are transduced into an endocrine response, is not well understood in songbirds. In this study, we played recordings of conspecific male song to captive female White-throated Sparrows and quantified their behavioral responses. We also quantified immediate early gene (IEG) induction in regions of the brain that process social information, and also in regions involved in gonadotropin releasing hormone (GnRH) synthesis and release. As expected, hearing male song induced copulation solicitation displays (CSD) and IEG induction in the auditory forebrain and in brain regions known to constitute an interconnected social behavior system, such as the lateral septum and the ventral tegmental area. Interestingly, IEG expression was tightly correlated across this system in birds listening to song but not in birds that did not hear song. Although GnRH neurons did not express IEGs themselves, IEGs were induced in an area of the brain defined by the distribution of GnRH cell bodies. IEGs also increased, relative to controls, in regions of the mediobasal hypothalamus known to be activated during photo- and NMDA-induced GnRH release. Several of these responses were correlated with the response in the auditory forebrain, suggesting that activation of these regions, and perhaps the GnRH response, may be linked to the behavioral salience of the song stimulus. Surprisingly, the CSD response to song was not correlated with IEG response in any brain region that we screened. This result suggests that activity in these regions may be involved in song perception, but do not drive the behavioral response to song. Future experiments will explore the effects of estradiol on patterns of IEG activation in response to social cues.

Deviche P, Small T

Non-photic environmental control of post-breeding reproductive regression and molt in a Sonoran desert passerine, the Rufous-winged Sparrow

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Photoperiod in most passerines studied so far plays an essential role in the control of reproduction. In such species, exposure to long days (LD) in spring stimulates the reproductive system. Subsequent regression of the system over summer, as well as post-breeding prebasic molt, results from absolute photorefractoriness, when birds lose sensitivity to the effects of LD. In contrast, some Sonoran desert species, including the Rufous-winged Sparrow (RWSP, *Aimophila carpalis*), are sensitive to LD year-round and undergo gonadal involution at the end of summer due to exposure to decreasing photoperiod. RWSP generally breed during the mid-summer monsoon and the timing of their post-breeding gonadal involution and prebasic molt shows substantial interannual variation, demonstrating involvement of non-photic factors as well. To identify these factors, captive adult male RWSP receiving *ad libitum* food and water were photostimulated (15L:9D) to induce gonadal development and then exposed to shorter day length (13L:11D) for five weeks to induce gradual gonadal involution and molt. During this period males were also exposed either to green vegetation (n=8) or, for two consecutive hours every evening, to the sight and sound of artificial rain (n=8). Exposure to vegetation did not influence the timing or rate of gonadal involution or of prebasic molt compared to controls (n=8). Rain-exposed sparrows, however, exhibited delayed molt and delayed gonadal regression relative to other birds, suggesting that this factor modulates the timing of breeding cycle termination in the wild. During gonadal regression, the three experimental groups had similarly low (< 0.3 ng/ml) plasma testosterone levels. Therefore, this hormone probably did not mediate the effects of artificial rain. New research is needed to elucidate the specific sensory modality and the neuroendocrine mechanism that mediate these effects. Support: National Geographic Society, Washington, D.C.

Raess M, Gwinner E

Life-history and reproductive physiology: Gonadal status and gonadal hormones in long-distance and short-distance migrating Stonechats

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Long-distance migration is often associated with relatively short breeding seasons, a start of reproductive activities rapidly after arrival, and restricted breeding opportunities. This has potential effects on the expression of reproductive physiology and behavior. Full activation of the reproductive system from the regressed state takes several weeks and has to be initiated in winter quarters or during migration. Thus, long-distance migrants face a potential conflict between the energetic and temporal requirements of migration and preparation for reproduction. Circulating gonadal androgens enhance male courtship and territorial behaviors in most temperate-breeding species. Because these hormones can compromise male parental care, the challenge-hypothesis predicts that the degree of male parental investment ultimately determines seasonal patterns of androgen secretion. We studied long-distance migrating single-brooded Siberian Stonechats (*Saxicola torquata maurus*) in northern Kazakhstan and short-distance migrating multi-brooded European Stonechats (*S. t. rubicola*) in Slovakia. We hypothesized that migratory distance and gonadal status at the time of arrival are related, and, furthermore, that circulating androgen levels might reflect differences in male parental investment in the two populations. Males of both populations arrived with gonads that were not fully developed. However, the populations neither differed in gonadal state at the time of arrival, nor in the rate of testicular development to the fully active state by the time of egg laying. The rate of the last stages of gonadal development may be determined more by physiological constraints than by a trade-off between migration and reproduction. Circulating androgen levels, both breeding baseline and maximum levels, were lower in Siberian Stonechats, and the relative share of non-aromatizable androgens was higher. This could indicate that different receptor types predominate in the regulation of reproduction in the two populations.

S35: Neuroendocrine control of behavior

Conveners: Stefan Leitner, UK; Wolfgang Goymann, Germany

Gahr M

Hormone dependent song pattern generation and perception

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Gonadal steroid hormones, androgens and estrogens are crucial for the production of and the response to sexual signals such as songs of songbirds. In this respect steroids alter both the differentiation of neural circuits during ontogeny and the morphological and electrophysiological fine-tuning of these circuits in adulthood. The neural song control circuit of songbirds consists of anatomically discrete interconnected areas in the fore-, mid-, and hindbrain. Two such areas, the forebrain sensory-motor areas HVC and RA appear to be crucial for the control of the temporal organization of the song and the frequency modulation of song motor units such as syllables. The development of the forebrain song areas depends both on brain-intrinsic, genetic mechanisms and on epigenetic actions of the androgen testosterone and the estrogen 17b-estradiol. The receptors of these hormones are expressed during early ontogeny of song areas while the onset of receptor expression does not require the hormones per se. In adulthood, the vocal areas contain receptors for a number of hormones including gonadal steroids, adrenal steroids, and the pineal hormone melatonin. The physical and socio-sexual environment might, thus, modulate vocal pattern and perception via a number of different endocrine pathways interacting with brain-intrinsic determinants. These neuroendocrine mechanisms affect neuroanatomical and neurophysiological entities of the song areas in correlation with hormone-dependent modulation of the song pattern and of auditory properties.

Leitner S, Catchpole CK

Neuroendocrine control of song plasticity in songbirds

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In songbirds, the differentiation of song and the song control system in the brain is mediated by the action of gonadal steroid hormones that depend on environmental factors such as day length, food availability, and social relationships. Thereby, the evolution of complex male song is thought to have evolved through sexual selection. Male canaries (*Serinus canaria*) produce elaborate songs and some contain syllables with a more complex structure (sexy syllables) that induce females to perform copulation solicitation display as an invitation to mate. Using playback of synthetic songs, we could demonstrate that females show differential expression of immediate early genes and an androgen receptor (AR) mRNA in the auditory forebrain in response to male song quality. In males, we found that syllable repertoire size, number of sexy syllables and the size of song control areas such as HVC and RA in the brain did not differ between one and two year old birds. A significant correlation, however, persisted in a positive relationship between the volume of HVC as delineated by AR mRNA expression and the proportion of sexy syllables within the song repertoire of two-year birds. Therefore, experienced males are likely to modulate vocal performance by modifying the control of particular syllables rather than by just increasing repertoire size or neural space, which is in accord with previous findings on wild canaries. Further, we found a more diverse modulation of song behavior in two-year birds when they were kept under restricted acoustic and social environments during their first year. The adaptive significance of these results is discussed with respect to the developmental stress hypothesis by comparing previous studies on songbirds.

Balthazart J

Rapid effects of estrogens on sexual appetite and consummation in quail

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It is widely accepted that androgens and estrogens derived from their aromatization in the brain activate male sexual behavior in birds and other vertebrates through their action in the preoptic area. Testosterone and estradiol bind to intracellular receptors, which then act as transcription factors to activate sexual behavior with latencies ranging from hours to days. We recently demonstrated that testosterone aromatization in the quail brain is affected within minutes by calcium-dependent phosphorylations and by changes in glutamatergic activity. We test here whether these fast changes in brain estrogen production have an impact on male sexual behavior. A single injection of estradiol rapidly and transiently activated copulatory behavior in castrated male Common Quail (*Coturnix coturnix*) that had been pre-treated with a dose of testosterone behaviorally ineffective by itself. Maximal behavioral effect was observed after 15 minutes. Conversely, a single intraperitoneal injection of the aromatase inhibitor, vorozole, inhibited expression of copulatory behavior as well as appetitive sexual behavior measured by the expression of the social proximity response or by rhythmic cloacal sphincter movements produced by the male in response to visual presentation of a female. Behavioral inhibitions reached a maximum at 30 minutes after injection and began to vanish at 60 minutes. Behavior returned to normal levels within 24 hours. Another aromatase inhibitor, androstatrienedione, induced a similar rapid inhibition of female-induced cloacal sphincter movements. Together, these data demonstrate that rapid changes in estrogen production in the brain significantly affect the expression of both consummatory and appetitive aspects of male sexual behavior and identify an additional and novel way by which hormones regulate behavior. These rapid effects presumably contribute to temporal regulation of the bouts of sexual activity and inactivity that are displayed by birds during the reproductive season.

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Neuroendocrine and behavioral adaptations to environmental constraints in the Arctic

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Arctic-breeding birds adapt their behavior to optimize reproductive success in a very short breeding season. There are rapid transitions from territorial and sexual behavior to parental behavior. In male breeding birds, the relationship between plasma testosterone and territorial behavior varies according to species. In the Lapland Longspur (*Calcarius lapponicus*), an unusually brief and high testosterone peak is associated with territorial aggression. Yet as soon as males are established with a mate, they become refractory to the behavioral effects of experimentally elevated testosterone. In Arctic-breeding White-crowned Sparrows (*Zonotrichia leucophrys gambelli*), the peak in testosterone lasts longer, but they too become behaviorally insensitive to experimentally elevated testosterone. Such insensitivity must require rapid and dynamic changes in the neuroendocrine system. At present, the neural mechanisms by which testosterone and oestrogen regulate aggressive behavior in Arctic-breeding birds are unknown. Testosterone may act directly within the brain to drive behavior via androgen receptors (AR), or it may be aromatized by aromatase within the brain itself to act on oestrogen receptor alpha (ER-alpha) and beta (ER-beta). In Arctic-breeding passerines, dense AR, ER-alpha and ER-beta mRNA expression is observed in brain regions implicated in aggressive behavior, memory and song. Quantitative analysis shows dynamic modifications in aromatase, AR and ER mRNA expression in these particular regions through the short breeding season. Such changes may be responsible for the rapid transition from aggressive to non-aggressive behavior and the observed behavioral insensitivity to experimentally elevated testosterone. Collectively, these findings provide strong evidence that neuroendocrine adaptations underlie the unique behavior required to maximize survival and reproductive success in Arctic-breeding passerines.

24th International Ornithol

S37: Vision and its function

Conveners: Graham Martin, UK; Luz Marina Rojas, Venezuela

Bennett ATD

Color vision and its functions

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Vision is the primary sense for many birds, and the avian eye is probably the most complex of any vertebrate. I commence with an overview of avian eye design, concentrating on the photoreceptors hypothesized to underlie color vision, examples of amino acid substitutions generating the different opsins variants found in avian cones, and methods used to infer differences in spectral sensitivity at a photoreceptor and whole animal level. I then summarize the evidence for the functions of avian color vision. This concentrates on the functions of UV sensitivity in birds for two main reasons: there have been substantial advances in our understanding of this topic in the last decade; and wavelength dependent properties of light, and spectral sensitivity of receiver and signaller, predispose the uses to which wavebands can be put. The section deals with the roles of avian spectral sensitivities in mate choice displays, predation and foraging.

Martin GR

Visual fields and their functions in birds

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Visual fields, describe the space around a bird from which information can be extracted to control behavior at any one instant. Interspecific comparisons suggest that in birds visual fields are of three main types. In most birds a narrow area of binocular overlap (20 deg) is found. This is independent of phylogeny and ecology, and occurs in species which use vision to guide the bill when feeding chicks (Flamingos) or when taking food items through pecking (pigeons), lunging at prey (herons, penguins), precision grasping (hornbills) or taking prey in talons (eagles). The more forward eye placement results in a blind area above and to the rear of the head which has consequences for vigilance behavior (demonstrated in some ducks) and head scanning movements (flamingos). In species which do not employ vision to obtain food items or to provision chicks, e.g. tactile probers and filter-feeding ducks, comprehensive visual coverage of the space around the head occurs and binocularity is just 10 deg. This shows that only a small area of binocularity is necessary for the control of flight. Only if birds need to place their bills precisely is comprehensive vision sacrificed. Owls are the only avian taxon in which eyes are more frontally placed giving a broad binocular field (50 deg) and a wide blind area behind the head. However, this is not associated with nocturnality since such binocular fields are not found in oilbirds, nightjars or night herons. It may be associated with auditory prey localization that is achieved through the use of large outer ear structures found uniquely in owls. These findings raise questions about the function of binocularity. It may result from the need to have each eye partially projecting forward in the direction of travel. This achieves in each eye a small diameter symmetrical optic flow field from which information predicting direction of travel and time to contact an obstacle can be extracted. Information that is crucial to birds.

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Head-bobbing behavior in foraging Whooping Cranes

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Many species of cursorial birds "head-bob", that is, they alternately thrust the head forward, then hold it still as they walk. Such a motion stabilizes visual fields intermittently and could be critical for visual search; yet the time available for stabilization vs. forward thrust varies with walking speed. Whooping Cranes (*Grus americana*) are extremely tall birds that visually search the ground for seeds, berries, and small prey. We examined head movements in unrestrained Whooping Cranes using digital video subsequently analyzed with a computer graphical overlay. When foraging, the cranes walk at speeds that allow the head to be held still for at least 50% of the time. This behavior is thought to balance the two needs for covering as much ground as possible and for maximizing the time for visual fixation of the ground in the search for prey. Our results strongly suggest that in cranes, and probably many other bird species, visual fixation of the ground is required for object detection and identification. The thrust phase of the head-bobbing cycle is probably also important for vision. As the head moves forward, the movement generates visual flow and motion parallax, providing visual cues for distances and the relative locations of objects. The eyes commonly change their point of fixation when the head is moving too, suggesting that they remain visually competent throughout the entire cycle of thrust and stabilization.

McFadden S

The function of focus in birds: Where can the avian eye see?

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The behavior of birds is diverse, whether foraging for food at close range or perceiving objects while flying at great distances. But where do their optics allow birds to look? The visual world of birds is remarkably different to that of humans. Unlike human vision, birds with laterally placed eyes have a dual visual system in each comprising two areas of high acuity, with one fovea directed frontally, and the other laterally. This raises two fundamental questions. First, can birds see simultaneously in two places - just as we hear and see, can they see and see? Secondly, what is the behavioral advantage of the two modes of viewing? To accomodate the distance over which birds can see, we suggest that, associated with their two viewing modes, there are two ways in which the avian eye can change focus rapidly, and serve fundamentally different behaviors. Birds have multiple ways of changing focus. They can not only change the curvature of the lens rapidly, much like mammals and primates, but also change the power of the cornea independently. We suggest that changing corneal power has evolved specifically for viewing close objects, particularly in the binocular field, and potentially allows simultaneous use of dual viewing modes. We also show that the avian eye can dramatically expand the choroid, a vascular layer located behind the retina, to push the photoreceptors precisely into the focal plane. It allows the eye to change its focal range from -8D of negative accommodation to over +10 D of positive. These multiple mechanisms for focusing allow birds to change their focal range temporarily over different time scales. Both costs and benefits to behavior arise from adaptation of the dual visual system to cope flexibly with an ever changing visual environment.

Hodos W, Ghim M

The limits of spatial vision in birds

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Achromatic contrast sensitivity (CS), the ability to discriminate small differences between dark and light, is a basic property of spatial vision that enables a viewer to distinguish an object from its surroundings and to identify the fine details of its surface. CS varies with the spatial frequency (SF) properties of the stimulus. Thus CS tends to be lowest for stimuli with high SFs (small objects, small details, sharp edges and corners) as well as for stimuli with low SFs (large features of objects such as overall shape). Maximum CS typically occurs at intermediate SFs. A plot of CS over a broad range of SFs is known as a contrast sensitivity function (CSF). CSFs represent the spatial vision of an animal more completely than does visual acuity, which only measures ability to detect high SF stimuli (small, dark objects, such as bars or letters) under high contrast. Although visual acuity data have been collected from many avian species, relatively few CSFs have been obtained from birds. The data described here document CSFs for white Carneaux pigeons (*Columba livia*), Barn Owls (*Tyto alba*), European Starlings (*Sturnus vulgaris*), American Kestrels (*Falco sparverius*), Japanese Quail (*Coturnix coturnix japonica*) and a Red-bellied Woodpecker (*Melanerpes carolinus*). Consistent with the literature on visual acuity, the CSFs of the pigeons and raptors have high SF cutoffs that indicate good to excellent visual acuity. The functions also reveal consistently lower maximum CS (by 0.5-1.0 log unit) than is typical for other vertebrate taxa, including those with far inferior acuity. This limitation in contrast vision, which reduces the ability to see subtle achromatic shadings in the details of objects such as variations in feather patterns and the details of flower petals or insect wings, may be compensated by the superior color vision of birds and by movement of the stimulus.

S38: Comparative avian immunology, from poultry to passerine

Conveners: Lynn Martin, USA; Dennis Hasselquist, Sweden

Hasselquist D

Comparative immunoecology in wild birds: hypotheses and tests

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Recently, evolutionary biologists have become interested in comparing patterns of immunocompetence in birds, both within- and between-species. I will review several hypotheses predicting adaptive patterns of immunocompetence using a comparative framework, and present some data to test them. Due to the seasonal pattern and action of melatonin, it has been proposed that immune function is enhanced in autumn/winter and suppressed in spring/summer. The few available studies of seasonal patterns of immunocompetence in birds do not support this hypothesis. Females often have stronger immune responses than males, possibly a consequence of immunosuppression by testosterone. Sexual selection is generally stronger in polygynous than monogamous species, and it has been predicted that the sex-difference in immunocompetence is enhanced in polygynous as compared with monogamous species. There are some data supporting this hypothesis. Species breeding and wintering in relatively parasite-free areas are predicted to have lower immunocompetence than birds breeding and/or wintering in parasite-rich areas. Thus, immunocompetence is expected to be higher in birds breeding in the tropics versus temperate birds, and higher in temperate versus arctic breeding birds. Some data on passerines partly support these predictions. Shorebirds wintering in salt-water habitats that are less exposed to parasites are expected to have lower immunocompetence than waders wintering in fresh water areas where they are more exposed to parasites. One study does not support this idea. So far there are few tests of these hypotheses in comparative immunoecology, however the ideas are fascinating and methods are now available for testing these hypotheses.

Klasing K

Divergence in strategies for immunocompetence between temperate and tropical birds

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Life-history theory predicts that birds found in tropical zones should live longer and allocate more resources to enhancing survival compared to birds found in temperate zones. In other words, birds of the tropics should protect future reproduction by investing in self-maintenance at the expense of current reproduction. Thus, investment in immunocompetence was predicted to be greater in tropical birds relative to those in temperate zones. This was tested by probing the immune system of phylogenetically matched species pairs from temperate and tropical environments. Assays of immunocompetence included bactericidal capacity of whole blood, phagocytic capacity of macrophages, lysozyme activity, natural antibodies, systemic acute phase response to bacterial cell walls (LPS), and the diversity of the antibody repertoire. The results indicate that there is remarkable interspecies diversity in immunological strategies. Capacity to phagocytose bacteria differed by 5-fold across species. Constitutive ability to kill Escherichia coli ranged from sterilizing immunity to a complete absence of protection. Similarly, the acute phase response to LPS ranged from robust to absent. Across environments, body size was an important determinant of immunological strategy. When controlling for body size, the acute phase response of tropical species was greater than that of temperate species, but there was little difference in the bactericidal capacity of their blood. It is concluded that, compared to temperate species, tropical species appear to invest more in expensive inducible defenses but not in constitutive defenses.

Owen-Ashley NT, Wingfield JC

Acute phase responses in passerine birds: Characterization and life-history variation

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The acute phase response (APR) is the first line of defense that many vertebrates employ during a pathogenic challenge. This response comprises a suite of physiological, behavioral, hormonal, and metabolic changes that include fever, iron sequestration, anorexia, adipsia, somnolence, and activation of the hypothalamo-pituiatary-adrenal (HPA) axis and suppression of the hypothalamo-pituitary-gonadal (HPG) axis. Although well-studied in mammals and domesticated birds, the APR of passerines is virtually unexplored. We characterize the APR in several species of Emberizidae from treatments of captive and free-living White-crowned Sparrows (*Zonotrichia leucophrys*) and Song Sparrows (*Melospiza melodia*) with lipopolysaccharide (LPS), an immunogenic compound that triggers APRs without actually causing infection in the host. We document how LPS treatment activates the HPA axis, suppresses the HPG axis, decreases activity and food and water intake, and induces short-term hypothermia in captives, while inhibiting territorial aggressive behavior and song in free-living males. The magnitude of the APR also varies seasonally in males, implicating a trade-off with particular life-history stages, such as reproduction. We then examine the proximate mechanisms underlying this seasonal modulation, which include hormonal suppression by the steroid testosterone and seasonal differences in energy stores which are rapidly depleted to a minimum threshold as a result of APR-induced sickness behavior. We conclude by comparing these findings to life-history variation in avian stress response to external environmental perturbations.

Matson K[1], Cohen A[1], Klasing K[2], Ricklefs R[1], Scheuerlein A[1]

Comparative immunology in ten species of waterfowl: A multivariate analysis

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Interest in quantifying immune function for comparative studies is growing, but interpretation of individual assay results is often less than straightforward. Moreover, relationships among different measures of immune function are poorly understood. We employed five basic protocols to measure thirteen variables of immune function in ten species of waterfowl (Anseriformes). All assays were run using a single blood sample from every individual that was separated into cellular (blood smear) and plasma (frozen for analysis) components. Of the variables, all eight measures of plasma immunity, but only one of five cell types (lymphocytes) varied significantly among species. A nested analysis was used to generate bivariate correlation matrices at the levels of species and individual. We extracted the principal components using these correlation matrices in order to gain insight into the underlying structure and relationships within both branches of the immune system at both individual and species levels. Within species, we uncovered simple, positive relationships between related measures of immunity that were not found between species. That canonical correlations failed to illuminate any significant relationship between plasma and cellular data at levels of individual and species suggests that there are no trade-offs between these divisions of immune function. We conclude that comparative studies addressing immune function will undoubtedly benefit from the simultaneous measurement of multiple immune variables.

Martin L[1], Wikelski M[2]

Life history and immune activity in House Sparrows

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Animals tend to either live fast and die young, or live slow and die old. Little is known, however, about what physiological factors mediate this pattern. We hypothesized that investments in immune defense could be important. Specifically, we expected that House Sparrows (*Passer domesticus*) that lived in habitats where disease threats were high would invest heavily in immune defense and subsequently breed modestly over a long period of time. Conversely, we expected that House Sparrows that lived where disease threats were lower, or at least seasonally variable, would invest less in immune defense when breeding conditions were optimal, which would subsequently allow them to produce more offspring in a smaller window of time. We tested this hypothesis in a series of studies on two populations of House Sparrows, a slow-living one from Colon, Panama and a fast-living one from New Jersey, USA. We found that Panamanian birds generally did invest more in immune defense than their temperate relatives. However, this pattern was dynamic both in time and character. We expect that this result is related to the complex nature of the immune system itself. Based on common garden studies, we further found evidence that some of the variation detected between the wild populations was fixed and perhaps in part genetic. In sum, these studies support an intricate albeit complicated relationship between life history and immune defense in this species. Future studies should appreciate that immune activity is probably not a monolithic trait that can be characterized by single assays, and should make effort to identify

the environmental factors that shape geographic patterns of phenotypic variation.

S39: Evolution of color ornaments

Conveners: Rauno Alatalo, Finland; Staffan Andersson, Sweden

Andersson S, Prager M

Phylogeny, sexual selection and constraints on carotenoid coloration and ornamental plumage diversity in widowbirds and bishops

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Male breeding plumages in African widowbirds and bishops, *Euplectes* spp., exhibit remarkable diversity in tail length and yellow to red carotenoid coloring. Selection analyses and experiments have shown that carotenoid redness functions primarily in male contest competition, while tail length is selected by female choice: the Multiple Receiver Hypothesis for maintenance of multiple handicaps. Given these apparently generalized sexual selection pressures and the similarities in ecology and social behavior across the genus, the diversity among the 17 extant species seems most likely to depend on phylogenetically and/or physiologically constrained proximate mechanisms. Here we use a well-supported molecular phylogeny of 33 terminal taxa in *Euplectes* plus outgroups for likelihood-based reconstructions of the evolution and interdependence of reflectance colorimetrics, HPLC-analysed carotenoid profiles, and tail lengths. Preliminary results support (1) directionality towards longer wavelengths (hues) and longer tails, (2) phylogenetically-constrained carotenoid metabolism, and (3) a trade-off between carotenoid and tail expression. *Euplectes* presents a unique case of generalized sexual selection on signals and a macro-evolutionary trade-off between multiple costly ornaments. Other potential social and ecological constraints on carotenoid pigmentation, such as variations in light condition and diet, are also discussed.

Alatalo RV[1], Höglund J[2], Siitari H[1], Kilpimaa J[1], Lebigre C[1]

Evolution of multiple ornaments in the Black Grouse

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Research on female preferences for male ornamentation has focused on the contradiction: do ornaments serve as indicators of heritable male quality, or do they act as Fisherian traits to enhance the attractiveness of sons. It has been very difficult to separate the two alternatives, not least because it is difficult to estimate weak effects inherited by offspring. Several theoretical models predict that in males with multiple sexual ornaments, only one ornament can be informative and reflect heritable viability. In the Black Grouse (*Tetrao tetrix*), males on leks have at least seven, partly independent, territorial, display or plumage signals that females use in mate choice. These traits reflect current, past and long-term male condition additively. Plumage signals effectively separate old individuals from yearlings, which may enable females to discriminate against young, low viability males that are capable of displaying actively in their first lekking season. Signals provide independent information on distinct quality components, allowing the evolution of several informative handicaps.

Hofmann CM, Cronin TW, Omland KE

Coloring in the past: The evolution of carotenoid coloration in New World orioles

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Ancestral state reconstructions often treat color as a discrete unordered qualitative character: for example, black and white or red and yellow. Reconstructing color characters as such makes several assumptions about how colors evolve, namely that no intermediates are possible, and that changes in direction, such as red to yellow or yellow to red, are equally likely. However, pigment-based colors may require complex metabolic machinery for pigment uptake, deposition, and other modifications that might not be readily gained or lost. Such physiological mechanisms may thus constrain changes in coloration. To address these issues, we used reflectance spectrometry to quantitatively score carotenoid-based red and yellow coloration in New World orioles (*Icterus* spp.). We found that color in these species varies continuously from yellow to red-orange, with considerable overlap between taxa, suggesting that color may evolve in a continuous manner. We also found that color appears to be highly labile, large changes often occurring among closely related taxa with little sign of phylogenetic constraint. These findings suggest that color changes may occur continuously and rapidly, which has important implications for understanding color evolution.

Jacot A, Kempenaers B

Condition-dependent expression of UV-plumage traits in Blue Tits

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Intraspecific sexual and social communication are among the most important factors shaping costly color traits in birds. Condition capture models assume that only animals in superior condition can develop and maintain bright plumage. While there is good evidence that pigment-based components of plumage colors are condition dependent, the issue is much less clear for the underlying UV-reflecting structural component. We conducted brood-size manipulation in Blue Tits (*Parus caeruleus*) to investigate condition-dependent effects on plumage traits in fledging birds. Chicks raised in reduced broods had significantly higher UV reflectance in UV/yellow breast and UV/blue tail feathers. In contrast, carotenoid chroma of yellow breast plumage was unaffected by the manipulation. Our findings support the idea that UV plumage traits show strong condition dependence, which is most likely mediated by characteristics of underlying microstructure in the feathers.

Bridge ES, Hylton JL, Gamble LG, Jones C, Schoech SJ
Cryptic plumage signaling in scrub jays, *Aphelocoma*
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Recent studies of avian vision and plumage coloration have revealed a surprising degree of cryptic sexual dimorphism, uncovering diverse male-female differences in UV reflectance that are invisible to humans. We examined the potential for cryptic plumage signaling in the scrub jays, genus *Aphelocoma*. This group of five species ranges across southern and central North America and comprises cooperatively breeding species (*A. coerulescens*), isolated island populations (*A. insularis*), tropical species (*A. unicolor*), and widespread species with considerable intraspecific variation in life history and appearance (*A. ultramarina* and *A. californica*). We assessed the visible and UV reflectance properties of *Aphelocoma* plumages by performing a series of reflectance measurements on hundreds of museum specimens representing all species and subspecies. Our findings indicate subtle but potentially important differences in reflectance, both between adult males and adult females and between first basic (subadult) and definitive basic (adult) plumages in some species. We discuss the roles of sexual dimorphism and delayed plumage maturation as it relates to breeding systems (cooperative *vs.* independent breeding) and other potential selective pressures.

S40: Behavior and physiology of under-water foraging in diving birds

Conveners: Patrick Butler, UK; Akiko Kato, Japan

Wanless S
Behavioral adaptations and constraints on avian diving - a northern hemisphere perspective
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The northern hemisphere has a rich avifauna of diving species. However, our knowledge of the underwater behavior of these birds has lagged behind species from southern latitudes because they are typically lighter and volant, characteristics that render the use of dive loggers designed for larger, flightless species such as penguins, impractical. Some of these technical limitations have been overcome in the last 5 years and a new generation of lightweight loggers has enabled the north to catch up with the south. The focus of research has also shifted away from largely descriptive studies to a more ecosystem-based approach with the emphasis on interactions between diving behavior and environmental factors e.g. hydrography, prey distribution etc. The temporal scale over which data have been collected has also expanded and now routinely includes the period outside the breeding season when environmental conditions for many diving species are extreme due to stormy weather, low temperatures and reduced day length. This presentation will provide examples of the 'joined up' approach linking behavior, physiology and ecology, and will highlight the important, and sometimes unexpected, new results that are emerging. Developing this integrated approach further is clearly a priority, particularly given the marked changes to the marine environment predicted by climate warming and some key species and knowledge gaps will be identified.

Handrich Y
Behavior and physiology of under-water foraging in diving birds
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The diving physiology of animals in their natural environment has been investigated for more than 30 years. Yet the electronic recording devices used were, until recently, only suitable for larger marine mammals. Advancements in such technology now enable the simultaneous recording of behavioral and physiological data on relatively small diving birds. The enlarged memories of recording devices and the miniaturization of their sensors, enable the investigation of foraging strategies at an incredibly fine temporal resolution. The first advantage of such simultaneous measurements is that they enable investigation of the relationships between behavior and physiology. The second and most innovative advantage is the exhibition of the full physiological capacities of many freely-diving animals. It is likely that with modern recording devices, more complex physiology will be uncovered than is presently appreciated, particularly with regard to the adaptations of endothermic divers to minimize the energy they invest for thermoregulation, locomotion and digestion. For example, penguins adjust their breathing, initial buoyancy and regional hypothermia depending upon the dives they are undertaking, presumably to optimize their diving behavior. The third advantage of such a holistic approach is the development of a new field of research: the study of the inter-individual variability in physiological abilities and the consequences in term of diving strategy. For example, different species show a reduced ascent rate compared to descent rate, a behavior that probably avoids the risk of decompression sickness. Observed individual exceptions within a species either question the validity of the hypothesis or highlight individuals with exceptional adaptation.

Enstipp MR[1], Grémillet D[1], Lorentsen S-H[2], Jones DR[3]
Diving energetics and foraging behavior in cormorants and shags
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Cormorants and shags are foot-propelled pursuit divers that forage on benthic and pelagic fish. Previous studies suggested that diving in cormorants is extremely costly and this is usually attributed to their wettable plumage and inefficient mode of propulsion. Cormorants supposedly employ a behavioral strategy to reduce foraging costs by minimizing the amount of time spent diving in water. However, during winter, European Shags (*Phalacrocorax aristotelis*, EUSH) in Scotland spend up to 7 hours per day foraging in cold water, which challenges this view.

We studied the energetic requirements of two *Phalacrocorax* species - EUSH and the Double-crested Cormorant (*P. auritus*, DCCO) - during diving and investigated the modifying effects of depth, temperature and feeding status on metabolic rate. Our results indicate that dive costs in both species are comparable to other foot-propelled avian divers. Depth had the strongest effect on dive costs, while declining water temperatures significantly increased metabolic rate. Using an underwater camera array, we also studied the fine scale foraging behavior of DCCO feeding on rainbow trout (*Oncorhynchus mykiss*). We used a bioenergetics model (based on time-energy budget data) to calculate the required prey capture rate of EUSH. The predicted prey capture rate of 10-15 g fish*min-1 submerged was easily achieved by DCCO in our experimental setting, even at fish densities as low as 0.2 g*min-3. However, foraging success of DCCO depended critically on fish density, with search time increasing and prey encounter rate drastically decreasing when density was below 2-3g*min-3. Hence, unfavourable conditions (e.g. low prey density) might force birds to expend considerably more energy in locating and catching sufficient prey such that a physiological ceiling might exist, beyond which survival could be affected.

Green J[1], Boyd I[2], Woakes A[3], Butler P[3]

Flexibility in the behavior, physiology and ecology of diving in Macaroni Penguins

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Diving animals are frequently flexible in diving behavior and performance. Such flexibility can be expressed by an individual, among individuals and between populations in response to a variety of ecological and physiological constraints. I recorded diving behavior in male and female Macaroni Penguins (*Eudyptes chrysolophus*) over two years. I found no differences in diving behavior between years but substantial variability within years. Macaroni Penguins appear to modify their diving behavior to match differences in foraging conditions across the seasons. Specifically, they tended to dive deeper, for longer and more efficiently during the winter migratory period than during the summer breeding season. These differences may be explained by changes in prey type and/or location and constraints in the amount of daylight available in which to forage. While flexibility in diving behavior is not uncommon, the physiological mechanisms enabling such variability are often overlooked. In my study, I was also able to estimate the energetic costs of diving by measuring heart rate simultaneously with diving behavior. It appears that seasonal modification in diving behavior is facilitated by change in the capacity of the penguins to forage underwater for extended periods. During winter months, diving penguins consume oxygen at a significantly lower rate than during summer months, principally as the result of a decrease in minimal rate of oxygen consumption. I show how a model that incorporates changes in the metabolic cost of diving can predict both observed improvements in diving performance and changes in the allocation of time during dives.

Bost CA[1], Handrich Y[2], Butler PJ[3], Ropert-Coudert Y[4]

Insights into the optimization of prey capture by penguins: A three dimensional approach

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Penguins play a major role in Antarctic food webs, raising central questions: when, where and on how much do these predators feed. Recent monitoring of the oesophageal temperature in penguins by data-logging systems is providing some answers. We investigated feeding strategies in penguins by using fast-response temperature sensors in the oesophagus together with time depth recorders in seven King Penguins (*Aptenodytes patagonicus*) over three seasons, and with speed-depth loggers in three Adélie Penguins (*Pygoscelis adelie*) over one season. This approach has revealed many of the feeding strategies used, especially how penguins optimize prey capture rate at different spatial and temporal scales. The feeding success of King Penguins per foraging trip was highest when they hunted in their preferred feeding zone of oceanic frontal structures. Here the number of successful dives and prey taken per dive peaked; dive rate also increased. The number of prey caught per dive varied greatly over the day, being highest during daylight, and high at dawn and dusk following diel rhythm in vertical migration of prey. In their dives, penguins modified dive angles, swim speed and post-dive interval according to prey encounter rate. A significant proportion of ingestion occurred during the ascent phase (22% and 44% in Adélie and King Penguins, respectively). Furthermore, most captures were made while penguins were heading upward, giving support to the counter-shading hypothesis, that penguins use backlighting to detect prey. The duration of the time spent at the bottom, and the number of wiggles per dive, were closely related to the number of capture events. The results are discussed in relation to predictions from some optimal diving models.

S41: Circadian rhythms and photoperiodism

Conveners: Vinod Kumar, India; Shizufumi Ebihara, Japan

Ebihara S, Yasuo S, Tada A, Yoshimura T

Overview of avian circadian system

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Avian circadian rhythms and photoperiodism have been of great interest to many ornithologists. Their study began with identification of the pineal gland as a circadian clock in early 1970s. Thereafter many studies have been carried out on diverse aspects of the rhythms, involving anatomy, physiology, endocrinology, and molecular biology. Recent progress in unraveling the genetic foundation of the mammalian circadian clock stimulated many ornithologists to proceed to molecular investigation of circadian rhythms, with impressive results. On the other hand, avian photoperiodism has not been examined from the molecular aspect until very recently, because the genes involved in photoperiodic expression were entirely unknown. Essential molecular genes regulating avian photoperiodism have now been reported, which may lead to an understanding of the mechanism of avian photoperiodism. As an introduction of this symposium, I will provide the framework of both circadian and photoperiodic phenomena with a historical overview and the progress of the researches with up-to-date results.

Hahn T[1], MacDougall-Shackleton S[2]

Mechanism and adaptation in avian photoperiodism

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Birds' use of photoperiod to time major life events such as breeding and migration has long fascinated biologists, and for 80 years avian photoperiodism has been a productive model for exploring mechanisms by which animals cope with a varying environment. Recent advances have clarified mechanisms underlying, as well as adaptive significance of interspecies variation in, avian photoperiodism. Here we will review the roles of the medial-basal hypothalamus (MBH) and of glia in avian photoperiodism. Localized deiodinase activity for conversion of T4 to T3, clock gene activity, presence of deep-brain photoreceptors, and expression of genomic responses to photostimulation within the MBH, all point to a central role for the MBH in avian photoperiodism. Glia evidently play important but relatively unexplored roles both in photoinduction and photorefractoriness. For instance, glia in the MBH are likely responsible for deiodination of T4 to T3 during photoinduction, and glial endfeet in the median eminence may contribute to deep absolute photorefractoriness. We also review contributions of comparative studies to our view of adaptive variation in avian photoperiodism, with special focus on such conspicuous phenomena as photorefractoriness and seasonal down-regulation within the septo-infundibular GnRH system. Among cardueline finches, the only taxon studied that meets neither criterion for absolute photorefractoriness is the crossbill, which breeds opportunistically on a wide range of photoperiods. Surprisingly, several other cardueline taxa spontaneously regress gonads and down-regulate the GnRH system after extended exposure to long days, but can still mount a reproductive response to constant light when putatively "refractory." These findings are consistent with the interpretation that the most flexible reproductive cycles are facilitated by a lack of absolute refractoriness, but that absolute refractoriness is not directly caused by GnRH system downregulation.

Yoshimura T, Yasuo S, Nakao N, Yamamura T, Ebihara S

Photoperiodic regulation of seasonal reproduction in birds

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Photoperiodic control of seasonal reproduction ensures that offspring are born when abundant food is available; and it is well known that the circadian clock is involved with photoperiodic time measurement (PTM). We have found expression of circadian clock genes in the mediobasal hypothalamus (MBH) where the center for PTM is located. This clock keeps stable time under various light conditions, evidently enabling birds to remain in steady state photo-inducible phase. Using Japanese Quail (*Coturnix japonica*) as our experimental model, we found that the expression of type 2 deiodinase (Dio2), which catalyses the deiodination of the thyroxine (T_4) prohormone to the active triiodothyronine (T_3), is induced by long day stimulus in the MBH. In contrast, expression of thyroid hormone-inactivating enzyme, type 3 deiodinase (Dio3), decreased after exposure to long days. Thyroid hormones in the MBH were high under long day conditions and low under short day conditions. The reciprocal switching of thyroid hormone-activating and -inactivating enzyme genes seems to fine tune photoperiodic information. In addition, intra-cerebroventricular administration of T_3 mimics the photoperiodic response of gonads. Since we found expression of thyroid hormone receptors in the median eminence and because thyroid hormones are known to be involved in the development and plasticity of the central nervous system, we examined the ultrastructure of the median eminence. Immumoelectron microscopy revealed that GnRH nerve terminals lie in close proximity to the basal lamina under long day conditions, and conventional transmission electron microscopy demonstrated the encasement of the terminals by the endfeet of glia under short day conditions. These morphological changes may regulate photoperiodic GnRH secretion. *This work was supported by the Promotion of Basic Research Activities for Innovative Biosciences (PROBRAIN).

Rani S, Singh S, Kumar V

Photoperiodism, pineal clock and seasonal reproduction in the Baya Weaver

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Previous studies suggest, that while pineal melatonin is important for circadian rhythmicity, and circadian rhythms mediate photoperiodic effects, pinealectomy or melatonin administration in photoperiodic induction of testicular growth has no effect in the majority of bird species investigated thus far. This is inconsistent with the fact that the avian pineal gland, which is an autonomous circadian clock, decodes daily and annual photoperiodic information both in the duration and amplitude of its melatonin output. Does this mean that in birds the pineal clock regulates circadian rhythms except for the one which regulates photoperiodic induction of seasonal response? This has not been studied. In a series of experiments we investigated the question in the Baya Weaver (*Ploceus philippinus*) by examining the effects of the absence of the pineal gland or exogenous melatonin administration on photoperiodic induction of testicular growth, androgen-dependent beak pigmentation, and luteinizing hormone (LH)-specific plumage coloration in birds subjected to short day length (8 hours light: 16 hours darkness, 8L:16D) and long day length (16L:8D), and to light-dark cycles that test the involvement of circadian rhythmicity in the photoperiodic time measurement. The results show that, in the Baya Weaver, the circadian pineal clock regulates circadian behavioral rhythm, but not the circadian rhythm involved in photoperiodic induction.

This suggests that circadian activity and photosensitivity rhythms are outputs of different circadian oscillators or of the same set of circadian oscillators without close coupling.

Bartell P, Moore A, Cassone V

The photoperiodic and circadian control of nocturnal migratory restlessness in the Brown-headed Cowbird: a new model for the study of Zugunruhe

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The migratory behaviors of the Brown-headed Cowbird (*Molothrus ater*) are unique in many characteristics and these qualities may be a reflection of the bird's unusual life history. Individual Cowbirds within a common population wintering in South-central Texas display a wide variation in their dispersal distances and directions, while a substantial population remains year round at this "wintering" site. The presence of these migratory and non-migratory sub-populations residing in the same wintering area has the potential to make the Brown-headed Cowbird a unique and useful model for studying the physiological and neurobiological basis of migratory behaviors. We examined the role of photoperiod and the circadian system in regulating nocturnal migratory restlessness to confirm the usefulness of the Brown-headed Cowbird as a model for studying Zugunruhe. When the photoperiod was modified from 16:8 to 12:12 in the autumn and from 8:16 to 12:12 in the spring, Zugunruhe was induced in a percentage of Cowbirds that closely approximates the percentage of Cowbirds from this population that is known to migrate to and from their wintering site. Furthermore, plasma melatonin levels in Cowbirds are reduced when Zugunruhe is present, a condition similar to that observed in other nocturnally migrating passerines. Finally, the circadian rhythm of Zugunruhe was abolished in Cowbirds after we surgically removed the pineal gland, which is the endogenous source of plasma melatonin in passerines. Thus, our data indicate that while Zugunruhe in the Brown-headed Cowbird is under circadian and photoperiodic control, other innate factors downstream of the circadian axis can regulate its appearance.

S42: Bioacoustics: pure and applied aspects

Conveners: Peter McGregor, UK; Georg Klump, Germany

Bretagnolle V[1], McGregor PK[2]

Using bird vocalisations as individual tags: Prospects for the conservation of threatened species in counts, survival rates and population structure

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Many features distinguish individuals among birds, including vocalizations. In effect, long-range vocalizations can function as individual tags and can generate information on individuals for use in conservation, as in censusing and monitoring. The identification of individual male Eurasian Bitterns (*Botaurus stellaris*) from features of their "boom" calls was one of the first applications of the technique to birds of conservation concern. Advances in bioacoustics and data analysis since the technique was first used on bitterns in the 1990s hold the prospect of using vocalizations in species counts, and to determine survival rates, at least for males, and population structure, using call quality as a proxy of male quality. Here we discuss whether these prospects can be realized in a variety of species of conservation concern - from bitterns and Corncrakes (*Crex crex*) to Corn Buntings (*Miliaria calandra*). We also provide an example using Little Owls (*Athene noctua*), although in its case, as to some extent in the bittern, individual calls vary both within and especially between season.

Langemann U

Auditory perception and communication limits

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The auditory system of birds has evolved with the need to separate behaviorally relevant sounds from interfering sounds that are ubiquitous in the acoustic environment. Interfering sounds have the potential to mask relevant sounds, like for example communication signals or sounds produced by potential prey, resulting in an impaired signal-to-noise ration for detecting these signals or in the total loss of the information. With the emergence of many noise sources resulting from human activities, birds might experience an additional selective pressure. In order to evaluate the impact of the human noise on natural habitats and acoustic communication, knowledge is needed not only on the physical characteristics of both communication sounds and interfering sounds but also on the perceptual abilities of the avian recipient. For example, environmental sounds often show temporal fluctuations of the signal envelope and perceptual studies have revealed that the auditory system of birds can make use of these amplitude patterns to improve detection of a target signal. Once perceptual limits of birds are known, we can estimate communication distances for different noise sources like, for example, traffic noise. This symposium contribution presents basic parameters of bird auditory perception together with estimates of communication limits. What is still needed, however, are more field experiments to directly measure the impact of noise pollution on different bird species.

Mulhauser BP, Zimmermann J-L

Censusing roding populations of Eurasian Woodcocks by bioacoustical methods

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Censusing breeding populations of the Eurasian Woodcock (*Scolopax rusticola*) is a recurrent problem, highlighted by the difficulty that an observer at a fixed point has of counting birds in roding flight. To resolve the problem, we have developed a new method of census that identifies male woodcocks and the limits of their roding areas precisely by the characteristics of their song. Graphic analysis of sonagrams shows that woodcock song comprises two to six deep notes, the “rrow”, and one shrill, the “tsip”. During normal roding flight, males sing with a precise number of deep notes that are constant over time, but give the high “tsip” at different measures of time such that each male can be identified individually. Since 2002, the population of the Vallée de La Brévine in the canton of Neuchâtel, Switzerland,

and department of Doubs, France, has been subject to such bioacoustical monitoring over the entire roding season, from April to July. As well, point localities have been mapped to determine the spatial organization of the birds. Yet this method of census cannot be applied globally without some precautions. The correlation between the numbers of voice contacts and the number of males on the ground was calculated in different areas of the Alps (Switzerland), Jura mountains (France, Switzerland) and Poland, with the finding that the correlation between them was linear.

Brumm H

How singing birds get their message across in noisy environments

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Adding to natural biotic and abiotic noise in every habitat, the sounds of human activity have turned the world into an increasingly noisy environment. The dramatic increase in traffic over the last century has brought considerable changes to the acoustic environment in many places. Recent bioacoustic research has revealed, however, that birds are not defenseless against interference from environmental noise. Rather, they have evolved a variety of ways to make themselves heard. I focus on vocal mechanisms and song organization, and review the latest advances in our understanding of how singing birds get their message across in noisy environments. Potential evolutionary and ontogenetic shaping of song characteristics are considered, as well as the growing evidence for noise-dependent individual short-term regulation of signal features.

S43: Avian senescence

Conveners: Pat Monaghan, UK; Carol Vleck, USA

Vleck C, Haussmann M, Vleck D

Senescence in birds I: Mechanisms

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To date, most studies on mechanisms that produce and defend against aging are based on cell culture or studies on lab animals. Candidate mechanisms for physiological aging with broad experimental support include oxidative stress, progressive erosion of telomeres and cellular senescence, age-dependent trade-offs in hormone signaling pathways, and immunosenescence, leading to an increased risk of infection, autoimmune disease and cancer. These mechanisms are inter-related, not mutually exclusive, and probably all contribute to the aging phenotype. Comparative studies on birds with their relatively long life-spans promise to shed light on the relative contribution of these mechanisms to aging and the processes by which evolution can modify the onset of senescence. Free radical production and oxidative damage result from cellular metabolism. Oxidative damage increases with age in some bird species and is higher in short-lived than in long-lived species, although birds appear to have lower rates of free radical production than mammals, despite their higher levels of oxidative metabolism. In culture, bird cells are more resistant to oxidative damage than are mammal cells. Recent comparative work in birds has shown that telomeres shorten with age and that rate of shortening is proportional to lifespan. Telomerase has higher activity in long-lived than short-lived species. In one species, short telomeres are correlated with reduced survival. Immunosenescence has been linked to both oxidative damage and telomere shortening. Both cellular and humoral immunosenescence have been observed in birds. The rate of decline in cell-mediated immune function is inversely correlated with life-span; short-lived species have a greater functional loss per year than long-lived species. Comparative studies on mechanisms underlying senescence in birds will continue to inform us on how aging mechanisms have evolved and how flexible they are in response to ecological and selective pressures.

Monaghan P[1], Ricklefs RE[2]

The evolutionary ecology of senescence in birds

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It is now clear that birds do age, albeit more slowly than mammals, and that the decline in performance with age has fitness consequences. The pattern and pace of ageing, and hence maximum lifespan, reflects the balance of damage generation and repair, which is linked to investment patterns and hence to life history adaptation. The rate of ageing varies substantially in birds, and this is not simply explained by metabolic rate or body size. Their relatively long lifespans evolve partly in response to reduced extrinsic mortality, which exposes a greater proportion of a population to selection pressures operational late in life. In this talk we will examine the variation in the lifespan across avian species, and consider the selection pressures that might have shaped this life history parameter. We will also examine variation within species, and the potential environmental factors, such as early growth conditions, that can influence the rate of ageing in individuals. We will also discuss the different applicability of comparative and experimental approaches to understanding the factors that mould the pattern of senescence in birds.

Altwegg R[1], Schaub M[2], Roulin A[3]

Age-specific fitness components and their temporal variation in the Barn Owl

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Senescence is the result of weaker selection on traits expressed at older age compared to traits expressed at younger age. Moreover, according to the current concept of demographic canalization, those vital states that are most closely related to overall fitness should be the least variable. There should thus be a predictable relationship between age-specific survival or reproduction, and the temporal variance in these traits. We examined age-specific reproduction and survival in female and male Barn Owls (*Tyto alba*) in western Switzerland, and estimated temporal variation using variance components methods. In both sexes, survival increased over the first two years of life and then stayed constant. For reproduction, on the other hand, we found different patterns in the two sexes. The number of fledglings produced per brood increased with female age and decreased with male age, while the number of eggs failing to hatch increased with male age only. In broad agreement with demographic canalization, one component of reproduction, namely the probability of producing a second clutch, was most variable, followed by juvenile and adult survival. However, clutch size and egg volume were the least variable fitness components, and instead determined by individual characteristics. Furthermore, the variability in fitness components was similar in both sexes, despite their different patterns of senescence.

Angelier F, Chastel O

Age-related breeding performance in long-lived birds: a hormonal perspective

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Understanding physiological mechanisms underlying age-specific pattern in avian reproductive success is essential because it can offer great insights into life-history trade-offs. We examine here how hormone levels vary with age and breeding experience in two long-lived seabirds at ages of 5-39 years (N=170): the Wandering Albatross (*Diomeda exulans*) and the Black-browed Albatross (*Thalassrche melanophrys*). These species exhibit an age-specific pattern in reproductive performance with low breeding success in young and older/senescent breeders. We measured plasma levels of (1) prolactin, a hormone known to trigger parental behavior, and (2) baseline corticosterone, a stress hormone known to trigger nest desertion. We predicted that young and older/senescent birds would exhibit the highest levels of corticosterone and the lowest of prolactin. Instead, we found that breeding experience was a much better predictor of hormone levels than age *per se*. In both species, prolactin levels were positively correlated with breeding experience and only decreased in highly experienced/senescent Black-browed Albatrosses. For corticosterone, there were contrasting results between species: as predicted, corticosterone levels were highest in inexperienced and highly experienced/senescent Black-browed Albatrosses, but the opposite was recorded in Wandering Albatrosses. Moreover, prolactin levels were not a predictor of individual quality in either species whereas high corticosterone levels were associated with lower individual quality in Black-browed Albatrosses. To our knowledge, these results are the first to show relationships between hormonal patterns and breeding experience. They are discussed in the light of evolutionary theory of aging, and especially in the context of the costs and benefits associated with the hormones.

Verhulst S, Salomons M, Mulder E, van de Zande L

Telomere length in Jackdaws in relation to age, reproduction and survival

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Telomeres are short, tandem-repeated sequences of DNA found at the ends of eukaryotic chromosomes, and they serve to protect chromosomal integrity by reducing nucleolytic degradation and end-to-end ligation. Telomeres shorten with age, and telomere shortening *in vitro* is accelerated by oxidative stress. Oxidative damage to DNA is thought to be one of the major agents of senescence, and telomere shortening rate is a putative index of the rate of accumulated oxidative DNA damage. We examine telomere shortening in erythrocytes of individual Jackdaws (*Corvus monedula*) in relation to social behavior (dominance), age, reproductive success and survival. We also quantify markers of oxidative stress to verify whether the relationship between oxidative stress and telomere shortening also exists *in vivo*. From this we aim to provide a synthesis of the relations between energy allocation, ageing and life history evolution, thereby augmenting biomedical and genetic approaches towards understanding senescence.

S44: Life history and conservation

Conveners: Christiaan Both, The Netherlands; Pete Marra, USA

Both C

Climate change and adaptation of annual cycles of migratory birds

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One important effect of climate change is its advancing of phenology. The advances are not equal across trophic levels, and birds that rely on a short period of peak food availability for breeding may fail to match breeding time with the advancing food peak. Long-distance migrants may be especially vulnerable, because at their wintering grounds they have limited knowledge of when spring starts on their breeding grounds. Here I show how the long-distance migratory Pied Flycatcher (*Ficedula hypoleuca*) has responded to global warming on its European breeding grounds. Breeding date has advanced at sites that have got warmer, but not at sites where temperature has remained more-or-less stable, suggesting that it really is climate change that is causing the advances in breeding date. Such advances, however, have not been enough to match the advance in their main food sources everywhere, leading to dramatic population declines in the Netherlands. The reasons for inadequate adaptation to climate change are probably twofold. First, flycatchers on their wintering grounds in Africa have no information about when spring starts on breeding grounds, and so use day length to cue their migration. Secondly, early temperatures at the time of arrival on the breeding grounds have not risen, and any advance in arrival may have survival costs. I show that such a survival cost indeed exists: early-arriving birds survive less well when temperatures are low. I also discuss the options that long-distance migrants have for adapting to climate change.

Marra P, Studds C

The role of climate in driving within-season performance and carry-over effects from the non-breeding season for a long-distance migratory bird

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Rapid changes in climate can have multiple effects on the performance of long-distance migratory birds. On their tropical non-breeding grounds, migratory birds may encounter large inter-annual variability in temperature, rainfall, or the frequency and intensity of severe weather events, each of which can alter overwinter physical condition, annual survival and modify the departure schedules of birds on spring migration. Such events can have either positive or negative impacts on breeding season performance depending upon how birds are also impacted by events en route. Similarly, advanced phenological changes occurring on temperate breeding ground destinations could also result in long-distance migrants arriving back to breeding areas out of synchrony with local environmental conditions. Our long-term dataset for American redstarts overwintering in Jamaica encompasses several natural, short-term climatic perturbations, allowing us to test predictions about bird responses to different climatic events. In general, shifts in climate leading to increased levels of spring precipitation tend to ameliorate the negative effects of occupying sites in poor quality habitat. In contrast, winters with decreased precipitation tend to constrain the performance of birds in both high and low quality habitat. Interestingly, these negative effects are exacerbated in larger body birds and result in lower survival of these individuals. Our findings suggest that climatic events on tropical wintering areas can have major impacts on the life history strategies of migratory birds. In sum, understanding how migratory birds respond to a changing climate requires incorporating interactions of seasonal events throughout the annual life cycle.

Schaefer H-C[1], Jetz W[2], Boehning-Gaese K[1]

Impact of climate change on migratory birds: Evolution versus sorting of species

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Across Europe, the proportion of migratory species in bird communities declines with increasing temperature. Underlying this pattern are two phenomena. On the one hand, the colder the area, the more migratory species present. On the other, many short-distance migrants vary intra-specifically in migration behavior, a behavior that is weaker in warmer areas. Accordingly, if temperature increases with global climate change, the proportion of migrants at any particular site will decline, resulting from changes in geographic range (species sorting) and in migratory behavior (adaptive evolution). In order to understand the processes that affect bird communities and to predict the consequences of climate change, we used a macroecological approach to infer the magnitude of changes to be expected and the extent to which sorting and evolution will contribute to them. From the summer and winter distribution areas of all landbird species, we calculated the potential effect of climate change on the proportion of migratory species in European bird communities. Sorting effects were inferred by calculating changes in proportions of long-distance migratory species. Evolution of migratory behavior was measured by changes in the proportion of migratory short-distance migrants at a specific site. Our results predict that an increase of winter temperature by 1°C will cause a 2.3% decrease in the proportion of migratory species, made up by a decline of 1.5% in long-distance migrants and a drop of 0.8% in migratory behavior in short-distance migrants. Accordingly, global climate change is expected to change the proportion of migratory species in a bird community more through sorting of species than through evolutionary change in migratory behavior.

van der Jeugd H[1], Eichhorn G[2], Drent R[2], Larsson K[3], Litvin K[4]

Rapid range expansion and loss of migratory behavior in the Barnacle Goose: food for thought

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Within the last three decades, the population of the Barnacle Goose (*Branta leucopsis*) of the East Atlantic Flyway has undergone a dramatic change. Numbers have increased tenfold, and new, fast-growing populations have established themselves southwest of their original range. The new populations have considerably shorter migration routes, or are even sedentary. Because of its remarkable flexibility, the Barnacle Goose is an ideal candidate for investigating mechanisms of adaptation to new environments. Color-ring schemes in three populations have enabled us to follow large numbers of individuals and document the costs and benefits of life at different latitudes. There are considerable differences in the timing of migration, breeding and molt between populations. Other life-history traits, such as clutch size, growth rates of young, and adult survival, also differ greatly. Some traits, nevertheless, seem more flexible than others. Thus in southern populations, timing of breeding has advanced much more than timing of molt. Clutch size increases southwards, probably because the longer interval between hatching and molt allows birds to replenish reserves lost during laying and incubation. The adaptive advantage of migration to the arctic is that quality of food plants changes with seasonal patterns of growth and development, and that geese can track this green wave of food northwards on their journey. Because geese can store part of the food they eat *en route* in the form of body reserves, migration forms an evolutionary way out of the problem that birds breeding in seasonal environments face: breeding sufficiently early to be able to successfully raise young. Indeed, birds in recently established southern populations still breed too late to be able to fully exploit the peak in grass growth, which occurs well before eggs hatch. At the same time, penalties for lateness do not seem to be high, and evolution towards even earlier breeding has not been observed.

Schoech S

Food availability and timing of reproduction: Are high-latitude species less flexible in responding to supplementary cues?

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Food supplementation usually advances the timing of laying. A meta-analysis of 34 food supplementation studies shows, nevertheless, that species at high latitudes are less responsive to food supplementation than those at lower latitudes. Given that the length of the breeding season varies with latitude, it is likely that species at high latitudes, with a narrow window of opportunity, rely largely upon photic cues and are less responsive to other environmental stimuli. In contrast, species of lower latitudes, where periods suitable for breeding vary from year to year, are predicted to be more responsive to 'supplementary' information for adjusting timing of laying to coincide with conditions that favor successful rearing of young. Recent studies suggest that there may be a physiological underpinning to reduced responsiveness in high-latitude species. Given that temperature rises from global warming are most pronounced at high latitude and that flexibility of response is lower in high-latitude species, one might predict that such species will have difficulty synchronizing reproduction with a resource base that will peak earlier than previously, particularly for the successful rearing of young. They may not have the neural or genetic plasticity to adapt in time. As has been noted in studies of breeding in Great Tits (*Parus major*), decoupling of resources and breeding may result, for migratory birds at winter quarters, from a lack of information about environmental change on breeding grounds. Even if they could respond to earlier emergence of resources, the migrants might still not arrive from overwinter sites early enough to take advantage.

S45: What 'animal models' can tell ornithologists about the genetics of wild populations

Conveners: Erik Postma, The Netherlands; Anne Charmantier, UK

Sheldon B

Quantitative genetic perspectives on ornithology

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Birds are unusually suitable for studying the inheritance of quantitative characters in natural populations, and have long been at the forefront of this part of ecological genetics. Many long-term population studies produce detailed, multi-generation, pedigrees, and these provide a superb resource for quantitative genetic analysis. The last five years has seen considerable growth in the recent application of the 'animal model' to such data. This has revealed a great deal about what quantitative genetic studies of wild populations can, and cannot, tell us about the ecology and evolution of birds. In this talk, I will argue that this quantitative genetic perspective underpins many of the questions that we currently ask about individual birds within populations, and also many of the questions we ask about birds across populations. I will illustrate how this perspective has led to increased 7understanding of the behavior of birds in natural populations, and also how it has suggested new approaches to some old questions. Finally, I will discuss some challenges for the future development of this field.

Postma E

Predicting breeding values for natural bird populations, and how this can help us to understand their evolution

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Evolutionary biology tries to understand how variation has arisen among individuals, among groups of individuals, and across time, and how it is maintained. This requires separation of phenotypic variation into its underlying environmental and genetic components. Recently, the application of mixed model methodology in combination with a so-called 'animal model' has been used to estimate quantitative genetic parameters in a number of bird populations with known pedigrees. Animal model methodology has proved a powerful tool for separating phenotypic values into their genetic and environmental components for free-living birds as well as mammals, all in a non-experimental setting. Not only has this allowed sophisticated analyses of selection, but also enabled powerful tests of evolutionary change and differentiation. Since I believe that a basic understanding of the theory is essential for correct application of the methods and interpretation of results, I first provide a brief theoretical introduction to the rationale behind the prediction of breeding values, and then describe the possibilities offered by breeding values for those interested in the evolution of natural bird populations, illustrating the possibilities with a number of recent examples from my own work and others. Guidelines will also be presented that I believe are essential for formulating questions in studies using predicted breeding values; and the possibilities for future research will be discussed.

Jensen H[1], Steinsland I[2], Ringsby TH[1], Sæther B-E[1]

Indirect selection as a constraint on the evolution of sexual ornaments and other morphological traits in the House Sparrow

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Estimating the potential of populations to respond to selection is important for understanding evolutionary processes. There is often, however, a discrepancy between the expected and observed response. We examined some of the factors that may constrain evolutionary response to selection in a sexual ornament and in other morphological traits using a long-term data-set from a House Sparrow (*Passer domesticus*) metapopulation in northern Norway. We first estimated the patterns of selection on the morphological traits. Secondly, we examined whether the traits possessed any significant genetic variance, and estimated the genetic correlation matrices both within and across sexes to find out whether constraints on evolutionary change were incurred. We then used these estimates to predict evolutionary change in each trait across generations. Our analyses showed that there were differences between the sexes in the strength of selection on some morphological traits. Furthermore, all traits were heritable, but the heritability of the sexual ornament was somewhat smaller than for other traits. The size and sign of some genetic correlations between morphology and the sexual ornament were also different for males and females. These results suggest that adaptive evolution in each sex may be constrained by selection acting in the other sex. Consequently, to predict correctly the evolutionary change across generations, it seems that not only selection acting on phenotypically and genetically correlated traits within sexes, but also across sexes, need to be taken into account. We urge that future studies of evolution in natural populations strive to accomplish this.

Brommer J

Additive and environmental components of fitness in wild bird populations

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Proper knowledge of the components of variation in individual fitness is important for understanding both population and evolutionary dynamics. Environmental and demographic stochasticity substantially reduce population growth, and thus need to be quantified for a proper forecasting of future population sizes and evaluation of extinction risk. Likewise, evolutionary dynamics depend on the presence of additive genetic variance in fitness and the principle that a trait will evolve only if its additive genetic component covaries with the additive component of fitness. Applying animal model methodology, I partition the variance in estimates of individual fitness from a number of long-term data sets for wild bird populations into additive *vs*. various environmental components. My approach is to understand estimates of individual fitness at the correct level, i.e. on an annual *vs*. per-generation basis, with respect to the level on which the strongest environmental effects operate. I show how the animal-model approach provides important insights into how individual fitness should be quantified.

Quinn JL[1], Charmantier A[1], Garant D[2], Sheldon B[1]

Data depth and its influence on quantitative genetic estimation in two contrasting bird populations

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There is increasing interest in applying pedigree-based methods of quantitative genetic estimation to wild populations to test hypotheses about evolutionary dynamics, where phenotypic data is mapped onto pedigrees gathered as part of long-term population and ecological studies. In many cases, phenotypic data may have been collected only for recent parts of the study: how does this influence the performance of the models used to analyse these data? Here we test how data depth and completeness influence estimates of genetic variance and covariance within the context of an existing pedigree. Using long term datasets from two bird species with contrasting life histories, the Great Tit (*Parus major*) and the Mute Swan (*Cygnus olor*), we examined the effect of manipulating the amount of data included on h2 for two phenotypic traits, adult body mass and clutch size, and compared the performance of REML methods versus parent-offspring regression. Manipulating data depth and completeness did not influence estimates of either genetic variance, covariance or breeding value, but, as expected, it did influence confidence in these estimates. In addition, REML techniques generated smaller estimates, with smaller confidence intervals than did parent-offspring regression. Our analyses suggest the ‘rule of thumb’ that data from three years and from an absolute minimum of 100 individuals per year are needed to estimate genetic variances and covariances with acceptable confidence, and that using pedigree data is worthwhile, even if phenotypes are only available toward the tips of the pedigree.

S46: Brains and birdsong

Conveners: Erich Jarvis, USA; Constance Scharff, Germany

Scharff C[1], Liczerski P[2], Georgi B[1], Osten P[2], Haesler S[1]

A role for the speech gene FoxP2 in songbirds

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The FoxP2 gene is essential for developing full articulatory power for human language. Genetic aberrations of FoxP2 cause developmental verbal dyspraxia, characterized by impaired sequential mouth movements often accompanied by expressive and receptive language deficits. Brain imaging studies of FoxP2 patients show the basal ganglia as a key affected region in the brain. As speech acquisition bears many parallels to song learning in songbirds, songbirds provide a good model for investigating the neural mechanisms of auditory-guided, imitative learning, including speech and its pathologies. We have shown that the FoxP2 protein in songbirds is very similar to mammalian FoxP2, suggesting functional conservation. We also found that the FoxP2 expression pattern in the songbird brain is analogous to that in rodents and humans, with strong expression in the basal ganglia, thalamus and cerebellum. Within the striatal song nucleus Area X, which is required for learning, FoxP2 expression increased during times of song plasticity, both in adult canaries (*Serinus canaria*) and in juvenal Zebra Finches (*Taeniopygia guttata*). To test for a causal relationship between FoxP2 expression and song learning, we injected a lentivirus targeting FoxP2 by RNAi into Area X before the song learning period in young Zebra Finches. Injected juvenals were tutored by adult males. At 90 days, we assessed targeting of the virus and quantified FoxP2 mRNA levels in Area X. Analysis of adult song showed that FoxP2 knockdown Zebra Finches had copied tutor song both incompletely and inaccurately. The variability in singing the motif from rendition to rendition was also increased in knockdown birds. Together, these data show that song learning cannot occur normally in Zebra Finches with lower than physiological FoxP2 levels. Clearly, in FoxP2 patients with speech deficits, the role of FoxP2 not only in brain development but also in brain function during language acquisition needs to be considered.

Okanoya K

Neural, behavioral, and functional correlates of multi-branch song syntax in Bengalese Finches

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The Bengalese Finch (*Lonchura striata* var. *domestica*) is a strain of the White-rumped Munia (*Lonchura striata*) that has been domesticated in Japan for more than 240 years. Comparing their song syntax to that of their wild ancestors, we found that it has highly complex, conspicuous songs with finite-state syntax whereas its wild ancestor sings stereotyped linear songs. To examine the functional utility of song complexity, we compared serum levels of estradiol and measured the amount of nesting materials carried into the nest by female birds that were stimulated with either the complex "domesticated" song or the simple wild-type song. In the females stimulated with complex songs, estradiol levels were significantly higher and the amount of nesting material carried was significantly greater. We also performed a phono-taxis experiment in which females selected complex song syntax over simple syntax. We then performed brain lesions in the song system to identify the neural substrates responsible for the differences in song behavior. In Bengalese Finches, lesions of NIf, a higher order song control nucleus, resulted in simplification of complex song syntax to the wild-type. Partial lesions of basal ganglia also exaggerated note-repetition, a characteristic of domestic Bengalese Finch songs. Electro-physiological recordings from the song nucleus HVC indicated that neural selectivity for song note combinations were related to song complexity. Based on these data, we hypothesize that mutations in the song control nuclei enabled complex song syntax and became fixed in domesticated Bengalese Finches through a process of indirect sexual selection.

Voigt C, Gahr M

Sex and social status affect the morphology of the song control system in cooperatively breeding White-browed Sparrow Weavers

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Cooperatively breeding birds present an interesting model for investigating the neuroendocrine mechanisms underlying behavior because they have phenoypes that are alternative to male and female, i.e., subordinates which might differ in behavior patterns from dominants. Studies exploring the neural basis of behavioral polymorphism, however, have so far been conducted mainly on fish. White-browed Sparrow Weavers (*Plocepasser mahali*) live year-round in eastern and southern Africa in small groups consisting of a dominant breeding pair, and subordinate, non-breeding males and females. This species possesses an elaborate vocal communication system: solo songs are produced exclusively by the dominant male, duet songs are produced mainly by the dominant pair, and chorus songs, similar in syllable structure and temporal pattern to duet songs, are produced by all group members. We studied song behavior in males and females in a population in Zimbabwe in relation to the neuroanatomical characterization of the song control system in the brain. Sex differences in song production among dominant individuals were paralleled by sex differences in the size of the song control nuclei HVC and RA. Further, males that differed in social status and therefore in song pattern differed also in the size and cytochemical properties of the song nuclei. These results suggest that the transition from subordinate to dominant status induces differentiation in the vocal control system in adulthood. This would be the first evidence for socially induced brain differentiation in adult higher vertebrates.

Salwiczek LH

Is singing proficiency limited by functional morphology or brain size?

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Any biological trait will evolve under the influence of a variety of selective forces, which often act in opposition, a phenomenon especially important in vocal communication systems. Research on the functional morphology and evolution of song in birds has typically targeted syringeal morphology, leaving cranial structure as the province of feeding studies. Recent work has nevertheless demonstrated that changes in beak gape are correlated closely with the acoustic frequency of sound produced. Sound modification by opening and closing the beak suggests a limiting constraint on vocal skills by body morphology (beak size, jaw mechanics, increasing inertial forces), especially when syllables are produced quickly as in trills and rapid frequency modulations. Further physiological constraints on the temporal complexity of song are imposed by respiratory demands, as increasing body size almost certainly limits the maximum trill rate possible. The song of the canary (*Serinus canaria*) comprises sequences of one syllable repeated rapidly, called tours; and joined tours form song types. House Sparrows (*Passer domesticus*) in my study imitated canary tours, but were unable to acieve the length or temporal complexity of canary song. I show that differences in body structure rather than neuronal or syringeal properties limit the extent to which canary tours and song types can be copied by sparrows.

Ball GF

Neuroendocrine control of seasonal plasticity in the song control system: Androgen action in relation to photoperiod, social context and behavioral activity

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In many seasonally breeding songbirds, the volumes of forebrain nuclei that control song behavior, such as HVC, area X and the robust nucleus of the arcopallium (RA), have been found to be substantially larger in spring than in autumn. Such variation in brain area volume is often correlated positively with variation in song behavior and concentrations of plasma testosterone (T). Studies in several species have demonstrated that T exerts powerful effects on several cellular processes that enhance song nucleus volume. Dissociations among high concentrations of T, enlarged song nuclei and high rates of singing behavior have, however, been observed. For example, some field and laboratory studies have found that increases in song nucleus volume can occur well before maximal recrudescence of the testes and the correlated highest concentrations of T. Studies with castrated birds have also identified photoperiodic stimulation of song nucleus volume in the absence of maximal T concentrations. The social context experienced by male songbirds, such as the presence of another male or a female, can enhance or inhibit brain plasticity, in some cases apparently independently of T. These findings raise important questions about the natural regulation of neuroplasticity in the song system. Factors other than testosterone can stimulate genes and proteins down-stream of the transcriptional action of steroids, and induce the same cellular result as T itself. One way in which T enhances the volume of the song nucleus HVC is via the upregulation of a neurotrophin: brain-derived neurotrophic factor (BDNF). Thus any stimulus of BDNF could potentially enhance song nucleus volume. Social context also modulates song-induced gene expression in song nuclei via the action of catecholamine pathways. Both BDNF and catecholamine action can be modulated by environmental factors independently of T. These findings stress the importance of studying brain plasticity in its natural context.

S47: How do birds sense the earth's magnetic field? Magnetoreception mechanisms in birds

Conveners: Henrik Mouritsen, Germany; Thorsten Ritz, USA

Ritz T

Navigation with a map and a magnetic compass – what sailors can learn from birds

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More than a thousand years of maritime history have demonstrated the usefulness as well as the pitfalls of using magnets and compasses for navigation. Birds face some of the same challenges on their migratory routes. For example, a compass needle is easy to read when stationary, but difficult to read when it is moving as on a ship or during a bird's flight. On evolutionary timescales, additional challenges like the reversal of the geomagnetic field arise. Recent studies suggest that birds have developed several magnetic sensory systems that may be well suited to overcome these challenges by exploiting physics and engineering principles. I will briefly review the better documented magnetic sensory capabilities of birds and then present the recently gained knowledge into the mechanisms underlying avian magnetic sensing. Particular emphasis will be placed on the magnetic compass of birds that appears to be based on an indirect effect on the visual system of birds. Finally, I will provide suggestions for the road towards the identification of the elusive magnetoreceptors in birds.

Mouritsen H

The magnetic sense(s) of birds: recent molecular and physiological evidence

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Since the last IOC, a lot of new molecular and physiological evidence related to how birds are able to sense the Earth's magnetic field have been published. In my keynote address, I will review this evidence. New evidence supports the idea that many birds seem to have two magnetodetection senses, one based on magnetite near the beak and one based on light-dependent radical-pair processes in the bird's eye(s). Among the most exciting recent molecular and physiological findings are: (1) Occurrence of putative magnetosensory molecules, the cryptochromes, in the eyes of migratory birds. (2) The finding that these molecules are located in cells showing high levels of neuronal activity during magnetic orientation. (3) Detection of a brain area integrating specialized visual input at night in night-migratory songbirds. (4) A putative magnetosensory cluster of magnetite in the upper beak. I will also briefly discuss the implications of recent behavioral results on the various suggested underlying molecular and physiological mechanisms.

Liedvogel M

Cryptochromes and magnetoreception in migratory songbirds

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Although migratory birds use a magnetic compass for orientation during their migratory journeys over thousands of kilometres, it is as yet unclear how they sense direction from the earth's magnetic field. Over the last two decades, two mechanisms of magnetoreception have been suggested as potential explanations, one based on magnetite particles and the other on photoreceptors forming radical-pair intermediates by photo excitation. Behavioral evidence and theory suggest that birds perceive the direction of the magnetic field by specialized retinal photo pigments, which require light from the blue-green part of the spectrum. Radical-pair processes in differently oriented, light sensitive molecules in the retina could potentially enable migratory birds to perceive the magnetic field as a visual pattern. The cryptochromes (CRY), with an absorption spectrum of 300-500 nm, have been suggested as the most likely candidate class of molecules. But are there cryptochromes in the retina of migratory birds? Here I show that at least one member of the cryptochrome family is present in the retina of migratory Garden Warblers (*Sylvia borin*). I also found that gwCRY1 is concentrated in specific cell types, particularly in those ganglion cells that are large and displaced, and which significantly also showed high levels of neuronal activity at night when my Garden Warblers performed magnetic orientation. In addition, there seem to be striking differences in CRY1 expression between migratory and non-migratory songbirds at night. To further characterize the candidate class of primary receptor molecules, I used the retinal cDNA of garden warblers as a template for amplifying cryptochromes expressed in the eyes of night-migrating songbirds, and then sequencing and identifying the independent PCR products in this multigene family.

Kavokin K[1], Bojarinova J[2]

How does the bird's magnetic compass work?

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Much experimental evidence has been accumulated in support of the hypothesis that the ability of birds to use the geomagnetic field for orientation depends on illumination, and that the magnetic sensor is situated in the eye. Yet the underlying physics remains unclear. Due to the weakness of the earth's magnetic field, the effects involving equilibrium (thermal) magnetization should be ruled out. We therefore have to consider the class of phenomena caused by the influence of the magnetic field on non-equilibrium electronic states created by light absorption. One possibility is magnetic field-dependent chemical reaction involving, as an intermediate state, a radical pair in a certain electron spin configuration (Ritz et al., Biophys.J. 78 (2000) 707). But, as no such reaction is known to phototransduce, this explanation does not seem convincing. Another explanation makes use of the fact that the electric field of light waves is a vector. This property allows selective excitation of electronic states with a particular direction of dipole moment that, ultimately, creates non-equilibrium magnetization or polarization of the medium. Such non-equilibrium polarization is easily affected by magnetic fields, and for this reason it is used to create extremely sensitive magnetometers. This wide group of phenomena is known generally as optical pumping (Kastler, Science 158 (1967) 214). Unfortunately, the term "optical pumping" in the ornithological literature has become associated with an obscure paper by Leask in 1977 who erroneously stated that radio-frequency radiation should be involved in the process. Here, we show that the rich structure of the avian retina, with many types of photopigments, oil drops containing organic dyes, and sensitivity to polarization, provides various ways by which optical pumping can induce magnetic sensitivity in the eye of a bird.

Fleissner G[1], Stahl B[1], Fleissner G[1], Falkenberg G[2]

Magnetite nanoparticles alone are not able to explain ironmineral-based magnetoreception in birds

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Ultrastructural and biophysical investigations of a putative magnetoreceptor in the upper beak of homing pigeons have revealed two types of iron-minerals that both seem to be involved in the primary transduction processes. So far, magnetite nanomagnets assembled in tiny clusters that are attached to the cell membrane have been assumed to respond mechanically to changes of the magnetic field vector. This would activate strain- or stress-sensitive membrane channels. Model experiments with ferrofluids and calculation of the magneto-mechanical properties, however, have clearly shown a gap between the field-sensitivity for this concept and the observed sensitivity in behavioral and electrophysiological experiments. Another unsolved question is the magnetic stability of the magnetite particles found due to their small size of 2-4 nm. They should be superparamagnetic at room temperature and thus insensitive to the Earth's magnetic field. Therefore we have looked for a more sophisticated magnetic concept in accordance with the peculiarities of the Fe-containing structures in the beak. Most intriguing is the size, shape and arrangement of Fe-based platelets. Magnetic considerations support the possible role as flux concentrators when chains of these platelets are in parallel to Earth's magnetic field, possibly increasing the local field strength by up to 4 log units. In this strong field and fieldgradient nanomagnets like those found in the magnetite clusters could be pulled into the region of high flux and thus could exert a pull vertical to the cell membrane at multiple sites. As the dendrites are arranged in distinct spatial directions in well-defined areas in the beak skin, the enhancement concept allows for a biological Gaussmeter of high sensitivity, selectivity and maximized signal-to-noise-ratio. Our contribution will outline the consistency between the complex biological structures found and fundamental magnetic concepts for Fe-based nano- and microstructures.

S48: Special symposium honouring Ebo Gwinner

Conveners: Michaela Hau, USA; John Wingfield, USA; Hubert Schwabl USA

Daan S

Circadian timing in birds: Gwinner's legacy

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Eberhard Gwinner's contributions to chronobiology will be best remembered by his demonstration of endogenous circannual rhythms and by his life long effort to unravel their functions and mechanisms. This undertaking also led him to highly original functional approaches to avian circadian systems involved in the measurement of daylength. In this presentation I focus upon three of the seminal topics in circadian timing advanced by Gwinner: (1) Circadian entrainment by zeitgebers other than light; (2) Melatonin and the resonance model of circadian function; (3) The role of a memory for daylength in photoperiodic time measurement. These topics remain at the forefront of current research in circadian rhythms at large, and recent progress highlights the significant role of avian studies in this field.

Kumar V, Rani S

Possible interaction of circannual rhythms and photoperiodism in regulation of seasonal breeding in birds

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Seasonality in birds, represented by the initiation-termination-reinitiation of a physiological process, appears to be regulated by two mechanisms: circannual rhythm and photoperiodism. A self-sustained endogenous clock (circannual clock), generating rhythmicity of ca. 1-year, permits anticipation of the appropriate time of the year for physiological processes by timing the onset of seasonal transitions in reproduction. The actual physiological processes in many species, such as gonadal growth, are triggered by changes in day length, photoperiodism, which is mediated by circadian photoperiodic rhythm. Implicit in the above concept is that both mechanisms are not be mutually exclusive and, in fact, might interact closely, albeit adaptively. We have examined this possibility in a series of experiments on two strongly photoperiodic species of emberizids, the Black-headed Bunting (*Emberiza melanocephala*) and Red-headed Bunting (*Emberiza bruniceps*), which are palearctic-Indian migrants and in which the involvement of photoperiodic circadian rhythm is well established. When buntings maintained on non-inductive short photoperiods (8L:16D) were subjected each month to long photoperiods (16L:8D), the magnitude of testicular response was found to be influenced by the time of the year. Further, a comparison of photoperiodic induction of buntings that were held captives for 1 or 2 years at 27^{o}N with those freshly arrived from breeding grounds at ~40^{o}N revealed that exposure to changing photoperiods during migration, and long photoperiods at breeding grounds, were not critical for subsequent cycles. When considered together with other findings, it appears that the regulatory mechanisms generating circannual rhythm and photoperiodism are mutually inclusive; and that photoperiodism is a dominant mechanism in such species as buntings which experience high-amplitude photoperiodic cycles in nature.

Bairlein F

Photoperiod and migratory fattening

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Many migratory species accumulate large amounts of fat prior to migratory flights. Migratory fattening is endogenously controlled, and initiation and termination occur even under constant laboratory conditions without changing environmental cues. Photoperiod synchronizes the innate circannual rhythm with the environment. In wild birds during autumn migration, late migrating birds of many species are heavier and fatter than early migrating individuals of the same species at the same site. That difference could be shaped by photoperiod. Thus we conducted experiments with young Garden Warblers (*Sylvia borin*) and Eurasian Reed Warblers (*Acrocephalus scirpaceus*) in captivity during the period of autumn migration. All birds were kept under controlled laboratory conditions, first in long days (LD 14:10) and then split, either into a long day group of both species under the same (control) conditions, or two short day groups, one for Garden Warblers (LD 12:12), the other for Reed Warblers (LD 10:14). In both species, migratory fattening accelerated significantly in short day groups, and both species reached significantly higher maximum body mass in short than in long days. Short days may signal delayed departure times, thus stimulating accelerated body mass gain in order to compensate for late departure. Higher departure fuel loads enable longer flights and skipping intermediate stopovers, and consequently increase the overall speed of migration.

Yohannes E[1], Gwinner H[1], Lee R[2], Schwabl H[2]

What's special about the first and last eggs of Eurasian Starlings?

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Egg quality and hormonal maternal contributions to eggs, including steroid hormones, vary among females and influence development and fitness of offspring. We investigated such maternal effects in two breeding populations of migratory European Starlings (*Sturnus vulgaris*) in southern Germany. We report population differences in measures of egg quality such as egg, yolk, albumin, and shell mass and concentrations of yolk androgens in relation to the food quality of the breeding grounds. In the population in which females produced higher quality eggs (meadow habitat) yolk testosterone concentrations increased with laying order of the eggs while such an increase was absent in the population in which females produced lower quality eggs (agricultural habitat). Moreover, monogamously but not polygamously mated females showed increased yolk androgen concentrations with laying order. Nestling mass was positively correlated with yolk testosterone concentrations suggesting that yolk androgens enhance nestling development. Stable isotope ratios in yolks suggest production of the eggs in a clutch from different sources and effects of habitat quality on maternal effects.

Contributed Orals

O01: Foraging behavior and diet

Molokwu MN[1], Olsson O[2], Ottosson U[1]

Seasonal variation in patch use by granivorous birds in a tropical African environment

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We used behavioral indicators to establish differences in macro- and micro- habitat use among four granivorous passerines that coexist in a rural savanna in central Nigeria. We tracked the birds throughout the year and measured the density of food left in artificial food patches after they had foraged there. This measure, a 'giving-up density' (GUD), was assessed in three different habitats of varying degrees of forest cover and humidity. In each habitat, we placed food patches in both open areas and under cover to investigate possible effects from risk of predation and thermal hazard on behavior. We then compared differences in GUDs and the peck rates of foraging birds among habitats. We also investigated the effects of water, temperature and environmentally-influenced seasonal change on food abundance. In more open parts of the savanna, GUDs were lower and pecking rates higher in the dry season than in other habitats. An initial decline in GUDs in the dry season was followed by a steady increase during and after rains, which coincided with the seasonal change in availability of local seed. GUDs were reduced in habitats where water was more plentiful, although the seasonal increase in food during the rainy season leveled out this effect. Understanding spatial and temporal variation in foraging behavior is important for sketching out the ecology and life-history decisions in African woodland birds.

Herrera M[1], Luis G[1], Hobson KA[2], Hernández P[1], Rodríguez M[1]

Differential responses in rainforest birds to fruit abundance, based on long-term isotopic monitoring

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Most tropical passerines feed on insects, fruits or a combination of them; and the sugary pulp of fruit has less protein than insects. To quantify the relative amounts of protein assimilated from animal and plant sources in tropical rainforest birds, we used stable-nitrogen isotope analysis (d15N) of blood from two species that regularly eat fruit and insects: the Red-throated Ant Tanager (*Habia fuscicauda*) and the Ochre-bellied Flycatcher (*Mionectes oleagineus*). Because the abundance of fruit and insects varies seasonally in the tropics, the study was conducted over one year at Los Tuxtlas, Mexico, a site where there is a major peak of fruiting in April-July, a secondary peak in September-October, and heightened abundance in many insects between May and August. Both ant tanagers and flycatchers relied heavily on insect protein when fruits were more scarce, and then steadily increased the intake of fruit protein as fruit abundance increased. The ant tanagers relied almost entirely on fruit protein during the major peak of fruiting, whereas the flycatchers focused more on fruit protein over the secondary peak. Both species bred in June-August, when most incubating individuals relied on a mixture of insects and fruit for their diet. Fecal contents revealed that both species ingested the largest number of fruiting species during the major peak of fruiting peak.

Gauthier G[1], Hobson K[2], Bêty J[3]

Diet change inferred from stable-isotopes in spring-staging Greater Snow Geese

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Spring-staging enables many arctic-nesting birds to accumulate nutrient reserves essential to cover the energetic cost of migrating to the Arctic as well as some of the cost of reproduction. Changes in diet or habitat use due to natural variation in food availability or human-induced perturbation can have an impact on nutrient storage during staging, but they are difficult to measure. We used stable-isotopes to infer diet change in Greater Snow Geese (*Chen caerulescens atlantica*) staging in southern Quebec, Canada, in spring. Over a 3-year period, we collected 111 geese in 3 different areas of Quebec at the end of staging (Lac-St-Pierre, LSP; Upper estuary, UEST; and Lower estuary, LEST), together with samples of major food plants at each site. We determined the 13-C and 15-N content of plants and of abdominal fat, breast muscle and liver of the geese, and then used the isotopic signatures of goose tissues to infer diet change. We also measured diet using isotope mixing models and assessed the timing of diet switch by comparing the isotopic signatures of storage tissues (fat and muscles) and liver. We found that the diet of geese staging at LSP was dominated by waste corn in farmlands, though with considerable variation among years. At UEST and LEST, the diet of geese comprised a mixture of natural plants from tidal marshes and young shoots of grass in hayfields. The main marsh plant available at LEST (*Spartina*) is known to be of much lower nutritive value than that at UEST (*Scirpus*), and thus we expected that feeding in hayfields would be more important at the former site. This was true in one year but not in another. Disturbance due to implementation of a new spring hunt on the farmlands may have forced the geese to rely more heavily on the low quality *Spartina* in the latter year. We conclude that stable-isotopes can provide an accurate assessment of diet change in spring- staging geese.

Le Corre M[1], Jaquemet S[1], Kojadinovic J[1], Bustamante P[2], Cherel Y[3]

Geographic variation in the trophic ecology of a tropical seabird, the Sooty Tern: a multidisciplinary approach using diet analysis, stable isotope ratios and heavy metal levels

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Although tropical seabirds forage over oceanic habitats comparatively poor in food and rely on unpredictable prey patches, their populations that breed on remote oceanic islands can reach thousands or even millions of birds. This paradox suggests that tropical species have developed specific and efficient foraging strategies to cope with a paucity of resources. The pantropical Sooty Tern (*Sterna fuscata*) is the most abundant tropical tern and one of the most abundant seabirds in the world. Its some 80 million pairs world-wide consume 3.3 million tons of biomass annually, ranking the species fourth in a recent calculation of the annual quantity of food consumed by seabirds globally (Brooke 2004). In the western Indian Ocean, 6.2 million pairs of Sooty Terns breed on diverse islets and forage over very different marine habitats; they are thus excellent indicator populations for investigating geographic variation in trophic ecology in a top marine predator. In this paper we present results from a multidisciplinary study of Sooty Tern trophic ecology in four well-separated colonies in the western Indian Ocean, using three complementary methods: classical food sample analysis, stable isotope ratios of C and N, and bioaccumulation of heavy metals. Our results demonstrate great plasticity in trophic ecology, notably in main prey items, prey size and trophic levels, which may explain the success of this species throughout the tropics. Geographic variation in diet, dC, dN and heavy metal levels are analyzed simultaneously and discussed against geographic variation in the marine environment.

Weimerskirch H[1], Lecorre M.[2]

Foraging behavior and environmental conditions in seabirds

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Since environmental productivity and structure vary extensively among marine biomes, specific morphological and behavioral adaptations for foraging should exist among contrasted environments. We compare the morphological and foraging strategies of seabirds in two contrasted environments, tropical waters where productivity is low and the environment less structured, and sub-polar region where productivity is higher and enhanced in specific zones such as fronts or shelf edges. We use telemetry data (Argos, GPS tracking systems, accelerometers, activity recorders) to study the foraging strategy of a series of sub-Antarctic and tropical seabirds species covering petrels, albatrosses, frigatebirds, sulids, tropicbirds, penguins and terns. We also examine how seabirds respond to the environment at a range of spatial scales, and test some entrenched hypotheses about the way animals should adjust their search effort in the two contrasted environments.

O02: Parental care

Boos M[1], Carriere A[1], Robin J-P[1], Arnauduc J-P[2], Petit O[1]

How is serum prolactin level linked to posthatch parental care behavior in a precocial bird, the Mallard?

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Parental care is a key component of reproductive success during incubation and when risks of nestling mortality are high because of predation or need for food. It is a behavior controlled by prolactin release during incubation in precocial and altricial birds. The link between care and hormone persists in altricial parents after hatching, but has never been studied in depth in precocial species during rearing. Our study was performed from early April to mid June on the precocial Mallard (*Anas platyrhynchos*), using eight ducks which had hatched ducklings in outdoor closed aviaries. Food and water were provided *ad libitum* and ravens (*Corvus corax*), potential predators of young, were in evidence. Over 9 posthatch weeks, blood was sampled from the ducks every 3/4 days, and the behavior of hens and ducklings recorded daily on other days by the focal animal sampling method. Contact between ducks and their ducklings, and the leadership and creching of ducklings, decreased through time ($p>0.05$); and sleeping and preening by the ducks, together with aggressive and avoidance behavior toward young. increased ($p>0.05$). Serum prolactin concentration remained at high levels during the four first weeks posthatch (40 ± 10 to 47 ± 2 ng/ml), followed by a decline below 26 ± 5 ng/ml after the 6th week. At that time, young had grown to more than 80-90% of the body mass of the ducks. From a Principal Component Analysis of 7 behaviors that changed significantly over the period of rearing, we extracted a so-called parental care variable that we then regressed against prolactin levels. The regression revealed that prolactin levels explained 80% of the variation in posthatch parental care in this precocial species. Further research should now focus on factors governing concomitant declines in prolactin and parental care, not only photoperiodic response and duckling mass, but also interactions with molt.

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Maternal yolk hormones adjust chicks to the post-hatching social environment - inter-nest competition in the semi-precocial Black-headed Gull

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Avian eggs contain considerable amounts of maternal androgen which influence the physiology and behavior of the hatchling. These findings, and marked within-clutch variation in yolk androgens, have been interpreted as a mechanism for maternal mediation of sibling competition within the brood. However, unlike intra-clutch variation, the adaptive significance of inter-clutch competitiveness, which is often variably greater, has been little studied. Here we tested whether high levels of yolk androgen, deposited across clutches as a consequence of enhanced social stimulation in breeding colonies of high density, adjusted offspring to the post-hatching social environment. Accordingly, we manipulated yolk androgen concentrations in the eggs of colonially-breeding Black-headed Gulls (*Larus ridibundus*) to investigate, by observations of behavior, the role of androgens in between-nest contexts. In this semi-precocial species, chicks participate in defending the natal territory and food against intruding adults and chicks from other nests soon after hatching. We found that chicks hatched from androgen-treated eggs were more involved in territorial defense and tended to show more kleptoparasitic behavior. This increase in aggressive behavior in between-nest broods was not matched by an increase in sibling aggression within broods. Higher levels of yolk androgen in species that breed colonially in high density may therefore play an important role in adjusting chick behavior to levels required for territorial interaction post-hatching.

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The duration of post-fledging parental care in the Barn Swallow: Relevance to fitness

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Most passerine birds continue to care for their young after fledging, an investment that probably has an important fitness component as juvenal mortality during the first week post-fledging is high. In multi-brooded species, the duration of post-fledging parental care may determine the success of subsequent clutches by affecting their timing. Investigations of the post-fledging stage are still rare, however, due to technical problems. Using radio-telemetry, we assessed the effect of the duration of post-fledging care on juvenal survival in Barn Swallows (*Hirundo rustica*) in a cross-fostering experiment that produced four groups of fledglings: those with (1) long post-fledging care, (2) short post-fledging care, (3) post-fledging care shortened compared to the brood of origin, (4) post-fledging care prolonged compared to the brood of origin. In total, 54 families with 225 fledglings were tracked for up to 50 days. Mortality peaked after family break-up, at 10-15 days post-fledging. The duration of parental care had a strong effect on juvenal survival: fledglings given long or prolonged post-fledging care were more likely to survive, and peak mortality rate decreased with increasing length of parental care. Behavioral observations revealed that post-fledging parental care indirectly reduced the risk of juvenal predation. Moreover, the experiment revealed an effect of origin. In groups (2) and (3) receiving short care, fledglings with shortened care (group 3) survived better than their foster siblings. In contrast, the opposite was observed in the two groups receiving long parental care. The results show that the duration of post-fledging parental care is an important reproductive trait, accounting for a large proportion of differential post-fledging survival. In such double-brooded species as the Barn Swallow, we assume a trade-off between prolonging the care of first brood fledglings and advancing the start of the second clutch.

Reynaud PA

Red-billed Hornbills select aromatic plants to provide an insect-free environment for nidification

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Between 1999 and 2004, we monitored the nidification of 51 pairs of Red-billed Hornbills (*Tockus erythrorhynchus*) in nest boxes on a reserve station in Senegal. 50% of the birds were infested by the tick (*Hyalomma marginatum rufipes*) when captured in the wild, but we found no infestation at all among the females and chicks in our nest boxes. To investigate the cause, we analyzed the composition of the litter in the boxes, and then removed or added some vegetal elements which were normally present. The presence of three aromatic plants - seeds of *Azadiracta indica* and leaves and bark of *Eucalyptus calmadulensis* and *Prosopis chilensis* - were found to be essential for optimum breeding success. All three plants constituted about 50% of the vegetal matter that the hornbills accumulated in nest boxes during breeding, the ratio between them depending on sequences of rain fall. The importance of the three plants as insect repellents is well known, but they are not native to Africa, having been introduced by man. In that short time, hornbills have learned the insect-repelling properties of these plants, and have adapted their behavior to choose them over indigenous plants as nest protection for offspring.

Ostreiher R

Parental care is affected by intra-sex competition among breeders in the Arabian Babbler

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Observations over eight seasons of nestling feeding in the cooperatively breeding Arabian Babbler (*Turdoides squamiceps*) suggest that parental investment is affected by the social composition of the group. In simple groups comprising a breeding pair and their offspring, both parents fed at the same rate. In polyandrous groups comprising a single female breeder and two or more breeding males (with or without helpers), each breeding male fed at a higher rate than the sole breeding female. In polygynous groups, each breeding female fed at a higher rate than the sole breeding male. And in eight polygamic groups (three polygynous and five polyandrous), one of the breeders was evicted by a breeder of the same sex during the period of nestling feeding. In all cases, the feeding rates of the rivals increased significantly immediately before eviction. After eviction, the winner reduced its feeding effort instead of increasing it, in reverse to expectations if the sole purpose of feeding was to provide food, in compensation. These observations support the suggestion that nestling feeding in cooperative breeders, besides its direct role in providing food to nestlings, is also used to establish rights of possession and improve social status within the group.

O03: Conservation: riparian and wetland

Finch D, Hawksworth D, Galloway J

Avian responses to exotic woody plants and their removal along a river in arid southwest USA

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The riparian forests of the Rio Grande, southwest USA, have become more susceptible to wildfire due to increased growth of salt cedar and other invasive plants, accumulation of woody debris, flood control and long-term drought. Dead and downed wood, and exotic Tamarisk (*Tamarix ramosissima*) and Russian Olive (*Elaeagnus angustifolia*), are fuels that lead to high fire risk along the middle Rio Grande. To identify effects of fuel removal on breeding bird populations and productivity, we quantified avian species richness, relative abundance and reproductive success at nine treatment and three control sites. Breeding birds were monitored during the pre- and post-treatment phases from 15 May through 15 July at all study sites. Point-count stations were placed at a density of 1 per 3 ha. The location of each point was recorded via GPS so that observers could return to exact count locations during the post-treatment phase. During each count, all birds seen or heard were recorded at each point for 8 minutes. Nest searches were conducted following point-count sessions, and nest contents were recorded and nests monitored every third day to determine nesting success. Our results demonstrate that responses in relative abundance to removal of fuels and exotic plants varied among bird species, guild, year, and treatment type. At the guild level, shrub-nesting and ground-nesting birds showed significant declines in relative abundance after removal of fuels and exotic plants, whereas cavity-nesting species increased. Prior to treatment, birds nesting in exotic plants produced as many young as those nesting in native plants. After treatment, few shrub and ground nests were found because the exotic shrub layer had been removed. This suggests that removal of exotic plants to reduce fuels and restore systems may reduce local productivity of shrub bird species.

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Partial extinction: The case of the globally threatened Aquatic Warbler

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The Aquatic Warbler (*Acrocephalus paludicola*) is the only globally threatened passerine in continental Europe and has declined by more than 95% during the 20th century. Since 1998, the BirdLife Aquatic Warbler Conservation Team (AWCT), as an assemblage of specialists working on this warbler, has undertaken intense interdisciplinary research to clarify the current status of the species. The warbler is a habitat specialist breeding in no more than 50 large sedge fens in central Europe and southwest Siberia. The surviving populations (14000-20000 males in total) have been systematically surveyed, accompanied by conservation measures at the key sites and studies on population genetics, breeding biology, diet, habitat needs and stable isotopes in feathers. The latter was carried out to identify winter molting areas, which are probably located in the sub-Saharan West Africa and could form an additional bottleneck. After extensive destruction of its breeding habitat during the 20th century, the present population is split into a large, currently stable or possibly recovering central European core in east Poland, Belarus and the Ukraine, a much smaller Hungarian population, a tiny, rapidly declining Pomeranian population in east Germany/northwest Poland, and a probably an even smaller west Siberian population on the verge of extinction. DNA and stable isotope studies have revealed that the endangered Pomeranian population is genetically isolated, with indications of increasing inbreeding depression; it also appears to have separate molting grounds to the north of those of the core population. It is also possible that the west Siberian population is experiencing the same fate, but this can not be proved due to the lack of information. We thus conclude that the species is losing a proportion of its genetic variability, including some migration and wintering traditions, and this we define as ‘partial extinction’.

Malan G, Panagos M, Meyer B

Rehabilitating riparian zones on a forestry estate: Grasslands versus woodlands for plants and birds?

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This study compared avian and plant diversity in plantation, infested, rehabilitated and pristine riparian ecosystems to review the potential outcomes of two different management practices. The study was conducted on a forestry estate in KwaZulu-Natal Province, South Africa, in circumstances where exotic conifer trees are removed from riparian zones. After the conifers are harvested, the 5-20 m wide weed-infested zones left behind are cleared of broadleaf woody plants, and the resulting grasslands, as rehabilitated zones, are managed as firebreaks. A vegetation assessment found that the conifer and infested zones were dominated by exotic forbs, the rehabilitated zones by indigenous grasses, and the pristine or control zones by indigenous trees, shrubs and grasses. Birds were sampled in these habitats with mist nets, and species caught adjacent to streams in plantations have been found associated with exotic conifer plantations, whereas those from the infested zones were associated with woodlands and indigenous forests. Bird species caught in the rehabilitated zones were associated equally with exotic plantations, woodlands and indigenous forests, water-associated habitats and grasslands, whereas birds from control sites were only associated with plantations and woodlands. Managing the rehabilitated riparian zones as grasslands thus introduced grassland- and water- associated birds not found in pristine ecosystems. If trees and shrubs are allowed to regenerate in some of the rehabilitated riparian zones, e.g. on narrow or steep sites, then tree-associated hole-nesting birds such as woodpeckers (*Dendropicos*) and barbets (*Stactolaema*) will be able to return to

the estate, thereby increasing biodiversity and raising the conservation value of the rehabilitation program.

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Integrating bird ecology with socio-economy for a sustainable wetland management

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Reedbeds are multi-uses wetlands. Grazing, reed harvesting, waterfowl hunting, and nature conservation projects are each associated with specific management practices that interact at several scales, with potentially long-term consequences on human uses and conservation issues. Although reedbeds support few animal species, they have a high heritage value due to the specificity and vulnerability of the species they enclose. Because the sustainability of reedbeds is not only a matter of ecosystem functioning but also of understanding the socio-economical context and interaction among uses, a 10-year scientific multidisciplinary programme on Mediterranean reedbeds was carried out at the Station Biologique de la Tour du Valat. A focal study site enclosing 2270 ha of reed marshes offering a wide gradient of environmental conditions and human activities was used to identify and test experimentally the requirements of the birds and users in terms of hydrological regime, vegetation structure and food resources. The best compromises between bird and human needs arising from scientific studies and negotiation processes were further integrated into a Water Management Plan and Agro-environmental measures for reed exploitation. Because management actions with short-term positive repercussions can potentially be detrimental to ecosystem functioning in the long term, we simulated the impacts of various water management scenarios and economic contexts on reedbed health and biodiversity through a multi-agent model which integrated the physical, biological and socio-economic data. A simpler version of this model is further used in a role playing game designed to promote public and student awareness about the conservation value of the reedbed habitat and its fauna, as well as to provide a companion modelling approach to support collective decision-making among stakeholders.

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Conservation of wetland birds in India

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A recent study on the inland wetlands of India has mapped, classified and prioritised these wetlands for conservation. A total of 655 wetlands were identified and surveyed for birds with the participation of a network of more than 500 persons from all over the country. The prioritisation of wetlands was done using birds as the criteria. Contamination of organochlorine pesticides and heavy metals was also assessed. Change in the wetland cover was broght out by comparing data of 1990 and 2001.Of the 325 species of birds occurring in the wetlands of India, 314 species were recorded during the study. Twenty six of the 37 threatened wetland dependent bird species and 12 of the 18 near threatened were recorded. Distribution of the threatened and near threatened birds shows the sensitivity of Indo-Gangetic plains, Brahmaputra Valley and Krishna, Godavary, Cauvery delta in terms of conservation of wetland birds. A total of 199 sites were identified for conservation with the highest priority and recommended to be declared as Ramsar Sites. The remaining 456 sites were of national and regional importance. All these wetlands may be brought under a National Network of Wetland Conservation Areas. A few critical areas may be fully protected while others could be used sustainably and managed with participation of the stakeholders. The two major issues in wetland conservation are huge loss of wetlands and contamination of the remaining ones. During the last ten years 38% of wetlands have been lost, which is because of the lake of awareness of their values and protection measures. All the wetlands showed contamination by heavy metals and pesticide residues, many with levels higher than safe limits suggested by statutory bodies for human consumption. Immediate attention is needed to prevent such polloutuion and to find out effective alternatives. An Action Plan is suggested for the conservation and sustainable use of the wetlands which would help in the survival of birds and human.

O04: Species diversity and conservation

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The mid-domain effect on the pattern of geographic species richness in Palearctic songbirds

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We tested a geometric constraint model, the mid-domain effect (MDE), as an explanation for spatial gradient in species richness of Palaearctic songbirds. A database was created of digitized equal area distribution maps of 3036 phylogenetic species of

Most time and energy spent by birds on migration are at stopovers, where there are many demands, principal among which is finding resources for refueling. Successful migration depends on this process. Here we used radio telemetry to investigate spatial behavior in the European Robin (*Erithacus rubecula*), a small short- to medium- distance nocturnal migrant, on the Courish Spit in the eastern Baltic during autumn and spring passage. We attached transmitters just after the birds landed, recorded their condition, released them around sunrise, and then followed them until migratory departure. Altogether, 20 birds were tagged in autumn 2004 and 13 in spring 2005. Stopover duration varied from 1 to 11 days; 55% of robins remained for only 1 day, behavior that was typical for fat individuals but also for occasional lean birds too. On the first day of stopover, robins moved from 135 to 1798 m from the site of release. Fat birds moved shorter distances than lean birds, and distance moved in spring was on average further than in autumn. Distance moved was also correlated positively with the number of robins present. Most robins moved off in an almost straight line after release, until they stopped in a small patch which they used until departure. Such movements took from 15 minutes to 12 hours. Some birds, nevertheless, moved about all day long or changed their ranges in the evening or on subsequent days. These data indicate that robins are rather flexible in spatial behavior. Individual territories were established temporarily mainly in deciduous or pine forest, but sometimes in partly open habitat during both seasons. We consider that such plasticity in spatial behavior and opportunistic use of habitat are adaptations to the diverse conditions at stopover sites during migration.

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Migrating Blackcaps use torpor during refueling at stopover in Eilat, Israel

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Lowering body temperature (T_b) below normothermic levels during the rest phase saves energy, and has been documented in several avian taxa. Among passerines, the phenomenon has been described in non-migrating, temperate zone species that, in winter, have to cope with severe weather and food shortage. Although small migrating birds could clearly benefit from such low energy consumption as torpor while refueling at stopovers, this behavior has only been described in hummingbirds. During the spring migration of 2005, we monitored skin temperature (T_{sk}), which closely approximates T_b, in six Blackcaps (*Sylvia atricapilla*) at a stopover site in Eilat, Israel, by radio-telemetry. After capture, birds were equipped with thermosensitive radio transmitters and kept in a large (16×10 ×2 m) outdoor flight cage with food *ad libitum* for 10 days before release. Forty-two bird-days of data were collected. During activity, Blackcaps maintained their T_{sk} at 41.13±1.23 °C. At night it dropped by some 6°C to an average of 35.26±2.22 °C for as long as 8 hours. This T_{sk} is significantly lower (by >3°C) than the mean normothermic rest-phase T_b reported for ~202 avian species. On average, minimum resting T_{sk} in the Blackcaps was 31.34±3.5°C, while in one individual it dropped to 26.77°C at an ambient temperature of 19°C. We tentatively conclude that resting Blackcaps refueling at stopover sites probably use torpor to conserve energy. Since torpor can lead to significant energy savings, its use may be a common phenomenon among small migrating passerines.

O06: Physiology- metabolism

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Sources of variation in basal metabolic rate in a wild passerine

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We studied the sources of variation in basal metabolic rate (BMR) among individuals from two wild populations i.e. Oulu (northern Finland) and Lund (southern Sweden), of Great Tit (*Parus major*) during six consecutive winters. Previous studies have shown that birds from these both populations are locally adapted to react differently to different environmental conditions. A multivariate approach was used to find which predictors (locality, date, year, day length, minimum temperature, age, sex, body size and body mass) explained best the variation in BMR. Birds from Oulu (n=165) appear to have a consistently higher BMR than Lund birds (n=126) even when controlling for date (-), day length (-), min. temp. (-), size (-), mass (+) and age (-), explaining altogether 63.87% of the variation. When birds from both populations were analyzed separately, BMR from Oulu birds were negatively affected by temperature and date but otherwise showed the same pattern as in Lund, with increasing BMR with mass and decreasing with size and age. To our knowledge this is the first study in a wild passerine, reporting an age-specific decline in BMR. Although previous research has shown that there may be consistent and intrinsically determined differences between populations, this study highlights the need to standardise BMR values when comparing measurements from wild individuals.

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Basal metabolic rates in tropical and temperate birds

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Many variables of the slow to fast life-history continuum have been linked to latitude and thus climate. Tropical and temperate zones represent climate extremes that have given rise to clear differences between physiological and behavioral life-history traits in bird species from the two zones. As part of an integrated, multidisciplinary project to compare reproductive variables, survival and physiological traits between tropical and temperate birds, we studied energy metabolism. Supposedly, tropical birds should have lower energetic demands in response to a less demanding environment, giving rise to lower basal metabolic rates (BMR) according to the idea that BMR reflects the input into the exercise and digestive machinery. We measured BMR, total evaporative water loss (TEWL), and body temperature (T_b) of tropical and temperate bird species. Phylogenetically closely-related tropical and temperate species pairs were selected to enable pair-wise comparisons. Most tropical birds were caught in lowland, secondary rainforest in Panama, and most temperate species in northeast USA. Our data will be compared with allometric relationships from the literature. Furthermore, variation in BMR will be linked to variation in habitat preference and life-styles, such as those defined by diet and foraging mode. The measurements of TEWL and T_b give insight into the underlying mechanisms producing variation in BMR.

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Energy metabolism and age in a long-lived seabird: No age-specific decrease in basal metabolic rate in the Snow Petrel

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The rate of living theory advocates that aging and lifespan are regulated by energy metabolism, and the free-radical theory provides a mechanism for how rates of energy metabolism cause aging. Birds deserve special attention because they have longer maximum life-span and less signs of aging than expected from their body size and rates of energy metabolism. In the light of evolutionary senescence theory, it has been proposed that birds may have specific adaptations for combating age-related cellular damage. Ideas about life-span, aging and energy metabolism are based mainly on comparisons between animal classes and on inter-specific studies. Intra-specific studies are clearly needed, especially within the Aves. We studied energy metabolism in relation to age in a long-lived seabird, the Snow Petrel (*Pagodroma nivea*). In a population that has been subject to a long-term research program, including annual banding of chicks since 1963, we measured basal metabolic rate (BMR) in 38 individuals ranging from 8 to 39 years old. We show that BMR does not decrease with increasing age, but seems to be sustained at a fixed level throughout life because, in Snow Petrels, the average age at first breeding is 10 years, close to our minimum age sample, while our oldest recaptured individual at 39 years old was probably very close to maximum life-span. To our knowledge, this is the first study to report intra-specific data on age and BMR from a seabird population. The results support the hypothesis that birds, and especially long-lived birds, possess specific adaptations for combating the causes of aging-related cellular damage. Long-lived seabirds thus may serve as particularly promising subjects in the search for the mechanisms that prevent senescence.

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The relationship between basal metabolism and body composition: A different view

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Several papers have linked basal metabolic rate (BMR) and body composition in such birds as long-distance migrants. Eared or Black-necked Grebes (*Podiceps nigricollis*) are migrating birds that undergo rapid seasonal fluctuations in body composition that are as massive and extreme as in any bird. We have examined BMR and body composition in these grebes as both stagers and migrants, and have found no linkage. We suggest that there may be another way to perceive relationships between BMR and body composition. Rather than being driven directly by the metabolic rate of its component organs and effectors, BMR may be set by another more integrative mechanism, which in turn influences the metabolic rate of the components. We recommend that future research attempt to assess both of these paradigms.

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Heart rate in migrating birds: effects of an increased body mass

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During migration, birds meet the challenge of high energetic costs of flight and, additionally, restricted food resources. This is probably the reason, why most species increase their body mass for up to 100% in preparation for migration. Body mass and energy expenditure during flight (EE) are strongly correlated. Thus, heavier birds fly at higher costs. As we know from wind tunnel studies, also within individuals changes in body mass are immediately reflected in flight costs. To understand the energetics of bird flight in more detail, we calibrated heart rate telemetry against the Doubly Labelled Water method in birds flying unrestrained for 6h under controlled conditions in the wind tunnel. First results show that heart rate (HR) is a very good predictor of EE. Individual birds flew repeatedly with natural differences in body mass: an increased mass not only results in higher flight costs, but also in an elevated HR. However, the energy equivalent (EE per heart stroke) does not seem to be constant but to increase with body mass. Within individual flights, the high time resolution of our HR measurements allows us to itemise different phases of prolonged flights. We will provide insight into detailed dynamics of heart rates both during the starting phase and during steady state flight. Furthermore, even changes in EE during longer flights can now be estimated: a continuous decrease in heart rate during flight can be attributed to losses in body mass. Based on our HR measurements, we will quantify the reductions in EE during simulated migratory flights.

O07: Population dynamics

Schwerdtfeger O

Migration and dispersal dynamics in the metapopulation of Tengmalm's Owl in central Europe

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In a study of population ecology in Tengmalm's Owl (*Aegolius funereus*) in the Harz mountains, Germany, the dispersal of adult owls and concomitant spatial and temporal changes were examined. Due to a lack of natural tree holes, nearly all breeding took place in 200 nest boxes spread uniformly about a study area of 200 km^2. Over 28 years, 750 broods have been monitored within the area. 85% of male and 95% of female breeding adults have also been captured, and their age determined according to species-specific part-molt of the wings. Only 20 percent of broods were reared by local recruits; breeding production derives largely from owls immigrating from other breeding areas up to 600 km away. Here sex-related differences are involved, the proportion of immigrating and emigrating owls being almost twice as high in females. Correspondingly, there were twice as many resident males. Lifetime reproduction is now known. Mortality rates could be estimated from representative spot checks of the age structure of the metapopulation. Of the many immigrant owls over years, most disappeared again after breeding, which was itself aumented by bigyny and biandry. The annual size and make-up of the breeding populations fluctuated markedly with the abundance of small mammals: species of *Microtus* and *Apodemus*; in the 10 peak years of the study, almost twice as many juveniles fledged than in the other 18 years. Fluctuation rates are compared with recaptures of ringed owls that shifted between other local populations, enabling calculation of a frequency distribution of migration distances; but such data are only available for females. These data indicate, nevertheless, that Tengmalm's Owl shifts its local populations variably and patchily through central Europe from year to year. It is a strategy that enables the owl to take optimal advantage of locally asynchronous population cycles in small mammals.

Arnold JM, Oswald S, Limmer B, Becker PH

The role of age and condition in predicting survival for a long-lived seabird: A mark-recapture analysis of the Common Tern

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Life history theory predicts that reproductive effort in long-lived species increases with age as a result of declining residual reproductive value, implying that older individuals should put more effort into current reproduction because they are less likely to survive for subsequent breeding. Although reproductive success in Common Terns (*Sterna hirundo*) is greater in older birds, experimental manipulations have failed to demonstrate increased reproductive effort with age, nor is there evidence of reduced survival probability in older birds. Recent work suggests instead that individual quality (state) may be more relevant than age in determining the allocation of reproductive effort, and ultimately reproductive success. The observed increase in reproductive success with age may, in fact, be an artifact of better survival in higher quality birds. Until recently, appropriate data were not available to investigate this phenomenon. Our study uses a 12-year data set that incorporates measurements of quality throughout the lifespan of individual birds derived from a transponder system. Annual mass is used as a proxy for quality, and is calculated for each individual using the mean of repeated measurements of mass from first arrival in the breeding colony to departure in late summer. Using mark-recapture models, we demonstrate increased survival in higher quality Common Terns and suggest that selection for quality is responsible for the greater reproductive success found in older birds. We also use mark-recapture models to investigate the roles of age, condition, and gender on breeding propensity. Our results support a state-based paradigm in life history theory for the Common Tern.

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Population structure of the Oriental Reed Warbler in the Russian Far East

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The social organization, reproductive behavior and ecology of the Oriental Reed Warbler (*Acrocephalus orientalis*) were investigated near Nahodka in the Russian Far East by means of individual marking and ringing in 2001 - 2005. Reed warblers there occur in upland habitats along forest edge and irrigation channels, and breed in small patches of reeds normally mixed with tall herbaceous vegetation. Data on their population dynamics, site tenacity and reproductive success are presented. Males sing most frequently while sitting within the canopy of high trees surrounding the reed beds, but females nest mainly below in the reeds. The population has a rather diffuse structure due to low density of birds and dispersion of habitat. Local clusters that included the territories of 3-4 males were found in more suitable sites. The percentage of polygynous males in 2004 was 30% (n=30) and in 2005 29% (n=31). Most polygynous males had two breeding females in their territories, but 33% and 29% had three females in 2004 and 2005 respectively. 10% and 23% of all males were batchelors in 2004 and 2005 repectively. Some males moved about widely throughout the breeding season, but not others. Differences between population structure in flooded and upland habitats will be discussed, as well as ecological and demographic differences between this species and Great (*A. arundinaceus*) and Clamarous (*A. stentoreus*) Reed Warblers.

Gruenkorn T

Population dynamics, reproductive success and intraspecific regulation in Common Ravens in Schleswig-Holstein, Germany: A long term study

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The breeding stock and breeding performance of the Common Raven (*Corvus corax*) has been studied for decades in Schleswig Holstein,Germany. Since 1950, three censuses have covered the breeding stock of the whole area, and more detailed information about breeding success is available from individual study areas:

eight covering 7200 km^2 in 1991 and two of 2280 km^2 in 2002. Two sites have been surveyed regularly for over 20 years. Our data show that the breeding stock underwent significant demographic change in the second half of the 20th century, from dense populations in the 1950s to a decline with lowest numbers in the 1970s, then recovery from the mid 1980s to highest densities after 1995. A leveling-off since suggests that mean maximum carrying capacity has been reached. Density locally correlates positively with the extent of available woodland, ranging between 2 and 12 breeding pairs/100 km^2. Breeding success in turn depends on the density of breeding pairs in any area, a correlation supported by different parameters: year, area (woodland), and distance to nearest neighbour. Furthermore, breeding performance is influenced by timing of breeding, density of voles, distance from roosts of non-breeders, and, in some woodlands, the presence of predatory Eurasian Eagle Owls, *Bubo bubo*. Since 1985, breeding success has fallen from 3 to 2 nestlings per brood, including failures. In summary, increasing density between 1985 and 1995 has resulted in a decline in breeding success, an increase in the stock of non-breeders, deferred maturity, and stabilization of the breeding population, all indicative of intraspecific regulation.

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Cryptic spatial variation in population growth rate in an island population of the Red-billed Chough

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Understanding spatial variation in demography and rate of population growth at a range of spatial scales is key to understanding the overall structure and dynamics of natural populations. However, it is often unclear how spatial variation is best assessed; and relatively few studies have rigorously quantified such variation within populations occupying continuous habitat. Accordingly, we used >20 years of data to quantify spatial variation in demography and rate of population growth in a single island population of the Red-billed Chough (*Pyrrhocorax pyrrhocorax*)on Islay, Scotland. Across years, breeding success differed significantly among individual nest sites, but did not vary consistently on a larger spatial scale across Islay. Survival differed among choughs fledged from different nest sites, and also varied markedly across Islay. Spatially structured capture-mark-recapture models identified discrete geographical regions where locally hatched fledglings survived relatively well (region BGE) or poorly (region CNSW) to adulthood. The population growth rate from breeding attempts in BGE therefore exceeded that in CNSW on average and in 16 of 17 individual years. Variation in adult survival was better explained by natal source than by the region where a given individual settled to breed. Similarly, breeding success varied with natal region for males but not females. Spatial variation in lambda would thus have been underestimated had demographic variation been measured across individuals currently resident in a region, rather than from individuals fledged there. Furthermore, average breeding success at each nest site proved a weak predictor of subsequent fledgling survival and therefore of the estimated productivity in recruits by the site. Life-long monitoring of individuals of known origin may therefore be required to accurately identify subpopulations of intrinsically positive and negative growth.

O08: Phylogeny

Braun MJ

The utility of introns and other non-coding DNA sequences for deep-node phylogenetic inference

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Nuclear DNA sequences have received increased attention in recent years as sources of data for phylogenetic inference, especially at deeper levels. Protein-coding sequences are often easy to align, so that homology of characters is assured, yet they also evolve slowly, so that there is relatively little phylogenetic

genetically monogamous. We conclude that social and genetic polyandry in woodpeckers are constrained by the long duration of cavity excavation, few re-mating opportunities, and the importance of bi-parental care for reproductive success.

Holveck M-J, Riebel K

Effects of rearing condition on song and mate preferences in female Zebra Finches

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Despite a wealth of research documenting how environmental effects contribute to within-population variation in male secondary sexual traits, surprisingly little is known about how early environment may influence variation in female preference. The nutritional stress hypothesis suggests that the quality of learned song in males, if affected by early condition, may provide an honest indicator of the developmental history of the singer to females. Evidence that female song preferences, like male song, result from early social learning is now accumulating too, although the process of preference acquisition as well as its susceptibility to early condition remains poorly understood. Accordingly, we tested how song and mate preferences in female Zebra Finches (*Taeniopygia guttata*) were affected by variation in brood size, which indirectly controls food intake during development and as a consequence, juvenal condition. The rearing treatment did indeed influence growth and physiology between birds raised in small or large broods. After they reached nutritional independence, matched pairs of fledglings from different nutritional backgrounds were housed with the same song tutor during the song acquisition phase. Upon reaching sexual maturity, the song preferences of females were tested in an operant setup, and afterwards their preferences for singers of the test songs were assessed in a multiple-choice arena. We report and discuss the results obtained both on song preferences (testing for preference learning and interactions by early nutrition) and ensuing mate preferences (testing for assortative mating by early environment) in females.

Moreno J

Blue egg coloration in female Pied Flycatchers as a signal to mates

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Based on the strong antioxidant character of the responsible pigment, biliverdin, a recent hypothesis proposes that the conspicuous blue and green egg coloration found in many species signals the phenotypic quality of the laying female to mates. Males would be provisioning more food to nestlings hatched from more colorful clutches because the nestlings could have inherited better maternal quality or obtained more maternal resources through the eggs themselves. This differential allocation by males would select for female signals which do not accrue costs of increased conspicuousness. In a Spanish population of Pied Flycatchers (*Ficedula hypoleuca*), a species laying blue eggs, we have found that there is much variation in egg coloration among clutches, that ageing females lay paler eggs, that eggs become successively paler through the laying sequence as a sign of pigment depletion, that females with better cell-mediated and humoral immune responses lay more intensely pigmented eggs, that females in better condition lay eggs shifted towards shorter wavelengths, and that nestlings with more immunoglobulins hatch from such eggs. Males feed more at nests with eggs that are more intensely blue in coloration, and male provisioning affects positively offspring condition at fledging. These results support a signaling function for egg coloration in this population, but are based on descriptive information. It is possible that males may be responding to female cues other than the coloration of eggs when allocating parental effort. Therefore, both food supplementation and clutch exchange experiments are underway to test whether egg coloration can be manipulated, and if males respond to clutch color and not other sources of information about mate quality. The signaling hypothesis offers the best attempt at present to explain the large interspecific and intraspecific variation in non-cryptic egg colors.

O10: Behavioral ecology of foraging

Hino T

Intraspecific differences in benefits from feeding in mixed-species flocks

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The Madagascar Paradise Flycatcher (*Terpsiphone mutata*) and Common Newtonia (*Newtonia brunneicauda*) frequently form two-species flocks in the dry deciduous forest of western Madagascar. In *T. mutata*, some males have long tails while others, and all females, have short tails. When foraging in mixed flocks, flycatchers of each tail type captured prey more rapidly than in other circumstances, but the rate of increase in feeding was lower in long-tailed males. When in mixed flocks, *T. mutata* caught prey exclusively on leaves in the canopy where *N. brunneicauda* foraged. Long-tailed males shifted from sallying when not in mixed flocks, whereas short-tailed birds did not. The elongated tails of long-tailed males may make their foraging less efficient owing to decreased agility in the canopy. *N. brunneicauda* is monomorphic and often formed foraging groups of three to five individuals. In monospecific flocks, subordinate birds fed at low rates on branches owing to frequent hostile encounters. When foraging in mixed flocks, however, subordinates foraged higher among leaves, and their feeding rates increased because of a marked drop in the frequency of intraspecific interference. Dominant birds did not vary in their feeding pattern with social situation, such that heterospecific flocking became more advantageous for subordinates.

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Behavioral plasticity in the foraging of global-ranging sulids

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Most members of the family Sulidae (boobies and gannets) are little different structurally, and all employ the same spectacular plunge dives to capture fish prey. Yet they have successfully colonized various environments, from the cold, nutrient-rich waters of the North Sea or upwelling zones near the African coast to the warm, nutrient-poor waters of the tropics. We investigated behavioral plasticity in the foraging ecology of four species towards understanding how birds with similar body constraints succeed in adapting to diverse ecosystems. Using miniature accelerometers, occasionally in tandem with heart rate recorders and/or GPS data-loggers on free-ranging Cape (*Morus capensis*), Northern (*M. bassanus*), and Australasian Gannets (*Morus serrator*), and Red-footed Boobies (*Sula sula*), we reconstructed the time budgets for all species over a foraging trip, including total time spent flying and the proportion of gliding in relation to local wind condition. The proportion of gliding was greater for tropical (60%) than more temperate sulids (20-30%). The proportion of gliding flight also decreased markedly during active feeding. Surprisingly, heart rate measurements revealed only an average 8% decrease in rate from flapping to gliding flight, notwithstanding that gliding is thought to reduce energy expenditure significantly during flight. Cape and Northern Gannets exhibited bimodal activity in their daily feeding, suggesting a capacity to optimize self-feeding and chick provisioning on a single foraging trip; feeding activity in Red-footed Boobies was more scattered throughout the day. Species-specific differences in plunge diving are discussed in relation to environmental conditions and anticipated prey distribution, including the maximum depths attainable in the dive and the frequency of underwater wing flapping.

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Evolutionary significance of geographic variation in a plumage-based foraging adaptation

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Foraging redstarts of the genus *Myioborus* flash contrasting patches of black and white in tail and wing to flush insects which are then pursued and captured in flight; and greater the distance at which insects are startled, the better the foraging performance. Because the Painted Redstart (*M. pictus*) in Arizona and Slate-throated Redstart (*M. miniatus*) in Costa Rica rely primarily on dipteran and homopteran insects, efficiency for capturing such insects should be under strong natural selection. Experiments using bird models showed that these groups of insects are among the most responsive to the flushing techniques of redstarts, suggesting that that such sensitivity might drive the evolution of contrasting plumage patterns and flush-pursuit foraging in the redstarts. We then tested the escape responses of dipterans to tails of different patch-size in habitats of different background (light to dark) to determine the combination of factors that maximizes flushing, and perhaps creates a potential for selection for habitat-specific plumage patterns. Our results indicate that (1) effectiveness in flushing dipterans depends strongly on the background against which a contrasting plumage pattern is displayed, and (2) larger white tail patches are more effective in darker habitat. The addition of white patches in the wing, moreover, generally heightened escape reponses in insects, but reduced the effect of tail pattern. The results support the hypothesis that geographic variation in habitat can produce geographic variation in plumage pattern in flush-pursuers via habitat-specific natural selection for enhanced foraging performance.

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Individual quality and foraging strategies in Australasian Gannets

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The mechanisms that regulate seabird populations and influence their reproductive output, knowledge of which is crucial for seabird management, understandably continue to receive much attention. A series of long-term studies have recently concluded that only a few 'high quality' individuals within a population contribute most to subsequent generations. Identifying these 'high quality' individuals and defining what distinguishes them (e.g. increased foraging ability, nutritional reserves or body condition) has proven difficult due to technical limitations in studying seabird foraging behavior and energetics at sea. Taking advantage of recent advances in technology, we attached recording devices to breeding Australasian Gannets (*Morus serrator*) to measure the foraging performance of adults of differing parental quality. Foraging performance was parameterized by depth, duration and shape of dives, dive frequency and duration of foraging journey; and parental quality was gauged from data on reproductive success. The resulting information will contribute to identifying characteristics that distinguish 'high quality' individuals, information that is of critical conservation importance for populations of threatened or endangered species because management for such species can be tailored to increasing the survival and breeding success of their 'high quality' members.

Schaefer HM, Catoni C

Avian vision explains a trade-off between health benefits and foraging costs

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As in humans, the consumption of fruits confers various health benefits to birds owing to the high anti-oxidant capacity of anthocyanins. By challenging the immune system of Blackcaps (*Sylvia atricapilla*), we document how anthocyanins boost the avian immune system. We show that Blackcaps select food according to its anthocyanin concentrations, which are lower in red fruits and higher in black. Birds feed preferentially on food high in anthocyanins. In another experiment, we document how these dietary preferences translate to different foraging strategies.

The different color of fruits with high and low anthocyanin content translates to differences in conspicuousness to birds. Against a background of foliage, free-flying Fish Crows (*Corvus ossifragus*) detect the strongly chromatic signals of red objects from a greater distance than the strongly achromatic signals of black objects. Not only did the distance from which crows detected red and black objects differ, but crows also used different search strategies for finding red and black fruits. Crows found more red than black objects when perched or in flight, but equal proportions of both colors when walking. Since the perception of chromatic and achromatic contrasts translates into different search strategies, the distinction of these types of contrasts is probably more important than hitherto acknowledged. This result has broad applications for the study of perception in foraging and, more generally, in other signaling systems, such as mate choice. We further conclude that foraging on fruits entails a trade-off for birds between foraging costs and health benefits, as fruits richer in health-stimulating anthocyanins are more difficult to detect.

O11: Contaminants

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Seabirds as a bio-indicator of mercury levels in the food web of the tropical western Indian Ocean

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Because of their high trophic position on the food chain, capacity for bioaccumulation and longevity, seabirds as good bio-indicators of metal levels in the marine environment. In this context, bird feathers provide a non-invasive alternative source for assessing contaminants. During feather formation, metals present in the blood are deposited in the growing feathers, where they bind to sulfhydryl groups in keratin. Once the feather is formed, blood irrigation ceases, with the consequence that no further metals are deposited: the feather thus becomes a record of exposure during the time of its formation. Concentrations of metals in feathers, however, derive not only from such exposure, but also from mobilization in other tissues. Feathers are thus indicators of total metal content in the body. This is particularly true for mercury, the almost entire body burden of which is deposited in the feathers. In this paper we present assessments of mercury levels in breast feathers of four species of seabirds from the western Indian Ocean collected on four geographically distant islands: the Seychelles, Reunion, Glorieuses and Juan de Nova. Variations in mercury burdens among islands and species there are detailed and discussed in the light of natural versus anthropogenic, and naturally enriched versus naturally depleted sources.

Szabo JK[1], Hooper M[2], Davy P[3], Astheimer L[4], Story P[5]

Landscape-level exposure assessment of locust-control pesticides in the Australian avifauna: Model predictions and field verification

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In eastern Australia, locust control events are seasonal and happen on a wide scale, mostly in agricultural and pastoral areas. The Australian Plague Locust Commission began the operational use of Fipronil, a second-generation GABA inhibitor, for locust control in 1999. Compared to organophospates, such as Fenitrothion, which had been used over the prior 30 years and have higher avian toxicity, the effects of Fipronil on birds are virtually unstudied under field conditions. Toxicity data from four of the five avian families tested indicated low toxicity, while gallinaceous species were found to be highly sensitive. Residue data suggest that birds may be exposed to Fipronil not only by taking locusts directly, but also by feeding on sprayed vegetation, such as grass, leaves and seeds. In an effort to evaluate the potential risk to Australian birds, this paper assesses the probability of pesticide exposure in 285 species. To analyse spatial co-occurrence of birds with locusts and pesticide treatments, distributions of bird species were obtained by applying generalised linear models to Birds Australia Atlas presence-absence data for the areas of interest for the years 1998-2002. Probabilities of presence of bird species at times and locations of locust control applications were calculated, and the risk of exposure evaluated against such life-history characteristics as feeding habits and movement patterns. Field surveys of bird species occurrence and behavior during locust outbreaks demonstrated the strength of the approach, identified unanticipated species and emphasized the need for special consideration of rare and endangered taxa.

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Radio-nuclides from the Chernobyl fallout in Polish raptors

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The first massive sources of radioactive contamination of the global environment were the nuclear weapon tests conducted in the open atmosphere between 1945 and 1980, resulting in a so-called global fallout of radio-nuclides. Most weapons were exploded before 1963, when an international nuclear test ban was signed by the main powers. Then, in April 1986, a further release of radio-nuclides from the damaged Chernobyl Nuclear Power Plant in the Ukraine seriously contaminated much of eastern Europe, mainly in former Soviet Union. Poland suffered contamination from both sources. Of the artificially-released long-lived isotopes still present in the environment, those of plutonium (238Pu, 239Pu, 240Pu), americium (241 Am) and strontium (90Sr) accumulates in bones, whereas caesium (137Cs) concentrates in soft tissues. As the contaminants are expected to accumulate at higher levels in the food-chain, we set out to assess their impact on raptors, screening bone, liver and kidney tissue in the White-tailed Eagle (*Haliaeetus albicilla*), Lesser Spotted Eagle (*Aquila pomarina*), Buzzard (*Buteo buteo*), Kestrel (*Falco tinnunculus*), Sparrowhawk (*Accipiter nisus*), Goshawk (*Accipiter gentilis*), Osprey (*Pandion haliaetus*), Barn Owl (*Tyto alba*), Tawny Owl (*Strix aluco*) and Long-eared Owl (*Asio otus*). The plutonium activity ratio was used to distinguish between Chernobyl and global fallout as source of contamination. The work is still in progress, and measurements are planned to finish in spring 2006. Results so far indicate that, although traces of the Chernobyl fallout are evident in birds from eastern Poland, there are no high levels of accumulation.

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The effects of exposure to polybrominated diphenyl ethers on reproductive performance and immune function in captive American Kestrels

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Polybrominated diphenyl ethers (PBDEs) are manufactured as additive flame retardants in the production of polyurethane foams, textiles and plastics. PBDEs are persistent, lipophilic compounds that have been reported in human breast milk and adipose tissue. PBDEs and their environmentally-relevant hydroxylated metabolites have demonstrated endocrine-disrupting properties, affecting the thyroid system and altering behavior. Concentrations of PBDE congeners have been reported in numerous wildlife species, with some of the highest concentrations to date found in the eggs of Swedish Peregrine Falcons (*Falco peregrinus*). Previous research in our laboratory found that exposure to PBDE congeners affected growth and thyroxine (T4) levels in juvenal American Kestrels (*Falco sparverius*). Here we studied the effects of exposure to a commercial pentabromodiphenyl ether mixture, DE-71, on immune function and reproductive performance in captive American Kestrels. Thirty pairs of kestrels early in breeding were exposed to an environmentally-relevant low dose of 0.3 ppm DE-71, or a high dose of 1.5 ppm added to diet, 30 days prior to pairing and continuing until egg-hatching. Control pairs had safflower oil added to diet in lieu. Blood was collected from adult birds for measurement of PBDE congeners and their metabolites as well as circulating hormones. Results obtained to date indicate that, of the pairs that produced eggs, those receiving 1.5 ppm DE-71 experienced a significant delay (mean 7 days) in production of the first egg after pairing. The mean proportion of eggs produced that were fertile was lowest in the high dose group: 77%, compared to 85% in the controls and 88% in the low dose group. Hatchability of fertilized eggs was significantly depressed in the high dose group at 48% in comparison to the controls at 83% and low dose group at 85%. Assessments of immunocompetence, thyroid function and reproductive performance are also discussed.

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Influence of sulphide eruption and prey availability on the foraging areas of endangered African Penguins at Mercury Island, Namibia

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African Penguins (*Spheniscus demersus*) are listed as endangered in Namibia due to a steep and continuous decline in their populations over recent decades. Mercury Island is the only breeding site on the Namibian coast where African Penguins are increasing; and it hosts the largest number of penguins in Namibia. Although South African populations have been increasing recently due to the recovery of their main prey, sardine (*Sardinops sagax*) and anchovy (*Engraulis capensis*), Namibian stocks of sardine have not recovered from their collapse in the early 1970s. As a result, the main prey of Namibian penguins is now the Pelagic Goby (*Sufflogobius bibarbatus*). The collapse of the sardine has led to major changes in the food web off Namibia which, combined with intensive upwelling, increases the proportion of unutilised phytoplankton sinking to the sea floor. Large quantities of methane and hydrogen sulphide produced in the sediments lead to large-scale eruptions of gas and oxygen depletion in the water column. During the breeding season 2004-2005, we equipped 13 penguins with GPS depth temperature loggers at Mercury Island in order to determine their main foraging grounds and diving behavior. Satellite images and CTD stations were used to evaluate hydrographic situations during logger deployment. All birds except one foraged in an area 15-20 km north of the island. This area was coincident with areas of recurrent hydrogen sulphide eruptions, and diet samples taken from penguins at the same time revealed Pelagic Goby as the main prey. Penguins foraged at fronts of oxygen gradients near sulphide eruptions that presumably enhance prey availability. Pelagic Goby seems to be more resilient to low oxygen than other possible prey fish, and thus hydrographic events such as sulphide eruptions may affect prey availability - and penguin foraging behavior - considerably in Namibia.

O12: Bird communities in changing environments

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Seasonality and impacts of disturbance on understory birds on West Sumatra, Indonesia

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We investigated patterns of seasonality in understory birds on west Sumatra from March 2002 until October 2004. The study area was located in tropical rainforest that had been disturbed by selective logging and agricultural encroachment, where the local bird fauna was sampled by a line of mist nets 72 m long that were set throughout the day for five days in the first half of every month. Of the total 1893 individuals trapped of 109 species in 25 families, all were ringed; 779 were retrapped. Trapped birds were classified according to foraging guild, and population changes were analyzed by comparing densities for each six month period calculated by the Jolly-Saber method. The analysis showed that total species number did not fall dramatically due to selective logging, but that species composition and bird community structure and proportion may be affected. Opportunistic insectivore-nectarivores became more abundant, but insect gleaners of the foliage of shrubberies declined.

Tubelis DP[1], Pereira T[2], Lunardi R[2], Elian SN[2]

Edge effects within reserves: Occurrence of savanna birds in relation to adjacent native forests in the central Cerrado, Brazil

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Most investigations of edge effects on birds have been conducted within managed landscapes, and involve boundaries between native and managed vegetation. This study aimed to examine edge effects on the occurrence of non-forest bird species at boundaries between patches of native forest and savanna. Six study sites in savannas adjacent to gallery forests within protected reserves in central Cerrado, Brazil, were surveyed between February 2000 and January 2001. Transects (n=18) in savannas were set parallel and at right angles to gallery forests, and sampling (n=96) was conducted during both rainy and dry seasons. Statistical analysis of bird species occurrence by distance to gallery forest was performed, which partitioned the species into two groups. The first group comprised species that were more numerous at greater than shorter distances from forests. Species endemic to Cerrado, such as *Neothraupis fasciata* and *Cypsnagra hirundinacea*, were among the numerous species that avoided savanna close (<150m) to forests. The other group comprised species more abundant close to rather than distant from forests, such as *Colibri serrirostris*. Our study demonstrates that species inhabiting patch habitat within nature reserves can be affected negatively by intrinsic edge effects. Furthermore, our results beg two recommendations for the conservation of savanna remnants outside the system of governmental reserves in Cerrado. First, conservation of savannas adjacent to gallery forests in valleys will be essential for the survival of bird species that require habitat near gallery forests. Secondly, the maintenance of savanna remnants in uplands, away from valleys, will better conserve those species less numerous near gallery forests. The establishment of small private reserves, in which wide bands of savanna are conserved along gallery forests, will contribute greatly to the conservation of savanna bird communities in Cerrado.

Abalaka J[1], Manu S[1,2], Duhlinska DD[3]

The avifauna of Chanji Forest Reserve, central Nigeria, after 28 years of continuous degradation

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A survey of the avifauna of a degraded forest reserve, Chanji, in central Nigeria was carried out between February and March 2004 to determine bird species composition. As expected, species diversity in areas that had been completely cleared was lower than in areas with some remaining cover or remnant patches of forest. Such species as the African Green Pigeon (*Treron calvus*) and Green Turaco (*Tauraco persa*), which depend on forest canopy, were recorded in large numbers. That they are not completely reliant on undisturbed forest probably explains their persistence in such seriously degraded habitat. The survey also revealed that the occurrence of numbers of forest-dependent birds in degraded habitat may not be an indication that the forest *per se* is undamaged. The dominant species in Chanji in 2004 was the Bronze Munia (*Lonchura cucullata*), a species that inhabits farmbushes, scrubs and gardens and which was found only in patchy local enclaves in the area over twenty years ago. This is a better indication of the high level of degradation in the reserve, which supported extensive outliers of lowland rainforest at the time of an earlier survey 28 years ago.

Tomialojc L

Old urban parks: The evidence that predation may shape breeding bird communities

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Most studies of bird communities have been carried out in an environment subject to man-made changes or plant succession, invariably concluding that structure of vegetation and food resources shape bird communities. This interpretation is challenged by long-term data from a stable habitat: the climax-like deciduous urban parks of Legnica and Wroclaw which have remained almost unchanged structurally and trophically for more than 40 years. Censuses from the turn of the 1960s that were repeated between 1996 and 2004 reveal dramatic differences in bird community composition and structure which reflect primarily the long-term absence or co-occurrence of Hooded Crows (*Corvus corone*) and Pine Martens. In the absence of predators for 100 generations, the bird community in the parks of Legnica has grown slightly in species richness and increased in overall abundance from 16.7 to 29.4 individuals per hectare. Although disturbed by the World War II, an analogous trend in two Wroclaw parks was halted in the 1970s by the arrival of predators, and then reversed. Overall density dropped abruptly to

77 and 63% respectively of prior numbers, and previously dominant species declined sharply or disappeared. Some, conversely, failed to decline or continued to increase elsewhere in absence of predators. Thus Eurasian Blackbirds (*Turdus merula*) maintained their numbers in one of the Wroclaw parks that had come to be controlled by crows, but declined in the other invaded by Pine Martens. In the meantime, blackbirds in the predator-free parks of Legnica have tripled in numbers, while those of the Fieldfare (*Turdus pilaris*) have risen from 12 pairs during the 1960s to 71 in 2004. Blackcaps (*Sylvia atricapilla*) and Collared Doves have also increased 10 fold. Such re-shaping of local urban bird communities was driven by natural experiments in predator presence and absence. It documents how birds often fail to saturate their habitat and show, when protected from predator pressue, that the carrying capacity of bird habitat may often be much higher than assumed from other evidence.

Pidgeon A[1], Radeloff V[1], Lepczyk C[1], Flather C[2], Hammer R[3]

Understanding the effects of rural sprawl on bird communities

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Growth in housing has been strong in many rural areas of the USA, especially through the 1970s and 1990s. This is of potential concern because our analysis shows that housing density is a significant predictor of bird species richness. The response of bird communities to growth in housing nevertheless differs by guilds and ecoregions. Our objective was to elucidate trends in the conterminous USA for the thirty year period from 1970 to 2000 by analyzing a variety of forest guilds, including forest and woodland species, forest interior species, neotropocial migrants, ground nesters, cavity nesters, and synanthropic species. Species richness was estimated from North American Breeding Bird Survey data; housing data came from the U.S. Decennial Census. Regression analysis was conducted to determine the relative importance of human population and housing as predictors of guild richness within the United States, stratified by ecoregions. We found that correlates of housing density for ground-nesting birds were strongly and simply negative. For other guilds, relationships were more complex. Housing density in both current and previous decades were important predictors, suggesting that for some guilds there is a lag effect in the ecological impact of housing on occupancy patterns. Our results suggest that housing density is strongly related to patterns of bird habitat occupancy throughout the USA, and that projected development may pose a serious threat to many forest bird populations.

O13: Biogeography and phylogeny

Lei F-M, Zhao D-L, Li D-M,Zhao H-F, Yin Z-H, Wei G-A

Thirty years of change in the regional distribution of endemic birds in China

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The regional distribution of birds in China was reviewed by Cheng (1976), and that of endemic species by Lei et al. (2003a), based on current geographical distribution databases. From the resulting template of avifaunal regionalization in China, this paper compares regional distributional shifts in 99 endemic species over 30 years. It reveals that current regional distributional ranges have, in general, expanded significantly since Cheng's (1976)review. Distributional change in 23 species found only in the palaearctic or oriental realms before 1976s was analyzed: 17 (74%) were exclusively oriental but now occur in the palaearctic realm, whereas the remaining 6, all palaearctic endemics, have now extended to the oriental realm. Overall, the distributional ranges of the endemics have shifted northward. Most of these species appear to have dispersed from the Eastern Hillock-Plain region (and also the Western Mountainous Plateau region) of Mid China to the Huang-Huai Plain region (and also the Loess Plateau Subregion) of North China. The Qinling Mountains in Shaanxi Province seem to block expansionist exchange between palaearctic and oriental realms, while eastern areas off the Eastern Hillock-Plain region and Huang-Huai Plain region form a corridor for northward shifts.

Tellkamp MP

Prehistoric exploitation and biogeography of birds in coastal and Andean Ecuador

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Analyses of bird assemblages from five archeological sites in coastal Ecuador (c. 3000-1670 yr BP) and one site from the northern Andes (c. 2640-1700 yr BP) reveal several broad patterns in bird exploitation and avian biogeography. Prehistoric people in Ecuador tended to consume common species from the immediate surroundings of their settlements. The most dominant species were small to medium-sized birds (30-300 g) with terrestrial foraging habits, probably hunted with projectiles, traps, and snares close to the ground. Use of domesticated foxes or dogs, and possibly nets, may have enhanced hunting efficiency. Biogeographically, the study suggests that nearly 20% of the species from the sites have experienced recent range contractions or arrived at the sites via trade. Range reductions can be attributed to both human and natural changes in habitat. Deforestation may have been severe locally, as at El Azucar (2370-2030 yr BP), where most birds recovered archeologically are of open-habitat species associated with brushy vegetation. The presence of humid forest species at this arid site are best explained by fluctuations in rainfall associated with the El Niño Southern Oscillation, leading to temporal shifts in range limits. Tectonic uplift is probably the most important process altering the distribution of mangroves and their avifaunas on the southwest Ecuadorian coast. The assemblage at the Andean site suggests that the ecotone between high elevation forest and paramo grasslands was not as sharp prehistorically as it is today, and that humid forest cover in the now dry inter-Andean valley was more extensive. Zooarcheological studies on birds show that many species have been able to rebound after severe habitat change and hunting in the past. Thus, habitat restoration projects in the heavily deforested western lowlands and northern Andes of Ecuador could be more successful in the long term than often assumed.

Rheindt FE[1], Christidis L[2], Norman J[3]

When morphology does not suffice: Phylogenetic relationships in the cryptic radiation of elaeniid flycatchers (Tyrannidae)

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The New World suboscine flycatcher family Tyrannidae comprises numerous genera that are renowned for their morphological conservatism. For many decades, the classification of this family has been based largely on plumage and morphological characters. Recently, the use of acoustic and molecular data has helped uncover hidden taxonomic complexity and several erroneous groupings, especially at species and subfamily levels. Yet research into the inter-relationships and monophyly of taxonomic groupings at the genus level has been limited. We used both mitochondrial coding genes and nuclear introns from a substantial cross-section of genera and species in the so-called 'elaeniid' assemblage to analyze more closely the genus-level relationships within Tyrannidae. The traditional classification of an unexpectedly high number of taxa bears little resemblance to our findings, and we suggest several major re-arrangements within the elaeniids, as well as between elaeniids and other tyrannid assemblages. Plumage conservatism and the reliance on few and uninformative morphological characters have presumably introduced flawed taxonomic hypotheses that have long persisted for want of better evidence. Our revised understanding of elaeniid systematics reveals preliminary insights into the complicated phylogenetic patterns of the group. Furthermore, our results allow a fresh look at the evolutionary history of a number of important morphological and behavioral traits within this complex avian lineage. Specifically, we are now in a position to gauge the level of evolutionary conservatism and thus assess the phylogenetic utility of each trait, which may prove invaluable in evaluating the validity of current taxonomic understanding of other little-known tyrannid lineages.

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Phylogeny and biogeography of the bulbuls, family Pycnonotidae

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Bulbuls (Pycnonotidae) are confined primarily to the tropical regions of Africa and Asia. The family consists of approximately 130 species, most of which occur in forests and woods, often in secondary or edge habitats. Using nuclear intron sequences, this study investigated the phylogenetic position of the bulbuls within the larger passeridan group, Sylvioidea, as well as basal relationships within the family. The results strongly support separate Asian and African radiations, excluding the African *Pycnonotus* bulbuls which form part of the Asian clade. African nicators (*Nicator*) are excluded from the bulbuls, although their position within Sylvioidea remains unresolved. As previously suggested, Kretschmer's Longbill (*Macrosphenus kretschmeri*), but not short-tailed members of *Macrosphenus*, a genus conventionally included in the Sylviidae, is a bulbul; this study places it within African *Phyllastrephus*, rendering that group paraphyletic. The genus *Andropadus* is polyphyletic but incomplete sampling makes conclusion about the exact relationships of all species currently included in this genus uncertain.

Pereira S, Baker A

Diversification of cracids, tanagers and amazon parrots correlates with historical physiographic changes in the neotropics

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The neotropical region harbors the highest avian biodiversity on the planet, and paleogeographic and paleoclimatic changes seem to have had a major impact on diversification in its biota. For species level diversification at the tips of clades, it might be expected that vicariance has played a substantial role. Therefore we hypothesized that (1) many taxa in the Atlantic biomes became separated from their Amazonian or Pantanal/Chaco counterparts around 4-5 million years ago (mya) during a period of marine transgression, (2) many trans- and cis- Andean taxa in northern South America became isolated from one another about 6 mya when the northern part of the Andes underwent major orogenic uplift, and (3) many Central American taxa sorted themselves from their South American sister groups at the time the Panamanian land bridge finally connected South and Central America around 3 mya, or possibly before when the Costa Rica-Panama island arc formed a stepping stone route between Central America and South America around 15 mya on. To test these hypotheses, we applied maximum likelihood and Bayesian methods that account for variation in rates of DNA substitution to estimate the divergence time among several groups of birds comprising curassows, piping-guans, amazon parrots, and tanagers. These groups share congruent overlaps in their geographic distributions, which are delimited by similar geographic barriers and biomes. We used relevant fossil and palaeogeographic events as calibration points to set temporal constraints. As predicted, the results indicated an average estimated age of 4 to 6 mya for Atlantic taxa, 2 to 3 mya for taxa on opposite sides of the lower Amazon River, 6 mya for sister species isolated on opposite sides of the Andes, and 3 to 6 mya for Mesoamerican taxa. This temporal pattern of diversification has also been observed in mammals.

O14: Communication

Bhatt D, Sethi VK

Year-to-year variation in the song of the Oriental Magpie-Robin

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The Oriental Magpie-Robin (*Copsychus saularis*), an insectivorous hole-nester, is one of the renowned songbirds of the India. Males sing highly varied and complex songs to defend and maintain territory during the breeding season, from March to August. The present study was carried out to determine whether songs given in any year comprise a constant repertoire, or whether they vary from year to year. Repertoire size was calculated from phrase types, and obtained by analyzing a total of 372 song samples (25-30 songs/individual/year) recorded from seven color-banded males in their natural territories at Haridwar during 2003 and 2004. All the phrase-types recorded from an individual in year one were compared with those recorded in the second year. Considerable variation was found in repertoire size among individuals and between years. In most cases, complex phrases consisted of dissimilar varying elements, and in a song bout, the same or different types of phrases were repeated randomly, without syntaxical rules. On average, only 10.50% of the year one repertoire was retained unchanged in the following year. 16.35% of phrases were modified, 89.49% were dropped and 70.59% were novel, indicating that a substantial number of new phrases had been learned every year, with concomitant deletion of others.

Kiefer S, Hultsch H

Age-related increase of song type repertoires in Common Nightingales

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If acoustic features of bird song are related to male quality and quality is related to age, older birds should 'signal' their age. That is, at least some song features should vary with age, for example song composition or repertoire size. We investigated this issue by determining song features of individually-marked, free-ranging Common Nightingales (*Luscinia magarhynchos*) of known age. The nightingale is an especially good model because (1) it is an 'open-ended learner', that is, birds can acquire new song types after an early learning-sensitive period as fledglings, and (2) it develops exceptionally large repertoires, of about 200 different song types per male. We analyzed the nocturnal singing of nightingales (n=9) in their first breeding season and compared it to that of older males (n=9). In the two age groups we measured repertoire size and, in addition, characteristics of a particular song category - 'whistle songs' - that is supposed to be focal in mate attraction. Furthermore, we conducted interactive playback experiments to examine whether the use of particular song types or song features is biased towards older males. The repertoire size of older males was found to be more than 50% higher than in yearling birds. Whistle songs contributed to the difference as much as non-whistle songs, such that older birds produced more different whistle songs than yearlings. However, the two age groups did not differ in overall production of whistle songs. Measures of putative 'vocal competence', such as the pitch and duration of whistle notes, did not show age-related differences either. Our findings show that nightingales increase their song-type repertoires markedly between their first and ensuing breeding seasons.

Geberzahn N[1], Goymann W[2], Muck C[2], ten Cate C[1]

Acoustic variation in the song of the female African Black Coucal, a species with reversed sex-roles

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Bird song serves to attract mates and deter territorial rivals. This has been demonstrated in diverse studies of temperate zone species, in most of which only males sing, thereby underscoring a fundamental weakness in current explanations for the functions of bird song. Song is not restricted to males; and in tropical species, in particular, singing in females is rather common. Here we tested the generality of hypotheses for the function of bird song by investigating vocal behavior in the sex-role reversed African Black Coucal (*Centropus grillii*). In African Black Coucals, females are larger than males, defend territories aggressively, and are the vocally active sex. We studied a population of individually-marked African Black Coucals in Tanzania and related individual variation in the acoustic parameters of female vocalizations to biometrical data. We focused on those acoustic parameters which had been shown in males of other non-passerines to indicate quality, size and strength in individuals, such as pitch, duration, number and structure of vocal elements. We present results that answer the question whether female vocal behavior reliably reflects the quality of the bird.

Goretskaia MI

The number of elements per phrase in bird songs is related to male-male interaction

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It is well known that, in addition to variability in types of song, there is variability of song structure within each type. These variations may be functional, transmitting useful additional information to males and females in different contexts. Thus it has been shown recently that small variations in Willow Warbler (*Phylloscopus trochilus*) song is related to the number of interactions between males and to the density of the population. Moreover, similar relationships between singing context and the number of elements per phrase and other variations within song type have been found in other species. The number of elements in first and second phrases were studied in 9 Chaffinches (*Fringilla coelebs*) singing in the following contexts: (1) without interaction, i.e. singing in the absence of singing neighbouring males; (2) in heterospecific singing duels, i.e. singing in gaps between the songs of a heterospecific male and/or singing simultaneously with it; and (3) in conspecific singing duels, i.e. singing in gaps between the songs of a conspecific male and/or singing simultaneously with it. In total 315 songs, comprising 25 to 75 songs from each bird, were analyzed. The number of elements per first phrase varied from 1 to 17 (mean 7.05, s.d 3.65), and per second phrase from 1 to 13 (mean 6.25, s.d. 3.14). However there were individual differences in the number of elements per phrase: significant differences were found in the number of elements per first and second phrases uttered in different singing contexts in 8 of the 9 males ($p<0.05$, Kruskal-Wallis test). Moreover, the number of elements increased from situation (1) to situation (3). The results suggest that minor variations in song structure can transmit important information to other birds, may be related to interaction between males, and could occur in many species of birds.

Fox E[1], Roberts JD[1], Bennamoun M[2]

Recognizing individuals in vocal bird species: A new perspective

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Acoustic recognition could be an effective, non-invasive means for identifying individual birds of many species in field research; but it has rarely been used. This is because a method for extracting individually distinctive features from a common song type has first to be developed, conditional on use of the song type by all members of the population under study. I propose a new method of acoustic recognition which does not use features specific to a particular song. Using the mel-cepstrum coefficients to extract features related to vocal tract configuration, I have been able to determine individual identity irrespective of the song type produced or the complexity of the song. This eliminates the need for accessing common song types and incorporates data from complex repertoires; it can also be used for any bird species. Neural networks were chosen as the classifier for this task as they can solve complex, non-linear classification problems. Results to date show that individual identification within a singing bout is possible, notwithstanding highly susceptibility to noise effects. Results, together with possible solutions to problems that have arisen, will be presented.

O15: Natal dispersal/philopatry

Ganter B[1], Rösner H-U[2]

Natal philopatry and close in-breeding in Dunlins

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We report data from a 15-year study of a population of arctic-breeding Dunlin (*Calidris alpina*) in northernmost Norway. The breeding population in the study area consists of 35-60 pairs. During the study, more than 1800 newly hatched chicks were ringed, and more than 80 of these returned to the natal area to breed. Both males and females returned, albeit with different frequency, and we compare dispersal distances from the natal nest and subsequent breeding success between sexes. In this small population we observed a number of cases of close in-breeding, i.e. mothers breeding with sons or full sibs breeding together. Hatching of eggs in clutches of these in-breeding pairs was significantly lower than in the rest of the population. To our knowledge, this is one of a very few studies demonstrating close in-breeding and its effects in a free-living population of birds.

Ding P, Peng Y, Jiang P

Movements and factors affecting dispersal of Elliot's Pheasant

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Between October 2002 and April 2005, studies of movements and their effecting factors were carried out on Elliot's Pheasant (*Syrmaticus ellioti*), a threatened species endemic to China, in the Gutianshan National Nature Reserve, Zhejiang Province. To do this, we used radiotelemetry, GPS siting, SAW modeling and routine field sampling. The results show that monthly movement ranged from 0.095 km^2 to 0.243 km^2 in broad-leaved forest and mixed broad-leaved and coniferous forest, and from 0.031 km^2 to 0.240 km^2 in coniferous forest. It suggests that the range of movement in Elliot's Pheasant is dependent on habitat type, and probably related to the degree of habitat fragmentation. Maximum daily movements covered about 0.387~0.593 km, and average daily distance travelled was about 0.325~0.436 km. In early spring, both male and female pheasants made a relatively long-distance movement of 1.5-2.1 km in one direction, away from winter quarters, taking 16~23 days for the shift. A t-test on habitat variables between used and unused patches revealed that the birds travelled along selected routes, from one patch of preferred habitat to the next, in their shift. Diversity of shrub species, canopy height of shrubs, slope and shrub abundance were major factors determining the routes, and seem to be correlated with reduction in obstacles to movement. After dispersal, the pheasants preferred habitats away from forest edges, with taller shrub coverage, higher shrub abundance and species diversity, and greater herb abundance, suggesting that early spring dispersal is driven by the need to find suitable breeding sites with reduced disturbance, improved safety and greater food supply.

Sherry TW[1], Lebreton J-D[2], Holmes RT[3]

Survival and breeding dispersal in a migratory passerine in relation to condition-dependent site tenacity: a multi-state capture-resight analysis

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Annual survival and dispersal are particularly challenging to measure in small, migratory birds due to difficulties in detection and tracking, and to dispersal-biased survival estimates. We used multi-state capture-recapture models to estimate breeding dispersal, survival, and recapture probabilities in the American Redstart (*Setophaga ruticilla*) breeding for 13 years in continuous northern hardwood forest in central New Hampshire, USA. The four model states were occupancy of a core area (34 ha) partitioned into three levels of seasonal reproductive success, versus periphery (146 ha) occupancy. We used Akaike's Information Criterion to select the best-fit models from full-rank and reduced-parameter candidates; and we analyzed sexes independently. The best-fit models for the two sexes were almost identical, with constant re-sight probability (0.53 in females, 0.71 males), and apparent survival proportional to reproductive success state, indicating high heterogeneity in site fidelity among individuals. The best male model included an additive effect of age on apparent survival, with older males surviving better than first-year individuals by about 10%. Annual apparent survival estimates for the highest site-fidelity group within each sex were 0.6-0.7, higher than estimated previously in this and similar species. Estimates of site tenacity (probability of remaining in core or periphery area) tended to be about three times greater than movement probabilities, and accounted for most of the variation in apparent survival estimates. Our results reveal substantial breeding dispersal in redstarts in response to poor reproduction, raise questions about prior survival estimates that ignore dispersal, and reinforce the power of multi-state models to estimate critical demographic parameters.

Simeone A[1], Wallace RS[2], Whittington P[3]

Dispersal and philopatry in Humboldt Penguins at a breeding colony off central Chile

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Seabirds are well-known for their philopatry, returning to their natal site to breed; but much less is known about their dispersal to reproduce in other colonies, particularly in penguins. We set out to compare these behaviors in Humboldt Penguins (*Spheniscus humboldti*) from the colony at Pajaro Nino Island at 33º S, one of the largest breeding sites for this species off central Chile. Between 1994 and 2003, we marked 267 pre-fledged chicks with transponder chips. Between these years, the colony was monitored at least at monthly intervals. In 2004, we started to check other penguin colonies for marked birds, both at three colonies up to 400 km to the north and one 70 km to the south. No marked birds were found south of the natal colony at Pajaro Nino, but four penguins, 1.5% of total marked birds, were located at northern colonies on Cachagua and Concon Islands, up to 95 km away. All were attending nests with eggs or chicks, indicating dispersal. Five further birds, 1.9% of the total, had returned to nest at their natal island; two of them had been seen there in previous seasons, presumably prospecting for nesting sites. Two additional marked birds were found at nests at the natal colony, but no breeding was confirmed. The age of the birds when found breeding ranged from 4 to 6 years.

Matthysen E, Adriaensen F

Landscape structure constrains the dispersal of a mobile songbird: A paradox?

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Small songbirds have intrinsically high locomotory capacities compared to other organisms of the same body size, and thus their movement patterns might be expected to be relatively insensitive to fine-grained landscape structure. Nevertheless, many songbird species are restricted in dispersal capacity and respond negatively to isolation of habitat patches. To better understand the relationship between landscape structure, movement behavior and realized disperal, we studied daily movements and dispersal in a forest-restricted passerine, the Great Tit (*Parus major*), in a study area of 10 km^2 containing 15 forest patches of 1 to 15 ha. Birds are physically able to fly across the entire area in less than an hour, and winter observations showed that individual birds commute daily between roosting and feeding sites over distances of 500 m or more. Despite such high mobility, we found several indications that dispersal is not neutral with respect to fine-grained landscape structure. First, up to 30% of birds never left their natal forest patch, a proportion that was significantly higher than for similar study plots embedded in larger forest. Secondly, dispersal between forest patches was related positively to an index of between-patch connectivity, based on least-cost paths. Thirdly, dispersal directions were spatially autocorrelated, i.e., birds hatched in nearby nestboxes moved in similar directions, presumably in response to surrounding landscape structure. We hypothesize that the influence of landscape structure on dispersal reflects settlement decisions taken early in life when birds are less mobile. In particular, we discuss the potential impact of early experiences gained during family movements.

O16: Conservation: habitat requirements

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The response of wintering Kirtland's Warblers to food patch dynamics in The Bahamas and its implications for conservation on the wintering grounds.

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Sub-tropical and tropical dry forests can be challenging habitats for many birds, especially overwintering nearctic/neotropical migrants which may be faced periodically with droughts at a time when energy demands are highest due to the need to accumulate fat for migration to breeding grounds. Failure to store sufficient fat may contribute to mortality or delayed departure resulting in negative breeding consequences. These may be the prospects faced by the endangered Kirtland's Warbler (*Dendroica kirtlandii*), which winters in The Bahamas. Despite an intensive and so far successful recovery effort on its restricted breeding grounds in Michigan, USA, little is known of its biology on its wintering grounds, where it spends seven months of the year. We address this knowledge deficit by studying site fidelity and movements of color-ringed birds in relation to food resources in The Bahamas. In October, arriving warblers settle initially in a variety of early successional habitats when conditions are moist and food resources widespread. As the season proceeds, however, and conditions become drier, food supplies decline and become patchier because certain sites are more susceptible to desiccation than others. The warblers respond by shifting from sites of low to sites of high resource levels. The importance of tracking changing resource distributions is evident in warbler body condition which may decline substantially from mid to late winter. As the warblers shift to richer food patches they may become concentrated in smaller patches, where home ranges can overlap substantially. Thus, as drought intensifies, warblers concentrate in patches with residually abundant food supplies, maintained by moisture availability. Sites that retain moisture, especially in the late winter, may be crucial for conservation as they provide the resources for a timely spring migration.

Steinfurth A[1], Vargas H[2], Wilson R[3]

Marine ecology and conservation of the Galápagos Penguin

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The endangered Galápagos Penguin (*Spheniscus mendiculus*) is endemic to the Galápagos archipelago with a population of less than 1700 individuals. Although censuses of this species have been carried out since 1970, little attention has been paid to its marine-pelagic life and conservation threats at sea. The precarious position of this species, together with expanding human activities in the Galápagos Islands, makes the need for ecological information more urgent than ever. Here we report the results of a two-year marine ecological study gathering such information. By attaching Global Positioning System (GPS) data loggers and temperature-depth recorders (PreciTD) to 32 breeding birds from three colonies for 1-5 days during 2004 and 2005, we have derived information on the three-dimensional movements of penguins at sea in the context of oceanographic features of the environment. Preliminary results confirm that the penguins forage mostly by shallow dives of short duration rarely more than 1.5 km from the coast, and travel only up to 2.5 km from the nest. Yet penguins perform deep dives too, up to 46 meters, thus using the vertical water column more than had been expected. Penguin distribution at sea relative to the Galápagos Marine Reserve (GMR) zoning system raises interesting points and some concern. We found that even those penguins that breed on sites surrounded by the zone of highest protection zone do not necessarily feed in the immediate area, but go straight into the current fishery zone to forage. Commercial fisheries have the potential to harm penguin populations, their netting entangling and drowning birds. Thus, information on foraging at sea, as provided here, is crucial for implementation of effective conservation management of the GMR zoning system.

Bidwell MT[1], Ryan P[2], Shaw K[3]

Habitat selection and reproductive success in Blue Cranes in a South African agricultural landscape

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Habitat loss and fragmentation in the grasslands of South Africa have precipitated dramatic declines in Blue Cranes (*Anthropoides paradiseus*). Losses have been partly offset, however, by crane colonization of agricultural landscapes in the fynbos biome of the Western Cape Province, itself threatened but now a stronghold for the species. We studied breeding habitat selection by the crane in this transformed habitat at two spatial scales: among agricultural fields available for nesting, and within fields containing nests. Cranes selected pastures over cereal crops, and avoided natural fynbos vegetation. Fields selected for nesting were those further away from areas of human settlement and closer to patches of natural vegetation. Cranes also nested in fields that were larger and contained more natural vegetation than those unused. Within fields containing nests, cranes selected sites that were further from buildings and farm tracks and closer to natural vegetation and sources of water. We also investigated breeding success as a function of land-use type. Mayfield nest survival rates were higher in pastures than in cereal crops, but there were no significant differences in reproductive output among land-use types. Remnant patches of endangered fynbos vegetation were not used directly by nesting cranes but our observations suggest that fynbos may provide young cranes with cover from predators and human disturbance, implying that the interests of cranes and fynbos may have more in common than is currently thought. The results of this study highlight the importance of the current mosaic of pasture and cereal cropping in South Africa's Western Cape for Blue Crane conservation, and suggest that pressures to intensify agriculture, adopt new crops, or increase human population in farming areas will be detrimental.

Olsson O

An optimality-based predictive habitat use model for reintroduced White Storks

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Here I present a temporally and spatially explicit predictive habitat use model for White Storks (*Ciconia ciconia*) that are currently being reintroduced to southern Sweden. The model is based on an optimality theory approach which makes the concepts completely general, but still applicable to specific cases. Actual habitat use by a bird is the consequence of the habitat composition of the landscape and the costs and benefits associated with using different habitat patches. Thus, optimal habitat use can be determined by cost-benefit analysis, given that habitat composition in the landscape is known. Habitat composition in a landscape affects perception of expected reproductive success, which in turn effects the best choice of habitat use. Using an extension of central-place foraging theory, I have created an optimality model for habitat use that applies, *inter alia*, to nesting birds. Using this model, realistic functions for energy gain, predation risk and travel costs can be evaluated. As a generality, the model predicts that birds will demand a higher reward for using distant patches, but the relation between distance and acceptable patch quality depends on the condition of the bird. Individuals with a high demand for energy will generally fly further than those with lower demands. Over the breeding season, the energy requirements of stork chicks change drastically. Food availability also changes more-or-less predictably in different habitats over the season, partly due to farming practices. Moreover, storks use thermals in their flying, with the consequence that their travel costs may change from day to day due to weather conditions. Therefore, both temporal and spatial components need to be - and are - taken into account in the model. I have tested the model against field data of habitat use by breeding storks over three years, and then used it to identify areas sufficiently good as breeding sites, and areas requiring some restoration to provide conditions adequate for storks.

Robin VV[1], Thiollay J-M[2], Anindya S[1], Sancheti A[3]

Population isolation in a naturally fragmented landscape: the White-bellied Shortwing in the montane evergreen forests of the Western Ghats, southern India

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The White-bellied Shortwing (*Brachypteryx major*), a threatened understory thrush, is endemic to pockets of high elevation montane evergreen forest (*Shola* forest) in the Western Ghats, southern India. A 40km gap in the Ghats separates the species into two subspecies. *Shola* forests are a natural mosaic of small patches of forest (0.5ha - 1500ha) in high valleys within a grassland-dominated landscape. We investigated whether the shortwings were capable of moving between these isolated patches, and also examined probable geographical isolation by comparing song structure from individually marked birds of one subspecies. We chose four small patches of forest, each <2.5ha, separated by varying distances of 70m - 200m, with one large patch as a control. The other subspecies was used as an out-group for song analysis. We examined movement between the patches by mist-netting over a period of two years, marking 68 individuals. With a net density of 10.8/ha and 4700 net hours of effort, we detected movement between only the closest patches. Analysis of song structure across the patches, however, revealed no significant difference when compared to inter-individual variation within a patch. Though we found little evidence for inter-patch dispersal, results from song analysis suggest that the natural matrix of discrete forest patches does not isolate populations of White-bellied Shortwings. This also raises the larger issue of the scales at which populations may be considered isolated. Studies are underway to extend and verify these findings with experiments over larger geographical distances.

O17: Foraging and energetics

Reynolds J[1], Harrison T[1], Martin G[1], Chamberlain D[2]

The influence of supplementary feeding in spring and early summer on the breeding performance of British garden birds

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Food provisioning in gardens is widespread in Britain but, historically, it has been restricted to the winter months. In recent years, however, sustained year-round provisioning is more common, exposing birds increasingly to supplementary food while they are breeding. Food availability influences the probability of occurrence of certain species in British gardens, yet we understand little about how supplemental food influences the productivity of garden birds. In this study, we provided seeds and seeds plus live food in the spring and early summer to birds breeding in nestboxes in mixed woodland. Supplementary feeding had marked effects on proximate (e.g., clutch size, laying date, brood size) and more ultimate (e.g., chick growth, fledging success) measures of breeding performance. Future work will focus on (1) investigating the extent to which breeding birds are reliant on supplemental food, using stable isotope analysis and focal feeder watches, (2) how dependence on supplementary food affects different aspects of reproductive behavior, such as incubation and brood provisioning, and (3) whether, ultimately, the chronic provisioning of supplementary food throughout the breeding season will be beneficial to the ‘health’ of populations of British garden bird species. Such research is timely now that the British public are being advised increasingly to feed garden birds beyond the winter months and are recruiting well to the Garden BirdWatch Scheme run by the British Trust for Ornithology and CJ Wildbird Foods Ltd.

Nilsson J, Nilsson J-Å

How do different metabolic rates during the winter affect breeding next summer?

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During its life time, an animal will experience periods of varying energy demands. This is reflected in metabolism, where it has been found that breeding or migrating birds increase their metabolic rates substantially over levels at other times of the year. Birds, in fact, have an astonishing ability to adjust metabolic rates to meet the demands facing them. Little however is known about the consequences a varying metabolic level over a long time. In this study, we measured basal metabolic rate (BMR) during winter in a large number of wild Blue Tits (*Parus caeruleus*) in southern Sweden. These birds were then monitored during subsequent breeding to determine whether winter BMR had in any way affected fitness-related measures such as local survival, date of first egg, number of eggs, and number of fledglings. This procedure was carried out over two consecutive seasons, in 2005 and 2006. To our knowledge, this is the first attempt to find out how metabolic rate at one time of the year might influence future fitness, a question most important for understanding life history trade-offs in birds.

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Sex differences in resting metabolic rate in Pied Flycatchers

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In Pied Flycatchers (*Ficedula hypoleuca*), father's basal metabolic rate (BMR) and offspring resting metabolic rate (RMR) were found to be positively related (Bushuev et al., 2003). Recent cross-fostering experiments assumed the existence of heritability of resting metabolic rate in Pied Flycatcher (Bushuev et al., in press). To consider the problem more fully, we studied sexual differences of fledglings in energetics. RMR of fledglings, which reached asymptotic body mass (13-15 days old), was measured by oxygen consumption at nighttime and its estimates were expressed as body mass residuals. Sex identification of monomorphic fledglings was based on analysis of DNA (Kahn et al., 1998) extracted from blood samples (n = 79 from 40 broods). On average, male and female fledglings did not differ in body mass and wing length, but tarsus was longer in females than in males. RMR of male fledglings was higher than that of female ones, and this difference was more pronounced among offspring of old (>= 2 ys) males (ANOVA: $F=9.6$; $p=0.003$; $n=50$). Sexual asymmetry in energetics of fledglings appeared to be unrelated to variation in growth rate and may reflect the superiority of male fledglings in such components of RMR as basal metabolism. The opposite trend was demonstrated by adults during the period of rearing chicks: BMR of females was significantly higher than that of males ($n=137$). Possible functional consequences of sex-dependent differences in resting metabolism will be discussed.

Lopez-Calleja MV[1], Fernandez MJ[2], Bozinovic F[3], Hodum P[4]

Foraging ecology and energetic of Juan Fernandez Firecrown (Trochilidae)

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The Juan Fernandez firecrown (*Sephanoides fernandensis*) is endemic of Archipielago Juan Fernandez and one the most endangered birds of the world. The principal threats to this firecrown includes lost of foraging resources and competition with a continental hummingbird, the Green-backed firecrown (*Sephanoides sephaniodes*). Green-backed firecrown is Juan Fernandez firecrown's sister species, being recently in the island (around 200 years). We present information related with floral offers, foraging strategies and energetic costs of different activities on both species. During two years we visited the island and recover information about flower nectar production, foraging behavior of both species, and made energetic measurements as oxygen consumption during different activities. During the post-reproductive period, the most important plant visited for both hummingbirds was *Dendroseris litoralis* (Col). The nectar concentration and production of *D. litoralis* is similar to the flowers use by hummingbirds. The foraging strategy is totally different in both species, the endemic *S. fernandensis* present a significant preference to perch while foraging like the Andean Hillstar (*Oreothrochilus estella*). *Sephanoides sephaniodes* prefer to hover while foraging, spending more energy in this activity, but being more alert for other hummingbirds and predators. The Juan Fernandez firecrown spend significantly more time and energy defending their foraging patch respect Green-backed firecrown. This information permit us to propose several conservation strategies for recover this very endanger species.

White C, Halsey L, Martin G, Butler P

Wading, walking, waddling: The energetics of terrestrial locomotion in birds

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In birds, the relationship between speed and rate of oxygen consumption during pedestrian locomotion is linear, where net cost of transport (NCOT, ml O_2 m^{-1}) is calculated as the slope of the line. This value represents the cost of moving an animal a unit distance excluding maintenance and other speed-independent costs. NCOT not only increases as mass increases, but also varies from apparently clumsy animals to apparently graceful ones. Thus waders (turnstones, plovers, oystercatchers) have a low NCOT while waddlers (cormorants, geese, penguins) have a high NCOT. Walking and running birds (emus, guinea fowl, quail) are intermediate. As many of these birds spend a major portion of their day walking to obtain food, understanding the cause of this variation could potentially enable accurate estimates of pedestrian energy expenditure. To throw light on this issue we measured oxygen consumption during treadmill exercise for Great Cormorants (*Phalacrocorax carbo*), of 2289±136 g mass. We also filmed cormorants and Barnacle Geese (*Branta leucopsis*) of 1963±95 g mass during treadmill exercise, and determined foot contact time (t_c, s). We then investigated the relationship between NCOT and $1/t_c$ (rate of force generation) using our new data from cormorants and geese, and combined this with data for a range of species gleaned from the literature, including penguins, emus, quails and turkeys. We conclude that the high net cost of locomotion in waddling species is associated not with waddling *per se*, but with short, fast strides necessitating high rates of force generation. Similarly, the low NCOT of waders is associated with long slow strides, and low rates of force generation. Together, body mass and rate of force generation by the foot account for 99.7% of the 58-fold range of variation in NCOT during pedestrian locomotion among the eight species for which appropriate data are available.

O18: Territory

Goymann W, Muck C, Schwabl I

Blocking androgen and estrogen action does not affect territorial behavior in female Black Coucals

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In male birds, territorial behavior and song during the breeding season is commonly regulated by androgens. In classically polyandrous species, the sex roles are reversed, i.e. females aggressively defend terriories or partners and sing while males provide all the parental care. Are androgens involved in the regulation of territorial and singing behavior in polyandrous females as well? Polyandrous species investigated so far do not show a reversal in sex steroid levels. Androgens, however, may act at a low concentration if the sensitivity of the target tissues in females is increased. To test this, we implanted free-ranging female Black Coucals (*Centropus grillii*), a classically polyandrous species, with an androgen receptor blocker and an aromatase inhibitor. This prevented androgen action through both androgen and estrogen receptors. We then investigated territorial and song behavior in experimental- and control- implanted females. Experimental and control birds did not differ in territorial aggression (latency to respond, song rate, closest approach) towards a simulated territorial intrusion with a stuffed Black Coucal and playback of female song. Territory size and passive song rate over a 3 week period after treatment did not differ between experimental and control birds either. Thus it seems that androgen action via androgen and estrogen receptors is not involved in the immediate control of territorial behavior in female Black Coucals. Even so, we cannot exclude non-genomic androgen action that is not mediated via the androgen or estrogen receptors. Moreover, androgens may only be required for the activation of territorial behavior at the beginning of breeding.

Schmidt R[1], Kunc HP[2], Amrhein V[3], Naguib M[1]

Is territory defense in Common Nightingales influenced by prior information?

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Individuals that interact repeatedly should benefit from remembering information obtained during previous encounters with conspecifics: conditional response strategies based on previous encounters may be used in such repeated interactions. Little, however, is known about the time period over which information obtained in first encounters is memorized for subsequent use. Vocal communication among male songbirds provides an ideal means for investigating how prior information is used in subsequent encounters, because male songbirds commonly interact repeatedly with one another when establishing and defending territory. Here we investigate how male Common Nightingales (*Luscinia megarhynchos*) use information obtained on rivals during vocal interactions at night in subsequent encounters in which the same rivals intrude on territory. In initial interactive playback at night, we simulated either an aggressive rival by overlapping its song on that of the subject or a less aggressive rival by song alternation. Then, in a non-interactive playback next morning, we investigated how subjects used information on the aggressiveness of a rival in territorial defense during simulated intrusions. We predicted that males which had been challenged more seriously in song by night would defend their territories more vigorously when challenged next day. Our study provides insights into how territorial defense strategies in songbirds are adjusted to the outcome of previous vocal interactions.

Boucher S

Where can a pair nest around here? Habitat selection in the Black Guillemot on Great Duck Island, Maine, USA

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The southward expansion of large predatory gulls in the northwest Atlantic has caused concern over potential impacts from predation, piracy, and habitat displacement. Few studies have examined habitat selection in alcids quantitatively, especially in relation to potential predators or competition. A colony of roughly 400 pairs of Black Guillemots (*Cepphus grylle*) nests on Great Duck Island in eastern Maine, USA; and increasing numbers of Great Black-backed Gulls (*Larus marinus*) are invading breeding areas on the shore. All nests on the island were located and mapped using GPS and incorporated into a GIS database. Shoreline was classified into 16 categories according to rock structure and added as a GIS map layer. iButton stand-alone temperature recorders were deployed in 15 nests. Multivariate analysis showed that the density of nesting burrows was correlated negatively with crevice size and slope, and positively with the proportion of a shore type: mixed-boulder-and-rock-slab. This habitat, although comprising less than 2% of the island, contained 37% of nesting guillemots and was also the most used by sub-colonies of Herring Gulls (*Larus argentatus*) and Great Black-backed Gulls, species which commonly pirate nests and take guillemots directly. Guillemots are thus faced with a dilemma: their preferred nesting habitat brings them into direct contact with potential piracy and predation. Only 6% of guillemot nests were found in cliffs on the island, a substrate on which gulls did not nest. Only flooding and egg predation by the American Crow (*Corvus brachyrhynchos*) threaten them there. Sample nests in mixed-boulder-and-rock-slab habitat were significantly warmer than the outside environment and nests in cliffs or ledges. Nests in mixed-boulder-and-rock-slab also fledged more young per unit area than other sites on the island, which may compensate for the high frequency of piracy and predation by gulls.

Hazler KR[1], Cooper RJ[1], Twedt DJ[2]

Risky business: Site selection by Acadian Flycatchers under threat of nest predation and brood parasitism

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Habitat quality is determined not only by habitat structure and the availability of resources, but also by competitors, cooperators, predators, and parasites. We hypothesized that, for passerines, minimizing risk from avian nest predators and brood parasites is an important factor in selecting a breeding site. Through the early part of two breeding seasons, we spot-mapped locations of Acadian Flycatchers (*Empidonax virescens*, territory selectors), Red-bellied Woodpeckers (*Melanerpes carolinus*, nest predators) and Brown-headed Cowbirds (*Molothrus ater*, brood parasites) in a 56-ha study area within an extensive bottomland hardwood forest. We were thereby able to determine the order of flycatcher territory settlement and nest initiation in relation to risk of predation and parasitism, while accounting for habitat structure. Male settlement was influenced by both habitat structure and risk avoidance. However, risk from woodpeckers was relatively more important in the first season and risk from cowbirds in the second, evidently due to differences in the relative abundance of predator and brood-parasite in each year. For male flycatchers, settlement choices appear to be flexible in the face of changing "risk landscapes." For females, habitat structure was the most important predictor of nest site selection. Even so, there was evidence that females avoided cowbirds. Surprisingly, nest site selection was positively associated with woodpecker abundance in the first season when woodpeckers were present in greater numbers. Possible explanations for this contradictory result are discussed.

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Inadvertent social information in breeding site selection of natal dispersing birds

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Several species use the number of young produced as public information (PI) to assess breeding site quality. PI is inaccessible to synchronously-breeding birds because nests are empty by the time young can collect such information. We investigated whether location cues are the next best source of inadvertent social information (ISI) used by young prospectors when choosing breeding sites. We experimentally deployed ISI as decoys, and song playbacks of breeding males in suitable and sub-optimal habitats during pre- and post-breeding periods, and monitored territory establishment during the subsequent breeding season for a social, Bobolink (*Dolichonyx oryzivorus*) and a more solitary species, Nelson's Sharp-tailed Sparrow (*Ammodramus nelsoni*). The sparrows did not respond to treatments, but Bobolinks responded strongly to post-breeding location cues, irrespective of habitat quality. The following year, 17-20 sub-optimal plots to which Bobolink males were recruited were defended for at least two weeks, indicating that song heard the previous year could exert a 'carry-over attraction' for conspecifics the following year. Sixteen recruited males were local natal dispersers, as expected for birds that have little opportunity to directly sample the quality of natal habitat. We suggest that differences in breeding synchrony may induce an equivalent clinal distribution in use of ISI.

O19: Threatened species

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Concerning the "least concern": Conservation of the Short-clawed Lark in South Africa

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The endemic southern African Short-clawed Lark (*Certhilauda chuana*) comprises two isolated populations: one widespread in the west and the other restricted in the east. During the Southern African Bird Atlas Project (SABAP) period , the western population was recorded in 29 grid squares and the eastern in 15 grid squares. To determine present distribution and conservation status of the species, we surveyed the known range of western and eastern populations in South Africa during the 2004-2005 breeding season. In addition to grids in which presence was recorded during the SABAP, we also surveyed absence grids which included suitable habitat. The survey recorded the western population in only three and the eastern population in just five of the grid squares in which they were recorded during the SABAP,

overall changes in landscape configuration. While insectivores profit from the CAP reform, species richness of omnivore birds changes little, and richness of granivore birds declines in many regions. Income support programs allowing farmers to improve environmental performance in specific resource and management settings have a more positive effect on farmland bird diversity in our study area than production-based subsidies. The spatially explicit nature of the output of the model provides a powerful tool for analysing the current and future diversity of key bird species, aiding decision makers and nature conservationists in evaluating trade-offs between economic values and values of nature conservation.

O21: Population genetics

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So close and so divergent: phylogeographic structure of the Ground Tit, an endemic of the Tibetan Plateau

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The Ground Tit (*Pseudopodoces humilis*) is a weak-flying, typically alpine bird that dwells above the tree line at 3300-5500 m a.s.l. on rocky steppes and grasslands from north-west Sichuan Province, China, to the Tibetan Plateau. It has long been recognized as the smallest corvid, sharing common traits with *Podoces* as a result of adaptations to high-altitude treeless habitat: pale cryptic plumage, long decurved bill and long legs. Two previous anatomical studies cast doubt on its assignment to the Corvidae, and one recent phylogenetic analysis based on comparative osteology and sequences of the nuclear c-myc gene and mitochondrial cytochrome b gene identified the Ground Tit as a parid (Paridae). Here genetic variation at five microsatellite loci and the mitochondrial control region (590 bp) is analysed to test for inter-population differentiation in this species across its geographic range. Both nuclear and mitochondrial datasets reveal two distinct groups separated by relatively large mutational distances that were obviously generated by isolation on either side of the Qaidam Basin. According to geological data, the Tibetan plateau was uplifted to at least 3000m a.s.l. some 700 KYBP, altering the summer and winter monsoon circulation immensely. Subsequently, developing arid climate and abundant lacustrine sands led to the desertification of the Quaidam Basin about 600 KYBP. Requiring moister alpine habitat, populations of the Ground Tit became isolated on the mountains on either side and evolved into two genetically distinct groups. Restricted gene flow attenuated by distance was detected as substructure within samples from the Tibetan Plateau to the south of Qaidam Basin. In morphology, however, no parallel differentiation was found, perhaps due to the homogeneity of habitat across the range of the species.

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The phylogeography of the Elegant Scops Owl on the East Asian Islands

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The phylogeography of bird species reflects the influence of both the geographic history of the area of occurrence and the dispersability of the species. Islands have proved ideal sites for such studies due to their isolation from one another. The Elegant Scops Owl (*Otus elegans*) is a small owl found only in the forests of some East Asian islands. We used sequences of complete mitochondrial DNA cytochrome b and NADH dehydrogenase subunit 6 genes (1665 bp in total) to analyze population genetic structure in this owl on 10 islands in the Ryukyu Archipelago and on Lanyu, with the objective of inferring its genetic diversity, pattern of population differentiation, gene flow, and demographic history. Based on a sampling of 164 owls, we found higher genetic diversity on northern islands than in the south. No genetic variation was detected in the remote island populations on Minami Daito and Lanyu. Pairwise Fst between islands showed population differentiation among most of them. A deep divergence between northern and southern Ryukyu populations indicated a long period of isolation between north and south groups. Bayesian estimation using an MDIV program also revealed that divergence time and rate of gene flow differed among island pairs. Maximum likelihood estimates using the MIGRATE procedure found that gene flow between islands was low and directionally asymmetrical, with more northward flow than southern. Maximum likelihood analysis using the FLUCTUATE procedure revealed that Ryukyu populations have been expanding since the last glaciation, at a lower rate in the north than the south.

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Congruent phylogeography of the Rufous Gnateater and Variable Antshrike (Passeriformes) reveals secondary contact between lineages

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Congruent phylogeographies can reflect the influence of co-occurrent historical events on species distribution. Using mitochondrial DNA (mtDNA) sequences, we investigated phylogeographic patterns in the suboscinine Rufous Gnateater (*Conopophaga lineata*, C.li) and Variable Antshrike (*Thamnophilus caerulescens*, T.ca), both characterized by significant geographic variation in song and plumage throughout their wide distribution in South America. Nine remnant fragments of Atlantic Forest were sampled in the Brazilian State of Minas Gerais (MG), where subspecific range limits are not well defined for either species. Both species exhibited high intra-specific diversity, measured as p-distance: 1.2% for C.li (1580 bp of control region and Cyt b; n=104) and 0.7% for T.ca (2158 bp of control region, Cyt b and ND 2; n=26). Haplotype networks and phylogenetic trees revealed two divergent clades occurring sympatrically in southeastern MG. The genetic divergence between intra-specific clades was 1.3% for T.ca and 5% for C.li, while within clades, divergence was never higher than 0.3% and 0.7%, respectively. This area could be considered a secondary contact zone between lineages that expanded after evolving in allopatry. Another explanation could be that reproductively isolated taxa were misinterpreted as a single species, a reasonable hypothesis for C.li and T.ca due to their unknown variations in song and plumage. Furthermore, within the more common C.li clade, individuals from northeastern MG formed a divergent group, analogous to a pattern described in two other suboscinine species. On the other hand, northeast and southeast haplotypes in T.ca were closely related. Yet, even though future fieldwork is needed to compare songs and specimen material from more complete sampling, our observations of congruent phylogeography in these species is compelling evidence for long term divergence in allopatry followed by recent secondary contact. Financial support: CAPES, CNPq, FAPEMIG.

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Implications of recent artificial range expansion on the genetic structure of an endangered subspecies of the Purple Gallinule

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The nominate subspecies of the Purple Gallinule (*Porphyrio p. porphyrio*) ranges from Europe to northwest Africa but is fragmented in distribution today due to marked contractions in range during the last century. Only in the last 30 years has its distribution increased in Spain and Portugal, and more recently in Italy. These expansions have been mediated by natural and artificial causes, including several re-introduction events and a captive-breeding program in Spain. We sequenced intron 7 of the nuclear gene beta-fibrinogen (beta-fibint 7) from captive-reared birds introduced into central Portugal, east Spain and south Italy, and from birds from natural populations in south Portugal and southwest Spain, in order to verify that re-introduced populations were genetically similar to natural populations. Two common and highly divergent lineages were found that differ by one indel of 14 base pairs and several additional nucleotide positions. Their frequency, moreover, differed between natural and re-introduced populations. Although the captive-breeding program was based on birds from natural populations in southwest Spain, we show that this difference was originally present in the sample of birds used to start the captive-breeding program. Thus this case study addresses a key issue in conservation genetics, namely the effects of human-mediated genetic bottlenecks on the long-term viability of fragmented populations.

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Inferring the mode of speciation in *Nesospiza* buntings of the Tristan da Cunha islands

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Adaptive radiations on oceanic islands provide unique opportunities to investigate modes of speciation in birds. The Tristan da Cunha islands in the South Atlantic Ocean comprise three closely situated volcanic islands that are host to two morphologically well-defined bunting species, a small billed generalist Tristan bunting (*N. acunhae*) and a large-billed specialist Wilkins' bunting (*N. wilkinsi*). In addition, each of these species has morphological subspecies on each of two islands (Inaccessible & Nightingale). Both Wilkins' (*N. w. wilkinsi*) and Tristan (*N. a. questi*) buntings occur on Nightingale Island yet do not hybridise. Inaccessible, a larger island with greater habitat diversity than Nightingale, also hosts both Wilkins' (*N. w. dunnei*) and Tristan (*N. a. acunhae*) buntings. Furthermore, two morphs of *N. a. acunhae*, which appear to be segregated by habitat type and altitude, also occur on Inaccessible. Hybridisation on Inaccessible only occurs between the upland *N. a. acunhae* morph and *N. w. dunnei* in *Phylica* Woodland habitat, where the distribution of seed sizes is multimodal and relative abundances of seeds significantly lower than in adjacent lowland habitats where both subspecies co-occur, yet do not hybridize. An adaptive radiation in this case appears to have generated at least five independent lineages. In this paper we use microsatellite loci to infer the evolutionary affinities of each of these lineages, and thus identify the most likely mode of speciation in these birds. Our results indicate independent speciation events on each of the two islands, since birds segregate genetically by island and not by morphology. On Nightingale Island complete lineage sorting is evident, yet Inaccessible Island is characterized by incomplete lineage sorting with respect to habitat and morphology. Our results suggest speciation is complete on Nightingale Island, yet ongoing on Inaccessible Island.

O22: Timing of breeding

Malik S, Rani S, Kumar V

Regulation of seasonal response in migratory Black-headed Buntings: The role of photoperiod, temperature and food availability

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We investigated the importance of photoperiod, temperature and food availability in regulating seasonal responses (body fattening and testicular growth) in Black-headed Buntings (*Emberiza melanocephala*), a Palaearctic migrant which breeds at high latitudes (~40°N and higher) and overwinters in India (~25°N). Two experiments were performed. In one, birds were subjected to 11L:13D (11 hours light: 13 hours darkness), 13L:11D, and simulated natural lighting conditions for 16 weeks at two different temperatures: ~25°C and ~35°C. We also recorded observations simultaneously on a group of birds in an outdoor aviary, which served as the control. In the other experiment, we exposed birds to long days (16L:8D) with restricted food supply. Two groups of birds were given food for 5 hours beginning 11 hours after light on, one of which received glucose in water as a supplement. A group receiving food and water ad libitum served as control. Taken together, the results show that temperature and food availability modulate photoperiodic induction of body fattening and testicular recrudescence in this species.

Masello J, Quillfeldt P

Breeding during contrasting environmental conditions: Influence of ENSO in a colony of Burrowing Parrots on the Atlantic coast of Patagonia

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Birds are sensitive to perturbations in climate. Through their effect on food availability, interannual fluctuations in environmental conditions, such those caused by the El Niño Southern Oscillation (ENSO), may influence the condition of breeding birds and, consequently, nestling growth and breeding success. We studied the influence of ENSO on the reproductive ecology of Burrowing Parrots (*Cyanoliseus patagonus*) in the largest and most important colony of the species on the Atlantic coast of Patagonia, southern South America. This region experiences extreme dry conditions during the La Niña phase of the ENSO phenomenon, and highly increased rainfall during the years of El Niño. We used the contrasting conditions under these phases as a natural experiment for determining how environmental conditions affect breeding success, and survival and growth of nestlings, in Burrowing Parrots.

Ahola MP, Laaksonen T, Eeva T, Lehikoinen E

Competition over nest-holes between a sedentary and a migratory bird under climatic fluctuation

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It has been suggested that climatic change causes more difficulties for long-distance migrants than sedentary species, because they cannot sense phenological shifts in their breeding environments on the spot. Consequent changes of breeding times for hole-breeding species may then lead to changes in strength of competition over nest-holes. We studied the timing of breeding and competition between resident Great Tits (*Parus major*) and trans-Saharan migrant Pied Flycatchers (*Ficedula hypoleuca*) in a half-century-long time series in southwest Finland. Both species bred earlier in springs when breeding area temperature during species-specific sensitive periods was higher. In spite of this, the breeding periods for both species lagged each year behind both temperature rise and environmental phenology. We assessed probability of nest site competition from differences between the median laying dates of the two species, from a measure of breeding period overlap, and from numbers of observed conflict cases. There was considerable year-to-year variation in all three variables, but no evidence of a long-term trend. The difference between temperatures for the species-specific sensitive periods explained positively the difference in laying date medians, but had no effect on the other two variables. There was no evidence of differential ability to cope with climatic fluctuations between sedentary and migratory species.

Sternberg H[1], Grinkov VG[2]

The effect of hatching date on arrival time in spring, and the timing of breeding in male Pied Flycatchers

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Individual migrants arrive on their breeding sites at different times, ranging from a few days to more than a month. Data on variation in migratory behavior among individuals in wild bird populations are scant (Potti, 1998); and comparative histories, such as hatching date, are unknown. Little, too, is known about the factors controlling arrival time in long-distance migrants, other than that early arrival on breeding sites increases chances of producing more and better offspring for later recruitment. We studied timing of arrival in Pied Flycatchers (*Ficedula hypoleuca*) over four years in northern Germany and two years in Western Siberia, Russia. *Inter alia*, 393 males ringed as fledglings were retrapped in Germany and 132 in Russia. Here we compare breeding time and hatching date of one-year old birds and the hatching date of their offspring in both areas. Arrival time in males gradually advanced with increasing age; and earlier hatched one-year old males arrived and generally bred earlier than those hatched later. Hatching date of one-year old males was correlated positively with the hatching date of mates of the same age; and hatching date of fledglings depended on the hatching date of their one-year old parents. Age-related and hatch-related arrival in Germany was not significant in some years due to bad weather. In Siberia, arrival time is significantly shorter and could not be related to hatching date. Captive birds hatched late in the season start migratory restlessness (Zugunruhe) later in autumn due to endogenous, circannual rhythms modified by proximate environmental factors. Overall, this response parallels that for date of arrival and timing of breeding in spring, as indicated by the hatching date of recruits.

Visser ME

Timing of reproduction: Genetic variation in the mechanism underlying phenotypic plasticity

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Climate change has led to mistimed reproduction in a Dutch population of Great Tits (*Parus major*); the birds are laying too late to take full advantage of the temporal peak in their caterpillar prey to feed nestlings. As a result, the reaction norm of laying date versus spring temperature is now under directional selection: the birds should be laying under colder conditions. A prerequisite for a response to such selection is that there is genetic variation in the reaction norm. A major complication is that egg laying is the end product of a whole cascade of processes (onset and rate of gonadal growth, start of follicle development, etc.) and that each of these processes may differ in their sensitivity to temperature. To investigate genetic variation in the mechanism underlying phenotypic plasticity - the response mechanism - Great Tits were kept in climatized aviaries under two temperature regimes and recorded their laying dates. These birds are the offspring of wild Great Tits for which there are breeding values for timing of reproduction, i.e., whether genetically early or late. Gonadal development was measured throughout the experiment, from

December to May. From the experiment it will be possible to assess whether (a) genetically early and late birds differ in laying date, (b) whether there is genetic variation in the response to temperature treatment, and (c) if so, the components of the response mechanism in which tit families differ in their sensitivity to temperature. This will help in predicting responses in Great Tits to selection due to climate change, and in assessing whether current mistiming can be redressed.

O23: Evolutionary biology

Forstmeier W

Quantitative genetics and behavioral correlates of digit ratio in the Zebra Finch

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A recent study of a captive population of Zebra Finches (*Taeniopygia guttata*) suggested that variation in digit ratio, i.e. the relative length of the second to the fourth toe, could be an indicator of the action of sex steroids during embryo development. Zebra Finch digit ratio was found to vary with sex of offspring and laying order of eggs within a clutch, and to predict aspects of female mating behavior. Hence, it was proposed that measurement of the digit ratio would give insights into how behavior is shaped by maternal environment. Studying 500 individuals of a different population of Zebra Finches, I set out (1) to determine the proximate causes of variation in digit ratio by means of quantitative genetics, and (2) to search for phenotypic and genetic correlations between digit ratio, sexual behavior and aspects of fitness. In contrast to the earlier study, I found no sexual dimorphism in digit ratio and no effect on digit ratio of either laying order or experimentally-altered hatching order (power > 0.999). Instead, I found that variation in digit ratio was almost entirely genetically additive, with heritability estimates ranging from 71% to 84%. The rearing environment, from egg laying to independence, explained an additional 5-6% of the variation, but there was no indication of any transmission of maternal effects through the egg. Moreover, I found highly significant phenotypic and genotypic correlations between digit ratio and male song rate, and between digit ratio and female hopping activity in a choice chamber. Rather surprisingly, these correlations differed significantly between subsequent generations of the same population, illustrating how quickly such correlations can appear and disappear, probably due to genotype-environment interactions.

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Investment in offspring in relation to offspring sex and egg-laying order in the lekking Black Grouse

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Differential investment of maternal resources in offspring through the eggs can have major effects on offspring quality in birds. Towards documenting such impacts, we studied the effects of female condition on breeding performance in the lekking Black Grouse (*Tetrao tetrix*). Females were caught during winter and blood-sampled to determine several physiological measures of condition. Using radiotelemetry, we then tracked down their nests after clutches had been completed and estimated the laying order of the eggs. Just after hatching, the newly-hatched chicks were blood-sampled too, and their laying order subsequently determined by comparing DNA microsatellite markers in egg shells and chick blood. To date, we have analyzed carotenoid and immunoglobulin concentrations both in both eggs and newly-hatched chicks. The data indicate that female Black Grouse invest more carotenoids in male offspring but that investment of immmunoglobulins is the same in both sexes. Male chicks are only slightly heavier than females at hatching, a disparity that nevertheless increases to about 40% in adulthood. Contrary to findings in many passerines, investment of carotenoids and immunoglobulins in eggs does not change with order of laying. Female condition has at least some effect on the offspring sex ratio: broods hatched early in the breeding season were more female-biased than broods hatched later, independent of female age.

Nowakowski JJ

Direct selection of phenotypic features in a Sedge Warbler population

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Studies on natural selection have shown that strong selection pressure may lead to significant and rapid changes in morphological and physiological diversity in animals. This study aimed to explain long-term fluctuations of metric traits in a Sedge Warbler (*Acrocephalus schoenobaenus*)population. It was conducted between 1989 and 1999 in the Biebrza River valley of northeast Poland where measurements of 16 metric traits were gathered from 8358 birds. Variance between years was determined by principal component analysis (PCA). Wing length, tail length and body weight (factor 1), and wing shape parameters (Kipp's distance, wing sharpness and asymmetry coefficients) (factor 2) contributed most to the variance of factorial axes. Relationships between average factor loadings of principal components and weather conditions over the breeding season (northeast Poland) and the wintering season (meteorological stations in equatorial and east Africa) were tested using multivariate stepwise regression models. An optimal model was selected by applying Mallow's Cp criterion. Mean values of traits varied significantly and fluctuated between seasons. A linear trend in variation was observed in both factors over a long-term period also. Traits were correlated significantly with weather conditions during breeding and pre-migratory seasons in the Biebrza River valley, as well as during the wintering season in Africa. It was found that selection episodes under various weather conditions may be the reason for different directions of feature determination. Bird fatness and body condition, treated as adaptation functions, were also correlated with average weather conditions over the breeding season.

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Alternative phenotypes in White-throated Sparrows are associated with differences in steroid hormones

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Understanding how the phenotype and genotype are mechanistically connected is a fundamental question in biology. Polymorphisms with a known genetic basis provide a unique opportunity for investigating this link. One potent mechanism by which alternative phenotypes may be mediated is via hormonal action. White-throated Sparrows (*Zonotrichia albicollis*) have two morphs within each sex that differ in reproductive behavior and plumage. During the breeding season, morphs have either tan or white head plumage irrespective of sex. White males and females are more aggressive and sing at higher rates then than tan morphs. Behavior and plumage differences are correlated directly with an inversion on the second chromosome. We investigated whether production of or sensitivity to sex steroids mediate the differences in behavior and morphology. At the initiation of breeding, free-living white males had significantly higher circulating concentrations of testosterone (T) than tan males, a difference missing from captive male morphs, thus suggesting that white males experience more social challenges in the wild which leads to increased T secretion. Moreover, white males appear to be able to produce more intrinsic T, as demonstrated in response to injections of standardized amounts of gonadotropin-releasing hormone, GnRH. Female morphs did not show differences in sex steroid concentrations. Administration of exogenous T before and during molt did not alter male phenotype either, yet affected female phenotype. We suggest therefore that phenotypic differences between the two morphs are related to endocrine differences, in particular T, and that differences between male morphs occur at different levels of the endocrine axis than in females.

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Female mate choice in the Pied Flycatcher in western Siberia – variability of breeding color in males and reinforcement

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Reproductive isolation leading to speciation arises as a by-product of independent evolution in populations; but in the case of reinforcement, natural selection is hypothesized to act directly in hastening it. The interaction between Pied (PF, *Ficedula hypoleuca*) and Collared Flycatchers (CF, *F. albicollis*) in sympatry is one of the best examples of reinforcement. Species recognition and mate choice processes in the females of these flycatchers are key points, demonstrating that plumage divergence between the species is attributable to reinforcement. Studies of PF in western Siberia since 2001 have clarified the processes underlying the origin and evolution of variability in male plumage color. The Siberian population has a unique combination of features: males with dull brown plumage dominate in the region, and CF does not occur there. We investigated female preferences for male characteristics by means of field observations, removal experiments and aviary tests. Field observations showed that color type was unrelated to date of clutch initiation. The removal experiments demonstrated that previous breeding experience was related to the ability of males to acquire mates, that male age affected the date of clutch initiation, but that color type was unrelated to any of these features. In aviary tests, females showed no preference for color type of male plumage. Although further aviary tests need to assess species recognition ability in Siberian females, we already conclude that dull brown coloration in PF males can arise in populations far from areas where both species live in sympatry as the result of selective processes other than reinforcement.

O24: Morphology

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Ecomorphological relationships and species similarities in the wheatears (Turdidae)

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Ecomorphological relationships in the wheatears (*Oenanthe*) is intriguing due to the uncertainty of relationships between species and because clusters of species often coexist in apparently simple arid environments. Using museum skins, we measured 21 biometrical variables of three functional units: (1) flight apparatus, (2) feeding apparatus, and (3) foot-leg complex. Color pattern was examined by coding 17 units of plumage according to 18 tints. Principal morphological gradients were evaluated by ordination techniques, and then correlated with several ecological and behavioral traits, including migration, prefered habitat structure, movement pattern, and foraging mode. We also evaluated morphological similarities among species. According to biometrical and coloration patterns, we identified three main groups of species. The first comprises those that often occur in vast, open, flat or gently sloping and stony ground; the second includes species that inhabit mixed open, boulder-strewn and/or rolling hillsides and sides of valleys; and the third comprises species that are resident on steep, rocky or boulder-strewn hillsides or cliffs. Our results show that morphological traits of species are correlated significantly with migratory behavior, habitat selection, movement patterns, and foraging techniques. Migrants tend to have long and pointed wings, while residents have relatively long tails and tarsi and round-and-slotted wings. Certain species inhabiting hyper-arid areas, although resident, have characteristics resembling those of migrant species.

Kurk K, Bout R, Videler J

Functional morphology of feeding in swans and geese, Anserinae

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Feeding is crucial for survival and reproduction, and directly affects fitness. Waterfowl use several techniques for feeding, such as filter-feeding and grazing. Mechanically efficient filter-feeding, as found in Mallards (*Anas platyrhynchos*), requires a bald palatal surface to allow the tongue to function smoothly as a piston. To avert pump leaking, food items are transported through a groove alongside the tongue. Terrestrial grazing, as seen in geese, requires backward-directed spines on the palate to hold severed vegetation during intra-oral transport. Previous measurements of feeding efficiency in both Mallards and domestic geese reflect a trade-off between grazing and filter-feeding, which in turn may be explained by these conflicting demands on beak morphology. The feeding technique of swans is largely unknown. Swans, aquatic in lifestyle, forage mainly on submerged vegetation. We investigated the oropharyngeal morphology of Mute Swans (*Cygnus olor*) and performed efficiency measurements of filter-feeding and grazing. The morphology of the tongue is similar to that in both ducks and geese. The palate, moreover, is intermediate; spines are present but are fewer and smaller than in geese. Based on bill morphology and efficiency experiments, we suggest that swans are efficient filter-feeders. Observations of swans feeding in water show that a flow of water is created during transport of vegetation in the mouth. Swans are less efficient than geese in grazing, but clearly more efficient than ducks. We hypothesise that the technique used by swans for feeding on submerged plants involves aspects of both filter-feeding and grazing. Pumping of water through the bill may aid in transport of severed vegetation while the spines on the palate hold the vegetation in place whenever the tongue moves forward.

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Biomechanical analysis of the quail walking: From avian walk to a bipedal robot

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The walking abilities of the birds are often overshadowed by their surpassing capability for flight. Yet the hind limbs of birds, despite their rather stable morphology throughout the class, are surprisingly efficient in many activities, such as in walking, swimming, landing and taking off. The benefit of using such a structure in robotics has now been realized, and a biomechanical study analyzing the kinematics and dynamic features of walking quails carried out. X-ray video records were used for 3-D reconstruction of skeletal movements. The force exchange between the ground and the birds was used to determine the mechanisms enabling the bird to balance. The avian head-bobbing reflex is triggered by visual stimuli, and its properties as well as the mechanisms allowing synchronization between walking and head bobbing, were studied using a treadmill fitted with an optical system that allowed synchronization between treadmill and visual stimulation velocity. The resulting biological data were then used for designing a bird-like bipedal robot, RoboCoq.

Elzanowski A

Limb eco-morphology of the most primitive birds

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The pre-enantiornithine basal birds (PEBBs: Archaeopterygidae, *Sapeornis*, *Jeholornis*, and Confuciusornithidae) have strong manual claws which were most probably used for take-off climbing. Their form is inconsistent with wing-assisted incline running (WAIR) as a stage in the origin of avian flight. The intra-membral leg ratios (femur/tibiotarsus/tarsometatarsus) of modern birds are well correlated with the ecology of ambulation and suggest that the Archaeopterygidae were largely, but not exclusively, terrestrial, which is in agreement with the Climbing Escape Model of the origins of avian flight. All other PEBBs show unique leg ratios not comparable to any modern bird. The wing intra-membral ratios (humerus/radius/carpometacarpus) of modern birds are mostly group-specific (at least at family and higher taxonomic levels) and thus of little use for reconstructing the flight ecology of primitive birds. However, the similarity of skeletal ratios in Archaeopterygidae and Confuciusornithidae is striking because of the dramatic differences in the proportions of their feathered wings.

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Skeleton build up in growing King Penguin chicks (*Aptenodytes patagonicus*): how to cope with undernutrition and shifting from terrestrial to marine life?

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Chicks' rapid skeletal growth may be at the expense of bone tissue resistance. Moreover, mechanical constraints supported by the skeleton may change dramatically at fledging. This is particularly true in king penguins whose chicks rapidly shift from terrestrial to marine life at 1 year of age. In addition, in this species growth is disrupted by a 4 month period of undernutrition. How penguins cope with these constraints was studied in 13 chicks injected with vital dyes during the whole rearing period. Diametrical bone tissue growth and types were determined in the appendicular skeleton and comparisons were done with adults. During the first month of growth chick's body mass increased by 10 fold and a fast growing (up to 171µm/day) radial bone tissue was deposited. This tissue is thought to have a weak mechanical resistance but at this age locomotion was limited. In 3-4 month old chicks, before winter undernutrition, osteogenesis was markedly reduced but haversian remodelling began to occur. By this time chicks were freely walking, bone longitudinal growth was almost completed and body mass reached a first maximum (c.a. 8kg). Bones diametrical growth stopped during winter undernutrition, as evidenced by marked lines of arrested growth present in 11 month old chicks. When normal feeding was resumed, the mean diametrical bone growth (fibro-lamellar bone matrix <10µm/d) was 5 fold lower than in 1 month old chicks (p<0.05). Intracortical and endosteal labelling indicated intense haversian remodelling (most tissues deposited before winter undernutrition being reshaped) and filling up of the bone medulla. In chicks leaving to sea, this resulted in a pachyostosis however less marked than in adults, indicating that bone maturation continued at the beginning of marine life. Bone compacity changes throughout ontogeny, and secondary bone remodelling are discussed in relation to adaptation to marine life and by considering changes in mechanical constraints throughout growth.

O25: Mate choice

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Sexual imprinting: Enlightenment from interspecific cross-fostering in the wild

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Sexual imprinting through early learning has received much attention during the last few years. Most results, however, have been obtained from experiments with isolated birds in captivity. The process of sexual imprinting should therefore be evaluated under more natural circumstances. Accordingly, we carried out large-scale cross-fostering experiments in the wild in which nestling birds were raised by parents of a different species. The principal study species were the Blue Tit (*Parus caeruleus*), Great Tit (*P. major*), and Pied Flycatcher (*Ficedula hypoleuca*). We summarize our main findings, including the influence of cross-fostering and subsequent imprinting on song repertoire, mate choice, extra-pair paternity, parental investment, formation of heterospecific pairs and hybridization (Great Tit x Blue Tit). We conclude that early learning has strong effects on many aspects of behavior and life history.

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Do females prefer genetically dissimilar males as mates: Genetically disassortative mating in the Green-backed Tit in central Taiwan

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The genetic compatibility hypothesis suggests that females should produce offspring with the most adaptive genetic combination by mating with the most compatible male. If offspring heterozygosity is positively correlated with fitness, the hypothesis predicts that females choice is biased towards genetically dissimilar males. To test this, we used nine polymorphic microsatellite loci to measure heterozygosity and genetic similarity among mated pairs of the socially monogamous Green-backed Tit (*Parus monticolus*) in central Taiwan from 2002 to 2004. We found that genetic similarity between pairs that did not engage in extra-pair fertilization (EPF) (mean Rxy=-0.164, n= 13) was lower than that expected at random (bootstrap mean Rxy=-0.046, p=0.005, n=36 males, 34 females). In contrast, genetic similarity between cuckolded pairs (mean Rxy=0.128, n=3) was significantly higher than that expected at random (bootstrap mean Rxy=-0.044, p=0.023), but not for pairs with philandering males (mean Rxy=0.016, p=0.255, n=3). Genetically disassortative mating in Green-backed Tits thus supported the major collateral of the genetic compatibility hypothesis: females tended to mate with more distantly related males. EPF may serve, moreoever, as an adaptive strategy for female tits to moderate matings with more genetically-similar partners, an option supported by significantly lower mean heterozygosity of WPY in EPF broods (average SH and IR per brood=0.905 and 0.0.32, respectively; n=3) than that in broods without EPF (bootstrap mean SH and IR per brood=1.038 and -0.096 respectively, n=18; p< 0.001 for both SH and IR). This indicates a tendency in females to elevate heterozygosity in offspring by engaging in EPFs with genetically dissimilar males, as predicted by the genetic compatibility hypothesis.

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Asymmetrical incest avoidance in the choice of social and genetic mates

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Mating with close relatives generally results in reduced reproductive success (inbreeding depression) because it increases the risk of expressing rare deleterious recessive alleles in offspring. Nonetheless, incest may occur when animals have incomplete knowledge about relatedness or when the costs of avoiding inbreeding are high. Over a 17-year period, Savannah Sparrows (*Passerculus sandwichensis*) in an island population rarely paired incestuously: 9 of 1110 pairs, 15 of 1609 nesting attempts. All but one of the cases of close inbreeding (coefficient of inbreeding, F > 0.25) involved 1-year-old males breeding for the first time, and more than half of the cases involved females that were 3 years old or older. Father-daughter matings were avoided completely, despite 138 cases where fathers and daughters nested within 10-1000 m of each other. Incest avoidance was apparent in the choice of genetic as well as social mates. Paternity analysis using microsatellite screening revealed that birds refrained from choosing close relatives as genetic mates, with only three exceptions: an extra-pair and a within-pair mating between two older mothers and their 1-year-old sons, and an extra-pair mating between half-siblings. These results support a model of asymmetrical incest avoidance, which predicts differences in the likelihood of incestuous matings as a function of sex, age, and relationship, even when coefficients of inbreeding are identical. The model and the results of this study also emphasize the importance of distinguishing between types of inbreeding and of taking the social and historical context of mating choices into account. The model may help to explain such patterns as female-biased natal dispersal in birds.

Aidnik AU, Friedl TWP

The effect of plumage coloration on male-male interactions and reproductive success in the Red Bishop

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Secondary sexual characters in many species function both as status badges in male-male competition (intrasexual selection) and as cues for female choice (intersexual selection). Especially visual signals, such as bright, sexually dimorphic plumage, may serve such dual functions in birds. We examined the effect of male plumage brightness on both male-male interactions and male attractiveness in the Red Bishop (*Euplectes orix*), a polygynous and sexually dimorphic weaverbird occurring in Sub-Saharan Africa. In this species, males in breeding plumage defend small territories in reed beds or bulrush stands around water, and construct several nests within their territories. They also give a striking courtship display to attract females, and compete aggressively with other males for nesting sites that are invariably limited. Male reproductive success is determined mainly by territory tenure and the number of nests built, which are also good indicators of male quality. Here we analyse whether plumage brightness, hue and chroma in males, as calculated from measurements of spectral reflectance, are related to ability to defend territory against conspecific males and ability to attract females to territories. In addition, we determine the genetic parentage of nestlings by non-radioactive multilocus DNA fingerprinting to investigate whether plumage characteristics in males affect the likelihood of their social mates making extra-pair copulations with other males.

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Individual differences in the courtship displays of male Golden-collared Manakins: The bases for mate choice?

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The manakins (Pipridae) are neotropical passerines that perform some of the most spectacular courtship displays among birds. In the rainforests of Panama, male Golden-collared Manakins (*Manacus vitellinus*) form leks of 4-12 individuals in which each male clears a court on the ground between several vertical saplings. Males spend most of the time in or around the court performing acrobatic displays that include production of mechanical sounds with the wings: wingsnaps. These elaborate courtship displays are the result of an intense process of sexual selection. Until recently it was difficult to study manakin courtship displays because the movements of the birds were too fast for analysis by standard videography. In the last two years, however, we have recorded courtship displays of Golden-collared Manakins in the field with a portable high-speed videocamera. The analysis of the high-speed videos (500-1000 frames per second) has shown that the display of the male is particularly elaborate, similar to a gymnastic routine performed at a very high speed. Wingsnaps are produced by an explosive upward lift of the wings during a single wing stroke. At the end of each jump, the male turns in midair to land accurately facing the female. Other elements of the displays are back-flips and very fast vertical hovering. The analysis has revealed significant differences between individuals in features of displays, as in the speed of the jumps, in the time required to resume the 'statuary' posture after the jump, and in the time spent jumping during display. We discuss how such variability could indicate male quality and how sexual selection might have shaped courtship display in mamakins.

O26: Conservation: forests

Loyn R, McNabb E, Macak P

How can tree plantations contribute to meeting conservation objectives in varied landscapes?

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In many parts of the world, woodland birds are declining from the combined effects of habitat reduction, degradation and fragmentation. Programs to restore degraded landscapes often must involve the planting of native trees and shrubs. Until recently, few studies have examined the effectiveness of new plantations in this respect, despite an upsurge in their establishment on marginal farmland for commercial and amenity purposes. Recent studies in Victoria in southeastern Australia examined bird populations in 70 plantations of native eucalypt species (>5 years old) and on 30 comparable sites in both natural eucalypt forest and farmland. Data on habitat and landscape context were collected at each site. Eucalypt plantations generally supported higher bird densities than farmland, and lower densities than forest. The pattern varied between bird species and guilds. Plantations provided valuable habitat for seed-eating birds (including parrots, which are highly mobile and can access multiple habitats) and for insectivores that feed over open ground among trees. These guilds were at least as common as in native forest. Plantations also provided important habitat for honeyeaters and for insectivores that feed in tall shrubs and the eucalypt canopy. However, insectivores that feed on eucalypt bark or low shrubs were poorly represented in plantations. These patterns were related to habitat features of the plantations, including their age and species composition. Management options could be considered to increase the supply of rough-barked eucalypts, artificial hollows and a diverse understorey in plantations, to enhance their role in contributing to landscape restoration goals.

Hussin MZ, Leong PC, Yusuf ME

Understorey bird species as indicators of tropical forest ecosystem health

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The increasing use of forest land has motivated efforts to develop methods of sustainable management. One way of identifying and monitoring the status and qualities of such ecosystems is to use specialized species as indicators of particular ecosystem conditions. Thus the aim of this study was to identify those bird species or groups that are potentially useful indicators of the health of tropical forests. Bird surveys were carried out using mist-nets in three study sites, in primary forest and in 5-year-old and 10-year-old logged forests, in Sungai Lalang Forest Reserve, West Malaysia. A total of 58 species (271 individuals) was recorded in primary forest, 62 species (288 individuals) in 5-year-old logged forest, and 61 species (386 individuals) in 10-year-old logged forest. Assessment of feeding guilds indicated that insectivorous interior forest species dominated in primary forest, and frugivore/insectivore and nectarivore/insectivore species of secondary forest and forest edge in logged forest. The study revealed significant changes in species composition after logging, with retention of many original species but declines or disappearances in others. At the same time, secondary growth or colonizing species increased. This implies that the sensitivity of birds, particularly those of the understorey, to changes in forest condition may provide direct indications of the health of tropical forest ecosystems. Thus the maintenance of core components of biodiversity, such as understorey avifauna, may be key to the sustainable management and long-term productivity of tropical forests.

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Consequences of forest fragmentation on frugivores, seed dispersal and genetic structure of *Prunus africana* populations in Kenya

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Forest fragmentation can have consequences for species diversity and ecosystem processes such as seed dispersal and, in the long-term, may reduce genetic diversity among populations. In the fragmented Kakamega Forest, Kenya, we investigatedthese issues based on the frugivore community, seed dispersal and the genetic structure of adult and seedling populations of *Prunus africana* (Rosaceae). In the main forest and five forest fragments we quantified the overall frugivore community, the frugivores visiting 28 fruiting *P. africana* trees, and estimated seed dispersal. Using six microsatellite markers, we also analyzed the genetic structure of adult *Prunus* trees (N=93) and their seedlings (N=58). Samples of both adult trees and seedlings allowed examination of changes in gene flow between generations, adults reflecting the pattern before and seedlings after forest fragmentation. Although frugivore species richness was 1.1x lower in forest fragments than in the main forest, *P. africana* attracted 1.1x higher numbers of frugivores in the fragments. Correspondingly, seed dispersal was 1.5x higher in the fragments than in main forest sites. Genetic differentiation between populations of adult trees was very low (FST=0.03), with ~97% of the genetic variation within populations, reflecting extensive gene flow before fragmentation. Genetic variation between populations of seedlings was somewhat higher (FST=0.09), with ~91% of the variation within populations. We only recorded an isolation by distance pattern for seedlings. The slightly greater differentiation among populations of seedlings is the first sign of restricted gene flow caused by fragmentation. Yet even though overall frugivore abundance was lower in the fragments, quantitative seed dispersal was still as or more effective there, notwithstanding diminished gene flow indicated by genetic analyses in the past 80-100 years.

Sun Y-H

The Relationship between the bird fauna in the Conifer Forest around Qinghai-Tibet Plateau and in the Eurasian Taiga Forest

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The forest around the Qinghai-Tibet Plateau is an area with high bird diversity and endemism. There are many endemic birds in this forest having sibling species or subspecies in the Eurasian Taiga forest, including the Chinese Grouse (*Bonasa sewerzowi*) and the Hazel Grouse (*B. bonasia*), the Sichuan Jay (*Perisoreus internigrans*) and the Siberian Jay (*P. infaustus*), the Sichuan Wood Owl (*Strix davidi*) and the Ural owl (*S. uralensis*), the Gansu subspecies of the Boreal Owl (*Aegolius funereus beickianus*) and its northern races, the endemic subspecies of the Three-toed Woodpecker (*Picoides tridactylus funebris*) and their northern races, etc. The evolution of the two bird faunas should be related to the uplift of the Qinghai-Tibet Plateau and the movements of the Pleistocene glacial rebound. Starting from 1995, we have been working on the Chinese Grouse, Sichuan Jay, Boreal Owl and the Sichuan Wood Owl in Gansu and Sichuan, and getting basic knowledge of these birds. During this round table discussion, we wish to discuss with the colleagues in Europe and compare the behavior, ecology, genetics and other aspects of these sibling species. In North America, there is another sibling species or subspecies in each of these groups, such as the Ruffed Grouse (*B. umbellus*), the Gray Jay (*P. canadensis*), the Boreal Owl (*A. f. richadsoni*), etc, we welcome people working on those birds attending the discussion.

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Short-term responses of birds to reduced-impact logging in a lowland Amazon forest: Can reduced-impact methods help to retain avian biodiversity in tropical timber production forests?

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Reduced-impact logging, in which damage due to felling, skidding or log processing is minimized, has been touted as a means for retaining avian diversity in timber production forests in the tropics. Yet the effects of such methods on bird communities have rarely been investigated. Here we describe two mist netting studies that assess short-term responses in birds to low harvest (18.7 m^3/ha) reduced-impact logging in a terra firme forest in the Tapajós National Forest, Brazil. In the first study, birds were sampled in 60 m mist net lines, starting with a baseline one month prior to harvest followed by sampling for five years in control and cut blocks. A second study, which lacked a pre-harvest baseline record, used physiognomy specific sampling (i.e. gaps vs. understory) to compare samples in cut and control blocks at 20 to 42 months post-harvest. As expected, the results of the two studies were not fully concordant, given that physiognomy was not considered in the first study and that pre-harvest baseline samples were missing from the second. The physiognomy-specific study found increases in nectarivores and frugivores in cut forest, especially in cut gaps where guild members evidently tracked resource blooms. Understory sampling in the first study, in turn, detected a post-harvest decline in terrestrial insectivores and mixed-species flock insectivores in cut forest, in contrast to the other study in which insectivores, especially mixed-species flock insectivores increased in cut forest, particularly in gaps. Army ant followers were unaffected by cutting in both studies. Overall, both studies found no significant differences between control and cut forest in species richness, diversity (H'), rarity, and dominance. In general, effects of logging were relatively minor; low harvest rates and reduced-impact methods may thus help to retain aspects of avian biodiversity in Amazon forest understories.

O27: Population recovery

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Prioritizing the world's islands for vertebrate eradication; Or how to obtain maximum conservation bangs for bucks spent

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Despite the expected economic benefits of biodiversity conservation, current conservation resources fall well short of those needed to prevent major extinctions. Accordingly, conservation biology has long been preoccupied with optimizing the selection of protected areas. However, no commensurate attention has yet been paid to the issue of prioritizing the restoration of islands, even though, over the last 400 years, far more species have gone extinct on small islands than continents. Consequently, a large proportion of conservation effort is now devoted to removing the major cause of such extinctions from islands: invasive alien vertebrate species. With the development of anti-coagulant toxins and effective bait delivery systems, quite large islands can now be cleared of invasive vertebrates. Because of the urgency of the situation, a robust strategy for allocating available funds is needed quickly. The prioritization of eradication programs requires, for each candidate island, a system for objective estimation of the conservation gain, and an internally consistent method of predicting its financial cost. Using a global data file on vertebrate eradications, we show that costs can be predicted from basic information of island area, species to be eradicated and distance to main airport. We also describe a method for assessing the conservation benefit to birds. We can therefore offer the conservation community the tools for assessing which islands yield the greatest conservation bangs for each buck spent on vertebrate eradication. Lists of the islands which we consider should be high priority targets for future eradications will be presented.

Ndang'ang'a PK

Enabling implementation of action plans for threatened birds in Africa: The Species Interest Group approach

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The protection offered by protected areas and the identification by BirdLife International of Important Bird Areas, provides the basis of strategies for bird conservation that are site based. Some species, however, occur largely outside protected areas, are present in low densities over very large areas, or face threats that site protection alone cannot address. For such species, site-based strategies must be complemented by a targeted single species approach. From April 2001 to March 2004, the BirdLife International Africa Species Working Group implemented a Species Action Planning project in 17 mainland BirdLife Africa partner countries. It promoted participative action planning for globally threatened birds in Africa and trained African conservationists in principles and methods of species conservation. An African format and process for producing Species Action Plans (SAPs), was developed; and seven international and 15 national SAPs for seven priority globally threatened species were prepared through participative stakeholder workshops. At least 11 Species Interests Groups (SIGs) were established from this project as vehicles for implementing the SAPs. To move from the stage of producing SAPs to their implementation, follow-up work started in April 2004. Its aim was to build the capacity of and enable SIGs to drive the implementation of the produced SAPs and significantly contribute to conserving Africa's threatened species. Practical training has been given to the SIG coordinators, and the SIGs are being activated and energized to reach as many individuals as possible in the entire BirdLife Africa network of countries and beyond. As a result, the SIGs are playing their role as key promoters of the species conservation concept in Africa and are now implementing some of the species conservation projects in at least 10 countries. Further research to enhance knowledge of the conservation biology of most of the threatened species has also been stimulated.

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The role of captive rearing in kiwi conservation

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In the absence of conservation management, populations of kiwis (*Apteryx* spp.) on mainland New Zealand are declining at a rate of 6% per year, primarily due to depredation by stoats. One response has been to artificially incubate wild-laid kiwi eggs, and raise the chicks to "stoat-proof" size in captivity before release into the wild (Operation Nest Egg). Little is known of the artificial incubation requirements of kiwis, and hatching success is often low. Since 1996, we have been involved in a collaborative research program focusing on increasing kiwi hatching success. Prior to our study, average hatching success at the Kiwi Encounter captive breeding centre was 40%. Using knowledge of the incubation requirements of other ratites, and an adaptive management framework, we have increased hatching success to over 90%. Similarly, post-hatching mortality of captive kiwi chicks has declined markedly, and is now less than 10% per year. Over the nine years of the study, we have hatched over 300 kiwi chicks for release back into the wild; 86 of them were hatched in the 2004-2005 breeding season. We discuss the challenges associated with the collection and artificial incubation of kiwi eggs, and highlight areas for further research and management of these endangered species. Although captive rearing of kiwis is an effective short-term tool, longer term solutions are still required if populations are to maintain themselves in the wild.

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Do we need to be more creative in rehabilitating the Asian Houbara Bustard in Saudi Arabia?

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Since pre-Islamic times, the Asian Houbara Bustard (*Chlamydotis macqueenii*) has been the favored quarry of falconers in the Middle East. Over-exploitation, in combination with habitat degradation, has nevertheless contributed to its ongoing decline throughout its entire range. In Saudi Arabia, restoration of the bustard has been a focus of the National Wildlife Research Centre (NWRC) since its inception in 1986. As a result of successful captive breeding, reintroductions to the wild started in 1992, the first bustards being released into the Mahazat as-Sayd Protected Area (2,244km²). During 1993 an ambitious Species Conservation Strategy was developed in Saudi Arabia, with the long-term goal of securing self-sustainable bustard populations throughout the Kingdom that, in turn, would allow sustainable utilization. In this paper we provide the first assessment of that strategy. In so doing, we look at what has been learnt during the past 13 years, both of bustard ecology and the practicalities facing restoration of species in such a hyper-arid environment. This information is used to identify potential ways of maximizing the efficacy of future reintroductions in Saudi Arabia, and to highlight areas where more research is needed.

Klaus S[1], Unger C[2], Graf K[3]

A translocation success story using Capercaillie from central Russia

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As compensation for damaging Capercaillie (*Tetrao urogallus*) habitat in Thuringia in eastern Germany, an electric power company was required to repair the affected habitat and to undertake a translocation experiment to supplement the small population of Capercaillies remaining. Capercaillies were caught in autumn near Yaroslavl, c. 500 km northeast of Moscow in central Russia. Birds were released after two weeks of quarantine in pens located in adequate habitat. Between December 1999 and the end of 2003, 144 individuals were released, all of which were banded and 24 equipped with transmitters. The sex ratio was biased in favour of males, at 1.2:1, and the distribution of male age classes resembled that in the wild. Survival times for 16 marked birds averaged 242 days, 10 times higher than in released pen-reared Thuringian birds. In addition to single displaying males, a new lek with three displaying males was formed, and six independent cases of reproduction were observed in the released birds. Despite differences in habitat - wet lowland pine forest in Russia compared to drier mountain pine-spruce forest in Thuringia - the birds adapted well to Thuringian landscape topography, as well as to the different ground vegetation as a new nutrient source. Dispersal distances of released adults averaged 2.8 km.

O28: Breeding success

Zhang Z, Zhang Y, Zhang X

Studies on the sex ratio of Reeves's Pheasant in its natural habitat in China

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As an important parameter affecting the dynamics of natural populations, sex ratios have been studied intensively in several common species of birds. There is, nevertheless, limited information on sex ratios in many threatened species with small populations, such as the endemic Reeves's Pheasant (*Syrmaticus reevesii*) of China. By using RBS resolution, albuminuria K and RNA enzymes, total DNA was extracted from post-hatch eggshells of Reeve's Pheasants collected in the field for determining the sexes of hatched chicks by the CHD gene technique. Results indicate that the sex ratio of the chicks' male/female was 1:0.92 (n=37) in Dongzhai National Nature Reserve in central China. Field surveys conducted in two study areas in Dongzhai NNR and the southern Qinling Mountains in 2003-2004, moreover, showed that the adult sex ratio there was respectively 1:1.14 (n=373) and 1:1.10 (n=210). Comparing these data with those for Ring-necked (*Phasianus colchicus*) and Golden (*Chrysolophus pictus*) Pheasants in the same areas reveals that the proportion of females in the population structure of Reeves's Pheasant is relatively low, which could become a factor limiting recruitment in the wild. Variations in sex ratios have also been found in different seasons in Reeve's Pheasant in Dongzhai NNR. Two hypotheses are offered in explanation of these variations.

Limmer B, Becker PH

Effects of age, breeding experience and age of recruitment on the breeding performance of Common Terns

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The breeding cycle is a period of high energetic cost in the life of birds, for which several reproductive cost-based hypotheses have been proposed in explanation. Thus it has been suggested that breeding performance differs between young and old birds due either to the appearance/disappearance of phenotypes through differential survival (selection hypothesis) or previous breeding experience (constraint hypothesis). In this contribution, we test the constraint hypothesis while controlling for the current breeding and recruitment age of individuals. Common Terns (*Sterna hirundo*) were chosen as the study species, because they work near the limits of their physiological capacity; and our study was conducted in a tern colony in the harbour area of Wilhelmshaven on the German Wadden Sea coast. Applied transponders were used to monitor individuals throughout the breeding season and in consecutive years, using a system of antennas installed around the colony and at nests. Individual clutch size, hatching success and fledging success was measured for over 10 years. Across-years analyses showed a clear increase in all breeding parameters up to 6 years of age. Furthermore, significant differences were found between inexperienced and experienced breeders in clutch size, hatching success and fledging success. Where no significant correlation was found between breeding parameters and age, a positive correlation with experience was clearly evident. The strength of the relationship between age and breeding success, or experience and breeding success, also depends on the age of recruitment: 2-year old recruits have less success than 3- or 4-year old recruits; but the positive relationship between experience and breeding success was stronger. Thus we suggest that experienced birds cope better with the physiological constraints of reproduction.

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Breeding success in a Houbara Bustard population in eastern Morocco

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Breeding success in a wild population of the threatened Houbara Bustard (*Chlamydotis undulata undulata*) was investigated in eastern Morocco from 2002 to 2005. The aims where twofold: (1) to improve knowledge of the breeding biology of the species and to measure the impact of climatic variations on such parameters as duration of breeding season, breeding effort, clutch size, fresh egg weight and nest survival; and (2) to measure these parameters in a captive-bred released population to evaluate the success of a reinforcement program led by the Emirates Center for Wildlife Propagation. All breeding parameters varied significantly between breeding seasons according to climatic variation. Breeding success in 2004 was improved by a mild winter and rainfall in spring. It fell in 2005, which had a cold winter and dry spring. Climatic conditions were similar between years in the non-breeding season. Breeding success in Houbara Bustards seems to be influenced primarily by local environmental conditions on nesting grounds, rainfall and temperature having a direct effect and food resource availability an indirect one. Breeding parameters measured for released females did not differ from those for wild females, except in 2004 when environmental conditions were favorable: wild females, which were older and had a more breeding experience, had greater breeding success then. Nonetheless, the preliminary results on released birds are promising and long term studies are now needed to assess the success of the Houbara conservation program.

Toms M, Chamberlain D, Clark N

House Sparrows, home improvements and predators

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House Sparrows have declined throughout northern Europe in recent decades, and in several countries, declines have been steepest in urban areas. A number of hypotheses have been put forward to explain this, including increased predation and reduced availability of nest sites, particularly under the eaves and in the roofs of houses. We examined these two hypotheses through a carefully designed questionaire that was completed by c. 12000 people. Participants were asked to record the presence of House Sparrows in their gardens against a list of 96 variables that described the house, garden, surrounding habitat and other species in the vicinity. Results indicate that House Sparrows were more likely to occur where roof gaps were present, suggesting that nest site availability may be important in determining occurrence. Such roof gaps are apparently becoming less common due to ‘home improvements’, a possible factor effecting decline. Garden habitat was found generally unimportant, but the presence of sparrows was more likely where food was provided by householders. The presence of certain other species also influenced occurrence, which was significantly higher when Eurasian Sparrowhawks (*Accipiter nisus*) and domestic cats were present in the vicinity, but significantly lower when Common Magpies (*Pica pica*), crows (*Corvus* spp.), pigeons and squirrels were about, perhaps suggesting predation and/or competition as factors affecting sparrow presence. In 2004, a sparrow survey took place that sought to tease out some of these issues further. Results of this survey should provide crucial clues to the cause of House Sparrow decline, and suggest management practices that could restore its fortunes.

Pasinelli G, Schiegg K

The importance of spatial and temporal scales for avian nest predation: The case of the Reed Bunting

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Wetlands are affected globally by fragmentation at multiple spatial scales. Although the number and size of the remaining wetlands in Switzerland have not changed substantially in recent years, management practices in most wetland reserves have intensified, leading to increased fragmentation of reed patches, with unknown consequences for reed-dependent organisms. Drawing on data on the reproductive performance of color-banded populations of Reed Buntings (*Emberiza schoeniclus*) over three years, we investigated the ecological and landscape factors affecting probability of nest predation at four spatial scales. At both egg and nestling stages, probability of predation was determined mainly by factors acting on the nest, the edge and at landscape scale. At egg stage, predation rate was low when vegetation cover was high, but increased with increasing open water in the immediate neighborhood of the nest and water depth below the nest (nest scale). Nest predation declined with increasing size of reed patches and distance of nests from water edges, and with decreasing habitat edge-to-area ratio (edge scale). At landscape scale, nest predation increased with distance between wetlands. At nestling stage, probability of predation again declined with increasing vegetation cover, but increased with the number of tussocks around the nest (nest scale). At the edge scale, nest predation was negatively related to distances from both land and open water, as well as to patch size, but positively related to the relative amount of edge habitat. Nests located far from forests were more likely to be attacked than nests close to forests (landscape scale). Nest predation in Reed Buntings living in a highly fragmented landscape is thus related to factors acting at multiple spatial scales. Management of wetland reserves should aim at preserving reed patches large enough to provide safe nest sites for birds.

O29: Migration

Shamoun-Baranes J, van Loon E, Bouten W

Modeling adaptive behavior in migrating White Storks

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White Storks (*Ciconia ciconia*) are soaring migrants whose western Palearctic populations use several migration routes, concentrating mainly over Gibraltar and Israel to cross between their Palearctic breeding grounds and wintering quarters in Africa. Over the last several decades, a wealth of data has been collected on stork migration through visual observation, ringing, satellite telemetry, radar and motorized glider studies. Through these studies, much is known about migratory routes, migration timing and intensity, flight altitudes, and the influence of meteorological conditions at different scales. The data and knowledge from these studies, however, have yet to be combined to provide a comprehensive understanding of the mechanisms involved in shaping the course of White Stork migration. We are now integrating the available knowledge into a dynamic, individual-based simulation model. The model, comprising several equations and behavioral decision rules, will describe the behavior of White Storks during their autumn migration from Europe to Africa along the eastern migration route. Large-scale gridded meteorological data will be used to drive the model. We parameterize the model by restricting parameters and decision rules to the minimum required to give a close fit to observed distributions of migration speed and direction. By confronting model results with field observations, and by applying general-purpose optimization algorithms to identify the “best” parameter sets, we test different combinations of decision rules and theories regarding adaptations in flight behavior against meteorological conditions. Different parameter sets resulting in, for example, successful migration, can be used as surrogates for different stork personalities and help in understanding how individuals cope in their own way with dynamic environmental conditions during migration.

Fitzgerald T, Taylor P

Displaced migratory juvenile Yellow-rumped Warblers adjust their orientation following stop-over

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Birds that migrate in poor weather conditions, such as strong winds, risk becoming displaced enroute. Risk may be even greater along coastal areas where prevailing winds could cause displacement over the ocean. If birds traditionally migrate in environments where displacement risks are high, then adaptations for adjustment or correction should be present, particularly following stop-over. We hypothesized three scenarios following displacement: 1) continued orientation in the innately preferred direction, 2) orientation from the new location to the intended destination or 3) a mid-course correction to return to the original pathway. To test these hypotheses, we used video-based orientation cages to measure migratory orientation of juvenile Yellow-rumped Warblers (*Dendroica coronata*) captured at a coastal island stop-over site in southern Nova Scotia, Canada. We measured the deuterium isotopic signature from collected feathers to determine an individual’s natal origin. We assumed that birds with natal origins north and northwest of the stopover site were displaced from their normal migratory pathway due to prevailing northwesterlies and were east of their intended routes. After statistically accounting for possible treatment and physiological effects, individuals originating from north-northwest natal origins, oriented in a more westerly direction, whereas migrants originating from northeast of our study area oriented southwesterly. This supports scenario three: individuals from north-northwest origins likely respond to an easterly displacement by orienting in a westerly direction to re-establish their previous migratory route. We suggest that migratory populations regularly prone to such displacement may have adaptive behavior to overcome these movements.

Phillips LM[1], Oppel S[1], Powell AN[2]

Movements of the King Eider during the non-breeding period revealed by satellite telemetry

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The North American population of the King Eider (*Somateria spectabilis*) has declined substantially over the past 30 years, but the causes are poorly understood. As King Eiders spend about 10 months of the year at sea, a potential source of mortality might be associated with molting and wintering at sea. In order to determine core areas for non-breeding King Eiders off the Alaskan North Slope, we caught 60 adult birds (27 females, 33 males) in two breeding areas and equipped them with internal satellite transmitters. The transmitters sent location information every 48 hours during late summer and fall migration, and lasted up to 13 months. Satellite tracking revealed a leap-frog pattern on both fall and spring migration. Important molting areas included the Chukotka and Kamchatka Peninsulas, St. Lawrence Island, Kuskokwim Bay, and the Beaufort Sea. Females arrived later in molting areas, but used much the same areas as males. During molt, King Eiders remained in shallow waters (3-18 m) for 4-6 weeks at an average distance of 16 km from shore; water depth and distance from shore differed between sexes. Winter quarters were located along the Chukotka, Kamchatka, Alaska and Kenai Peninsulas. King Eiders moved extensively between different wintering areas, potentially indicating some adaptability to weather patterns. In both molting and wintering areas salinity and ice cover were significantly lower than in unused areas. Further factors determining molt and wintering areas, such as food abundance and availability, will be explored in the near future. Ledyard Bay appeared to be an important spring staging area used by both sexes. Female King Eiders returned to the same breeding site in the year following their capture, but males wandered as far afield as the central Russian and Canadian Arctic. This indicates that males may be the main contributors to gene drift between eastern and western Arctic populations.

Gerkmann B, Riede K

Use of satellite telemetry and remote sensing data for identifying important habitats of migratory birds: The White Stork as an example

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This study aimed to develop a new method for identifying important habitats for migratory birds by combining satellite telemetry and remote sensing data. Telemetry data are analyzed to localize staging areas on the migration route or on wintering grounds. Overlay of telemetry and remote sensing data then enables input of habitat parameters for vital conservation information. In cooperation with the Max Planck Institute for Ornithology, satellite tracking data from 66 White Storks (*Ciconia ciconia*) was analyzed. Reanalyzing telemetry data with a newly developed algorithm provided an index for differentiating migrational and staging datasets. Subsequent investigation using GIS then enabled localization of staging areas. Initial results stress the importance of newly-found pre-wintering areas for White Storks in the Sudan and Chad. Further important staging areas were also found on the migration route and in wintering areas such as Botswana. For combining remote sensing with telemetry data, remote sensed data were obtained from the Global Land Cover Project. Overlaying this information on staging data revealed that White Storks had a preference for croplands and grasslands. Ongoing work will focus on correlating changes in vegetation (judged from precipitation) with stopovers of storks, clarified by overlays of telemetry and NDVI data.

Busse P

Bird navigation models as a theoretical basis for field cage tests

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The factors involved in the migration of a young holarctic bird from its natal grounds to winter quarters are so complex that they should be treated as a "blackbox" with "inputs" and "outputs". Return migration only adds to complexity, as evidenced in the following sequence: (1) start of autumn migration = "switch on" migrational activity and "switch on" southward direction, (2) arrival at winter quarters = azimuth of migration and "switch off" migrational activity, (3) start of spring migration = "switch on" migrational activity and "switch on" northward direction, and so on. If the bird has inherited a biased line of navigation, it must have in its orientation system additonal "switches" for correction. If the individual is an interpopulation hybrid, it may be endowed with more than one navigation program. Directional switches sometimes also work improperly, producing such variants as "reversed" migration. In the classic cage experiments, the main questions tested were those properties of the environment that could be used as cues for orientation. Experimental birds responded to changing cues, but their status did not change - they did not move according to their activity. In our tests, birds were confined in an artificial situation for only a short time, but visual cues for nocturnal orientation and diurnal feeding were blocked. Whether the birds reacted by switching on other inherited long-distance navigation cues or behaved by remembering the immediate environment is discussed.

O30: Immune responses

Palacios MG[1], Cunnick JE[1], Winkler DW[2], Vleck CM[1]

Patterns and mechanisms of immunosenescence in the tree swallow

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Biological aging, or senescence, is one of the least understood components of a life-history. Most knowledge about patterns and mechanisms of senescence comes from laboratory studies of model organisms, and relatively little is known about its relevance for aging in free-living populations. Immunosenescence, an age-related decline in immune function, is well documented in humans and mammalian models, but not well known in birds. We assessed patterns and mechanisms of immunosenescence in a free-living Tree Swallow (*Tachycineta bicolor*) population in Ithaca, NY, USA. We measured cellular (acquired) and humoral (acquired and innate) immune function of adult individuals spanning 1-8 years in age. We used *in vivo* and *ex vivo* assays of immune function to understand underlying mechanisms. Proliferation of lymphocytes *ex vivo* in response to T-cell mitogens (PHA and ConA) decreased with age. This suggests reduced proliferative ability of T-lymphocytes might be one mechanism underlying the previously documented age-related decline in *in vivo* cellular immune response in this population. In contrast, proliferation of lymphocytes in response to a B-cell mitogen (LPS) did not change with age, in accordance with our lack of detection of immunosenescence in humoral immune responses, both innate and acquired. Studies in humans and other mammals indicate that decreased ability of lymphocytes to proliferate upon stimulation is a hallmark of immunosenescence and that B-cell function does not decline with age as pervasively as T-cell function does. Our finding of immunosenescence in avian T-cell, but not B-cell proliferation, is in accordance with these ideas. Our study suggests that deterioration in T-cell function might be an important mechanism underlying immunosenescence in birds. In future studies, we will examine other components of immune function and variation in rate of immunosenescence in species with diverse life-histories.

Tieleman BI[1], Kleynhans EJ[2], Versteegh M[2], Helm B[1], Gwinner E[1]

Annual patterns of immune function and energetics: A common-garden study on stonechats from different environments

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Life history traits can not only be phenotypically adjusted to prevailing environmental conditions but can also evolve in response to them. A unique assembly of Stonechats (*Saxicola torquata*) originating from populations with markedly different life history characteristics reared in a common garden, and the existence of hybrids between the populations, provide an excellent opportunity for investigating the endogenous bases for seasonal adaptations of interconnected physiological systems and life cycle events. The current Stonechat assembly maintained at the Max Planck Institute for Ornithology consists of resident equatorial birds from Kenya that have evolved in a year-round benign environment, Irish and central European birds from environments with moderate seasonal variation, and Stonechats from Kazakhstan that are subject to severe seasonality in their native habitat. The seasonality of the respective environments is reflected in different internal annual calendars in the birds, as exemplified by their diverse migratory strategies. We investigated their annual cycle in innate immune function by examining the bactericidal ability of blood when exposed to *Escherichia coli* and *Staphylococcus aureus*, and by quantifying natural antibodies and complement. In addition to measuring innate immunity during each major life cycle stage, we also determined basal metabolic rates in the same birds. Preliminary results suggest that subspecies differ in innate immune function: the long-distance migrants from Kazakhstan posessed the highest bacteria-killing ability. These results tentatively support the hypothesis that animals which live in disease-prone environments or that encounter diverse habitats should invest more in immune defense. They do not corroborate the alternative hypothesis that species which live life at a slower pace (longer life span, low metabolic rate) should have the strongest immune defense.

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Immune strategies in migratory birds

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The massive movements of migratory birds raise growing concern about their role as vectors for emerging infectious diseases. Migrants, however, appear to cope amazingly well with the challenges posed by movements between often strikingly different breeding and wintering environments. Research has addressed the possible role of birds in the occurrence and spread of enzootic diseases. In contrast, little attention has been paid to features of the immune system which enable birds to cope with these challenges. Recent developments in immunology point to an array of arms by which immune systems optimize defences, while presumably minimizing fitness costs of concomitant metabolic and behavioral changes. Migratory birds face the simultaneous challenge of migration and exposure to novel pathogens. Accordingly, their choice of immune strategies must be balanced between the requirements of migration and the thwarting of novel pathogens. We study immunological and behavioral mechanisms for coping with immune challenges in captive Common Stonechats (*Saxicola torquata*). This passerine breeds over a wide geographical range and differs regionally in migratory behavior. We assess stonechat responses to a simulated infectious challenge (LPS), accounting for responses by different arms of the immune system by considering multiple parameters. Simultaneously, we monitor behavioral changes in the birds in response to the challenge, in order to assess whether migratory activity is compromised by immune response. This test is applied to birds of different migratory disposition, both during and outside migration seasons. The results suggest immunological strength in migrants, but also behavioral costs in coping with immune challenges.

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Evidence of an inter-annual effect from maternal immunization on the immune response of juveniles in a long-lived seabird

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Maternally-derived antibodies (Ab) that enhance offspring resistance against parasites may have several implications for the ecology and evolution of host-parasite interactions. Studies on domestic animals have nevertheless underlined a potential “blocking effect” from Ab, i.e., that maternal Ab against a given antigen can block the immune response of juveniles against that same antigen when exposure occurs early in life. We tested this hypothesis in a wild species, the Black-legged Kittiwake (*Rissa tridactyla*). Combining a vaccination against Newcastle Disease Virus (NDV) and a cross-fostering design, we show that specific maternal Ab blocks the production of specific antibodies in chicks following vaccination at one day of age. Depending on when and how nestlings are exposed to parasites, the possible benefit of maternal Ab may thus be outweighed by it interference with the immune reponse in the nestling itself. Evaluating the cross-generational implications of immunity transfer will thus require further experimental investigation to determine how these trade-offs have evolved under different host-parasite regimes. In the current study, females were exposed to the antigen one year before the functional effect of their maternal antibodies was tested on their chicks. Such studies thus will also have to consider the natural patterns of exposure of females and nestlings to deleterious parasites at different scales.

Nilsson J-Å, Granbom M, Råberg L

Does the strength of an immune response reflect its energetic cost?

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Europe. The recent expansion and development of such populations there was probably caused by climate change and the provision of novel man-made habitats suitable for wintering ducks.

Kéry M, Schmid H, Zbinden N

Trend analyses from chance observations of birds in Switzerland: Correction for effort and random-effects models for combined analyses across species

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Trends of abundance or occurrence in single species, or in groups of species specific to a certain habitat or region, are among the main nation- or even continent-wide indicators for biodiversity conservation. Apart from running standardized schemes focusing mainly on common species, fauna monitoring organizations also often collect chance observations made by volunteers. Two of the problems with the interpretation of the data resulting are: (1) how to correct for variation in observer effort to estimate population trends, and (2) how to combine estimates for groups of species, such as farmland birds. In Switzerland, a certain degree of standardization in the collection of chance observations was introduced in 1985. This involved the selection of particular breeding bird species for which inscribed observers had to submit all observations from a particular excursion, which were then stored on a 1x1 km grid of country-wide quadrats. Based on the annual total of records for these species, and the number of visits carried out to each quadrat, we calculated a measure for observer effort. We present our attempts to statistically standardize the resulting data, finding that better measures of effort would be desirable but that useful results are still obtainable. We further present the use of random effects models for estimating combined trends for groups of species. These models provide a natural way of expressing the contribution of each individual species to an overall trend for a group of species. They have hardly been considered so far in avian indicator development, yet they provide a statistically rigorous way of combining information across species in a coherent way and correct for the fact that trends in different species are estimated with different precision.

Leech D, Crick H

Influence of weather variables on the productivity of single-brooded bird species in Britain

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There is increasing evidence that global climate is warming rapidly. Mean annual temperatures in Britain have risen by almost 1°C since the beginning of the 20th Century, and further increases are predicted over the next 100 years. Patterns of precipitation are also likely to vary, with rainfall increasing during winter and early spring and decreasing in summer. The weather conditions that the British avifauna will experience in the future, therefore, are likely to differ markedly from those with which they contend at present. Such differences have potential to influence species abundance through their impact on both survival rates and productivity. Volunteers participating in the Nest Record Scheme (NRS) of the British Trust for Ornithology have been collecting data on avian productivity throughout Britain since 1939; the NRS dataset now holds c. 1.3 million records of individual breeding attempts for 232 species. The impact of weather conditions and climate change on the phenology of reproduction has already been investigated for a number of species, analyses of the NRS dataset indicating a significant advancement in laying dates across a broad range of taxa. However, fewer studies have explored the relationship between weather and productivity *per se*, particularly at a national scale. In this analysis of NRS data, we investigate the influence of weather conditions on productivity - clutch size, brood size and stage-specific failure rates - in a range of common British birds during the breeding season. Using identified relationships between climate and productivity, we were able to make predictions about the future reproductive success of these species based upon climate change scenarios produced by the United Kingdom Climate Impacts Programme (UKCIP).

Sandvik H

Towards a nomothetic study of the effects of climatic change: Causes and correlations revealed by seabird population dynamics

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Climatic change is predicted to affect many species in both direct and indirect ways. Even so, our ability to forecast the biological consequences of global change is still severely impaired. A better understanding of how species and ecosystems respond to naturally occurring climatic oscillations is therefore of critical importance. Climatic conditions vary at several temporal and spatial scales. Documentation is accumulating from both terrestrial and aquatic animals that such climatic variability exerts effects on a variety of morphological, demographic and other parameters. Thus far, however, many studies merely report whether or not or how strongly a set of biological parameters co-varies with climatic parameters; the underlying causes are often far more poorly understood. This is so partly because most studies focus on the level of population. In addition to descriptive studies of this kind, research needs to aim at understanding *why species differ* in their responses, both in sign and magnitude. To achieve this goal, it is necessary to carry out comparative studies at interspecific levels. Accordingly, I report here findings from phylogenetic analyses of seabirds, the objective of which was to explain between-species differences in responsiveness to climatic variability. Seabirds were chosen as the subject for study because this group offers unique opportunities for analyzing causal links: seabirds share a marine environment while at the same time exhibiting an amazing variation in trophic adaptations, behavioral traits, life-history tactics and geographic distribution. A database was compiled using published long-term demographic data from all taxa of seabirds. Analysis of the data yields insights as to how the ecology and life history traits of species affects their response, and vulnerability, to climatic oscillations at different time scales.

Poster Presentations

Abbasi F, Yahya HSA

Natural selection favors temporal distribution as a niche partitioning mechanism among four coexisting egrets at Sheikha Lake, India

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Four egrets - Great Egret (*Egretta alba*), Intermediate Egret (*E. intermedia*), Little Egret (*E. garzetta*) and Cattle egret (*Bubulcus ibis*) - that coexist throughout the year on Sheikha Lake, India, are the focus of this study. The study area is a perennial wetland adjacent to an irrigation canal on the upper Gangetic plains. To examine the presumption that natural selection in sympatric species with similar foaging niches leads to differing temporal patterns to avoid competitive exclusion, we investigated the feeding behavior in all four egrets from August 2000 to March 2004 in the non-breeding season. Individuals were watched through their daily cycles, and data pooled and analyzed with the Kruskall Wallis test for differences in energy budget over three seasons (winter, summer and monsoon) and at three times of the day (morning, afternoon and evening). Differences among species were significant at the $P<0.05$ level. When a one-way ANOVA was performed to compare time budgets among the four species, further differences were revealed. A post hoc Tukey's test confirmed this as due to differing activity patterns between combinations of two species. A factorial analysis using Principal Component Analysis was then carried out to establish the most important variables of the activity budget that depended on the time allocated to particular activities in each species. It was found that foraging, roosting and preening were the major types of activities, and that these were spaced over gradients differing between species. As a result, we have been able to demonstrate niche partitioning among the four coexisting egrets.

Abraham A

Parental investment and rank order in fledged Arabian Babblers (Timaliidae)

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Hierarchical social systems are known in many bird species, with consequences for reproduction in adults and survival in siblings. The Arabian Babbler (*Turdoides squamiceps*) is one such species, its social groups ranked patrilinearly with older above younger and males above females. Here I investigated different classes of social behavior in four captive juvenal babblers and their parents through the first ten weeks after fledging. My aim was to analyse differences in sibling care allocated by parents, determine when and how rank order was established among siblings, evaluate behaviors relevant to the babbler hierarchical system, and learn the consequences of a rank system for social behavior in the siblings. Throughout the period, the parents focused their feeding and attention on the most dominant sibling. Moreover, a strict hierarchical order was quickly formed, with the oldest juvenal dominant and the youngest subordinate to the rest. The clearest indicator of the hierarchy was pecking behavior, and its consequences were reflected particularly clearly in the clusters formed at roosts to sleep where the dominant sibling commonly occupied the innermost position and the younger the outer margins. Advantages in thermoregulation and protection from predators may be conferred to dominant siblings by such behavior. In other aspects of behavior, such as playing, dominant siblings also invariably interacted with dominant and subordinate with subordinate, in dyads. The study showed that an hierarchy is formed early in the social life of babblers, and that parents favor the dominant sibling.

Ade M [1], Frahnert S[2]

The Rock Dove in the city: A new look at an old problem

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A question not yet answered adequately is: what are the factors that make the Rock Dove (*Columba livia*) so successful in colonizing cities? We seek the answers through an organismal approach, one which regards organisms as self-sustaining systems with specific abilities and limitations determined by their structure and organization. The abilities and limitations of the organism will be used to explain the high potential of the Rock Dove to colonize urban areas, because in the structure and organization of the organism are found the germs for successful habitat binding. Evolutionary history is also part of the process. Every evolutionary step is embedded within an array of characters that already exist with functional attributes: new attributes are embedded within the old. Yet novel attributes are selected in specific response to immediate environmental constraints, and thus rank higher than the old in terms of determining response or function to specific cues. The more specific the cue, the more rigid or canalized the path of action constrained by evolutionary history. Both function and history will provide a robust hypothesis for explaining the colonizing capacity of the Rock Dove.

Adelman J, Wikelski M, Hau M

Does testosterone-mediated immunosuppression vary with the probability of adult survival?

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Recent research suggests that testosterone (T) -mediated immunosuppression may be an adaptive and evolutionarily labile reallocation of physiological resources (Wedekind and Folstad, 1994), rather than a universal constraint on T-related phenotypes (Folstad and Karter, 1992). The particular life history scenarios that favor T-mediated immunosuppression, however, remain unclear both among and within species. Life history theory proposes that under a low probability of adult survival, an organism maximizes lifetime reproductive success by investing more resources in reproduction than self-maintenance. We hypothesized that populations with a lower probability of adult survival would exhibit more severe T-mediated immunosuppression, allocating more resources away from self-maintenance. We are testing these predictions in two geographically separated populations of the song sparrow (*Melospiza melodia*). Data from the Institute for Bird Populations' MAPS banding program show that *M. m. melodia* populations in the NE United States have significantly lower adult survival than *M. m. morphna* populations in the NW US (Michel et al. 2005). During spring 2006, birds from these populations received either testosterone or empty implants and, 7-14 days later, injections of lipopolysaccharide (LPS) to activate the innate immune system. A blood sample was then taken to assay acute-phase protein production as a marker of immune response strength. We also took blood from unmanipulated birds to quantify constitutive immune defenses. All birds were sampled at comparable stages of the breeding cycle. Experimental implants significantly increased circulating levels of T (p=0.001, Mann-Whitney U-test). Constitutive immune defenses tended toward stronger complement-mediated lysis in the higher-survival Washington population (p=0.03, Mann-Whitney U-test). We are currently determining whether populations differ in acute-phase protein response to LPS between T- and control-treatments.

Adriaensen F[1], Githiru M[1], Matthysen E[1], Lens L[2]

Modelling forest connectivity for critically-endangered bird species: A case study in the Taita Hills, Kenya

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The montane forests of the Taita Hills in southeast Kenya have lost over 95% of their indigenous cover in the last 200 years, mainly due to clearing for agriculture. Despite the small size of the twelve remaining indigenous forest fragments (1-179 ha, 9 of which are smaller than 10 ha), they are of global conservation importance because they retain several endemic and threatened plants and animals, including the critically endangered Taita Thrush (*Turdus helleri*). To maintain the ecological integrity of these remnant forest fragments and to ensure the long-term viability of their endemic populations, there is an urgent need to increase the area of indigenous forest in order to restore connectivity among the fragments through carefully-planned forest restoration. We will present the results of a connectivity analysis for the Taita Hills landscape based on least-cost path analysis, and supported by dispersal data estimated from nine years of capture-mark-recapture effort. The least-cost analysis provides quantitative estimates of the isolation of forest fragments, based on the relative resistance or friction of the matrix between patches and enables the identification of existing or potential corridors for dispersal between patches. Because it can be used to assess the conservation value of specific corridors or stepping-stones, it is an important conservation tool for pin-pointing priorities for forest restoration throughout the landscape. The project is funded by the Critical Ecosystem Partnership Fund and the results will be implemented directly in local forest restoration plans.

Ajagbe AA

Habitat use by the Adamawa Turtle Dove in Amurum Forest Reserve and surrounding farmlands in northern Nigeria

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The Adamawa Turtle Dove (*Streptopelia hypopyrrha*) is endemic to northern Nigeria and adjacent Cameroun, where it is found in wooded ravines and cultivated areas. The daily routines of the dove were monitored in the Amurum Forest Reserve, Jos, in central north Nigeria, and surrounding farmlands between February and April 2004. A total of 413 birds were recorded at two study sites using line transects, 185 in the reserve and 228 in surrounding farmlands. In the forest, activity peaked before 0700 hours, particularly around gallery forests. Birds perched and flew about but did not forage at the time. After 0720 hours, abundance and movement shifted to the farmlands, where most birds foraged. Unique asemblages also gathered on freshly burnt farmland. The pattern of movements indicated that the doves use farmlands by day for foraging and the Amurum Forest Reserve by night to roost communally; they also nest in the forest. The presence of islands of forest in cultivated farmland is of obvious benefit to the dove, and maintenance of such mosaics should be explored as a strategy for conserving this and other granivorous birds.

Albayrak T[1], Erdogan A[1], Bairlein F[2]

The density and habitat of Krueper's Nuthatch in Mediterranean Turkey

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The global distribution of Krueper's Nuthatch (*Sitta krueperi*) is centered in Anatolia, with outliers breeding on Lesvos and the Caucasus. Krueper's Nuthach occurs mainly in coniferous forests of Red Pine (*Pinus brutia*), Black Pine (*Pinus nigra*), cedar (*Cedrus libani*), fir (*Abies cilicica*) and juniper (*Juniperus* sp.). We investigated the distribution and density of Krueper's Nuthach in various regions of Mediterranean Turkey. Density at pairs/ha was derived from standardized line transect observation, with highest numbers in fir stands (mean 0.142±0.02 s.e., n=4 study plots at mean altitude of 1464 m asl), followed by juniper (0.128±0.06, n=4 at 1086 m asl), Black Pine (0.122±0.01, n=6 at 1532 m asl), cedar (0.075±0.01, n=4 at 1476 m asl) and Red Pine (0.075±0.01, n=35 at 654±66 m asl). Within Red Pine, density was related positively to altitude, between a range of 50 - 1499 m asl.

Aleixo A[1], Burlamaqui T[2], Gonçalves E[2], Schneider P[2]

Molecular systematics of the Ocellated Woodcreeper complex (Dendrocolaptidae) in tropical South America: Implications for taxonomy, conservation, and historical biogeography

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The Ocellated Woodcreeper (*Xiphorhynchus pardalotus - X. ocellatus*) complex includes three currently recognized polytypic species (*X. pardalotus, X. ocellatus*, and *X. chunchotambo*), the taxonomic limits of which are still uncertain. To address these issues, we sequenced between 666 and 1,064 base pairs of the mitochondrial DNA cytochrome b gene for 58 individuals of all described taxa in the complex, except *X. o. lineatocapilla*, the validity of which is doubtful. Estimates of phylogenetic relationship based on maximum parsimony, maximum likelihood, and Bayesian inference were produced with PAUP* 4.0b10 and MrBayes 3.1 software using only unique haplotypes and two intra-generic outgroups: *X. fuscus* and *X. spixii*). Models of molecular evolution used in maximum likelihood and Bayesian estimates of phylogeny were selected by a likelihood ratio-test implemented with MODELTEST 3.7 software. The different criteria employed produced essentially congruent estimates of phylogeny, and the only conflict between them and an earlier smaller dataset pertained to the position of the form *weddellii*, now placed consistently as sister to *X. pardalotus*. Such a relationship is consistent with a biogeographic connection between the Guianan shield and northwestern Amazonia, as also documented for several other avian taxa. Furthermore, the genetic distinction of *weddelli*i is indicative of species status, a rank not evident from its highly conservative plumage. This and other studies suggest that accurate estimates of avian diversity in the Neotropics will only become possible when the systematics of polytypic species complexes are revised by in-depth multi-character taxonomic analysis.

Allen S, Briskie J

The fitness costs of population bottlenecks in introduced bird species of New Zealand

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Many endangered species, both by definition and through conservation-led translocation and captive breeding programmes, go through population bottlenecks. Populations that undergo a bottleneck are likely to experience a reduction in fitness, as individuals are forced to mate with relatives, leading to decreased genetic diversity and increased levels of inbreeding. It is therefore of crucial conservation relevance to establish if there are negative fitness effects associated with these events, and if so, at what severity of bottleneck these effects become apparent. The introduced birds of New Zealand provide a perfect opportunity to examine the fitness of a range of wild-living species that have experienced population bottlenecks of differing severities. A number of exotic (mainly British) birds were established in New Zealand in the 19th century by acclimatisation societies. The number released, and hence the severity of their bottleneck, varied from just 11 individuals to more than 1000 individuals. Furthermore, the source (and presumably non-bottlenecked) populations of these species are still extant in the UK, enabling a pre- and post-bottleneck comparison. We are examining if negative fitness effects, measured by level of parasitic infection, immunocompetence, and developmental abnormalities, increase with severity of bottleneck, and if so how large a bottleneck is required to eradicate these negative effects when founding a population. We are conducting both a cross-species comparison, across the range of bottleneck severity within New Zealand, and an intra-species comparison between the UK and New Zealand (i.e. comparing ‘before’ and ‘after’ populations of the same species). Our aims are: (i) to establish the extent and effect of population bottlenecks on bird populations, and (ii) to determine the critical number of individuals needed to avoid these fitness costs when founding a new population.

Almasi B[1], Jenni-Eiermann S[1], Roulin A[2], Jenni L

Genetic, maternal and environmental variability of circulating corticosterone levels in Barn Owl nestlings: Effects on postnatal development and phenotype

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Most organisms live in unpredictable and changing environments which force them to modulate their behavior to maximize fitness. In birds, environmental perturbations generally elevate circulating corticosterone, a stress hormone capa.ch of adapting behaviorasi(

on populations of migratory birds, three main factors have to be considered: the risk of collision, the risk of marine habitat loss, and the risk to migrants from expenditure of additional energy to circumvent the barrier-effects caused by windfarms. The latter problem has been pointed out several times but no attempt has yet been made to estimate its importance. One reason is the lack of sufficient empirical data on the body condition of birds, namely of non-passerines; and another is species-specific flight behavior in relation to wind turbines. Against this background, we developed an approach that should enable an initial theoretical risk-assessment of the problem in quantitative terms, by combining empirical data on body condition with several alternative assumptions about flight behavior. We chose as our models a number of passerine migrants that use different flight strategies. For these species, extensive data from birds trapped on the offshore-island of Helgoland in the German Bight provide a good basis for distinguishing and quantifying those that belong to the different respective classes of body condition and related flight range, as derived from the Pennycuick aerodynamic model. By classifying the birds in this way, it is possible to quantify the proportion of a single migratory population that might be affected adversely by different scenarios of offshore windfarm development along the migration route if variable flight reactions are assumed. Supported by the German Federal Agency for Nature Conservation

Balmaki B, Barati A

Long-term changes and dynamics in populations of Caspian seabirds in Gilan Province, Northen Iran

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Because communities of seabirds are core elements of aquatic ecosystems and play an integral role in ecological and biological cycles in these habitats, surveys on their status and fluctuations in diversity and abundance are crucial in the management of such ecosystems. Because of its diverse habitats and position on migration routes, the south Caspian Sea provides a critical refuge for different species of seabirds. Accordingly, we monitored the diversity and abundance of seabirds in the Gilan Province on the southern Caspian Sea over ten years from 1992 to 2002, and report here the patterns of occurrence and fluctuations found. Mid-winter census data collected by the Department of Environment, Iran, revealed no clear trends in the abundance of members of Laridae, Pelecanidae and Phalacrocoracidae. Maximum and minimum numbers occurred in 2002 and 1994 respectively, both in Laridae. Numbers of two threatened species, the Pygmy Cormorant (*Phalacrocorax pygmeus*) and Dalmatian Pelican (*Pelecanus crispus*), remained stable across this period. Factors influencing abundance and diversity were analyzed. Such assessments were considered necessary prior to conservation action for seabird communities in this diverse habitat, in order to provide basic information for management plans.

Bamola VD, Rauthan US, Chandola-Saklani A

Management of Himalayan pheasants: Current status, habitat preferences and nesting

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A number of pheasants (Phasianidae) are confined to the Himalayan hills where, in the Garhwal region of the central and west Himalayas, surveys have been carried out to database their status, habitat, ecology and behavior. Results show that the Kalij Pheasant (*Lophura leucomelanos*)prefered temperate/subtropical mixed deciduous forest and shrubs for nesting, and laid a clutch of 11.1±2.9 eggs. The Himalayan Monal (*Lophophorus impejanus*) prefered temperate moist/evergreen forests around rocky cliffs instead for nesting, and laid a smaller clutch of 5.3±0.7 eggs. Population densities of Monals were 11.8±1, 6.5±2.5, and 1.8±0.9 individuals/km^2 in Kedarnath Sanctuary, Dodital Forest and Gangi Forest respectively. Hunting rather than habitat destruction is probably the cause for the relatively low numbers in Gangi Forest, as the condition of forest habitat is much the same in all three areas and indirect evidence of hunting was found in Gangi. Hunting has apparently depleted some populations of Kalij Pheasants also. Data from 40 villages indicated that 2.4% of villagers held guns, and that hunting forays were carried out about three times a month; average loss due to hunting was 3+0.4 birds/month. Repetitive data for a subtropical population of the Kalij Pheasant revealed marked seasonal variation in population numbers which constant monitoring showed to be due neither to migration nor hunting but to the annual increment of chicks which dispersed after attaining sexual maturity. After ten years, the relative indices of its population status had not changed, indicating that the population is stable despite human interference, hunting and wild fires. Comparisons of current relative indices for the Monal from Kedarnath Sanctuary with those obtained a decade ago similarly indicate no change.

Banik M

Brood division: One more difference between Whinchat and Common Stonechat

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Though widespread, brood division is one of the lesser known phenomena in bird behavior. It is expressed in post-fledging family groups, where particular young birds are fed consistently by only one of the parents. One way of exploring its causes is to compare its manifestation in related species, such as the Whinchat (*Saxicola rubetra*) and Common Stonechat (*S. torquata*). I gathered data on the question in long-term studies of both species in the Kharkiv region, Ukraine, between 1992 and 2004. Brood division was common in the Whinchat but rarely observed in the Common Stonechat. Whinchats usually rear only one brood in a season and their territorial boundaries are relaxed soon after fledging. As a rule, Whinchat pairs divide their broods, and the two subfamilies become separated spatially. Initially, brood division may be a by-product of staggered nest departure and differential dispersion of fledglings, but later it is obviously ruled by the increased mobility of the parents. There was no brood division in some of the few pairs of Winchats that were able to raise second broods on stable territories; others did divide their broods but both subfamilies remained within the breeding territory. Common Stonechats have two broods, which are raised on territories occupied throughout the breeding season. Rare cases of brood division were recorded before fledglings could fly fully, but later all broods combined in united families. Thus, territorial behavior in adults contributes significantly to the appearance or absence of brood division in these species. When manifested, it seems to be initiated by dispersion of fledglings but is later controlled by the territorial behavior of adults.

Bankovics A[1], Bankovics A[2], Széll A[3]

Partial migration in the Great Bustard in Hungary

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The Great Bustard (*Otis tarda*) suffered a severe decline in Hungary in the late 1980s, reaching a minimum of around 1000 birds. Since then, the population has slightly increased due to nature conservation efforts, exceeding 1300 individuals by 2006. One of the main threats to the population is loss during migration, which led to an international conservation initiative under the auspices of the Bonn Convention. Partial migration of the Great Bustard manifests itself in three different ways. First, bustards breeding east of the river Tisza migrate locally or regionally almost every winter whereas birds from Kiskunság, between the Danube and Tisza rivers, usually winter on their breeding grounds. Secondly, all birds migrate in severe winters when temperatures reach -20°C and snow cover lasts more than a week, moving southwards to the Balkan or the Appenine peninsulas. It is in such cases that the bustards suffer highest winter mortality. Thirdly, in mild winters, usually only the lighter-bodied females migrate well to the south, while the heavier males remain either on the breeding grounds or elsewhere near the Hungarian border.

Baratti M[1], Ammannati M[2], Dessì-Fulgheri F[2]

Mhc variation and mate choice in pheasant

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The ring-necked pheasant (*Phasianus colchicus*) is a species not endemic to Italy, but it is nevertheless an important animal for the Italian wildlife management plans. The common pheasant is polygamous: males, belonging to three possible hierarchical levels (territorial, satellite and peripheral), are characterized by secondary sexual traits. Typical pheasant male ornaments, involved in sexual selection, are represented by the wattle, the tarsal spur and the tail, although the wattle seems to be the only secondary sexual character linked to the effects of testosterone. The size of the wattle at the beginning of the reproductive season correlates with high testosterone level. According to the "good genes" hypothesis, choosy females can improve the genetic quality of their offspring by mating only with males that will contribute good genes to their offspring. Male ornaments function as good quality signals, inheritable from the progeny, appearing to be correlated with male viability and resistance to parasites. Only individuals with enhanced genetic resistance to parasites would be able to express better secondary sexual ornaments. Given that there are no studies showing a direct relationships between molecular variation and male ornaments under the control of testosterone, we have explored this point analysing MHC and microsatellite polymorphism in semi-natural populations and artificial lines of the ring-necked pheasant. In particular we have analysed two captive-bred lines (n=60) (minus and plus-variant), subject to a six-year captive breeding program by which males have been selected for the "wattle" character, and a semi-natural population (n=70) inhabiting a restocking area in Tuscany. Genetic analysis will be carried out using amplifications, CE-SSCP, cloning and sequencing. This molecular analysis allowed us to compare neutral and adaptive genetic variation in these populations and to describe new PhcoMhc alleles.

Baratti M[1], Cordaro M[2], Dessì-Fulgheri F[2]

Investigating wild and domestic forms of the mallard by microsatellite markers

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The Mallard (*Anas plathyrinchos L.*) is undoubtedly the most common waterfowl and can be found almost anywhere in the world. In accordance with recent studies, this species is an important migratory component of the Holoartic fauna, probably an important vehicle for spreading the avian flu along the migration routes. In the study of this complex task, the molecular approach utilized to obtain data on the genetic structure of the taxon could give an important contribution to understand how the disease spreads out. In the wild massive restockings, for hunting purposes as well as for ornamental aims in the aquatic urban habitats, were often performed using bred and domestic animals. These latter ones, well identifiable through some eco-ethological characteristics, were generated in the past by the domestication of the wild mallard and the artificial crossings of the different domestic breeds. In this study we want to determine the genetic identity of the wild and domestic forms, their possible interspecific hybridisation with other taxa of the genus Anas and to analyse the genetic structure of the local and the winter (permanent individuals together to migratory ones) Italian populations. At this aim, we have studied urban and wild populations, further to captive-bred and sentry stocks of mallard ducks from Central and Northern Italy, using microsatellite markers. This analysis had allowed us to characterize the genetic structure of the populations and to obtain some interesting results, as that indicating the wild populations significantly divergent from the urban populations, which also show the typical eco-ethological adaptations of the domestic form. These data represent the first molecular contribution for the knowledge of mallard duck populations in Italy and their relationships with northern and eastern European fauna, and should help to improve management and conservation of the wild form.

Barbosa A, Barrientos R, Valera F, Moreno E

Selection of different nesting microhabitat as a response to different predator pools

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Nest predation is one of the main factors determining avian fitness, and nest location is considered the main adaptive response to this selective pressure. We test this hypothesis by comparing nest siting in two populations of an arid zone species, the Trumpeter Finch (*Bucanetes githagineus*), subject to different numbers of predators. Fuerteventura in the Canary Islands has the lower number of predator species while Almeria in southeast Spain has the higher. At these locations, the following variables - percentage vegetation, flat ground and rock coverage, maximum vegetation height and substrate slope - were measured in 2x2 m squares at five levels in relation to nests: ahead, behind, at fixed distances of 5 and 15 m, and at random points. Nests were also classified as accessible (mainly on the ground) or inaccessible (on cliffs) to predators. In the Almeria population, Trumpeter Finches seemed to select nest habitat with less vegetation and ground floor coverage, more rock coverage, shorter vegetation, and greater slope; 68% of the nests were located on the ground and 32% in cliffs. In the Fuerteventura population, they preferred sites with taller vegetation. In this population, all the nests were placed on the ground. When examining the effects of nest habitat on predation, we found that all non-predated nests in Almeria were secreted in sites with short vegetation or in cliffs, while in Fuerteventura, lowest predation rates were found on nests located in broken terrain with low vegetation and ground floor coverage, high rock coverage and high slope. Our results indicate that the two populations of Trumpeter Finches select habitat differentially according to the abundance of predators. We also suggest that ground-nesting, as found in Fuerteventura, seems to be the primitive condition, while in Almeria where the finches are faced with more predators, new positions less accessible to predators are used.

Barbosa A, Carrillo C, Valera F, Moreno E

Abiotic factors and ecto- and haemo- parasite pressure in an arid zone bird, the Trumpeter Finch

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Parasites have a major influence on the ecology and evolution of their host and much effort has been invested in its research. Ecological and environmental factors also affect host-parasite relationships but less attention has been paid to these proximate mechanisms. The information that is available is in any case incomplete because most studies addressing spatio-temporal variation in parasite pressure have been carried out on organisms living in temperate and mesic environments; little is known about the pressures in desert organisms. Several hypotheses have been proposed to explain parasite pressure in arid environments. The absence or scarcity of appropriate vectors as a consequence of lack of suitable habitats has been one reason put forward to explain the low prevalence of haemoparasites there. Low ambient humidity has also been considered a factor in reduced ectoparasite pressure. Here we study spatio-temporal variation in the prevalence and intensity of infection of haemoparasites and chewing lice in the Trumpeter Finch (*Bucanetes githagineus*), an arid zone bird breeding in southern Spain. We compare these variables with abiotic factors (precipitation, relative humidity) and their variability over study areas and across years (2002-2004) to investigate relationships between parasitism and environmental factors. Prevalence and intensity of haemoparasites was low and did not vary between areas or among years in spite of interannual variation in precipitation. Prevalence of chewing lice (*Brueelia* and *Philopterus* spp.) varied among years in some seasons and age classes. Differences in parasitic load were found only in *Brueelia*. No clear association exists between humidity and ectoparasite pressure, and our data does not support effects from the external environment on haemo- and ecto- parasitic pressure.

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Spring stopover for a long distance migrant on the Island of Gavdos, the southernmost point of Europe

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Successful migration depends on fuel deposition rate (FDR) and the duration of stopover refuelling. The latter is the most important factor determining overall speed of migration. Fuel deposition rate (FDR), stopover length, and rate of body mass change, a variable that affects the duration of stopovers, were estimated for spring-migrating Garden Warblers (*Sylvia borin*) on the Island of Gavdos, Greece. Gavdos is located south of Crete and is the first land that northwards moving birds encounter after leaving the African coast on spring migration. Data on the Garden Warbler were collected during spring migration over three consecutive years, from 2002 to 2004. Average FDR was 0.8% of lean body mass per day, and varied between years. Garden Warblers reached Gavdos with an average body mass of 15.2g and gained mass at a rate of 0.05 g/h or 0.29 g/d. Average stopover length was 3 days. The only variable that seemed to affect stopover length was the rate of body mass change.

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Arrival times and biometric correlations in sylviine warblers in Vojvodina, Serbia

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Five of the 17 western Palearctic warblers of the genus *Sylvia* occur in Vojvodina, the northern province of Serbia. Of these, only two, the Blackcap (*S. atricapilla*) and Greater Whitethroat (*S. communis*), are common, permanent breeding species in diverse forests and woods. Depending on weather conditions, most Blackcaps arrive in the second half of March on spring migration, but both Greater and Lesser Whitethroats (*S. curruca*) are later, usually appearing in mid April. Within the last five years, the Lesser Whitethroat has begun to breed in northwest Vojvodina, but only in very small numbers. The Barred Warbler (*Sylvia nisoria*), which arrives in early May, stays on to breed in still smaller numbers. The Garden Warbler (*Sylvia borin*) also migrates through Vojvodina at the end of April or very beginning of May, but does not remain to nest. Using ringing data from the National Centre for Animal Marking, we analyzed 10878 ringing records of sylviine warblers from over ten years. The analysis included biometric data such as wing length and age, which was correlated with the timing of movements in spring and autumn of adults and juveniles in all five species. No statistically significant biometric correlations were obtained for short-distance migrants, such as the Blackcap and Lesser Whitethroat. For long-distance migrants, however, a positive correlation was found between wing length and age in respective sexes. Wing length in the Greater Whitethroat was particularly dimorphic sexually and with age: males and older birds of both sexes are longer winged than females and juveniles, respectively. A similar relatioship was found in the Garden Warbler, in which older birds had longer wings, while Barred Warblers showed correlations between arrival date and age. Such relationships suggest further correlations between molt and age.

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Phylogeny and speciation in African larks (Alaudidae)

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There are two centers of endemism in the predominantly Old World family of larks (Alaudidae) in Africa, in respective north-east and south-west arid zones of the continent. We investigated the phylogenetic relationships among 55 of the African species, together with finer scale data for three species complexes: the Karoo (*Certhilauda albescens*), Long-billed (*C. curvirostris sensu lato*) and Spike-heeled (*Chersomanes albofasciata*) Larks. Analysis of two mitochondrial DNA gene sequences suggests an ancient rapid radiation of the family in Africa and the presence of eight distinct lineages. Among these, several genera are polyphyletic, notably *Mirafra, Ammomanes, Eremalauda, Calandrella* and *Certhilauda*, and there is also evidence of cryptic taxa, especially among locally resident forms. We suggest that this diversity was driven largely by independent speciation within the two arid zones. More recently, during the Plio-Pleistocene, there has been some exchange between the zones via the arid-corridor. Finer scale analysis of morphological and genetic diversity within the three species complexes from the south-west arid zone revealed considerable diversity that has been overlooked in these wide-ranging but sedentary larks.

Barrett G, Reid J, Nicholls AO, Drew A, Freudenberger D

Rebirding rural landscapes - Australia's temperate woodlands

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Dominated by stock grazing and cereal cropping, Australia's temperate woodlands are its bread basket, and support the national meat and wool industry. Not surprisingly, more than 80 per cent of original vegetation in the woodlands was cleared for agriculture by early in the last century, and much of what remains is fragmented and impacted by surrounding land use. The loss and simplification of this native grassy woodland has led to the prediction that as many as half of the Australian farm bird species will eventually disappear from these intensive rural landscapes. An analysis of reporting rates using national bird atlas data indicates that one in six bird species has declined significantly over the last 20 years. In New South Wales, much of which falls within the agricultural zone, one in four birds species were found to have declined. Some results from this analysis will be presented, and the implications for farm birds discussed. The Holbrook Landcare Rebirding Project will be introduced in the context of catchment-based management bodies that provide a framework for setting conservation targets and achieving outcomes through on-ground farm works. Although there are considerable grounds for optimism in this new planning scenario, birds will continue to decline in rural Australia without a dramatic increase in funding for conservation. With targets for protecting birds being set for whole catchments and conservation works being planned and implemented by individual farmers, the issue of scale needs to be considered as well.

Barri F, Navarro J, Martella M

The effects of livestock density and vegetal biomass production on breeding success in wild Lesser Rheas

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The abundance of Lesser Rheas (*Rhea pennata*) is related to food availability and hunting intensity. The aim of this study was to determine how reproductive parameters for this species are affected by competitive livestock density and production of vegetal biomass. We studied wild Lesser Rheas in two contrasting fields in southwest Río Negro, Argentina. One field of 7800 ha was stocked at low density at 4 sheep/10 ha and produced high vegetal biomass of 750 kg/ha/year; the other field of 2800 ha carried high livestock density at 11 sheep/10 ha and produced less vegetal biomass of 500 kg/ha/year. From August 2004 to February 2005, we carried out periodic ground surveys to record the number of individuals, nests, and eggs per nest of Lesser Rheas in the two fields. Hatching success and chick survival rate were calculated afterwards. In the first field, 89 adult rheas (1.26 + 0.06 individuals/km^2) and 16 nests (0.21/km^2) were found, 11 of which produced chicks from an average clutch of 22 eggs, and with a hatching success of 72%. In the second field, 28 adults (1 + 0.03 individuals/km^2) and 5 nests (0.18/km^2) were recorded, of which 3 produced chicks from an average clutch of 19 eggs, with a hatching success of 70%. Average brood size was 16.2 chicks with a 76.6% survival rate in the first field, and 13.7 chicks with a 79.8% of survival rate in the second field. Thus parameters did not differ significantly between fields, and were similar to those obtained for rheas in other parts of Patagonia. Although the data are preliminary, they indicate that neither tested level of livestock density and primary productivity affected reproductive success in Lesser Rheas, perhaps because of the wide diversity of vegetation and low overlap between rhea and that of domestic sheep and cattle. In such circumstances, declines in Lesser Rhea populations are more probably related to direct anthropogenic disturbance, such as hunting.

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Resource partitioning in the Rock Firefinch and the Red-billed Firefinch

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Resource partitioning in birds is most frequently studied along a two-niche axis: habitat and diet and/or their derivatives. The habitat differences and seed preferences of two sympatric Firefinch species, the endemic Rock Firefinch (*Lagonosticta sanguinodorsalis*) and the Red-billed Firefinch (*L. senegala*), were studied during the early wet season of 2005 at the Amurum Forest Reserve and the surrounding Laminga Village, Jos, Nigeria. The populations of the two firefinches were recorded in farmlands, grasslands, and rocky outcrops using the line transect methods and seed preference was studied by observations at artificial feeding patches having two seed types: *Digiteria exilis/* (acha) and *Panicum* sp (millet). Both Firefinches exhibited habitat preferences; the Rock Firefinch chose rocky outcrops and grasslands while the Red-billed Firefinch showed a high preference for farmlands. The two Firefinches showed an overlap in diet. These two Firefinches probably avoid competition by exploiting food resources at differing feeding times as more Red-billed Firefinches were recorded on acha in the afternoon than in the morning. This knowledge of coexistence between the two studied species can help in their conservation, most especially the endemic Rock Firefinch.

Bauchinger U

Maintaining a water budget during starvation: May protein catabolism liberate water bound to protein?

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Migration often involves long periods of sustained flight without intake of food or water. So energy and water are both considered as limiting factors in successful migration. Almost all organs reduce substantially during long-distance flight. The water hypothesis postulates that protein is catabolised in order to liberate water bound to protein, thereby contributing to maintenance of water balance. Starvation experiments were performed on Japanese Quail (*Coturnix japonica*) with and without available water to investigate a possible "protein sparing effect" during starvation when drinking is still possible. After 84 hours of starvation, both groups lost significant body mass compared to a control group with access to food and water *ad libitum* ($p<0.001$). Yet mean body mass loss was significantly lower in those birds that had access to drinking water during starvation ($p<0.01$). Lean dry mass of flight muscle, the biggest organ in mass, did not differ between the three groups (GLM $p=0.1$). Water content (% of lean mass) of flight muscle was significantly reduced only in starved birds that had no access to water ($p<0.05$). In contrast, lean dry mass of the kidneys was lowest in the starvation group with access to water, differing significantly from both other groups (GLM $p<0.001$, $p<0.05$). Lean dry kidney mass did not differ between controls and starved quail without water. Whether the starvation groups catabolise different proteins and therefore differ in their water content (selective protein catabolism), or the difference in water content reflects interstitial water, remains unclear. The experiment nevertheless demonstrates the central role of the kidney in maintaining water budgets. Further compositional and histological analyses will be performed to clarify the mechanisms.

Baumung S, Eilers A

The bird ringing station "Reit" in Hamburg and the influence of climate change on migration

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The bird ringing station "Reit" is located in a 48 ha nature reserve 12 km southeast of the center of Hamburg where two old tributaries of the river Elbe meet. The site is part of an old cultivated area and characterized by reeds, wet forests and willow trees. Since 1973, the station has been part of the former "Mettnau-Reit-Illmitz network" of Vogelwarte Radolfzell, with annual trapping from June 30 until November 6. More than 100,000 birds have been ringed in that time, of which about 26,000 have been recaptured. Today the Vogelwarte Helgoland (Institut für Vogelforschung) and NABU Hamburg cooperate in running the station. Based on the results of this long-term bird ringing program, we could investigate the influence of climate change on the timing of migration. Our studies show that spring passage times generally tend to be earlier in recent years, whereas autumn passage times are unchanged in some species, delayed in others, earlier in yet other species. Detailed information about the work of the bird ringing station "Reit" are given. We present capture data on some central European songbirds from 1973-2005 as well as conclusions about the influence of climate change on migration, based on the analysis of more than three decades of standardized mist net trapping.

Beaven B[1], Oppel S[2]

Re-introduction of endangered forest birds to restored islands: lessons from Ulva Island, New Zealand

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A large part of New Zealand's avifauna has declined due to the impact of introduced alien predators. In an effort to preserve native bird species, several small islands were restored by the eradication of alien predators. As a result, birds formerly present on these islands have now been re-introduced to their native habitat. We present the case of Ulva Island, a 280 ha island that is entirely forest covered. Rats were eradicated on Ulva in 1996, and the first bird re-introductions began in 2000. Since then, five nationally threatened forest bird species have been re-introduced: Saddleback (*Philesturnus carunculatus*), New Zealand Robin (*Petroica australis*), Mohua (*Mohoua ochrocephala*), Rifleman (*Acanthisitta chloris*), and Fernbird (*Bowdleria punctata*). All transfers were successful, and all species have now established self-sustaining populations. Several important lessons were given during the process, and need to be taken into account in future translocations. One was stress from direct transfer which caused some birds to fly off the island or to miss their first breeding season. Another is the genetic variability of re-introduced stock which can be very small and needs to be mediated. And even though on-going preventive predator control protects Ulva against the accidental arrival of rats, studies show that rats can bypass the network of traps. This demonstrates the vulnerability of even very well protected islands. Population development in all bird species re-introduced to Ulva is now monitored by on-going programs of the New Zealand Department of Conservation and the University of Otago. Research is still required to determine the number of founder individuals effectively contributing to the growing populations in order to assess potential effects of genetic bottle-necks. Further, assessments of habitat carrying capacity and use are to be undertaken to provide information for potential transfer programs to other New Zealand islands.

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Impacts of nest predation on life history parameters in the Great Tit

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A central goal of evolutionary ecology is to understand why life history traits vary among populations and species. While the general patterns of life history variation are well known, the underlying causes of such variation are often unclear. Studies seeking ecological correlates of life history variation have focused on four major environmental factors: food limitation, predation, climatic conditions and duration of the breeding season. Nest predation is the primary cause of reproductive failure in land birds, and indeed predation has long been suggested as an important selection pressure driving life-history evolution. If nest predation has an impact on the evolution of life histories, that impact should be mediated through impacts on age-specific demographic rates: high nest predation will reduce fledging success and also expected recruitment rates and adult survival, lowering population growth rate. A reduction in the number of fledglings may also have the opposite effect through density-dependence. In this study, we focus on how changes in predation rates and densities affected demographic parameters in a Great Tit (*Parus major*) population in Sagunto, eastern Spain. Data was collected between 1992 and 2001, using capture-recapture methods for estimating female survival, local recruitment, realized population growth rates, and the processes affecting their variation. The proportion of predated nests ranged from 10–21%. Mean adult survival was 0.62±SE 0.02, local recruitment 0.14±0.01 and population growth rate 1.01±0.04. Changes in the growth rate were negatively related to nest predation (B =-6.79±2.29). Apparent female survival, however, was positively related to nest predation (B=12.96±4.89). The increase in survival probability was not related to density, but was explained most simply through the costs of reproduction. Our results support the hypothesis that predation on juveniles may favour life history strategies predicated on high adult survival.

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Returning the Hihi or Stitchbird to the New Zealand mainland: Sightings and movements after two translocation to the Karori Wildlife Sanctuary near Wellington

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The Hihi (*Notiomystis cincta*) is listed as “nationally endangered” in the New Zealand threat classification for it has a small range and population and, until recently, was restricted to a single offshore island. Intensive conservation efforts aim to improve its status, but long-term survival of translocated populations on two offshore islands remains uncertain. Here we describe results of a translocation that returns Hihi to the mainland for the first time in over 125 years. In 2005, 64 Hihi were released in the Karori Wildlife Sanctuary, a largely forested “mainland island” area of 252 ha protected from introduced mammalian predators and competitors by an 8.6 km 2.2 m high mammal-proof fence around its periphery. 33 Hihi were translocated in February 2005, 30 from Tiritiri Matangi Is. and 3 from the National Wildlife Center at Mount Bruce. A further Mount Bruce female was released in March 2005, followed by a second major release of 30 birds from Tiritiri Matangi in June 2005. About half were released immediately (“hard” release), the rest held in an aviary for 4-5 days (“soft” release). We document movements and survival of the birds following their release at Karori, comparing the success of soft and hard releases, and of February and June releases. Most birds were re-sighted following release, but there were differences between release cohorts and between sexes. Some birds moved beyond the protective boundary fence, but most remained within the Sanctuary. Many were observed at supplementary feeding stations, which provided information on social interactions, including dominance relationships, not just amongst Hihi but also between Hihi and Bellbirds (*Anthornis melanura*). We assess the likely success of the translocations, and discuss challenges facing those individuals that move beyond the perimeter of the Sanctuary into adjacent forested and urban habitats where introduced mammalian predators remain.

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Effects of human disturbance on abundance and spatial distribution of Lesser Rheas

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Recent research on spatial ecology reveals that human disturbance is a new variable in the conservation of threatened species. The Lesser Rhea (*Rhea pennata pennata*)is a flightless, herbivorous bird that depends almost exclusively today on habitat located on private lands. As privately-owned land management is a potentially important factor that could affect the persistence of wild populations, the aim of this work was to assess the factors determining the abundance and distribution of Lesser Rheas in areas subject to different levels of human disturbance. Fieldwork was conducted from 1998 to 2001 on three sheep ranches in Patagonia, Argentina. Using satellite images and a green index, we selected study sites with the same spectrum of habitat availability - steppe, shrub steppe, shrubland, and vegas - but subject to different degrees of land subdivision and intensity of human activity. On Loma Blanca (29,000 ha), hunting was actively controled, there were no free-pass roads and sheep density was regulated (1 sheep/4ha); on La Caledonia (20,000

ha), sheep carrying capacity was also controled, free-pass roads were present but hunting was not actively prohibited; and on El Remiendo (6,500 ha), there were also free-pass roads, sheep density was 2-3/4 ha, and hunting was allowed. Density and spatial distribution of Lesser Rheas were estimated using the software Distance sampling and CAMRIS GIS, respectively. Rhea abundance was 0.08 birds/km^2 on Loma Blanca (2306±513 birds; P<0.05), 0.03 birds/km^2 on La Caledonia (545±26 birds; P>0.05), and 0.02 birds/km^2 on El Remiendo (157±78 birds; P>0.05). Individuals were distributed in a wide and uniform pattern on the ranch with lowest human pressure (Loma Blanca), but were spread unevenly on the other two. Our results indicate that human disturbance is an important limiting factor for Lesser Rhea populations in Patagonia, stressing the importance of land use management in conservation efforts.

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Population structure of a metapopulation of Pinyon Jays

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Pinyon Jays (*Gymnorhinus cyanocephalus*)are non-migratory yet irruptive. Observational data suggest that local among-flock dispersal rate is low. Low dispersal implies minimal gene flow and elevated inbreeding and population structure; yet little is known about the population genetics of this species. To measure gene flow, inbreeding, and population structure, DNA was collected over four consecutive years from 652 wild Pinyon Jays in seven flocks in and around Flagstaff, Arizona. Genetic fingerprints for each bird were derived at six variable number tandem repeat (VNTR) loci. Within- and among-flock gene frequencies were calculated and compared. Inbreeding was estimated with F_{IS} and f; and population structure was estimated with F_{ST}, theta-p, and rho. Genetic distance (G_{ST}) among flocks and number of immigrants (N_M) per flock per year were determined. G_{ST} was represented by an unweighted pair-group method with an arithmetic mean (UPGMA) dendrogram. Results suggest that N_M is 1.4 individuals per flock per year. Some inbreeding occurs (F_{IS}=0.07, f= 0.07), but population structure is nominal (F_{ST}=0.007, theta-p=0.003, rho=0.007). Both inbreeding and population structure are lower than predicted, based on what is known of the life history of the species. Alternative hypotheses that would explain this apparent discrepancy are proposed.

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Cell-mediated immunocompetence in Common Terns

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The investigation of body condition using physiological measures has become increasingly important in avian research. One common technique is the phytohemagglutinin injection assay (PHA test), a reliable measure of cell-mediated immunocompetence (CMI) which indicates condition and viability in birds. In 20-day old chicks from a Common Tern (*Sterna hirundo*) colony on the German North Sea coast, we investigated inter-individual variability of immune response in relation to a number of attributes of nestlings (sex, size, growth rate, plasma proteins, hematocrit, parasite load, plasma carotenoids), parents (hatching date, clutch size, parental quality) and rearing conditions (hatching order, sub-colony density). Univariate tests showed a variety of significant relationships between CMI and chick size, clutch size, hematocrit and plasma proteins. Furthermore, positive correlations with maternal age and paternal body mass were found, as well as a brood-specific PHA response. Multivariate analyses revealed that chick CMI correlated positively only with clutch size and hematocrit levels. Thus, our results support an influence of nutritional condition and parental quality on immune response in chicks, which is probably due to differential reproductive effort. Supported by the Deutsche Forschungsgemeinschaft BE 916/5 and 8.

Berens DG[1], Farwig N[1], Schaab G[2], Böhning-Gaese K[1]

Exotic guava trees are promising centres of forest regeneration in Kenyan farmland

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Birds can have a major effect on regenerative processes in degraded areas. Isolated fruiting trees in such areas are attractive to frugivores, and thus may become centres of seed rain and seedling establishment. Exotic tree species, in particular, exploit degraded areas. Thus, it is important to know whether they attract indigenous frugivores and thereby act as potential foci for forest regeneration. In the farmland adjacent to the Kakamega Forest in western Kenya, we investigated the frugivore bird assemblage in, and seed rain and seedling establishment under, 29 exotic guava trees (*Psidium guajava*) at different distances from the forest. The results show that 61 bird species visited the guava trees, of which 40 were frugivorous. Of these, twelve were forest dependent, 26 species inhabited dense scrubby habitat and two were open country species. We found twelve seed and 35 seedling species under the tree crowns, of which 100% and 83% respectively were animal-dispersed. 58% and 55% of them, respectively, were climax forest species. The abundance of frugivorous birds, seeds and seedlings did not decrease up to a distance of 2 km from the forest. Surprisingly, the abundance of frugivorous birds inhabiting dense habitats actually increaeh distance abuniygivowe b

comprise genetically distinct lineages, suggesting evolutionary stasis operating in a habitat mosaic in which sedentary populations persisted for long periods in local areas without much interchange. Implications for our understanding of speciation theory and species concepts will be discussed in the context of African montane biogeography.

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Phylogeography of the Olive Sunbird in Africa

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This study, the first to examine phylogeographic structure in a forest bird occurring throughout the montane and lowland forest biomes of Africa, has a key objective: to investigate the importance of Pleistocene climatic cycles on avian diversification across Africa. The Olive Sunbird complex comprises relatively large and polytypic sunbirds that are widely distributed throughout evergreen, montane and coastal forests in Africa. Recently, it was split into two species, the Eastern Olive Sunbird (*Nectarinia olivacea*) and the Western Olive Sunbird (*N. obscura*), based on morphological characters. Analyses of a 395 bp fragment of the mtDNA NADH subunit 3 gene, with flanking tRNA sequences, from 196 individuals of *N. olivacea* and 86 from *N. obscura* indicate that genetic divergence levels are low at 1.0 to 2.4% across some 9000 km, from Ghana in the northwest of Africa to KwaZulu-Natal in eastern South Africa. Neither currently recognized species were monophyletic in phylogenetic trees constructed from either parsimony or likelihood tree-building methods. FST value suggested that there was less variation partitioned between species than among populations from most neighboring regions. Genetic diversity within the complex was dominated by three star-like phylogenies linked to one another by a single mutational step and two subnetworks separated from the core star-like phylogenies by five to six mutational steps. As identified by nested-clade analysis, the dominant evolutionary mechanism shaping genetic variation within the Olive Sunbird complex appears to be one of range expansion, possibly out of East Africa, associated with a period of forest expansion during the mid Pleistocene, some 1.1-0.7 million years ago. Mismatch profiles suggest that secondary contact has occurred between eastern and western lineages within the Ufipa Escarpment and possibly Zimbabwe, as well as among eastern lineages in the Kenyan Highlands and northern Eastern Arc Mountains.

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Heart rate and wingbeat frequency in naturally-migrating Swainson's Thrushes

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Energy used during migratory flight represents one of the most clear-cut costs of avian migration, but little is known about inter-individual variation in in-flight energy use and, more importantly, the determinants of that variation. Here we present data on in-flight energy expenditure and wingbeat frequency during natural migratory flight in Swainson's Thrush (*Catharus ustulatus*), a small Neotropical migrant. Radio-equipped birds were followed with a radio-tracking vehicle as they migrated northward from a stopover site in central Illinois, USA; the transmitters provided not only continuous details of location but also heart rate and, when applicable, wingbeat frequency. Both latter parameters varied between and within individuals during natural migratory flight, to which both individual morphology (particularly wingloading) and atmospheric conditions contributed.

Braasch A, Becker PH

Are testosterone levels of Common Tern chicks related to sex and hatching position?

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Growth rates of Common Tern chicks (*Sterna hirundo*) have shown sex-dependent differences in peak mass and pre-fledging mass: especially in mixed broods, male chicks in a late hatching position (b- or c-chick) are heavier than their siblings. Steroid hormones have been the focus of many studies considering early developmental traits with known effects on an individual's performance. Testosterone enhances the competitive ability of offspring, resulting in different growth and survival rates. According to the adaptive significance of maternally derived yolk androgens increasing with laying sequence, we suggest that testosterone may influence chick-growth, with brothers being heavier than sisters and later hatched sons being heavier than first hatched young. Therefore, we measured blood plasma testosterone levels in Common Tern chicks of known sex, age and hatching position in a colony in Wilhelmshaven, Germany. Our results revealed that in two-chick broods levels of testosterone interacted with the sex of the b-chick: If the b-chick was male, the a-chick had lower testosterone levels than if the b-chick was a female. We are continuing our studies of variation in testosterone level in relation to sex and hatching position.

Bragina E

Vocal communication in cranes: Acoustic features of the Siberian Crane

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I have been investigating the acoustical characteristics of vocal signals in cranes as potential sources of information on sex and individuals. The repertoire of the Siberian Crane (*Grus leucogeranus*) is derived from two main types of sound: tonal and rhythmical. Combination of these sounds produces a variety of calls: single independent notes, tonal and rythmical sequences, and multiplicity, which is achieved by rapid combination of notes of the same frequency. Each of the calls is used in a different context, such as aggression or threat, or for communication between mates and between parents and chick. Most of calls of

Siberian cranes, both in males and females, fall in the frequency range 600 - 1100 Hz. The nature of the call, and its sex, however, are more precisely defined. Rhythmical signals are lower than tonal calls in both sexes; and for both, those of the female average 150 Hz higher than in the male. For pre-flight preparation, tonal sounds are grouped into sequences given in unison by mated male and female for up to two minutes. Rhythmical calls are used in sequences at the nest and for parent-chick communication. Cranes also use low-frequency tonal signals of 80-150 Hz, either individually or mixed with higher frequency signals between 600-1100 Hz. As Siberian Cranes are sexually monomorphic, features of the voice should prove a useful tool for sexing cranes in the field.

Braun MP, Wink M

Molecular phylogeny of parrots, with special emphasis on the population genetics of the Ring-necked Parakeet Parrots (Psittaciformes) are a tropical avian order of about 350 species.

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Despite knowledge of them from ancient times, new species have continued to be discovered up to the present day. Molecular studies of many parrot taxa, nevertheless, still remain to be carried out, particularly in the family Loriidae. Accordingly, we will present a molecular phylogeny of the order to provide a basis for understanding relationships within it and the history of its evolution. Even though more than 140 species are included on the IUCN Red list, others have established themselves as invasive pests. Such a species is the Ring-necked Parakeet (*Psittacula krameri*), one of the commonest parrots with the widest natural distribution in the world, from India to Africa. It is the first parrot to have established itself, during the 20th century, in the temperate Western Palearctic. Genetic studies can determine from which of the four present subspecific taxa the successful invaders came. Our analyses will be carried out by sequencing two molecular markers, a mitochondrial (cytb) and a nuclear (RAG) gene. The resulting sequences will be aligned and analyzed by PAUP, MEGA and MrBayes.

Brinkmann J

Does the Kiwi really belong to the Ratites? New morphological evidence for the phylogeny of Palaeognathae

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The osteology and myology of the hind limb has been investigated on specimens of all recent palaeognathous families. Neglected in former studies, the hypotarsus at the ankle-joint with the toe-flexors on it has been described. In phylogenetic analyses, the hypotarsus has proven to be relevant. Namely, there are some striking similarities between the Tinamidae and the large Ratites (i.e. Struthionidae, Rheidae and Casuariidae), which are absent in Apterygidae and apear apomorph in comparison with neognathous and stem group birds. These findings suggest that the Tinamus and the recent Ratites excluding Kiwis form a monophyletic group, characterized mainly by a unique configuration of the flexor-tendons on the hypotarsus. This is in conflict with the prevailing conception that the Ratitae form a monophylum, enclosing all flightless palaeognathous families. My study implicates, that the ability to fly was lost twice within palaeognathous birds; once within the ancestors of the Kiwis and once within the other recent Ratites.

Buehler DM, Tieleman BI, Piersma T

Immune function and the annual cycle in long-distance migrating Red Knots: Seasonal, environmental and individual variation

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Long-distance migration and ecological immunology are exciting and productive fields of study, yet many aspects of both remain biological mysteries. Most studies of migration have focused so far on the physiological and energetic demands of that behavior, and most of ecological immunology on trade-offs between immune investment and reproduction. Little is yet known about seasonal, environmental and individual variation in immune investment in long-distance migrants throughout their annual cycle. Experimentation on wild birds in captivity is a powerful tool for teasing apart seasonal and environmental factors that affect immune function. This paper discusses such a study in which Red Knots (*Calidris canutus*), one of the longest distance migrants on earth, were maintained in three environmental treatment groups (warm, cold and variable) in aviaries for a complete annual cycle. The experiment aimed to uncouple the effects of seasonality on investment in immune fuction from those of varying ecological conditions. The contributions of seasonality, and environmental and individual factors found are thus discussed in the context of specific questions: (1) do wintering birds invest more in immune function when not investing in either migration or reproduction, (2) do birds that are "working hard" and expending large amounts of energy on thermoregulation invest less in immune function, and (3) do males and females differ in immune investment and does this change seasonally?

Buler J, Moore F

Effects of forest cover on the movement of a long-distance migrant during stopover after crossing the Gulf of Mexico

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We radio-tracked long-distance passerine migrants during stopover after crossing an ecological barrier, the Gulf of Mexico, to assess general stopover behavior and movement ecology and to examine whether size of habitat patch is an influencing factor. Twenty six Ovenbirds (*Seiurus aurocapillus*) were radio-tagged at a banding station on the north coast of the Gulf during spring migration in 2003 and 2004, and translocated in pairs to selected bottomland hardwood forest sites where they were released simultaneously at dawn: one of the pair was released in a small patch of riparian forest and the other within a large floodplain forest. The birds were tracked continuously from dawn until dusk each day either until they resumed migration or until the first 3-4 days of stopover had elapsed, after which they were monitored only to ascertain stopover length. Overall, the birds stopped over for a mean 3.75 days and ranged over an area of 2.7 ha during the days they were tracked, spending much of their time within the dense understory vegetation of canopy gaps. Movement rates declined by half over the course of the season, and were also correlated negatively with fat mass in birds. More birds undertook circumscribed movement when released within large forest sites, in which insect abundance within the understory was also 2.5 times greater. Birds exhibiting such circumscribed movement, moreover, stopped over 1.5 days longer on average than others. These and other results to be presented support the hypothesis that large forests provide higher quality stopover habitat for Ovenbirds than small forest patches.

Burger J[1], Gochfeld M[2]

Temporal trends in mercury, cadmium and lead in eggs of Common Terns in New Jersey, USA, 1971-2005

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Managers and public policy makers require information on the status and trends in contaminant levels in organisms for assessing ecosystem health. Seabirds are excellent bioindicators because they are long-lived, feed at different trophic levels, are at the top of the food chain, and are commonly abundant and widespread. They can reveal both spatial and temporal trends in levels of contaminants. We examined temporal trends in the levels of cadmium, lead, and mercury in eggs of Common Terns (*Sterna hirundo*) nesting on several salt marsh islands in Barnegat Bay, New Jersey, USA. We test the null hypothesis that there were no temporal differences in levels of these elements from 1971 to 2005. Levels were highest for mercury, followed by lead. The eggs of Barnegat Bay terns did show a decline in levels of cadmium and lead. Mercury declined from 1971 to 1982, increased dramatically in 1999, and then began to decline before increasing again, perhaps due to the relaxation of standards for power plants. The data indicate that Common Terns can serve as useful bioindicators of temporal trends in contaminants, and that some of the metals of concern in estuarine environments (lead, cadmium) have declined over the last thirty years, while others such as mercury have increased.

Butkauskas D[1], Sruoga A[1], Svazas S[1], Paulauskas A[2]

Genetic variability among Long-tailed Ducks wintering in the Baltic Sea

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The majority of Long-tailed Ducks (*Clangula hyemalis*) breeding in the Western Palearctic winter in the Baltic Sea. Little is yet known about population structure in wintering Long-tailed Ducks or their site fidelity to certain wintering areas, issues important in their conservation and management. Accordingly, we set out to determine genetic variability and possible gene flow among different wintering subpopulations. We used polyacrilamid gel electrophoresis to screen three enzyme systems (malatedehydrogenase, non-specific esterase and malic-enzyme) among Long-tailed Ducks wintering along the Lithuanian coast of the Baltic in 1994 and in 1999-2001. 22 loci (all polymorphic) were detected. Total observed heterozygosity in wintering populations, o=0.328, was lower than expected, e=0.530. Heterozygosis deficiency at D=-0.324 was characteristic of Long-tailed Ducks wintering in the Baltic Sea, as was annual variability of genetic structure. It is likely that winter movements of different sub-populations cause the defined annual genetic variability: mixing of individuals from different sub-populations in certain wintering sites then, and pair formation there, effects gene flow between the sub-populations. These findings are consistent with results of long-term direct observations of Long-tailed Ducks wintering in the Baltic Sea.

Byamana RK

Vocalizations of the endemic *Terpsiphone bedfordi* and *Terpsiphone viridis* (Aves:Monarchidae) in eastern DR Congo

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In this study I document 3 types of vocalization in *T. bedfordi* and *T.viridis* recorded in Mukowa primary forest (Irangi area) Eastern D R Congo. Contrary to the findings of previous studies, the vocalizations of *T.bedfordi* differ from those of *T.viridis*: each species responds to playback of its own calls, and analysis of recordings of the vocalizations using "Syrinx" software shows that the songs of *T.bedfordi* are longer, and have a lower tempo but higher frequencies than those of *T.viridis*. This study provides important information on the "Near Threatened" *T. bedfordi*.

Byholm P[1], Nikula A[2], Taivalmäki J-P[3]

The effect of territory quality on large-scale patterns of reproductive success in the Northern Goshawk

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It is well-known that territory quality, as measured by habitat quality or prey availability, is an important factor affecting the reproductive success in many bird species. The way in which such small-scale spatial variation in reproductive success translates to patterns observed over larger scales, however, is not well known. Using data gathered between 1989 and 2003 on a forest-dwelling raptor in Finland, the Northern Goshawk (*Accipiter gentilis*), we investigated how two different measures of prey availability (main and secondary prey) interacted with habitat quality on observed reproductive success as measured by number of eggs laid and number of chicks fledged. The combined effect of the three measures of territory quality was then integrated to explain patterns of goshawk reproductive success at regional scale. While availability of main prey and egg number did not differ significantly between territories of different habitat quality, the densities of secondary prey did. As a result of territory-specific patterns of brood reduction, more chicks were fledged from territories with higher densities of secondary prey ('forest territories') than on those where secondary prey were less abundant ('mire territories'). The number of chicks produced by goshawks is thus habitat-dependent. By simulations that set the relative proportions of territories of different quality in different combinations in the landscape, we show that such territory-specific patterns of reproductive success largely explain earlier reports of a weakening connection between main prey availability and goshawk reproductive success nationwide.

Calero M[1],García JT[2], Vicente G[1], Suárez F[1],

Does aridity determine rates of haematozoic infestation in Dupont's Lark? A comparative study in Spain and Morocco

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We investigated the prevalence of avian haematozoa in populations of Dupont's Lark (*Chersophilus duponti*) in Spain and Morocco, based on the prediction that exposure to parasites is reduced in birds living in arid habitats. To test this assumption, the number of haematozoa and rates of infection reported for individuals in arid and temperate habitats were compared. As in other arid zone birds, we found a generally low level of parasitemia in Dupont's Lark, both in Spain and Morocco. Individuals from more arid habitats also carried lower haematozoic parasite loads than those in more temperate habitats. Relative frequency of infection was lower in arid habitat larks as well. Neither body condition nor date of capture explained the differences. This study reports the first records of infections for this bird species, and suggests that risks of hematozoic parasitism are reduced in birds living in arid habitats, probably due to the lower numbers of invertebrate vectors. We also discuss other hypotheses that could explain the low levels of parasitemia found in arid bird species.

Calladine J, Wernham C

Extensive monitoring of the Rock Ptarmigan in Scotland

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The biodiversity of montane areas in Scotland is threatened by a number of factors that includes inappropriate grazing, increased disturbance and climate change. The Rock Ptarmigan (*Lagopus mutus*) is the only resident specialist montane bird in Britain, occurring rather widely in the Scottish Highlands and on islands in the Hebrides and Clyde. The species is predicted to be sensitive to the factors affecting montane habitats; and hence variation in their numbers and distribution should be important indicators of environmental condition. To date, Rock Ptarmigan have not been effectively monitored across their range in Scotland but there is some evidence of long-term range contraction. This project aims to test the efficacy of recruiting and training non-specialist bird surveyors to monitor Rock Ptarmigan. We give initial results of extensive, low-intensity monitoring using volunteer surveyors in 2006, and make comparisons with more intensive but local surveys using professional surveyors. We also consider the feasibility of extensive monitoring for a species that exhibits cyclical fluctuations in numbers.

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Population genetic structure in the Blue-fronted Amazon (Psittaciformes) based on mitochondrial DNA sequences

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The Blue-fronted Amazon (*Amazona aestiva)* is a neotropical parrot occurring over northeastern Brazil, Bolivia, Paraguay and northern Argentina. Despite its wide distribution, a remarkable decline in numbers has been observed in some regions, due mainly to habitat destruction and over-exploitation by the pet trade. In such circumstances, information on population genetic structure may provide important information for conservation, sorting out populations with significant genetic divergence as management units. Accordingly, we present results from an analysis of mitochondrial DNA (mtDNA) sequences of the COI gene. Thirty six parrots from four localities (population groups) in Brazil were sampled: 13 from southwestern Mato Grosso do Sul (MS), 6 from Distrito Federal (DF), 10 from northwestern Minas Gerais (MG), and 7 from eastern Bahia (BA). An Hierarchical Analysis of Nucleotide Diversity and an Analysis of Molecular Variance were performed to test for differentiation among the groups. We analyzed 552 base-pairs (bp) from each parrot and detected 13 variable sites and 11 haplotypes, with up to seven (1.27%) substitutions among them. Significant differentiation was found only between MS and the other groups in both analyses ($gST=0.53$, $p<0.01$; $FST=0.63$, $p<0.01$). The haplotype network indicated two main haplogroups: one comprising individuals exclusively from the MS group, and the other the parrots from all other groups plus two of the MS group. Such results indicate that the MS group and the remaining cluster of populations should advisedly be separated as two, discrete management units for conservation purposes. Even so, because mtDNA is a matrilineal molecular marker, the genetic structuring identified here will also need to be evaluated by analysis of nuclear DNA microsatellites from a broader geographical sampling. Financial support: CNPq.

Carere C, Santucci D, Montanino S, Moreschini F, Alleva E

Understanding patterns of pre-roost aerial displays in flocks of Eurasian Starlings: characterization and functional significance

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Most of the functional aspects involving grouping in birds have been studied extensively and concern mainly costs, benefits and related trade-offs associated with flight energetics, vigilance, antipredator behavior and foraging efficiency. Such explanations, however, fail to describe the process that creates and maintains the coordinated behavior of a flock. Moreover, the function of some types of group behaviors, such as aerial displays, is basically unknown. Included in the flocking behavior of European Starlings (*Sturnus vulgaris*) are mass aerial evolutions of swarms of thousands sweeping over or in proximity to their nocturnal roosts. Such collective and highly coordinated movements occur regularly in their wintering areas during pre-roost assemblies, even in the absence of any apparent conspicuous stimulus. We present here a characterization study of starling aerial swarming over a roost in Rome, Italy, during winter. To understand the possible function of these movements, we distinguish between three conditions occurring commonly in the study area: (1) swarming in apparent absence of conspicuous stimuli and under good atmospheric conditions, (2) swarming under adverse atmospheric conditions, such as low visibility or strong wind, and (3) swarming in response to a predator attack. The parameters estimated include flock size, shape and density, inter-individual and inter-flock distances, height, timing, frequency and duration of aerial swarming under the above mentioned conditions.

Castro A, Muñoz A-R, Real R

Modelling the spatial distribution of the Boreal Owl in its southwestern Palearctic limit

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The Boreal Owl finds in northern Spain one of its southern distribution limit in Europe, where it was first detected in 1983 and is limited to the Pyrenean ranges. Much of the research on the Boreal owl in the Iberian Peninsula has been focused on local-scale studies, but very little is known about the variables shaping its distribution considering a larger scale. We modelled the spatial distribution of the species in peninsular Spain, one of its European marginal populations, with multivariate statistical techniques and GIS. The presence/absence data for the Spanish UTM 10x10-km squares (n=5167) were obtained from the Atlas of breeding birds of Spain. To induce the factors that affect the Boreal owl distribution and to find out favourables areas in the study area, we used 36 independent variables (related to environmental conditions, spatial situation, topography, and human activity) and performed a favourability function based on GLM's. We performed a variation partitioning procedure to determine how much of the final model variation was explained by the pure effect of each factor in the model and by their interactions. The predictive model for the species in peninsular Spain is remarkably parsimonious since it only included 4 variables (mean annual number of frost days, max. precipitation in 24 hours, elevation range, and geographical longitude). Its correct classification rates in the Spanish squares were 98.3% for absences and 100% for presences. The variation partitioning procedure showed that climatic variables explain 53.1% of the variation of the final model, followed by the spatial and topographic variables, with 38.9% and 10.7% respectively. Climatically favourable squares tend to be located towards the Spanish north-western areas, where the species is absent because of the pure spatial factor. This suggests that the role of French populations as a source of emigrants to the Spanish populations is critical for the maintenance of the species in Spain. This work has been financed by the Alfonso Martín Escudero Foundation, Madrid.

Caula S, Marty P, Martin J-L, Lauret S

Ecological diversity of birds in relation to the structure of urban landscape at Montpellier, southern France

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Urbanization is the second most frequently cited cause of species endangerment. Even though the effects of urbanization can be huge, the knowledge on its consequences on fauna and vegetation is poor at best: thus it is important to evaluate the influence of urbanization on biodiversity. Birds are good bio-indicators to test the capacity of cities to take in wild fauna. In this study, we performed a stratified sampling of the avian communities of Montpellier, a city of 230 000 inhabitants and covering 56.88 km^2. Our objective was to analyze the effect of spatial heterogeneity on avian communities using a simple indicator: the ratio of vegetation density to buildings. The city was partitioned into seven sectors (70-523 ha) representing the continuum of urban pressure: downtown, residential areas (3 densities), an industrial area, an agriculture area and forest. With the help of an SIG, the size and proportion of each sector was calculated. Twenty-seven sampling units were then chosen according to the surface and heterogeneity of each sector. Each sampling unit was monitored in spring and winter. During the study, a total of 54 species were recorded. In winter, 37 species were found, representing 16 families, and in spring 50 species, representing 22 families. A positive correlation between the proportion of vegetation and the diversity of the avifauna was found in downtown, residential and industrial areas. Species richness in the agriculture and forest areas did not differ from that in the low density residential area. In contrast to more artificial areas, a higher number of specialist species was found in these sectors. Concerning abundance, several trends were observed, leading us to conclude that urban development encourages generalist species and tends to exclude specialist species.

Chamberlain D, Gough S, Vickery J, Freeman S

Factors affecting bird abundance in the parks of London

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Parks are major contributors to urban biodiversity; and an understanding of the factors that make them attractive to birds will enhance our ability to improve urban habitats for wildlife. This has been achieved through analysis of bird data in conjunction with habitat data from parks and surrounding landscape gathered from surveys of 301 parks in London. Multi-model inference was used to assess habitat associations of

individual species, and of species richness, in the breeding season. For within-site habitat variables, the area of unmanaged grass, nettles and weeds was found significantly associated with species richness. Many species showed a significant positive association between their numbers and presence of deciduous trees and bush cover. Those in the former group included several hole nesters, but also thrushes and crows. Bush cover was more important for smaller woodland passerines such as the Winter Wren (*Troglodytes troglodytes),* European Robin (*Erithacus rubecula*) and warblers, as well as farmland species such as the Common Linnet (*Carduelis cannabina*) and Yellowhammer (*Emberiza citrinella*). The extent of woodland and farmland in the surrounding landscape had little effect. Species richness and, for several species, density were nevertheless strongly positively correlated with the proportion of park boundary adjacent to private gardens. Provision of food in gardens is commonplace in London, so food availability in the surrounding habitat may influence bird use of urban parks. This study suggests that planting of deciduous trees and bushes in the parks of London is likely to enhance their attractiveness to several species, and that provision of areas of unmanaged ground-layer vegetation will enhance overall species richness. However, the nature of the surrounding landscape has a crucial influence on the status of bird communities there as well.

Chaskda AA, Mwansat GS

Implications of avian foraging on the reproductive ecology of the mistletoe, *Tapinanthus globiferus* (Loranthaceae)

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The reproductive success of ornithophilous plants depends greatly on avian foraging preferences, often measured as frequency of avian visits and duration of foraging. We investigated the foraging behavior of avian pollinators of the Mistletoe (*Tapinanthus globiferus*) during the mid wet season of 2005 in the Amurum Forest Reserve, Jos, Nigeria. Line transect observation was used to determine preferred host plant species and foraging heights among avian foragers. Frequency of visits and duration of foraging were also estimated. Results showed that the Variable Sunbird (*Cinnyris venustus*) and Scarlet-chested Sunbird (*Chalcomitra senegalensis*) were the only avian pollinators of *Tapinanthus globiferus*. Both sunbirds visited more and foraged longer when the numbers of open flowers on the mistletoe were high, and when isolated from conspecifics. Yet whereas the Scarlet-chested Sunbird visited more when the mistletoe was dense with ripe flowers, only the Variable opened the flowers. Opening of the flowers represents niche expansion; and the function of higher visitation rates in the Scarlet-chested Sunbird could be to avoid competition with the Variable as well as to assure nectar reward. A significant number of both species foraged on the mistletoe at lower heights on the host plants *Dichrostachys cinerea* and *Anogeisius leiocarpus*, implying enhanced reproductive success at those strata. Visits declined in high winds and temperatures, conditions probably inimical to reproduction of the mistletoe. An understanding of such flora-fauna interactions has significant implications for management decisions in the conservation of tropical birds.

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A spatio-temporal model for predicting when and where Red-billed Quelea will breed in southern Africa

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We present the first explicit spatio-temporal model of the movements of a nomadic granivorous bird, the Red-billed Quelea (*Quelea quelea*), in southern Africa. These abundant birds breed colonially whenever conditions permit, traveling long distances to find breeding habitat or to avoid food shortage. They breed in the wet season and shift about in dry seasons to concentrations of seeds of preferred annual grasses. Ecological and behavioral data suggest that, at the start of the rains, grass seeds germinate after a threshold quantity of 60 mm rain has fallen, forcing the birds to move out to zones where seeds have not yet germinated. When rain reaches the latter areas, the birds are forced to move again, usually returning in "early-rains migrations" in the direction whence they came. By this time, an additional 240 mm of rain (300 mm in total) needs to have fallen within a 6-week period for the new grass to produce fresh seed. Breeding may then begin. Adult birds subsequently move on a "breeding migration" to wherever at least 300 mm of rain has fallen for further nesting attempts in the season. Using estimates of rainfall derived from Meteosat Cold Cloud Duration (CCD) data, a forecasting model has been devised that shows, at weekly intervals, those areas where (a) the wet season has not yet started, (b) the "early-rains migration" threshold has been exceeded, (c) the threshold to permit breeding has been exceeded, and (d) conditions are no longer suitable for the establishment of new colonies. We review the simple algorithms necessary to produce a realistic model for predicting when and where quelea will breed, and describe the results for validating it using data on breeding by southern African populations of quelea over the past four breeding seasons 2001-02 to 2004-05. Queleas are major pests of small-grain cereal crops throughout sub-Saharan Africa, and our model has the potential to alleviate crop losses by enabling better targeting of control operations against these birds.

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Distributional partitioning among breeding seabirds in the Zhoushan Archipelago, China, and their influencing factors

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The Zhoushan Archipelago of over 1000 islands is located in the northeast Zhejiang Province, east China Sea. The status of its seabird populations is virtually undocumented. Accordingly, during June-July in 2003 and 2004, we surveyed breeding seabird colonies in the archipelago and their nesting habitats. We found 8 species breeding on 10 islands, and tried to determine the factors influencing selection of nesting site. Human poaching was found to have the most important effect. Furthermore, the distribution of the eight species among the islands showed a pattern of partitioning. Differences in flying ability, as estimated by wing aspect ratio and loading, and partitioned distribution of prey food were apparent determinants underlying the the pattern.

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Eurasian Reed Warblers compensate for longitudinal displacement during spring migration

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It is often assumed that avian long-distance migrants navigate with reference to their return migration in spring. Measuring latitude is relatively easy, but identification of longitude is a problem. In most parts of the world, geomagnetic cues are not reliable indicators of longitude. The theoretical possibility that migrants use the pattern of celestial rotation in combination with their inner clock to detect longitudinal displacement has not been supported in a planetarium experiment with Pied Flycatchers (*Ficedula hypoleuca*) and Blackcaps (*Sylvia atricapilla*). Therefore, it has been suggested that migrants returning in spring perform one-coordinate navigation: they may know the latitude, but not longitude, of their migratory destination. We tested whether long-distance avian migrants captured during spring passage and displaced longitudinally east-west were able to compensate for the displacement. We captured Eurasian Reed Warblers (*Acrocephalus scirpaceus*) on spring migration on the southeast Baltic coast (55.09 N, 20.52 E) and tested their orientation in Emlen funnels. Most birds were in their second year, but some may have been older. Significantly oriented individuals were displaced 1000 km to the east (55.42 N, 36.45 E). A total of 27 birds showed a significant orientation vector both before and after displacement. The pooled sample had a mean direction of A=40±31 (mean ± 95% confidence interval), r=0.49, N=27, P=0.001. The mean azimuth after displacement was A=341±35, r=0.45, N=27, P<0.005. Thus, even though the 95% confidence intervals overlap slightly, there seems to be clear evidence that the birds were able to compensate, in part, for the displacement. The nature of the cue(s) that are used to compensate for such displacement remains to be clarified.

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Does the Chinese Goshawk feed on frogs throughout the breeding season?

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Frogs are recorded as the main prey of breeding Chinese Goshawks (*Accipiter soloensis*), but no details have been quantified for 30 years. To document contemporary diet, we monitored four active nests by video recording and direct observation in Korea from 2004 to 2005 during the chick-rearing period which was divided into three stages. As a baseline for comparison, we also reviewed previous studies on diet published in the 1970s. Prey delivered to the nest or eaten by adults were regarded as food resources, of which four classes were recognized comprising 19 types of prey: 12 types of insects, 3 types of frogs, 3 types of birds and 1 type of mammal. In first and second stages of the chick-rearing period, frogs were the main prey both in frequency of feeding and in biomass; both size and biomass of frogs, nevertheless, decreased with time. In the third stage prior to fledging, however, the emphasis shifted to insects, especially cicadas, in both frequency and biomass. Thus diet across stages was dominated by both frogs and insects, a result different from those of earlier studies which suggested that the goshawks preyed on large frogs throughout the whole chick-rearing period. It seems likely that Chinese Goshawks shifted to insects late in the chick-rearing period to take advantage of massive emergences in cicadas then. Even so, we believe that the underlying reason for the change is a seasonal decline in frog abundance caused by environmental changes such as reduced areas of paddy fields, destruction of riparian vegetation, and use of toxic herbicides.

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The behavior of avian scavenger at Fowlers Gap in Australia

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The behavior of avian scavenger in western New South Wales was investigated by recording their activities at twenty one roadkilled carcasses. The Australian Raven (*Corvus coronoides*) Wedge-tailed Eagle (*Aquila audax*), Little Eagle (*Hieraaetus morphnoides*) and Black Kite (*Milvus migrans*) were the four avian scavengers commonly seen. Meanwhile, the Red Fox (*Vulpes vulpes*) was the only mammalian scavenger present during this study but it was not included in any of my analysis. The wedge-tailed eagle appeared to be behavior and morphologically best equipped for a scavenging lifestyle. Different carcass species seemed to have different attractiveness to scavengers and such attractiveness was unlikely to decline significantly within three days. The high success rate in attack by aggressor under both inter and intra-specific interaction suggested that most birds could have evaluated their chance of success before launching an attack. The inter-specific hierarchy in a decreasing order was: Wedge-tailed Eagles > Little Eagles >Black Kites > Australian Ravens. This conforms well with a size-based hierarchy except for ravens, which was always subordinate to raptors. In addition, the intensity of intra-specific competition was higher than inter-specific competition only in the dominant wedge-tailed eagle and the opposite was true for black kites and Australian ravens. Subordinate scavengers tended to be gregarious and used flock size as a tool to share carrion with those more dominant solitary scavengers.

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The complex insular evolution of the East Pacific reed warblers, *Acrocephalus* spp.

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The terrestrial avifauna of islands in the south-east Pacific Ocean is restricted to a few groups of land birds that have successfully reached the isolated archipelagos there. Most of these birds are endemic, sometimes restricted to a single island. They are generally endangered by human activities, which have already exterminated some populations. Reed warblers of the genus *Acrocephalus* (Sylviidae, Passeriformes) inhabit most archipelagos. Concomitant with such extensive distribution, they exhibit wide morphological diversity: large birds of the *caffer* group are found in the Society islands, smaller birds are typical of the Tuamotu archipelago (*atyphus*), brightly colored birds characterize the *mendanae* group in the Marquesas, and smaller and darker birds are found in the Austral (*vaughani*) and Cook (*kerearako*) archipelagos. Most of these warb war inhabit dry

Cucco M, Guasco B, Malacarne G

Repeatability and heritability of cell-mediated and innate immunity in the Grey Partridge

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Immunocompetence is considered a reliable indicator of general body condition and ultimately of fitness. It has been suggested that, as a parameter subjected to intense directional selection, the level of additive genetic variance expressed should be reduced; on the other hand, theoretical models of host-parasite coevolution assume that variation in parasite resistance has a genetic basis. Contradictory results have been reported in birds, since the heritability of immune responses varies from nil to high. In this study of the Grey Partridge (*Perdix perdix*), we examined the heritability of immune condition (PHA reaction, an index of T-cell-mediated immunocompetence) and of some parameters traditionally considered important for chick survival, such as egg mass and chick growth. Two statistical approaches were used: parent-offspring regression and full sibling intra-clutch repeatability. The repeatability of other parameters that reflect egg quality (egg proteins, lipids and carotenoids) and of substances that confer innate immunity (lysozyme and avidin) was also investigated. In agreement with previous studies, we found non-significant heritability for cell-mediated immunocompetence. In contrast, there were significant repeatabilities of chick mass and several egg characteristics (mass, size, total proteins), while lipid and carotenoid concentrations were not repeatable. Notably, we found significant repeatability of two molecules, lysozyme and avidin, that confer innate immunity to the developing embryo. Finally, we explored the short-term influence of an environmental factor, the daily temperature, on egg mass and quality (concentration of lysozyme, avidin and carotenoids).

Cygan JP[1], Jablonski P[2], Osiejuk T[3], Borowiec M[4], Stawarczyk T[5]

Reaction of male Painted Redstarts to playback stimuli: How it reflects social status

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Song organization in the Painted Redstart (*Myioborus pictus*) was studied in the breeding seasons of 1999, 2005 and 2006 in the Chiricahua Mountains of Arizona, USA. Birds were recorded several times during the season in different social contexts, as in the presence or absence of rival males, and before and after pairing. Playback experiments were conducted during which the reactions of paired and unpaired males to playback stimuli, such as high and low song variability and switching rate, were evaluated. In general, males responded to playback more strongly before pairing, singing on average at twice the song rate. Unpaired males remained almost silent in response to playback, while paired males uttered up to 14 calls per minute. Paired males also remained longer within 5 m of the loudspeaker during playback. Two different categories of male reaction could thus be distinguished: “dominant” and “subordinate”. Males of the first category always reacted strongly to stimuli, no matter what the stimulus. Males of the latter category reacted strongly only to low variability and song switching rate stimuli, while literally falling silent in reaction to high variability and song switching.

Cyr N, Romero LM

Chronic stress in free-living European starlings alters corticosterone concentrations and reproductive success

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We studied the effects of chronic stress on concentrations of the major stress hormone, corticosterone, and reproductive success in free-living European Starlings (*Sturnus vulgaris*). Nest boxes designed for starlings were erected in April 2004, and half of the breeding females in the population using them were subjected to a chronic stress paradigm (CSP) that consisted of four different 30 minute stressors (loud radio and predator decoys such as a snake, rat, or owl) administered in random order daily for 9 days. We chose a 9 day paradigm because laboratory experiments indicated that chronic stress altered corticosterone response 8 days after a CSP began. We initiated the CSP after clutches were complete. Experimental females were caught on the last day of the CSP, and control females from the other half of the population were caught 9 days after their clutches were complete. Blood samples were collected for corticosterone analysis. In 2004, five experimental females successfully fledged young, and two abandoned. Although experimental females would approach their nest, they would not enter the nest box for at least 20 minutes during each 30 minute stressor, suggesting that each treatment induced stress. Preliminary data show that experimental females caught at the end of the CSP had significantly lower baseline corticosterone concentrations than controls, which is similar to our laboratory results. These data contradict the general assumption that elevated corticosterone levels indicate stress. Moreover, experimentally stressed females fledged fewer young. Our initial findings indicate that chronic stress has fitness consequences for wild animals. Data from 2005 are currently being analyzed.

Czeszczewik D, Walankiewicz W

Foraging behavior of the White-backed Woodpecker during spring and winter in a primeval forest

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From 1999 to 2005, the foraging sites and techniques used by White-backed Woodpeckers (*Dendrocopos leucotos*) were studied throughout winter and spring in primary oak-lime-hornbeam forests in the Bialowieza National Park, east Poland. Habitat and tree species and their characteristics relevant to woodpecker foraging were documented, and the foraging methods used by the woodpeckers - pecking on bark or wood pecking, scaling, searching and gleaning - were recorded. White-browed Woodpeckers foraged on 12 tree species, and most frequently on Hornbeam (*Carpinus betulus*) and Spruce (*Picea abies*) ($p<0.01$). Utilization of trees and foraging behavior differed between winter and spring. In winter, 48% of records were on Hornbeam compared to 38% in spring, and 13% were on Spruce compared to 20% in spring. One third observations in winter were on dead trees, mainly those still standing. In spring, half of the trees visited by the woodpeckers were dead, as much as 27% of records coming from birds on fallen logs. In winter, woodpeckers foraged on average at twice the height that they did in spring. Bark pecking (80% of observations) was the principal technique used for foraging.

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The role of nest site and structure in incubation performance in the Common Eider

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In recent years, the avian nest has been perceived as an important determinant of incubation success. The extent to which birds modify nest construction to compensate for site deficiencies, nevertheless, has been little studied. Here we evaluate the effects of nest shelter and internal nest insulation on the microclimate and breeding performance of the Common Eider (*Somateria mollissima*) by examining the relationship between breeding performance and nest site and structure in a colony in southern Iceland. We manipulated (1) site exposure by surrounding experimental nests with sheltering screens, and (2) the amount of insulative down lining the nest cups. We then compared the nest microclimate and incubation performance of females in the different treatment groups. Our correlative results showed that birds in sheltered nests laid larger clutches and seemed to perform better at incubating; they also insulated their nests better with more down. The amount of down in the nest did not appear to be adjusted to the degree of site exposure, but rather seemed linked to female quality. In the nests with experimentally-enhanced shelter, nest temperature was higher and more constant than in exposed sites, showing that a more protected nest imposes less demanding thermal conditions on the female. Surprisingly, experimental reduction of down in nests did not result in any reduction in incubation temperature, although it was correlated with low nest humidity; and brooding birds never replaced the down. In general, incubation performance was unaffected by manipulations of exposure or insulation. Rather, it seems that brooding females adjust their own behavior and energetic input according to the nesting environment, which is likely to influence reproductive costs.

Dale J[1], Emlen ST[2], Montgomerie R[3],

Properties of egg coloration: Use for recognition *vs* camouflage

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The colors of eggs show extraordinary inter-specific and, in many species, intra-specific variability. What are the functions of egg coloration in birds? Two commonly cited functions are that it serves as (1) a signal of identity used to discriminate the eggs of the layer from those of intra- or inter- specific brood parasites, and (2) a means for concealing eggs from predators. Here we evaluate egg coloration in three bird species: the Common Murre (*Uria aalge*), the Grey-capped Social Weaver (*Pseudonigrita arnaudi*) and the Red Phalarope (*Phalaropus fulicarius*). In colonially breeding murres and weavers, we argue that egg coloration functions primarily for egg recognition, while in dispersed, ground-nesting phalaropes we argue that it serves primarily for camouflage. We contrast three properties of coloration in the eggs of these species: (1) degree of variability, (2) shape of frequency distributions of egg colors and patterns, and (3) inter-correlations between different color traits (e.g., pattern, spot color, background color). As selection for identity signals is expected to be negatively frequency-dependent, while selection for cryptic coloration is expected to be stabilizing, we predicted that egg variability in murres and weavers would be considerably higher and show more complex frequency distributions than color variability in phalaropes. Moreover, the identity-signaling hypothesis specifically predicts that variability in different components of coloration should not be correlated with one another because correlated traits diminish uniqueness, and thus recognizability, in overall egg phenotype. Accordingly, we also predicted that variability in different color traits in the eggs of murres and weavers will co-vary independently of one another. Our results shed light on these propositions.

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How do birds search for breeding areas at landscape level? Interpatch movements of Ortolan Buntings

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Animal movements at large spatial scales are of great importance in population ecology, yet little is known about them due to practical difficulties in following individuals across landscapes. In birds, the questions of when and how individuals search for new breeding areas, and how they decide when to stop searching, remain largely unanswered. We studied the whole Norwegian population of the Ortolan Bunting (*Emberiza hortulana*) occupying habitat patches dispersed over nearly 500 km^2. Movements of color-ringed individuals were monitored over ten years, and extensive long-distance dispersal was recorded. More than half of all cases of breeding dispersal took place within one breeding season, when some males moved up to 43 km between singing territories, using 1-22 days to do so. Movements of 6-9 km across areas of unsuitable habitat occurred regularly. The number of patches visited was low (1-4), even though search costs in terms of time spent moving from one site to another were relatively low. Previously, it had been thought that young birds prospected for future breeding sites during the post-fledging period. Natal dispersal, however, was usually quite restricted, either to a habitat patch nearby or within the natal patch itself if it was large enough. Thus we argue that within-breeding season prospecting may be superior to post-breeding season search whenever conspecific attraction can be used, and in particular

where suitable breeding areas can be located by using the songs of other individuals as a cue. We suggest that the late arrival of young birds on breeding grounds, previously seen as a constraint, may be an adaptive strategy if they use conspecifics for locating breeding sites.

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Social facilitation of novel food acceptance in Rooks

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The propensity to increase food consumption in the presence of feeding conspecifics can be attributed to a behavioral phenomenon known as social facilitation. In addition to enhancing food intake, the presence of conspecifics is also known to promote an individual's acceptance of novel food. The current study investigates the effect of social facilitation on feeding behavior and novel food acceptance in a corvid, the Rook (*Corvus frugilegus*). In Experiment 1, we show that feeding in Rooks is subject to social facilitation at the general level. That is, Rooks eat significantly more of a familiar food in the presence of a conspecific compared to when alone. As generalist feeders, however, Rooks might often have to exploit novel food resources, a behavior which carries an inherent risk of illness or even death. In Experiment 2, Rooks were presented with two novel foods, one of which they could observe a conspecific eating. Our results showed that Rooks selectively ate the food eaten by the demonstrator, thereby reducing the risks associated with consuming an unknown food. Note that this effect was not exhibited when the birds were presented with a choice of familiar foods. To the best of our knowledge, this is the first demonstration of specific social facilitation in an animal that discriminates between foodstuffs in the visual domain.

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Selective logging and bird conservation in the Cordillera de Colan, northern Peru

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This study examines the impacts of selective logging on understory birds in moist tropical forest in the Cordillera de Colán, Amazonas Department, northern Peru. Indigenous Aguaruna communities on the northern slopes of the cordillera practice single-tree selective logging, primarily for the timber species Tornillo (*Cedrelinga cateniformis*). Birds there were sampled using mist nets at nine low elevation sites (550 - 750 meters a.s.l.) during February and March 2005. Understory birds recorded in regenerating forest on sites logged one and five years previously were compared with those on unlogged sites using a sample effort of 165,120 net-meter-hours. We netted 723 individuals of 101 species in 19 families. Sites logged five years previously had the highest capture frequency, highest species richness, and highest number of species unique to a single forest treatment. Three species accounted for 30% of captures: the Wedge-billed Woodcreeper (*Glyphorynchus spirurus*), Koepcke's Hermit (*Phaethornis koepckeae*), and the Tawny-bellied Hermit (*Phaethornis syrmatophorus*). An additional 57 species were caught only one or two times. A number of new distributional records for bird species were documented as part of this study, along with other important findings concerning the ecology and natural history of the avifauna of this little-known region.

Davydenko I

A census of waterbirds on large fishponds in the northern Ukraine

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Large fishpond complexes can play a significant supporting role in the life of waterfowl and shorebirds by providing diverse biotopes, protective cover and feeding resources for breeding, molting, wintering and stopover staging. Thus a six-year waterbird census on large fishponds in the northern Ukraine (Kyiv, Zhitomir and Rivne regions) in 1997-2003 recorded 53 species of wetland birds. Most numerous were: Black-headed Gull (*Larus ridibundus*) – 32.2%, Mallard (*Anas platyrhynchos*) – 15.3%, Eurasian Coot (*Fulica atra*) – 11.2%, Yellow-legged Gull (*Larus cachinnans*) – 6.9%, Great Crested Grebe (*Podiceps cristatus*) – 5.1%, Whiskered Tern (*Chlidonias hybrida*) – 4.6%, Common Pochard (*Aythya ferina*) – 4.4%, Great White Egret (*Ardea alba*) – 3.9%, Common Tern (*Sterna hirundo*) – 3.1%, Grey Heron (*Ardea cinerea*) – 2.6%, and Mute Swan (*Cygnus olor*) – 2.1%. Other species were recorded in much smaller numbers, including the following threatened species listed in the Ukrainian Red Data Book: Black Stork (*Ciconia nigra*), Ferruginous Duck (*Aythya nyroca*), Goldeneye (*Bucephala clangula*) and White-tailed Sea Eagle (*Haliaeetus albicilla*).

De Laet J[1], Summers-Smith D[2], Lens L[1], Van Gestel C[1], Matheve H[1]

The status of the House Sparrow in large towns: Firs 0 TD0.02.37

potential of AG schemes for conserving European biodiversity through financing of the Natura 2000 network; (3) recent reviews showing that the environmental effects of AG schemes have seldom been evaluated rigorously; and (4) mixed results from these evaluations, suggesting equivocal effects on biodiversity. Methods for evaluation can be grouped into two main approaches: indirect and direct. Indirect methods, such as those based on wildlife-habitat or demographic models, evaluate the effectiveness of AG schemes through the effects of the practices of such schemes on the habitat requirements of birds or on selected population parameters such as reproductive success or mortality rate. Direct methods compare bird diversity and/or abundance between fields farmed under AG prescriptions and control fields. Demonstration projects financed by LIFE funds, and paired comparisons between fields with and without schemes but otherwise similar for traits potentially influencing bird species or communities, are included in this group. Indirect methods are usually used to design AG schemes; however, they cannot be used to evaluate them since they require the invariance in space and time of the wildlife-habitat relationships underlying this approach. Demonstration projects have the advantage of including economic as well as biodiversity evaluations, but their spatial and temporal replication is limited. Paired comparisons properly designed and replicated are thus the best method for evaluating AG schemes; in contrast, indirect methods and demonstration projects may be, at best, cost-effective approaches for scheme design.

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Preferential responses for song persist in the song contol nuclei of female Canaries

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Correlations between variations in brain space and behavior have been established in several species. In temperate-zone songbirds such as Canaries (*Serinus canaria*), there are prominent sex differences in the volume of brain nuclei involved in song production and perception that correlate with differences in song behavior. Moreover, seasonal changes in song behavior are correlated with volume changes in song control nuclei, such as the HVC, and changes in plasma testosterone (T) levels. The function of such volumetric changes for the control of song and behavior nevertheless remains unclear. As behavior is not mediated by brain volumes but by patterns of neuronal activity, we were interested in the electrophysiological properties and song-related activity of HVC neurons in female Canaries, in which T concentrations were manipulated to dramatically alter HVC morphologies. While adult female canaries have small HVCs and rarely sing, females treated with exogenous T develop male-like songs and large HVCs. Single unit recordings were made in the HVC of urethane-anesthetized female Canaries with either high or low T titers and large or small HVC volumes, respectively. Stimuli included several variants of own songs, reverse playbacks of own songs, and other songs of conspecifics. Neuronal activity in the HVC of singing, high-T/large HVC female Canaries was similar to the characteristic HVC activity of reproductively stimulated, singing adult males of different songbird species: neurons had bursty spontaneous activity, were tuned to acoustic properties of own song, and were highly selective to own song over all other stimuli tested. Interestingly, the complex representation of own song was maintained in low-T/small HVC females, suggesting that the underlying circuitry for selectivity for own song is maintained even in small HVCs. This outcome questions the role of brain space for learned behaviors in the song system.

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Molecular phylogeography of passerine bird species on the Atlantic islands

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The oceanic Atlantic islands of Macaronesia, including the Canary Islands, Madeira and the Azores, are of volcanic origin and have never been connected to the European or African mainland. Thus they offer an optimal scenario for analyzing such phylogeographic questions as intra- and inter- specific structuring, phylogeny and colonization events in bird taxa. The Macaronesian bird fauna is characterized by high endemism. We sequenced the mitochondrial cytochrome b genes of eight passerine bird species there: European Robin (*Erithacus rubecula*), Goldcrest and Firecrest (*Regulus regulus, R. ignicapillus*), Blue Tit (*Parus caeruleus*), Eurasian Blackbird (*Turdus merula*), and Blackcap and Sardinian and Spectacled Warblers (*Sylvia atricapilla, S. melanocephala, S. conspicillata*). With the help of modern tools for analyzing molecular data, we investigated intraspecific differentiation and phylogeographic structuring in the island populations and island versus mainland populations, as well as possible colonization pathways and their timeframes. The results reveal different degrees of intraspecific differentiation in different species, despite which some general patterns emerge for groups of species. Exceptionally high degrees of differentiation were found in *Erithacus rubecula*, *Regulus regulus* and *Parus caeruleus*, all of which showed strong intraspecific structuring; new, previously undescribed taxa are among them. Molecular findings are confirmed in part by preliminary analyses of morphological and acoustical data.

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Selection of feeding habitat by the Crested Ibis in winter

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The Crested Ibis (*Nipponia nippon*) is an endangered species, with only one surviving wild population in Yangxian County, Shaanxi Province, China. From 1999 to 2003, the characteristics of feeding sites used by Crested Ibis in winter there were studied using plot methods based on both observation and radio-tracking. Four types of feeding habitat were recorded: paddy field, river beach, shorelands of reservoirs and dry farmland, with paddy fields (49.4%) and river beach (39.9%) the most frequently used. Up to 79% of adult birds were found to feed in paddy fields, and 65% of juveniles were recorded on river beaches. An analysis of variance showed that the main factors influencing site selection for foraging were: gradient of slope, depth of water, softness of soil, size of the feeding area, availability of paddy fields nearby, and disturbance from human activities. Principal Component Analysis indicated that Crested Ibis preferred to feed in sites of low elevation in larger paddy fields providing wide visual perspective, soft soil and little vegetation. Restoration and protection of such paddy fields in winter are crucial to the conservation of the Crested Ibis.

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Winter patterns of foraging, fat deposition and corticosterone differ between Bearded and Blue Tits: Is this an expression of egalitarian or depositic winter flocks?

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Social organization in wintering birds reflects ecological and physiological constraints placed on a species in its wintering area. In addition, the expression of sociality can range from obligate gregariousness to facultative sociality. We have taken two very different species of tits (Bearded Tit *Panurus biarmicus*, Blue Tit *Parus caeruleus*) with extremes in sociality and nutritional ecology and compared their physiology and behavior in adjacent outdoor aviaries with ad libitum food resources. Conflict frequencies, dominance and feeding site use were monitored as behavioral parameters. Changes in body mass, fat indices and plasma corticosterone were the physiological parameters. The main differences between the species were seen in fat deposition and the use of dominance. Fat deposition was more constant and pronounced in the gregarious Bearded Tit. Feeding site use and conflict was relatively constant over the winter observation. The more flexible Blue Tit on the other hand had stronger behavioral and physiological reactions to changes in ambient temperature. Fat deposition and aggression increased with decreasing temperature and vice versa. The latter species was in a sense more reactive to environmental bottlenecks. The former was more pre-programmed. Similar differences were seen in the patterns of adrenal activity as documented in plasma corticosterone. These results exemplify the kinds of behavioral and physiological wintering strategies and environmental responses one might expect in the obligate, and perhaps more egalitarian wintering Bearded Tit compared to the flexible but depositic wintering Blue Tit. As a final point, there may be sexual differences in these reactions of Blue Tits that are not found in Bearded Tits. Results here were interesting but not conclusive. This point should be addressed in future studies.

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Spatio-temporal nocturnal migration patterns across the Strait of Gibraltar

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The Strait of Gibraltar is one of the world's most famous bottlenecks for bird migration. Each spring and autumn, millions of European migrants concentrate there on their way to and from African wintering grounds, and most are nocturnal migrants. However, seasonal and diurnal patterns of nocturnal migration have hardly been studied at the Strait of Gibraltar, and data on flight altitudes of migrants are nearly lacking. During autumn migration 2004 and spring migration 2005, we recorded nocturnal bird migration on a mountain ridge near Tangier, Morocco with a ship surveillance radar. According to known migration patterns of the most numerous species, we divided the signals into trans-Sahara migrants (long-distance) and short-distance migrants wintering in NW Africa. In autumn, for both short-distance and long-distance migrants, highest migration intensity was recorded in the second hour of the night. The start of migration after nightfall was later in autumn than in spring. Short-distance migrants were flying at lower altitudes than long-distance migrants, and showed a stronger decrease in flight altitude towards the late night hours, suggesting heading towards nearby wintering habitats. The data also indicate that, in autumn, the majority of birds start directly from southern Spain to cross the Straits. In spring, short-distance migrants reached a peak about 1 hour after sunset, and highest concentrations of migrating birds were recorded at an altitude of about 700 m. Long-distance migrants showed highest migration intensity in the first hour of the night, which is earlier than in autumn, but a second and even broader 'wave' was recorded around the 7th night hour. These later flying birds showed concentrations around 1000 m and, respectively, below 400 m above ground. These data may indicate different migration strategies in spring: Whereas lower flying birds may head for landfall on the peninsula, the high flying ones are apparently heading across the Strait.

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Do different elements of Black Redstart song have different threat values?

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The Black Redstart (*Phoenicurus ochruros*), a highly territorrial songbird, has a simple song composed of two distinct elements, henceforth called A and B. As in other songbirds, males emit either the first part alone or the complete song. We performed a playback experiment to find out whether the two parts have different threat values and if birds pay attention to the order in which the two elements are emitted. For fifteen males exposed to the songs of 7 different birds, we recorded latency of appearance, the number of entries, and the time spent within a 5 m and 1 m circle around the loudspeaker. In a first experiment (sequential presentation), the exposed males responded equally to elements A and B when they were presented alone, but gave stronger responses to the complete song (AB). In a second experiment, males responded equally to AA, BB, AB and BA arrangements of the elements. Our results suggest that birds simply respond to longer song emissions, but further investigation is needed to determine whether the threat values of the two elements differ (e. g. through "choice playback tests" in which the two elements are presented simultaneously) or whether the elements have different functions, e.g. in intra- *vs*. inter-sexual communication.

Dranzoa C

The illegal bird trade in east Africa: Implications for avifaunal conservation

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The east African region, particularly Uganda, is richly endowed with avian diversity: 1015 species are known from the region. If such biodiversity is wisely managed, it could make a significant contribution to the economy of the region as well as improve the welfare of local communities. Yet unprecedented habitat destruction and illicit trapping and trading in live fauna is going on without adequate documentation, let alone control. Although conservation policies are in place, the live trade in east African birds has gone on for years without major intervention. Its impact on the fauna, moreover, is compounded by on-going habitat degradation, fragmentation, and dramatic changes in land use. I present data compiled over the last ten years, covering particular groups affected, including Psittacines. The dilemmas facing biodiversity conservation in east Africa are highlighted, and remedies ranging from education of policy enforcers to capacity enhancement for avian conservation are identified.

Dulisz B, Nowakowski JJ

Breeding strategies of shorebirds under conditions of strong predator pressure

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Large breeding colonies of Northern Lapwing (*Vanellus vanellus*), Black-tailed Godwit (*Limosa limosa*) and Common Redshank (*Tringa totanus*) disappeared from lacustrine areas of the Biebrza River valley in northeast Poland between 1989 and 1999, and breeding populations of Ruff (*Philomachus pugnax*) and Great Snipe (*Gallinago media*) declined significantly as well. The hypothesis that this was due to increased predator pressure on breeding shorebirds, and the weakness of colony defense, was tested in 2002 - 2005. Breeding success, nest position, reasons for egg loss, colony penetration by diurnal predators and defensive strategies used by shorebirds were recorded separately for two types of colonies: dense and scattered. Artificial nests were set up to determine diurnal and nocturnal predation rates as well. The point location of all nests was marked using a global positioning system (GPS). Nest and egg loss differed between colony types, being significantly higher in dense colonies. Pressure from diurnal avian predators was similar in both colonies. Twelve species were identified, the most common being the Marsh Harrier (*Circus aeruginosus*), Carrion Crow (*Corvus corone*), Common Raven (*Corvus corax*) and White Stork (*Ciconia ciconia*). The most common defensive strategy used by shorebirds was aggressive nest defense, adopted particularly by lapwings and Black-tailed Godwits. The rates and effectiveness of such behaviors were higher in the scattered colony type. Colonies differed significantly in the estimated probability of nest destruction at night, where the pressure from nocturnal mammalian predators was much higher in dense colonies. The paper discusses hypothetical methods for reducing the probability of nest destruction and improving nest defense under different conditions and predator pressures.

Dundee B

The diet and foraging ecology of chick-rearing Cape Gannets on the Namibian Islands in relation to foraging aspects: A study using telemetry

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GPS telemetry in conjunction with a historical diet-time series was used to obtain novel information on the dietary trends and feeding ecology of the dramatically declining gannetries on Ichaboe Island (26º17'S, 14º56'E) and Mercury Island (24º43'S, 14º50'E) off Namibia, in relation to key environmental parameters. The diet-time series (1995-2004) for Ichaboe Island showed that trawler-scavenged Cape Hake (*Merluccius* spp.) and naturally foraged Saury (*Scomberesox saurus*) dominated by both percentage contribution to mass of Cape Gannets (*Morus capensis*) at 35 and 34% respectively, and percentage frequency of occurrence at 34 and25 % respectively. In contrast, juvenal Cape Horse Mackerel (*Trachurus trachurus capensis*) at 40% by mass and 26% by frequency, and juvenal Snoek (*Thursites atun*) at 20% by mass and 20% by frequency, dominated gannet diet on Mercury Island. Significant time and site effects were observed also in composition of diet between the two islands. GPS field deployments, made during the 2003/4 breeding season, revealed significant differences in gannet foraging patterns between the two islands. Birds from Ichaboe took shorter foraging trips (24.3 hrs vs 29.4 hrs), traveled shorter distances away from island (130 km vs 197 km) and made shorter foraging sweeps (422 km vs 673 km). There were, however, no significant differences in average traveling speeds and the number of foraging fixes associated with prey patch exploitation. Gannets from Ichaboe foraged in two main directions: west, presumably to obtain mainly scavenged fish offal, and north to obtain forage fish. Mercury birds foraged only north, overlapping with birds from Ichaboe in a northerly direction. In summary, Cape Gannets appear to be constrained by effects of intra-specific and inter-colonial competition, as well as lower quality diet and generally poor food availability, especially off southern Namibia; this may account for the poorer performance of colonies furthest south.

Durant JM

Climate and hunting success in male Barn Owls

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Reverse sexual dimorphism is common in raptors and is associated with a marked division of parental duties. This marked division is evident in barn owls (*Tyto alba*), where the female stays in the nest without foraging during incubation and early rearing (Taylor 1994, Cambridge University Press; Durant 2002, Avian Sci. 2: 167–173). Consequently, after hatching and before the female reinitiates foraging activities, the male has to provide for the growing nestlings through increased foraging efforts. During this period, the number of prey brought to nest by the male can reach 11 prey items per night (Durant et al. 2004). One of the limiting factors in nest provisioning by the male is obviously the time allotted to hunting and the environmental variables that may limit it. We explored the effect of local climate on the hunting duration, defined as the time lapse between two visits of the male to the nest. We applied a model taking into account a motivation index (based on the brood food requirement (Durant et al. 2004, Can. J. Zool. 82: 1011) and the previous food supply) and the prey species brought to nest to see the effect of environmental variables (rain and wind strength) on the duration between two entrances with prey to the nest. The nest-visits by males and prey identification were monitored remotely on six free ranging barn owl pairs nesting in eastern France using an automated weighing system (Durant et al. 2004). The climatic data came from local meteorological stations installed in the area of the nests. The model selection was conducted using Akaike's information criterion. The results are discussed in terms the effects of weather on food provisioning and chick rearing in Barn Owls.

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Competition in variable environments

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The impact of climatic variability on individuals and populations may operate either directly through physiology, involving metabolic and reproductive processes, or indirectly through the ecosystem, involving prey, predators, and competitors. Although the basic outcomes of competition for food and space are described by the classical Lokta-Volterra equations, the influence of changing climate can also affect the outcome of competition between two competitive species. Thus, in subalpine mixed deciduous forest near Dlouhá Loučka in the Czech Republic, adverse effects from a positive North Atlantic Oscillation (NAO) event on breeding density in Collared Flycatchers (*Ficedula albicollis*) allowed a weaker interspecific competitor unaffected by the event, the Pied Flycatcher (*Ficedula hypoleuca*), to live in sympatry. We pursued the question of climatic impact on competitive species in two different systems: the two flycatchers of Dlouhá Loučka, and the Great Tit (*Parus major*) - Blue Tit (*P. caeruleus*) populations breeding in mixed deciduous forest at Ghent in Belgium. Using the mgcv library of R, we estimated the outcome of competition between the two sets of competing species in a variable environment parameterized by temperature, rain and the NAO. Analysis of a graph of isoclines of density-combinations shows that climate can change competitive patterns completely, enabling otherwise weaker competitors to maintain populations or modify equilibrium points.

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Ecosystem tests of the match-mismatch hypothesis

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Climatic change is disrupting otherwise tight trophic interactions between predator and prey. Most earlier studies have focused primarily on the temporal dimension of the relationship in the framework of the match-mismatch hypothesis. The match-mismatch hypothesis, originally developed in a marine system, has since been used to explain avian population variation affected by climate change, such as phenology of reproduction and migration. Yet the pattern described by the hypothesis is more complex than it seems. Variability in climate affects birds both directly through physiology, such as metabolism and reproductive processes, as well as indirectly through the biological environment, such as prey. Here, in a food chain topped by a predatory seabird, the Atlantic Puffin (*Fratercula arctica*), we examined how trophic interactions affect reproductive success. The population of puffins breeding at Røst in the Norwegian Lofoten Islands depends substantially on the spring-spawning Herring (*Clupea harengus*), the original model species for the match-mismatch hypothesis. We analyzed the relationship between the degrees of mismatch among plankton availability, herring spawning and puffin fledging success, reaching the conclusion that match-mismatch patterns can hide one another and that the effects of climate at higher levels in a food chain can be amplified by match-mismatch relationships at lower levels.

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Phylogeography of the Capercaillie in Eurasia: what is the status of the Pyrenean-Cantabrian population?

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The Capercaillie (*Tetrao urogallus*) is a keystone species of Palearctic boreal and altitude coniferous forests. With the increase of mountain leisure activities and habitat loss, populations are declining on most mountain ranges in Western Europe. Endemic subspecies are described from each discrete mountain range. Recent work has shown that the populations from the Pyrenees (France-Spain, race *T. u. aquitanus*) and Montes Cantabricos (Spain, race *T. u. cantabrius*) survived a severe bottleneck during the 19th century, but are still considered threatened due to habitat fragmentation and isolation from other populations. We present an extensive phylogeographic study based on mitochondrial DNA sequence (D-loop) extracted non-invasively from faeces collected throughout the range of the Capercaillie, from western European mountains to central and eastern Europe, Fenno-Scandia, Russia and Siberia). We also compare our results with DNA sequences of the closely-related Black-billed Capercaillie (*T. parvirostris*) from Mongolia. Populations from the Pyrenees and Cantabricos are very closely related yet well differentiated from all other Capercaillie populations which form a homogenous clade. Thus we propose changes in the systematics of the complex, merging *T. u. aquitanus* and *T. u. cantabrius* in a single taxon separate from other members as an Evolutionary Significant Unit. These results have important implications for conservation planning and strategies for Pyrenees-Cantabrian Capercaillies within the Natura 2000 framework, and show that introductions of stock from other populations should not be part of them.

Duval EH

Adaptive benefits of cooperation for subordinate males in the Lance-tailed Manakin

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Sexual selection theory predicts that males will compete vigorously for mates; yet there are a few species in which they form partnerships with other males instead to cooperate to attract females. Pairs of male Lance-tailed Manakins (*Chiroxiphia lanceolata*) cooperate to perform elaborate, coordinated courtship displays, but only the alpha male copulates with females attracted to the display perch. This raises the question of why beta males cooperate. I investigated the selective basis for cooperative courtship coalitions among males of this species. I combined behavioral observations of a color-banded population with genetic analyses of paternity and relatedness to test three hypotheses for explaining the adaptive value of beta cooperation: (1) betas benefit directly through unobserved copulations, (2) betas increase their inclusive fitness by facilitating courtship displays of relatives, and (3) betas receive delayed direct benefits by inheriting the display territory from their alpha partner. Of 69 chicks assigned paternity under strict confidence limits, only one was sired by a beta male, demonstrating extremely low direct fitness return for males of beta status. Average pairwise relatedness between 35 alpha-beta pairs was -0.02±0.05 SE (95% CI -0.123 to 0.08), and not significantly different from random pairings of males. Natural territory turnovers and a removal experiment demonstrated that betas were more likely to become alphas than males that had not been betas, but that they do not necessarily inherit alpha roles at territories where they have served beta tenure. This suggests that betas derive delayed fitness benefits by ascending through a population-wide rather than territory-specific queue.

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Alien egg discrimination in sympatric populations of Great and Eurasian Reed Warblers in an area of cuckoo brood parasitism

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Our study of egg discrimination in the Eurasian (*Acrocephalus scirpaceus* - ERW) and Great (*A. arundinaceus* - GRW) Reed Warblers was carried out at the Milicz fish-ponds in southwest Poland in 2002-2003. There a total of 11.3% (n=346) ERW broods were found parasitized by cuckoos (*Cuculus canorus*) but only 1.7% (n=115) broods of GRW (chi square, Yates corr.=8.54, P=0.0035). Accordingly, we assessed discrimination response by replacing one egg in test nests with one of three types of conspecific eggs: one painted plain blue, one painted plain brown, and one unpainted. ERW rejected 61.8% (n=204) of non-mimetic eggs, and GRW 92.9% (n=70) (Fisher exact probability test: P<0.001). The rejection rate of unpainted alien conspecific eggs was 3.6% and 13.6% respectively (NS). In neither species were there significant differences in the rejection rate of blue and brown eggs. In GRW, 64 out of 65 rejected eggs were ejected, and in ERW 122 out of 126; two clutches were deserted and in two other nests the non-mimetic egg was buried. ERWs were more likely to accept non-mimetic eggs during incubation than at the egg laying stage, a pattern reversed in GRWs. Moreover, ERWs accepted introduced eggs more often in the morning than the afternoon, a pattern again reversed in GRWs. Overall, these data support the hypothesis that the low rate of cuckoo parasitism of GRWs in comparison to ERWs in our study area results at least in part from the higher rejection rate of non-mimetic eggs by GRWs.

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Reproduction and molt in high mountain Neotropical forest birds: overlap is as common as in temperate and boreal birds

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Responding similarly to environmental factors, tropical bird species are considered to breed year round compared to temperate species which breed only over two to three months. In temperate birds, molt occurs mainly after reproduction; but little is known of molting schedules in tropical birds. Accordingly, we screened the timing of reproduction and molt in bird assemblages in four Neotropical mountain cloud forests (two big and two small) to determine whether and to what degree these two energetically demanding events overlapped. Study sites were located at Sabana de Bogotá, Colombia, around 2700-2900 m.a.s.l., where birds were monitored monthly between December 1999 and December 2000. A total of 775 individuals of 54 species were examined. Reproduction (as gonadal development assessed by laparotomy) and molt (as scored values in an EMA index) overlapped in 27.7% of individuals and 46.3% of pecies. Overlap varied in duration according to area and gender (mean, males=28.5%, females=20.5%), at percentages higher than found in other tropical regions. It may be that high mountain Neotropical birds respond differently to climate than those in the lowlands, perhaps due to resource abundance. Thus, they resemble boreal or extreme north temperate zone birds in the timing of reproduction and molt, bird assemblages in which resources seem more critical in constraining and defining physiological strategies.

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Newly-discovered European crossbill diversity is driven by divergent natural selection

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As do many other bird groups, closely-related crossbill taxa differ in their ecology and in their adaptive biometry as it relates to key resource use (seeds of conifers). This is also true for the new Common Crossbill diversity that has recently been uncovered in North America, where up to 9 different incipient species seem to coexist, each specialising on a different type of conifer. Recently, several vocally differentiated Common Crossbill populations ('vocal types') have also been discovered in north-western Europe, and these seem to be reproductively isolated wherever they co-occur. This is surprising, since this number of potentially new species of crossbills (7) is much higher than the known diversity of key resources (only 1). Alternatively, it has been suggested that sexual or social selection alone could create new species, which in sympatry then either diverge in ecology or go extinct due to resource competition (´hopeful species´). We tested this alternative view of speciation by comparing the biometrics of the vocal types: a lack of differentiation of adaptive morphology would support speciation by means other than natural selection. However, we found considerable differences between vocal types, especially in certain bill traits that relate to resource specialisation. Morphological differentiation was away from the 'line of least evolutionary resistance'. These results suggest that divergent natural selection is playing an important role in the differentiation of crossbill populations. These results provide further evidence for the importance of ecology in causing population differentiation and speciation. In addition, they suggest that in order to have evolved and maintained this polymorphism, European crossbills have managed to subdivide a single resource in ways that are currently unknown, or are perhaps specialising on introduced conifers.

Egbert J, Schwabl H

The relationship between steroid levels in circulating plasma and yolk in the House Sparrow

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Steroid hormones produced by a female bird are recovered from the yolks of her eggs with incredible levels of variation within and between species, individuals, and clutches. This finding has led to extensive literature reporting on the potential benefits, costs, and evolutionary impacts of this phenomenon. What remains unknown, however, is the mechanism for this variation and the relationship between steroid levels in maternal plasma and yolk. There are two general possibilities: (1) a mechanism exists whereby a female can modulate yolk hormone levels independently of her own plasma levels, potentially releasing her from physiological costs or constraints associated with high levels of steroids, especially androgens, or (2) hormones enter the yolk passively and strictly proportionally to the circulating levels in the female over the period of yolk deposition; thus, yolk variation mirrors temporal plasma variation. Also poorly understood is the role of androgens in regulating aggressive behavior in female birds during breeding. To examine these questions, we conducted an experiment on captive House Sparrows (*Passer domesticus*) collected from the wild. On the day the first egg of a clutch was laid, we took a blood sample following a period in which the female was either challenged at the nest box by a novel female in a wire cage or left unchallenged. Subsequent eggs were fixed and stained to visualize ring structure, and a sample was obtained from the yolk ring that was being formed at the time of the treatment period. This should allow us to determine the extent to which plasma and yolk steroid levels are related, thus identifying which of the above scenarios is most correct. From there, research on the trade-offs and developmental or long term influences of yolk hormones can be interpreted more fully and with some knowledge of the process. Furthermore, the experimental challenges should indicate how plasma steroids vary with female aggression during laying.

Ekiert T

Changes in the prey of Polish Barn Owls in the Southern Wielkopolska region between 1950-52 and 2000-01

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Pellet analysis has been a very popular method used in dietary studies of the Barn Owl (*Tyto alba guttata*). However, there is little information on long-term changes in the prey of this species in Poland. Comparison of the results of a Barn Owls pellet survey in 1950-52 with those of a similar survey in 2000-01 shows that Barn Owl diet has changed significantly. Samples of pellets were analysed from two of the places where Barn Owls have been breeding since the 1950s (Odolanów 2905 and Skrzebowa 539 prey items in the 1950s, Odolanów 1152 Skrzebowa 570 prey items in the 2000s). In Odolanów the primary difference is a decrease in the percentage of Common Shrew (*Sorex araneus;* from 31.56% to 20.14%), Common Vole (*Microtus arvalis;* from 52.65% to 34.12%), combined with a rapid increase of Root Vole (*Microtus oeconomus;* from 1.20% to 17.62%), Pygmy Shrew (*Sorex minutes;* from 0.31% to 2.78%) and Water Vole (*Arvicola terrestris;* from 0.07% to 1.00%). In Skrzebowa, we noticed a steady increase in Field Voles (*Microtus arvalis;* from 53.06% to 66.14 %). Other groups of prey, such as the House Mouse (*Mus musculus*) and House Sparrow (*Passer domesticus*) had decreased in both places: House Mouse from 4.72% to 2.26% in Odolanów and from 14.47% to 7.19% in Skrzebowa; House Sparrow from 1.76% to 0.95% in Odolanów and from 5.75% to 1.58% in Skrzebowa. These changes in diet indicate that the relative abundance of small mammal species in these sites has changed, most likely due to the intensification of agriculture and other changes in land management since the 1950s.

El-Sayed A-A, González J, Wink M

Phylogenetic relationships in diurnal raptors and putative allies: Evidence from mitochondrial DNA sequences, nuclear RAG-1 genes and genomic fingerprints

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To test phylogenetic relationships formerly reconstructed from mitochondrial (mtDNA) cytochrome-b (cyt-b, 1000 bp), we obtained sequences of the RAG-1 nuclear gene (2,000 bp) from more than 150 species representing 48 genera of diurnal raptors and storks, covering 5 families. Molecular phylogenies were constructed for cyt-b and RAG-1 using maximum likelihood, neighbor-joining, and Bayesian analyses with maximum parsimony procedures. We compared mtDNA sequences against nuclear sequences using the incongruence length difference (ILD) test. Phylogenetic signals were congruent and complementary between cyt-b and RAG-1 trees. The polytomy found between Pandionidae, Sagittariidae, Ciconidae and Accipitridae at the base of the cyt-b tree was resolved with RAG-1 sequences that separate these monophyletic groups with high bootstrap values. Both cyt-b and RAG-1 sequences cluster the monotypic genera *Sagittarius* and *Pandion*, which are the sole representatives of their families, with the genus *Elanus* at the base of the clade which leads to the Accipitridae. Our complete data set (cyt-b and RAG-1) reveals Falconidae (falcons), Cathartidae (New World vultures), and Ciconidae (storks) as well-defined monophyletic groups with a high bootstrap support. However, the entire order Falconiformes is an artificial assemblage. Our approach using a multi-gene phylogeny that combines a maternally-inherited fast evolving gene (cyt-b), and a relatively slow evolving nuclear gene (RAG-1), provides resolution at both terminal and basal ends of the phylogenetic tree for diurnal raptors. Genomic fingerprinting with ISSR also supports the phylogenetic framework obtained from nucleotide sequences, indicating that those markers draw a realistic picture of raptor evolution.

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Energy costs and food requirements of Eared Grebes during autumnal staging

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Over 98% of the Eared or Black-necked Grebe (*Podiceps nigricollis*) population in North America stages every autumn on Mono Lake, California, or on Great Salt Lake, Utah. We evaluated the energy budget of adult Eared Grebes on Mono Lake to document energy use and to investigate the impact that staging congregations had on their main food source, the Brine Shrimp (*Artemia monica*). It was impossible to use a doubly-labeled water technique, so time-activity observations in the field and metabolic measurements of each activity in captive grebes were integrated to estimate the energy budget, together with other metabolic and body composition measurements. While staging, grebes gain over 3 g per day, 71% of which is fat, nearly tripling their body mass then. They prepare to leave when their previously superabundant food becomes scarce. At that point, they stop foraging and prepare for departure. During the two or more months of foraging, however, they spend the largest part of their daylight hours either surface swimming or feeding, mostly underwater. These two activities alone account for 40 to 50% of their daily energy costs. During the months of foraging, we estimated daily energy requirements, including growth and a 77% energy assimilation factor, to vary between 715 and 840 kJ/d, which is under 3 X basal metabolic rate. This cost is much less than the cost of flight during migration, so grebes apparently migrate only because they have depleted their food. When translating their daily energy requirements into food, we found that grebes must each eat over 25,000 brine shrimp at the peak of staging. As there are between one and two million grebes on the lake at this time, the impact on the brine shrimp population is significant.

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The “Big Six” in big trouble

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The “Big Six” in South Africa include the Kori Bustard (*Ardeotis kori*), Martial Eagle (*Polemaetus bellicosus*), Lappet-faced Vulture (*Torgos tracheliotus*), Southern Ground Hornbill (*Bucorvus leadbeateri*), Saddle-billed Stork (*Ephippiorhynchus senegalensis*) and Pel’s Fishing-Owl (*Scotopelia peli*). All six are of conservation concern and listed as vulnerable in South Africa, except for the Saddle-billed Stork which is endangered. All are also of commercial importance to eco-tourism, and represent a valuable marketing tool. Although they are widespread across southern Africa, they are also sparse in numbers. Very little, moreover, is known about their general biology and ecological requirements. We have been monitoring the distribution and abundance of the Big Six in the Limpopo Province, South Africa, since 2003, documenting breeding activity as well. All species reach peak abundance in the protected Kruger National Park and relatively undisturbed Limpopo River Valley, indicating that they are affected negatively by anthropogenic activities. The threats facing them are many, varied and complex. Major threats include encroachment of shrubs and woody weeds as a result of poor veld management practises, tree felling for fuel, construction and furniture, damming of rivers, persecution, poisoning, commercial crop farming and collisions with overhead transmission lines, amongst others. We used population modeling to determine the effect of various scenarios on their continued survival, relating this to changes in distribution reflected in comparisons of historical distribution with present range and density. The results will be used to develop management plans for the species in the Limpopo Province.

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Directional preferences of passerines trapped during autumn migration on the Kizilirmak delta, northern Turkey

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It is generally supposed that migratory birds track their routes and destinations using a bi-coordinate navigation system. The environmental variables constituting the navigational coordinates, however, are not well understood. In 2004, passerine birds on autumn migration were tested with Busse’s method for directional behavior at two localities, Cernek and Karabogaz, in the Kizilirmak delta, northern Turkey, to investigate how local geography influences directional preferences. At Karabogaz, 284 birds of 13 species were trapped and tested for directional preferences, and 184 of 17 species were tested at the Cernek site. The data demonstrated that directional headings were grouped on two main axes, one for each site. Birds in Cernek oriented mainly in a southwesterly direction and birds at Karabogaz mainly towards the southeast. Both orientations directed the birds to the Kizilirmak Valley.

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The breeding biology of the Common Redstart in the research forests, Bük-Lütfi Büyükyildirim and Elmali Cedar, in Antalya

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A study of the breeding biology of the Common Redstart (*Phoenicurus phoenicurus*) was carried out from 2000 to 2001 in the Bük-Lütfi Büyükyildirim (Redpine) (BL-W) and Elmali Cedar Research Forests (EZ-W) in the west Mediterranean forests of Antalya. The study area covered diverse vegetation types over a range of altitudes. Time taken for nest building, eggs hatched, total fledged young and comprehensive breeding success were all recorded. Timing of migration and factors influencing hatching were also investigated.

Estrella SM[1], Masero JA[2], Pérez-Hurtado A[3]

Aquatic foraging in shorebirds

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Shorebirds are organisms that show a high ecological plasticity, which allows them to cope with a changing environment and to exploit a wide range of prey in distinct habitats. Most foraging ecology studies on shorebirds have been carried out on intertidal mudflats, which can be classified as terrestrial media. Nevertheless, shorebirds are able to feed on prey suspended in the water column. Assuming that the feeding mechanisms of vertebrates are build upon the physical constrains impose by the medium, it is clear that the aquatic medium possesses a distinct set of features compared to the terrestrial medium, such as viscosity, drag forces or light refraction. However studies related to the effects that environmental features have on foraging mechanisms of shorebirds are scarce. We describe the capacity of Dunlins (*Calidris alpine;* n=20), Sanderlings (*C. alba;* n=51), Little Stint (*C. minuta;* n=27) and Curlew Sandpipers (*C. ferruginea;* n=34) to visually assess prey position and depth in the water column, adjusting to the constraint impose by the light refraction. We found that the depth at which the prey is situated has a significant effect on the strike mode (Dunlin: ANOVA, F=6.83, df = 6, P=0.001; Sanderling: ANOVA, F=16.35, df=6, P=0.001; Little Stint: ANOVA, F=12.15, df=6, P=0.001; Curlew Sandpiper: ANOVA, F=10.22, df=6, P=0.001). Modulation of the strike was produced depending on the prey depth in the water column: an open-billed attack was associated with the prey being in the surface layers of the water column, while a close-billed attack occurred with the prey in the lower layers of the water column. We hypothesize that this strike modulation is a strategy to minimize the effect of the bow wave and the drag forces characteristic of the aquatic medium.

Estrella SM[1], Masero JA[2]

The use of distal rhynchokinesis by shorebirds in the aquatic medium

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Up to now, shorebirds' distal rhynchokinesis is the only type of kinesis to be related to a specific terrestrial (mud) feeding behavior - that being the probing technique. Distal rhynchokinesis is used to capture and handle prey efficiently in the substratum, since distal rhynchokinesis minimizes the displacement of substratum and minimizes the bending forces acting on the bill. In addition, for handling and extracting prey efficiently, sandpipers use the bill as forceps and grasp prey only with the bill tip. This produces a concentration of the grasping force where the jaws contact at the bill tip. We describe for the first time the use of distal rhynchokinesis by Dunlins (*Calidris alpine*), Sanderlings (*C. alba*) and Little Stints (*C. minuta*) to capture prey items from the water column. We hypothesize that the functional explanation of the aquatic use of the distal rhynchokinesis is similar to that given for the terrestrial medium. The aquatic use of the distal rhynchokinesis may be related to an attempted reduction of the effect of drag forces and bow wave produced by the approaching predator when the jaws are fully opened, this disturbing the water, in turn producing prey displacement. Distal rhynchokinesis may minimize the displacement of water. If the distal part of the upper jaw alone is elevated and the lower jaw is depressed, the volume of water displaced and disturbance is minimal. As in the case of the terrestrial medium, distal rhynchokinesis may assist in the handling and efficient extraction of prey from water.

Fang Y, Gu Y, Sun Y-H, Tang S-H

Vocalizations, breeding ecology and diet of an endemic form of the Boreal Owl in Lianhuashan, China

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From 2003 to 2005, we studied the breeding biology of a regionally endemic subspecies of the Boreal owl, *Aegolius funereus beickianus*, at Lianhuashan Natural Reserve in Gansu Province, China. Six vocalizations were identified, and their characteristics and variance summarized; they included a primary, 'moo-a' call and a 'skiew' call in males, a weak call in females, and chirp and chatter calls in nestlings. Compared to its form in *A. f. funereus* in north Eurasia and *A. f. richardsoni* in boreal North America, the primary call of *A. f. beickianus* is of shorter and fewer notes at a somewhat higher frequency. Based on 4, 6 and 7 nests found in each year respectively, we documented clutch size, length of the breeding period, and the growth and survival of nestlings. The frequency of feeding visits to nestlings in the Lianhuashan population was higher than in other subspecies, but the size and numbers of prey delivered (1.5

items/visit) were lower, and nestling growth was slow and fluctuated much, probably due to erratic food supply and ambient temperature. Compared to other subspecies, *A. f. beickianus* begins egg-laying later, and lays smaller clutches of eggs of smaller volume. In the breeding season, small mammals form the staple diet (91.5%); only 8.4% comprises birds. Different prey were taken at different times, and the food niche breadth is broader in late breeding season; the index of food niche breadth was 5.46, higher than its mean value in other regions. Uncertainty in the food supply caused the owls to store food, the amount of food cached differing between territorial pairs. Food caching buffered weight loss in nestlings, the mass of which was found positively related to the amount of food cached late in the nestling period.

Fanny OID, Yuda P, Jati WN

Nesting niche partition between the Java Sparrow and Eurasian Tree Sparrow in the Prambanan temples complex

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It has been suggested that the Eurasian Tree Sparrow (*Passer montanus*) is a competitor of the Java Sparrow (*Lonchura oryzivora*) for nesting sites and is a threat to the survival of the latter, a vulnerable bird in the wild. The two nevertheless coexist in the Prambanan temple complex in central Java. Although the Eurasian Tree Sparrow is more abundant, the two species partition their nest sites, the tree sparrow making its their nests in the lower and middle parts of the temples at ~5-15 m above the ground, and the Java Sparrow using higher sections at ~15-30 m.

Farnsworth A

Perspectives on the evolutionary and behavioral ecology of flight calls in migrating birds

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Flight calls are the primary vocalizations given during sustained flight. Many species produce distinctive calls, especially during nocturnal migration; however, while the first accounts of flight calls appear in the ornithological literature as early as the late 19th century, some of their most basic features and attributes remain unstudied. Improving the understanding of why birds call at night could illuminate unclear associations between life-history traits and patterns observed in migration, such as how inter- and intraspecific associations appear on the ground and the mechanisms birds use to fine-tune migration strategies during crucial decision-making periods. Additionally, recent interest in flight call monitoring as a tool for studying nocturnal migration highlights a need to define more explicitly variability of nocturnal calling rates to refine interpretations of the nocturnal calling record as an index of bird density aloft, species composition, and location and timing of migration strategies. I studied the evolutionary history of flight calls and temporal and seasonal patterns of flight calling behavior in migratory passerine birds, focusing on *Catharus* thrushes and New World wood-warblers (*Parulidae*). I investigated whether morphological constraints drive the evolution of flight calls. I examined the relationship between genetic and acoustic similarity, assessing the degree of phylogenetic signal in flight calls, examining the changes that occurred in flight calls through comparative phylogenetic methods and studying convergence among unrelated species. I studied the distribution of flight calling behavior among taxa and differences in this distribution between migratory and non-migratory populations and species. I compared variation in flight call characteristics among individuals to the degree of variation among species. I report the results here, and I interpret them with respect to what is known about flight calls.

Farswan A, Negi K, Chandola-Saklani A

Maximal changes in daily photoperiod around the vernal equinox wind the circannual clock in Spotted Munias at low and mid latitudes

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Recently, evidence has been found for the first time in a bird, the Spotted Munia (*Lonchura punctulata*), that the part of the annual photocycle which increases at maximal rate near the vernal equinox synchronizes endogenous circannual reproductive rhythm with the geophysical cycle. This paper extends this research to populations of Spotted Munias at different latitudes. First-year males that had never experienced increasing day length in nature were procured from southern (13-14° N) and northern (29-30° N) parts of India. Separated into groups of 10-15 birds each, they were started on 28 December on photoperiodic schedules with increments of 1', 1.5', and 2' d^{-1}, representing a daily increase around vernal equinox at lower and mid latitudes, for 15 or 30 days. After that treatment, they were transferred to continuous illumination (LL) where they remained for more than a year. LL and NDL controls were maintained. Results indicated that all birds irrespective of southern or northern source showed clear-cut circannual testicular rhythms in LL. Treatment of 1' and 1.5'increase d^{-1} for 15 days prior to transfer to LL caused a phase delay in the reproductive cycle of the southern population, leading to synchronization, but not in the northern population which remained free-running. The northern population, as also observed earlier, was synchronized by daily increments of more than 1.5' d^{-1} only. Obviously, southern tropical populations have evolved a higher degree of sensitivity that allows their circannual clock to use daily ambient increases in day length around the vernal equinox to synchronize their seasonal cycle with the best time for reproduction - in this case, the monsoon.

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Effects of increased predation risk on the population dynamics of migratory birds: Optimal annual routine simulations

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Predation risk is an important factor that affects migratory bird populations on their breeding and wintering grounds, as well as along their migration routes. Here we investigate how a sudden increase in predation risk in these areas, such as hunting, influences the population dynamics of migrants. To do so, we simulate a population in which birds behave according to an optimal strategy determined by an annual routine model. In the model, decisions depend on the time of year, energy reserves, breeding status, experience, flight feather quality and location. Food at a location varies independently of food at other locations over a year, and there is explicit density dependence in the food supply. After tests have been run for several undisturbed years, predation risk is systematically increased at different sites, and changes in the size of the modeled population observed. It is assumed that the modeled birds do not have enough time to adapt evolutionarily to the new circumstances, and thus continue to follow the optimal policy for the original environment. Using this approach, we can estimate, for example, how events on wintering sites can affect population trends on breeding grounds. Another interesting feature of the model is that it enables investigation of physiological state to establish whether any of the state variables can predict the response of the population to hypothetical environmental change.

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Avian clock gene polymorphism: Evidence for occurrence and latitudinal clines in allele frequencies

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In comparison with most animal behaviors, circadian rhythms have a well-characterized molecular basis. Detailed studies of circadian clock genes in 'model' organisms provide a foundation for interpreting the functional and evolutionary significance of polymorphic circadian clock genes in free-living animal populations. Here we describe allelic variation in a region of the avian clock orthologue which encodes a functionally significant polyglutamine repeat, ClkpolyQcds, in free-living populations of two passerine birds, the migratory Bluethroat (*Luscinia svecica*) and the predominantly non-migratory Blue Tit (*Parus caeruleus*). Multiple ClkpolyQcds alleles were found in populations of both species: 12 populations, 7 alleles in Bluethroats, and 14 populations, 9 alleles in Blue Tits. Some populations of both species were differentiated at the ClkpolyQcds locus as measured by F_{ST} and R_{ST} values. In Blue Tit but not Bluethroat populations, we also found evidence of latitudinal clines in mean ClkpolyQcds repeat length and proportions of three ClkpolyQcds genotype groupings. We suggest that the allelic variation observed in ClkpolyQcds is not simply selectively neutral but is, at least in part, maintained by selection reflecting micro-evolutionary adaptation to photoperiodic parameters correlated with latitude.

Fiedler W

Causes of recent changes in the migratory behavior of European White Storks

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Analysis of more than 35,000 recoveries of ringed White Storks (*Ciconia ciconia*) since the beginning of the 20th century in a joint project of the European Union for Bird Ringing (EURING) reveals evidence for recent changes in migration distance, direction and timing in this species. The main central European migratory divide between migrants using the western and eastern flyways has become more of a zone of overlap between routes, and immature storks now return up to 2 years earlier to breeding grounds than 30 years ago. These changes are more pronounced in some populations than others, mainly in those in the west. So far there is no evidence that recent climate change is a primary cause of the observed changes. Much more likely, shifts in land use, including the availability of food in refuse dumps in the Mediterranean during winter, winter feeding by humans in central Europe, changes in population density, and the reintroduction and translocation of storks from conservation activities in the 1980s, especially in Switzerland, Germany and The Netherlands, have played major roles. High re-sighting rates of marked storks have enabled us not only to analyze changes in migration behavior for whole populations, but also to follow migratory patterns along parental lines.

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The energy costs of aggressive and comfort behaviors in incubating King Penguins

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Territorial defense through aggressive behavior, and activity related to body comfort, are important components of the time-budget of colonially breeding birds. What the energy costs of such behaviors are and how much they contribute to the reproductive energy budget under field conditions has never been estimated. The behavioral time-budget and the energy expenditure associated with episodes of territorial defense and comfort were determined in 15 freely-incubating King Penguins (*Aptenodytes patagonicus*) by simultaneously recording behavior using focals from video, and heart rate (HR) using external data loggers. The increase in HR induced by each behavior was converted into energy expenditure using an equation developed for incubating birds. During incubation, penguins spent 16% and 14% of time respectively defending their small territory and engaging in comfort activity. For defense, threatening (beak pointing) was used at a rate 5 and 23 times higher, respectively, than flipper blows and pecking ($P<0.01$). On average, HR increased by 28% above resting levels during episodes of defense, corresponding to an extra energy cost of 30 kJ/hr. The cost for body comfort was two times higher, averaging 60 kJ/hr ($P<0.01$). From mean daily HR, total daily energy expenditure (DEE) in incubating King Penguins was estimated at 3100 kJ, of which 115 kJ/day (4% of DEE) and 209 kJ/day (7% of DEE) were accounted for by territory defense and comfort behavior, respectively. Thus, although King Penguins defend their territories very actively, the associated energy expenditure is limited, possibly because threat is used rather than pecking and flipper blows. As King Penguins fast while incubating, such a strategy could enable efficient territorial defense without compromising energy saving. The relatively high amount of energy invested in body comfort seems to suggest that toiletting, stretching, and preening are determinants of fitness in breeding King Penguins.

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Identification and investigation of hotspot stopover habitats for migratory birds on military installations in the USA

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Military lands in the USA provide some of the highest quality habitats available for a wide range of bird species. Although significant emphasis has been placed on the conservation and management of breeding and wintering bird habitat on military installations, relatively little attention has been paid to stopover habitats used by migratory birds during spring and autumn migration. Even less is known about the locations and extent of important stopover sites (hotspots), or areas where birds congregate to rest during migration. By identifying where, when, how long, and in what numbers migratory birds use temporary stopover sites, we will be able to plan installations that can improve both flight safety and bird conservation. Using procedures employed in a companion study, our work focuses on intensive on-the-ground investigations of radar-identified hotspots to: (1) quantify the abundance and diversity of landbird migrants in different habitats to assess daily and seasonal patterns of migration within and across habitat types, (2) assess energetic conditions in individual birds captured by mist net, (3) conduct behavioral observations to quantify foraging behavior and micro-habitat use, and (4) evaluate habitat use, stopover duration, and temporary home range size from radio-telemetry investigation. Here we present preliminary data from two military installations in North America where we quantified relative abundance of migrant species during autumn and spring migration using line-transects and mist nets. We compare and contrast our data with radar models and provide information on the extent of habitat available and the relative use of different habitats by migrants. We also discuss our approach to future research on these installations to increase knowledge of migrant/habitat relationships.

Formanek L, Houdelier C, Richard M-A

Influence of maternal characteristics on the social motivation of young

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Social motivation is a fundamental driver in social relationships, and its variability is determined by both genetic and epigenetic factors. Among external factors, influences from the mother, the first interactive individual that young meet, seem to have a preponderant effect on development. Accordingly, we addressed maternal influence on the behavioral characteristics in young, particularly on social motivation. Social motivation was measured in fostered young Japanese Quail (*Coturnix japonica*) genetically selected for either high (HSM) or low (LSM) levels of social motivation. Behavioral characteristics were determined simultaneously by classical ethological procedures for both the adoptive mothers and the young, both during the maternal phase and after emancipation. Our results show that maternal social characteristics significantly influence social reinstatement behavior in young in both the short and long term: young reared by HSM females showed higher social motivation than those reared by LSM females. Not all facets of maternal behavior were expressed however, such that transmission is not total.

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Friends or foes: Interactions between neighboring resident Great Tits and migrant Pied Flycatchers

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Interspecific competition usually results in costs for all involved, and larger costs for the inferior competitor. Thus weaker species may be expected to avoid contact with interspecific rivals. We have shown, nevertheless, that Pied Flycatchers (*Ficedula hypoleuca*) prefer to nest in the vicinity of tit (*Parus* spp.) nests, gaining fitness benefits therefrom, even though suffering from competition with the tits. This result suggested a positive interspecific interaction between the two, a phenomenon very rarely described among mobile animals. In the present study we examined whether any benefits between flycatcher and tits were mutual. Our experiment was conducted at nest-site scale with nest boxes, and consisted of three treatments: (1) Great Tits (*Parus major*) breeding alone, (2) Pied Flycatchers breeding alone, and (3) both species breeding as neighbours 20 m apart. In the experimental set-up, the assignment of nests to treatments and the spatial location of nests was randomized for both species by moving tit nests to a random location, and then flycatcher nests either close to (20 m) or distant from (120 m) a tit nest during egg-laying. Results indicated that tits breeding alongside flycatchers produced on average 2 fledglings less than tits breeding alone, whereas flycatchers benefited from co-existence in terms of heavier nestlings. Thus there are no mutually beneficial interactions between these species. Rather, flycatchers seem to parasitize the presence of tits, with tits bearing all the costs. Such parasitic interactions are rarely described among organisms within the same trophic level. The results also conflict with earlier assumptions that resident birds are competitively superior to migrants. In concert with our earlier study, they indicate that flycatchers use nesting tits as a cue for good quality nest sites in terms of food resources.

Frahnert S

Ontogeny of the hind limb and evolution of the Hoatzin

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The Hoatzin (*Opisthocomus hoatzin*) is a monotypic species with unique traits in morphology and behavior. As a result, its phylogentic position has remained controversial for more than a hundred years, various studies associating it with the Galliformes, Musophagiformes, Cuculiformes and Tinamiformes. As a further contribution to the issue, I set out to clarify the phylogenetic information preserved in the morphology of its hind limb. This character complex is especially informative in the evolution of birds because it is intimately involved in locomotion - exclusive of flight - and the mechanism of feeding. Concerning the ontogeny of the scutellar pattern of the foot and digital pads, the adult hoatzin has a reticulate tarso-metatarsus and a single row of scutes on the dorsal surface of the digits. This pattern differs from all orders to which the Hoatzin has been commonly assigned and is at least partially plesiomorphic for birds. During ontogeny, no sign of any fusion or division of the scutes was detected. Differential growth of scutes leads to only slight ontogenetic differences in the pattern. The interrelationships of the scutellar pattern, skeleton and hind limb musculature reveal information about how the hind limb functions. In this respect, the study will form the basis for a evolutionary scenario for the Hoatzin that is correlated with its ecology and behavior.

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Environmental drivers of geographical variation in Black-legged Kittiwake demography

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In order to predict the consequences of current and future climate change on bird populations, understanding is needed of the factors that drive temporal and geographical variation in demography. Black-legged Kittiwakes (*Rissa tridactyla*) vary much geographically in demographic parameters at local, regional and global scales. Within the British Isles, previous work identified largely synchronous variation in breeding success in some regions, but with low correlation among regions. Corresponding aggregations of Lesser Sandeel (*Ammodytes marinus*), the main prey of breeding kittiwakes, are found in these regions. Unfortunately, monitoring data on sandeel abundance are unavailable for the regions. Another study showed that kittiwake breeding success at one site, the Isle of May in east Scotland, was negatively affected by high sea temperatures and the presence of an industrial sandeel fishery, presumably proxies for sandeel abundance. Hydrographic climate varies around the British Isles due to the underlying influence of bathymetry, currents, tides and large-scale weather phenomena, causing regional variation in productivity and abundance of plankton. Here we test the hypothesis that climatic and trophic drivers determine inter-regional variation in kittiwake breeding success in Britain and Ireland. We collate data on sea surface temperature and zooplankton abundance for each of the regions identified in previous work and investigate whether these potential drivers of sandeel abundance correlate consistently with kittiwake breeding success across regions. Using the results of this analysis, known climatic effects on plankton abundance, and forecasts from climate models, we attempt to predict future regional trends in kittiwake populations.

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Corticosterone patterns in Northern Bald Ibises during a human-led autumn migration

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We hand-raised Northern Bald Ibises (*Geronticus eremita*) and conditioned them to follow an ultra-light aircraft in an attempt to experimentally establish a new migration route between Austria and Italy. Faecal samples were collected before and along the 860 km migration route in order to determine the concentrations of excreted immuno-reactive metabolites of corticosterone (BM). In addition, daily body weight and early morning activity was measured. We found a parallel increase of BM, body weight and early morning activity at the beginning of August, indicating a physiological and behavioral change of the birds into a migratory state. In contrast, BM levels decreased continuously while the birds were actively migrating. This may be due to a down-regulation of corticosterone via the hypothalamic-pituitary-adrenal (HPA) stress axis. This decrease in BM seems to contradict the migration modulation hypothesis (MMH), which assumes that the corticosterone level should be elevated during migration to facilitate lipogenesis and hyperphagia. However, field data supporting the MMH are generally collected from birds caught at stop-over sites. In our birds, BM was low on flight days only, but elevated on intervening non-flight days. We discuss this pattern with respect to the alternation between flight and rest periods.

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How to establish and maintain viable populations of farmland birds on organic farms: The Nature Conservation Farm Brodowin

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Although organic farming systems potentially provide habitat of high quality for many farmland birds, reproduction sufficient to maintain viable populations is not guaranteed. Specific knowledge and financial incentives are necessary to integrate nature conservation goals successfully with agricultural practice. The main objectives of the interdisciplinary "Nature Conservation Farm Brodowin" Project, 2001–2006, financed by the German Federal Agency for Nature Conservation (BfN), were to: (1) assess interactions between large-scale organic farming and nature conservation, (2) identify points of conflict, and (3) develop solutions that can maintain viable populations of birds at farm scale while taking sufficient account of economic aspects. Research activities undertaken for farmland birds comprised assessment of territory densities, habitat preferences, breeding success, survival of pre-fledglings, and feeding habitats for target species characteristic of open farmland: Common Skylark (*Alauda arvensis*), Yellow Wagtail (*Motacilla flava*), Corn Bunting (*Miliaria calandra*), and Whinchat (*Saxicola rubetra*). The effects of modified farming procedures such as reduction of tillage, changes in mowing systems and implementation of structural measures, were investigated. We found above-average territory densities in all investigated species. In contrast, species productivity varied with agricultural procedure, ranging from low (Whinchat) to high (Skylark). For the Skylark, a population model has been calculated to assess whether the population studied is viable or not. An evaluation of the effects of modified agricultural methods on the reproductive success of target species has also been carried out, in context with full consideration of agricultural and economic parameters.

Fujii K, Fujii T

Declines in the Pacific Diver and its impact on a local fishery in the Hiroshima Prefecture

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In Japan, the Pacific Diver (*Gavia pacifica*) passes the winter around Itsukishima Island (34°07'N, 132°47'E), molting their their remiges there then. Until 1986, a remarkable relationship existed between local fishermen and diver in the strong tidal flows around the island, a relationship that had developed over 300 years. In the turbulent waters, the diver congregates to feed on the Japanese Sand Lance (*Ammodytes personatus*), a small fish. Such fish, in turn, are also prey for the Red Sea Bream (*Pagrus major*), which is prized for eating but becomes torpid in winter when it feeds little and is rarely caught, so attracting a high market price then. In the rough "Ikaru-umi" waters around Itsukishima, however, the activity of small fish continues to attract feeding bream at that time, enabling local fishermen to catch them. Pacific Divers, known as "Ikari-dori", played a critical role in the process, gathering at concentrations of small fish where bream were also feeding and thereby signposting the location of bream to fishermen. Much skill was needed to fish in the turbulent waters, and fishermen had to take account of boat speed, water movement, submarine geographical features and the capacity of their fishing tackle in combination with the position of foraging divers. Since 1986, however, the population of divers off Itsukishima has declined seriously, and fishing for Red Sea Bream there, known as "Ikari-ryou", has ceased. We thank the Hiroshima Prefecture for providing us with the opportunity for this investigation.

Fujita M

The relationship between head-bobbing and the kinematic characteristics of walking in the Black-headed Gull

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Some birds head-bob as they walk; and previous studies have shown that head-bobbing is a visually- elicited movement with several visual functions. Recently, I examined the relationship between body posture and the position of the center of gravity during walking which suggested that head-bobbing also has a function in enhancing stability during walking. If head-bobbing enhances stability in walking birds, it should affect the kinematic characteristics of gait. There are reports, in fact, that head-bobbing species walk with a longer stride and less frequent steps than non-bobbers. These characteristics are thought to result from decreasing lateral and rotational body movements brought about by head-bobbing during walking. All non-bobbing species in previous studies were waterfowl; nor were any waterfowl included in the head-bobbers studied. Therefore, absence of head bobbing could be involved with adaptation for swimming. In testing this idea, I found that Black-headed Gulls (*Larus ridibundus*) walked both with and without head-bobbing. They also walked with a longer stride and lower stride frequency when head-bobbing, paralleling the reported walking patterns of head-bobbers and non-head bobbers respectively. Such results suggest that the difference in kinematic gait characteristics between head-bobbing and non-bobbing walking is not the consequence of adaptation for swimming but of head-bobbing.

Gan X, Zhang K, Ma Z, Chen J, Li B

The effect of invasions of the grass *Spartina alterniflora* on wintering birds on Chongming Island, Dongtan Reserve, China

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Invasive species are widely recognized as one of the great threats to global biodiversity. The grass *Spartina alterniflora* is the main invasive species in the coastal wetlands of China, and its spread there has had a negative effect on native flora, soil nematodes and macro-invertebrates. Its impact on birds, however, is little known. The aim of this study was to quantify the effect of invasions of *S. alterniflora* on estuarine wetlands in China through a comparative analysis of vegetation structure and wintering bird assemblages in affected areas. Uniform *S. alterniflora* communities and reed (*Phragmites australis*) communities were compared by mist netting in 2004 on Chongming Island, Dongtan Reserve. A total of 262 birds of 10 species were caught in reedbeds, but only 14 birds of 5 species in *S. alterniflora* . Bird activity estimated from trapping rates was 0.595 birds/mist net hours in reed communities and significantly less, at 0.032 birds/mist net hours, in *S. alterniflora* ($p<0.05$). Pallas's Bunting (*Emberiza pallasi*) was the most abundant species in both habitats, at 25.6% in reedsbeds, and 35.7% in *S. alterniflora*). The endangered Reed Parrotbill (*Paradoxornis heudei*) was another common species, at 33.22% in reedbeds, but rare in *Spartina* communities. Compared to the reed communities, *S. alterniflora* stands were denser ($P<0.001$) and higher in biomass ($P<0.001$), which appears to hamper the movement of birds through them and partly explains the dearth of birds in them. Yet even though *Spartina* communities may be significantly poorer in bird species and numbers than reed beds, they may still be important as shelter for birds over winter when much of the reedbeds are cut for commercial purposes.

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How does Dupont's Lark cope with seasonality? A morphometric comparison of two populations

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We analyzed the variation in morphological features in males of two populations of Dupont's Lark (*Chersophilus duponti*) that occur in different northern and southern areas of Spain under different seasonal regimes due to different latitude and altitude. Northern males differ from southern in their longer wings, shorter tarsi and smaller body size, without corresponding differences in length of bill or body weight. Such disparities seem to be related to the way the two populations cope with seasonal differences in their habitats. Breeding birds in the more seasonal northern area were exposed to harder winters and longer food shortages than those in the south, but had the advantage of greater food abundance during breeding. Their smaller size also seemed adapted to coping with food scarcity in winter, enabling them to remain on their territories then. In contrast, a large proportion of the southern population was forced by food restriction in the non-breeding season to abandon breeding areas and track the spatio-temporal variation in abundance of insects regionally. These two distinct strategies could explain the morphological differentiation among the two populations, highlighting regional differences in ecological response in this species that might, in turn, have important implications for the conservation of isolated populations.

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Sex-specific trophic ecology of the Nazca Booby: Diet on Malpelo Island and support for the body-size hypothesis

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Sexual differences in diet in sexually dimorphic seabirds have been attributed to differences in body size. To examine this hypothesis, we examined the trophic ecology of the Nazca Booby (*Sula granti*), in which females are about 16% larger than males, on Malpelo Island off the Pacific coast of Colombia. Using regurgitation samples, we measured and compared weights and volumes of the gut contents of both sexes, as well as the size of all items ingested. All items were identified taxonomically to the finest level possible. Quantitative differences were found in all variables, females eating larger prey and thus taking larger and heavier volumes of food. Classification of the items showed fish of the families Hemiramphidae and Exocoetidae to be the main components of diet in both sexes, with some differences in the taxonomic composition of other prey ingested: carangid and scombrid fish, and squid. Minor seasonal differences were also found in the size of prey ingested: smaller items were taken during breeding, perhaps for chick feeding. Dietary range in the Malpelo colony was wide, and varied from diet recorded in the Galápagos Islands, suggesting that breeding adults from the two populations forage in different areas. Within the Malpelo population, moreoever, dietary disparity between the sexes supported the body-size hypothesis.

Garcia-Moreno J

MtDNA-phylogenies reveal a dynamic history among montane Mesoamerican birds

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In biogeographic studies, much importance has been given to vicariant explanations (emergence of a barrier between areas that used to be continuous), while the dispersal component (migration of taxa across a geographic barrier into a new area) has often been dismissed. Progress in phylogenetic methods using DNA sequences permit nowadays the rigorous testing of vicariant and dispersalist explanations for any given biota. In particular, one would expect agreement in the estimated ages of splits between taxa from the affected areas if vicariant mechanisms are at play, because these events have a general effect over entire biotas. MtDNA-based phylogenies for Mesoamerican populations of three species with similar distributions in Mesoamerica (*Lampornis amethystinus*, *Chlorospingus ophthalmicus* and *Buarremon brunneinucha)* suggest different histories for the different species surveyed. *Chlorospingus* and *Buarremon* show very clear geographic structure, with long branches leading to well differentiated clades that coincide with important geographic features in the region, although the branching patterns of the phylograms imply different histories. In contrast, the hummingbirds present very limited geographic structure, only an east-west divide that also coincides with an important geographic barrier. These results suggest a rather dynamic origin of the Mesoamerican avifauna, which cannot be solely explained by vicariant hypothesis. Rather, a mixture of vicariance and dispersal events are necessary to understand the origins of this rich avifauna.

Gauthreaux S, VanBlaricom D, Belser C

The use of surveillance radar to monitor the exodus of birds from migration stopovers

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Doppler weather radar can be used to detect birds shortly after take-off on migratory flight from stopovers as they climb into radar coverage. For 30-45 minutes, the concentrations of departing migrants map the areas just left. After this time, the outlines of departure sites are obscured by new migrants passing through and over them. The WSR-88D Doppler weather surveillance radar has a range resolution of 1 km, a one degree beam width, and detects concentrations of departing migrants at landscape scale within 120 km of the station. High-resolution marine surveillance radar can also detect individual migrants as they begin migratory flight. The Furuno 2155 BB marine radar has range resolutions of 12 m, 30 m, and 60 m; a 2.5 degree beam width with a 1 m parabolic antenna, and detects departing individuals at scales that permit discrimination of different types of vegetation and land cover within a 3 km range. Both approaches have their advantages in different situations, and we detail our methods and present data that relate concentrations of departing migrants to topography, landscape, and habitat type. We also show how use of stopover sites is related to spring and autumn migration patterns and geography. By relating bird data from radar to topography and habitat, researchers can characterize stopover sites for protection and management, and monitor changes in use over time.

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Jejunal degradation in Mallards exposed to prolonged fasting: Metabolic status versus time course of energy use

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Birds can undergo fasting at any time of the year, and then recover physiologically from even extreme bouts. Little is known, however, about the response of the intestine to prolonged fasting despite the importance of this organ for restoring body reserves. Thus, the effects of fasting on jejunal morphology was investigated in 21 fed and fasted Mallard (*Anas platyrhynchos*) ducks, both at the end of the protein sparing phase (phase II) and during the protein wasting stage (phase III). Jejunal samples were examined by using microscopy techniques (morphometry, SEM), and cell proliferation and apoptosis were evaluated using BrdU and TUNEL assays. Fasting phases were determined from daily loss of body mass loss (DBML) and body composition. Body mass in phase II and III fasting birds declined by 28±2% and 38±2%, respectively. At the end of phase III, 92% and 35 % of the lipid and protein masses, respectively, had been used. Jejunal cross-section, villus length and cell proliferation within the crypts fell in fasting birds ($P<0.05$), but no difference was found between the fasting phases ($P>0.05$). Apoptosis occurred throughout fasting. Two profiles emerged from SEM analysis: birds with low DBML values suffered little or no change in their jejunal villi, whereas birds with high DBML had heavily damaged villi with the chorion extending over large areas. During phase II, the higher the DBML values, the higher the protein degradation and the lower the initial fat stores. Thus, a key factor in intestinal response to prolonged fasting in Mallards could be the status of the fat store before fasting rather than the level of depletion of the energy store itself. Birds with limited energy stores and survival time would cut down this high-energy demanding tissue rapidly. Further studies should focus on how this could influence energy store repletion during refeeding.

Gerasimov KB

Functional morphology of the feeding apparatus in the Ruddy Turnstone: Evidence for a *Calidris*-like ancestor

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We examined the feeding apparatus of the Ruddy Turnstone (*Arenaria interpres*). The turnstone's adaptation is traditionally considered as gaping - powerfull opening the jaws under various objects, with what connect the strengthened development m. depressor mandibulae and strong short bill. But turnstone also has not the external jugomandibular ligament, which transfers protractional force from the lower jaw on the jugal bar. This absence makes m. pterygoideus able to lower the upper jaw independently, and be not only the transfer of retractional component of dorsal adductors effort (Dzerzhinsky, 1972). Such ability is necessary for pulling out the prey, which is fixed deeply in the substratum, because in this case the prey applies to jaws the protractional force, which is directed opposite to retractional force, which lowers the upper jaw. This is the reason why the majority of waders with distal rhynchokinesis (probing waders) lack l. jugomandibulare externus, which remained "unclear" for Burton (1974). Other feature of turnstone - second type of m. hypoglossus (Burton, 1974), this condition of this muscle makes possible for tongue to transport effectively the prey with small inertia (for example, surface-dwelling invertebrates, especially Diptera) from tip of bill to an entrance of esophagus. Both foregoing feeding methods are uncharacteristic for modern turnstones, therefore, one can suggest, what determinant them anatomic features have got from ancestors. It is appropriate mention here about the conclusion of Lowe (1931), who has defined Arenaria as specialized Calidrinae on the basis of the analysis of another morphological features. We also can conclude, that turnstones had calidrid-like ancestor and secondarily has adapted to gaping, probable owing to feeding on sandy -stony grounds.

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Conservation status of preferred habitats of tragopans in Northeast India

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Northeast India is located within the Indo-Burma Biodiversity Hotspot and is also regarded as an Endemic Bird Area. During a four years' study of the distribution and habitat preference of *Tragopan blythii*, *T. satyra* and *T. temminckii*

levels of endemism and migratory species. Theoretically, the intensive anthropogenic pressure exerted on this region by agriculture and urban development might seem to pose a serious threat to the assemblages. Nevertheless, it is also possible that human intervention there, through provision of artificial water and crops, could have positive impacts too. In this study, we compared species diversity in bird assemblages associated with natural and agricultural areas in an arid sector of northwest Venezuela. Every two months over two years, we captured birds in selected natural and agricultural areas. Species were assigned to different feeding guilds on the basis of fecal contents, field observations, and prior studies. Six primary feeding guilds were identified: insectivores, frugivores, frugivores/insectivores, nectarivores, granivores, and carnivores. Dominant among guilds were the insectivores (s=20), followed by granivores (s=13) and frugivores (s=9). Three diversity indices were calculated (Shannon-Wiener, Simpson, and Margalef). Very similar temporal patterns of diversity were found in the assemblages of the two land types. Moderate levels of similarity in species composition (CCS=0.6-0.7) were also obtained over the two years using the Sorensen's coefficient. We used the rarefaction method as well to compare species richness between both land types, and here significant differences were detected: the agricultural area held the greater diversity, especially in insectivorous birds. These results suggest that a certain, moderate level of agricultural intervention may increase species diversity in bird assemblages in Neotropical arid zones.

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Evidence that White-backed Mousebirds feed nestlings a merocrine secretion produced by esophageal mucous glands

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Mousebirds (Coliidae), a group of birds endemic to sub-Saharan Africa, feed prevailingly on fruit pulp and the leaves of trees and shrubs. Since plant matter is nutritionally and energetically poor for raising altricial nestlings, we considered the possibility that adult mousebirds fed their nestlings nutritious secretions produced in the digestive tract. Accordingly, we investigated breeding White-backed Mousebirds (*Colius colius*) at Koeberg Nature Reserve, 25 km north of Cape Town, between August and October 2003. Breeding mousebirds did not feed on insects or other arthropods, nor did they feed them to nestlings. The semi-precocial nestlings grow rapidly and are fed regurgitated liquid food; solid matter does not seem to be added. We examined the tissue histology of the digestive tract of two pairs of breeding mousebirds, comparing it to that in a non-breeding male. The thickness and surface area of the epithelium and glands in the underlying lamina propria of the esophagus were found to be significantly enlarged in the breeding birds. Unlike the lining of the milk-producing crop epithelium in breeding pigeons, however, no proliferative basal buds or accumulation of intracellular lipids had developed in the stratum spinosum and disjunctum of the esophageal epithelium. In some, seemingly active hypertrophic cells, nevertheless, we observed granules and tiny vacuoles of what seemed to be droplets of lipid. We tentatively conclude that both male and female White-backed Mousebirds nourish their young with a merocrine secretion produced primarily by mucous glands in the esophagus.

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Wing-shape variation in migrant and resident Eurasian Blackbirds: a geometric morphometric approach

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On Heligoland Island, North Sea, Eurasian Blackbirds (*Turdus merula*) have established a breeding population of 60-70 pairs within the last two decades. Origin, detailed demographic history, genetic structure and migratory behavior of this geographically isolated population are currently under investigation. A preliminary analysis of two basic morphometric measures, wing-length and length of the third outermost primary (P8), indicates that island birds have shorter, possibly less pointed wings than immigrant conspecifics, which regularly stopover on the island in large numbers on migration. This may reflect genetic differentiation and reduced migratoriness in local birds. In order to test more rigorously whether birds from the newly-founded island population have less pointed wings than those caught on migration, we introduced and re-evaluated an alternative methodology for quantifying within- and between- population variation in avian wing-shape: geometric morphometrics based on digitized outlines of extended wings. We analysed wing-shapes of immigrants and of color-ringed individuals bred on the island. The results are discussed in an evolutionary context, assuming that trade-offs between the costs of manoeuvrability and the costs of migration generate intraspecific differences in wing-shape between birds of different origin and status, such as age and sex. Supported by the Deutsche Forschungsgemeinschaft (DFG)

Gosler AG

The function of protoporhyrin pigments in the eggshells of small passerines

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For more than 150 years, ornithologists have debated the function of the red-brown spots on the eggs of diverse passerines worldwide. It has generally been assumed that such pigments serve a signal function, such as for crypsis (a specialized form of signal) or egg recognition. These suggestions are nevertheless unconvincing for a variety of reasons, not least because such "maculated" eggs are found in almost every passerine family, and in every ecological situation involving nest-type, diet, cuckoldry and predation risk. I studied protoporphyrin maculation in the eggshells of the Great Tit (*Parus major*) to test the hypothesis that rather than a signal function, the pigment serves a structural purpose, compensating for shell-thinning caused, for example, by calcium deficiency. Accordingly, egg sampling was carried out in Wytham Woods, Oxford, in Britain, a site that exhibits a huge range of variability (460-fold) in available soil calcium. I found that at any pigment spot, the shell was consistently thinner than neighbouring unpigmented eggshell, and that the degree to which the shell was thinner correlated with the intensity of pigmentation. Several causes were found for shell thinning. First, changes in egg-shape altered the relative thickness of shell in different parts of the egg. Secondly, eggs were generally thinner-shelled on low-calcium soils; and this was reflected in the presence of darker, more extensive pigmentation. I also found that available soil calcium is reflected in the abundance of small snails, which are known to be the main calcium-rich food for female Great Tits during egg formation. While the generality of these findings has still to be confirmed for the many other small passerines that lay maculated eggs, the probability that the extent of deficiencies in eggshell is reflected in the distribution and intensity of pigmentation has numerous practical applications in ecology and perhaps also environmental monitoring.

Gottschalk T[1], Huettmann F[2]

Thirty years of analyzing and modeling avian habitat relationships using satellite imagery data: A review

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The application of Remote Sensing (RS) and Geographic Information Systems (GIS) technologies provides powerful tools when used to investigate wildlife and its habitat for an analysis or modeling approach. Birds have been of great and progressive value as biological and environmental indicators, and have often provided a research template for many other wildlife species and habitat studies. In order to bring together the common approaches and issues - methods, processing steps, trends, advantages and challenges - we reviewed over 120 representative publications of the last thirty years that made use of satellite imagery for avian applications. The reviewed studies have shown that, so far, Landsat TM (61%), additional environmental data (36%), Point-Stopp Counts (53%) and multivariate statistics (53%), were applied within a large range of scales and habitats. In order to improve the quality of inference and for comparative analyses, we recommend clearly documented studies in high detail. In order to verify and improve results, additional ground data (ground truth) on the main structure of vegetation relevant to the bird species in question are usually necessary. Satellite-based RS applications in ornithology and wildlife research could be used increasingly for assisting in habitat evaluation, modeling and monitoring, and in achieving overall wildlife conservation and management objectives effectively, especially in inaccessible regions of the world.

Green J[1], Boyd I[2], Woakes A[3], Butler P[3]

The division of labour between breeding male and female Macaroni Penguins

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Like most seabirds, Macaroni Penguins (*Eudyptes chrysolophus*) are long-lived and monogamous, and are obligate bi-parental carers for their single annual chick. Unlike most seabirds, however, breeding Macaroni Penguins, and other crested penguins of their genus, divide the labor among the sexes in an unsual way. After the chick hatches, the male guards it continuously for approximately 23 days while the female engages in short foraging trips of 1-2 days to bring back food for the chick. The chick then joins a crèche for the next 35 days or so until fledging, and during this time both male and female provide food. We measured foraging behavior and estimated the rate of energy expenditure in this species for two years continuously, and estimated the costs to both parents of the breeding and non-breeding periods. As might be expected, we found that male energy expenditure, and hence investment, was 22% lower than in females during the breeding season. This, however, was compensated for by increased costs to males during the non-breeding period, such that over the complete annual cycle, investment by males and females was equal. Our data also enabled us to examine the chick-rearing period in greater detail. During the crèche phase when both parents are provisioning the chick, males increased in body mass while females decreased. From data on chick mass, adult mass, foraging effort and energy expenditure, we could assess how males and females partitioned their foraging effort and caught prey among themselves and their chick. It revealed that the contribution of the male to chick provisioning was even less than estimated, and therefore that for male Macaroni Penguins there is more to the cost of reproduction than first meets the eye.

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Monitoring nesting activity with an automated surveillance video system: A case study of the endangered Bearded Vulture in Crete

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This study describes the construction of a video monitoring and surveillance system that was designed, with maximally automated function, low cost and minimal disturbance to birds, to collect data on the breeding biology of the Bearded Vulture (*Gypaetus barbatus*) in Crete, Greece. The system operates autonomously for at least one week depending on nesting activity, and was evaluated in use on one nest over the breeding seasons of 2003-2005 as a part of an extended conservation project. The system comprised: (1) a nest monitoring subsystem - camera, microphone, battery with a controller, and transmitter plus antenna - that was installed on the nesting cliff where it was energized by a solar panel, and (2) a recording subsystem - antenna receiver, video signal controller and a remote-controlled PC through a GSM modem - that compressed audio-video signal and provided real time continuous monitoring of all nest events during daylight hours. The conservation applications of the data collected included assessment of fertility problems and predation risks, and the improvement of management actions such as the appropriate timing for artificial feeding and marking of nestlings.

Selected images were used for public promotion and awareness campaigns, both as still or motion pictures. Ease of installation, and the merits and drawbacks of the technique were validated, based on the quality and quantity of data produced and the number of recording days. Solutions to technical problems and improvements for each of the subsystems are discussed.

Guay P-J[1], McCracken KG[2], Chesser T[3], Paton DC[4], Mulder RA[1]

Phylogeography of the Musk Duck

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The Musk Duck (*Biziura lobata*) is an Australian endemic diving duck that occurs in the wetlands of the southeast and southwest of the continent separated by the Nullarbor Plain, an expansive arid region inhospitable for waterfowl. Studies of mate-attracting calls and displays have found differences between the eastern and western populations, suggesting that they are isolated. Although Musk Ducks are known to be strong flyers, it is not clear if they cross the Nullarbor Plain. Over the last decade, the eastern population has declined drastically in numbers due to prolonged drought, thus increasing the need to evaluate the level of divergence between the two populations. We sequenced two nuclear introns and the 5'end of the mitochondrial control region to investigate potential genetic differentiation between the two populations. We found that Musk Ducks from both sides of the continent shared similar haplotypes for the two nuclear introns, but possessed different mitochondrial haplotypes. Although the level of DNA variation detected between eastern and western populations is quite small, it reinforces the evidence for minimal dispersal across the Nullarbor Plain.

Gueneau P[1], Pizani F[2], Porco Giambra A[3], Bosque C[2]

Presence of nitrogen-fixing bacteria in the crops of the Hoatzin and Green-rumped Parrotlet

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Productive processes in consumers of plant-tissues are frequently limited by the nitrogen content of foodstuffs. Consequently, many consumers of wood, foliage, fruits, seeds and nectar develop adaptations to subsist on nitrogen-poor foods. One such adaptation is the hosting in the digestive tract of nitrogen-fixing microorganisms that are able to incorporate atmospheric nitrogen into a form that can be used nutritionally by the host, contributing to its nitrogen budget. Although birds of many species feed exclusively on plant parts, nitrogen fixation in the digestive tract of birds has never been studied. Only some prokaryotes and archaea are able to fix atmospheric nitrogen, a process catalyzed by the nitrogenase enzyme complex. The highly conserved nifH gene encodes dinitrogenase reductase, and has been previously used for detection of nitrogenase activity through molecular techniques. The aim of this study was to detect, by PCR and RT-PCR procedures respectively, the possible presence and expression of nifH directly from (bacterial) gut content of two florivorous birds: the folivorous Hoatzin (*Opisthocomus hoazin*) and the seed-eating Green-rumped Parrotlet (*Forpus passerinus*). We chose these species because they host a dense and diverse bacterial community in their crops, and both have unusually long digesta retention times. Our results confirm the presence of nifH in these species and suggest that the nitrogenase complex is expressed *in situ*. This finding is consistent with the low-dietary-nitrogen and low-O2-pressure environment in the gut of Hoatzin and parrotlet, which is known to promote transcription and activity of the nitrogenase complex. Fluorescent terminal restriction fragment length polymorphism (FLT-RFLP) and cloning-sequencing techniques will now be used to determine the nifH transcripts that are most likely responsible for nitrogenase activity. We envision an important role for symbiotic bacteria in balancing the nitrogen budget of florivorous birds.

Guse N[1], Garthe S[1], Mundry R[1], Schirmeister B[2]

Seasonal variation in the diet of the red-throated diver (*Gavia stellata*) in the Pomeranian Bight, Baltic Sea

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The Pomeranian Bight, southern Baltic Sea, is one of the seabird hot spots during migration in north-central Europe. During winter and spring, red-throated divers concentrate in that area in internationally important numbers. To set up efficient conservation management structures, it is necessary to evaluate habitat requirements for the species concerned. Until now, information on diets of red-throated divers outside the breeding season has been scarce or old. Thus, substantial sample sizes of by-caught red-throated divers from the set net fishery carried out in the Pomeranian Bight offered a unique possibility for gaining information on winter and spring diet by analysis of stomach and gut contents. The birds analysed originated from one winter and two subsequent spring periods. While earlier studies provided only rather limited information on the diet choice of red-throated divers, the large sample size of male and female birds studied allowed us to analyse the composition of at-sea diet and to compare findings between sexes, seasons and years. No differences were found between sexes, neither with regard to the number of fish species found nor for numbers or biomass of fish consumed. Overall, 11 fish species from eight different families could be detected. Some fish species were consumed in similar quantities over all analysed periods. In contrast, the consumption of zander (*Sander lucioperca*) and herring (*Clupea harengus*) showed clear seasonal differences. The percids zander and ruffe (*Gymnocephalus cernuus*) were the most important prey during winter whereas herring clearly dominated the diet in both spring periods. The fish species found in the diet of the divers only comprised a fraction of the fish species occurring in the

Pomeranian Bight. The observed differences between fish availability and fish consumption gave insight into the dietary choices of red-throated divers regarding abundance, habitat, behavior and size of preferred prey.

Gutierrez-Corchero F[1], Hernández MA[2], Campos F[3]

Sex ratios in nestling Southern Grey Shrike on agricultural land: Evidence of adaptive variation

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The Southern Grey Shrike (*Lanius meridionalis*) is a small, sexually monomorphic, socially monogamous, territorial passerine. Despite its wide distribution in Eurasia and North Africa, little has been published about variation in its sex ratio. Here we assess the sex ratio in nestlings in agricultural habitat in northern Spain. The sex ratio, measured as percentage of males per nest (51.7%), did not differ significantly from 1:1. Neither laying date, clutch size, hatching order, nest mortality, territory quality nor age of maternal females were correlated significantly with the sex ratio. The size of the parents, estimated by wing length, varied inversely with the proportion of male nestlings, suggesting an adaptive adjustment of the sex ratio. Female shrikes tended to disperse more than males in low quality habitats, in agreement with the theory of local resource competition.

Gwinner H, Berger S

What cues use European starlings to select green nestmaterial?

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During courtship and nest building male starlings show parts of fresh green plants to visiting females. Subsequently, males incorporate these pieces into their nests. They prefer plants rich in volatile compounds. Several studies have shown that these herbs benefit nestlings` condition and may also play a role in mate attraction. In a field–aviary experiment we investigated whether starling males select herbs using olfaction and whether they learn as nestlings from the odors in their nests which herbs to use as adults. We scented 20 nests of wild starlings with milfoil oil, (milfoil is the most preferred nest-herb in our starling-colony), and -as control- 20 nests with vanilla. We hand-raised males from both nest types and tested them in the year following their birth for their odor preference. A male and a female were put into an aviary with a nest box. We offered 2 plates, each containing 10 scented or not scented leaves of a non-volatile plant. The males had to choose between: 1.vanilla-versus milfoil scent, 2. milfoil-versus no-scent, and 3. vanilla-versus no-scent. Males which grew up in milfoil scented nests, as well as males from vanilla scented nests, preferred milfoil scented leaves during courtship and for nest building when they had the choice between milfoil versus vanilla or no-scent, respectively. However, when males had to choose between vanilla and no-scent, vanilla birds preferred vanilla scented over not scented leaves while milfoil birds did not discriminate between the two. Because males had to choose between leaves of plants from the same species but with different odors, we conclude that starlings used the sense of smell to make their choice. They chose their green nest material following an innate pattern which may be supplemented by learning.

Halsey L[1], White C[1], Handrich Y[2], Butler P[1]

A simple method for estimating pedestrian energetics in penguins

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The addition of energetics data to behavioral observations creates a robust platform from which to investigate the ecology of species. However, data on energetics can be difficult to obtain because of logistical complexities; and some methods are invasive. If such data could be obtained easily by simply observing the target animal, however, then behavioral and energetic data may be more readily married. Recently, an accurate method to estimate resting metabolic rate (RMR) in King Penguins (*Aptenodytes patagonicus*) has been developed by simply weighing the bird and measuring simple morphometric characteristics. These metrics give the condition and structural size of the bird, which together were shown to be correlated closely with RMR (ml of oxygen used per minute). Other workers have shown that over and above RMR, the two energy costs for birds during pedestrian locomotion are the 'postural' cost (PCOT) and the net cost of transport (NPOC), the former in ml of oxygen and the latter in ml of oxygen per metre. We demonstrate that PCOT in King Penguins can also be predicted from mass and body morphometrics, while NCOT is constant and independent of mass or speed of travel. The cost of pedestrian transport in King Penguins was measured with a treadmill and respirometer system, and the resulting values then compared with predictions for the same birds from mass and morphometric measurements. The error in the predictions was less than 5%. Thus, once the mass and structural size of a King Penguin are known, the energy cost of transport over land can be estimated accurately by an observer with only a stopwatch and distance measuring wheel.

Halupka L, Dyrcz A, Borowiec M

Eurasian Reed Warblers benefit from warmer breeding seasons

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Between 1970 and 2005, Eurasian Reed Warblers (*Acrocephalus scirpaceus*) started breeding about three weeks earlier around Wroclaw, Poland, than in previous decades, corresponding with higher seasonal temperatures between May and August. Earlier breeding was manifested both in earlier laying of the first clutch of the season and in an earlier peak in laying across the whole population (median first-egg laying dates). The start of the season estimated by first-egg date was not influenced by temperature in

May when breeding began, but the peak of laying correlated significantly with mean seasonal diurnal temperature. As the end of season has not changed since 1970, reed warblers now have more opportunities for renesting. Our data indicate that in warmer seasons, reed warblers suffer lower nest losses and produce more offspring.

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Evolutionary relationships between the Luzon and Japanese Bush Warblers

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As the Luzon Bush Warbler (*Cettia seebohemi*) of the Philippines resembles the Japanese Bush Warbler (*C. diphone*) in morphology, opinion differs as to whether they are the same or different species. To clarify the relationship between them, we compared their song structure, response to playback of allotaxic song, and mitochondrial DNA sequences. Songs of both bush warblers consisted of initial notes at constant frequency, followed a frequency-modulated sequence. The songs of Luzon Bush Warblers, however, were of higher frequency and more notes. In spite of these differences, the response of males of both forms to reciprocal playback did not differ, indicating that neither distinguished the songs of the other. In mtDNA analysis, the total cytochrome b region (1143 bp) was sequenced. We found differences in 48 bp (4.2%), suggesting that the two taxa diverged around 2.1 million years ago, based on the assumption of constant substitutional rates of 2%/MY. In general, such differences are found among distinct species. The songs of the two taxa have also diverged, but without reciprocal recognition, probably due to allopatry.

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Effects of forest fragmentation on behavior and movement patterns in selected bird species of the Mata Atlântica in the State of São Paulo, Brazil

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The Mata Atlântica, the coastal rainforest of Brazil, is one of 25 global biodiversity hotspots and also one of the most highly threatened ecosystems. Its deforestation has been followed by habitat loss and forest fragmentation, the patches of which differ in size, successional stage, vegetation structure, and surrounding matrix. The objective of our study was to assess how forest fragmentation and landscape features affect the movements of three Atlantic forest bird species. Within this landscape, some forest birds are confined to the largest fragments, while others traverse the matrix and move between fragments. We conducted field work in eight fragments of 3-53 ha, with a natural reserve of 10,000 ha as control, on the Atlantic Plateau of São Paulo, Brazil. The three study species were the frugivorous Blue Manakin (*Chiroxiphia caudata*, Pipridae), the insectivorous White-shouldered Fire-Eye (*Pyriglena leucoptera*, Thamnophilidae) and the insectivorous Rufous-breasted Leaftosser (*Sclerurus scansor*, Furnariidae). We used radio telemetry to follow the movements of the birds. Via triangulation of daily positions, the daily pattern of movements in tagged individuals was documented for over three to five weeks. Vegetation structure at sites through which the birds passed was analyzed to determine habitat requirements. The different species used areas of 1-9 ha (*C. caudata*), 9 to 19 ha (*P. leucoptera*), and 6 to 16 ha (*S. scansor*). As yet, the results are preliminary and insufficient to support conclusions about general habitat use and response to fragmentation by birds in fragmented forest landscapes, the ultimate goal of the study. Final results are expected to contribute to landscape planning for maintaining optimal biodiversity within the fragmented forests of the Mata Atlântica.

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Partitioning field metabolic rate into multiple activity-specific metabolic rates using a mixture model multiple regression

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This study illustrates the statistical analysis of actual time/energy data as commonly obtained in the study of field energetics, in order to obtain accurate activity-specific energy expenditures. Daily energy expenditure (DEE) of Razorbill (*Alca torda*) parents during the nestling period was measured with the doubly-labeled water method. Precise and exhaustive time allocation was measured simultaneously with data-loggers, separated into four activity-specific time categories: flying, diving, swimming, and at the nest. A previously overlooked method, the mixture model multiple regression, was used to partition the DEE into four corresponding average activity-specific energy expenditures. The model explained 96.2% (R^2) of the variance in DEE among individuals, and its generally outstanding performance strongly advocates its use for partitioning DEE and time budget data with two or more behavioral categories. The statistical problem of multicollinearity is nonexistent in time/energy budget data since the behaviuoral categories are mutually exclusive. The metabolic rate at the nest and swimming were statistically indistinguishable at 2xBMR. Metabolic rates of both flight (17.7xBMR), and diving (11.8xBMR) were high, but not statistically different. Flight metabolism estimate is 168% of an allometric prediction, and diving metabolism 355% of an allometric prediction compiled from laboratory studies. This difference can be attributed primarily to instrument drag, affecting diving to a substantially greater extent than flight.

Harebottle DM[1], Williams T[2], Weiss Y[3], Tong G[3]

Ten years of waterbird counts on an urban wetland: Paarl Sewage Works, South Africa, 1994-2004

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Ten years of waterbird counts on Paarl Sewage Works (45 ha), South Africa, from May 1994 - April 2004, are analyzed. Seventy-two waterbird species were recorded, of which 33 species (46%) bred there. Mean summer and winter counts were 2551±692 and 1632±171 birds respectively. Summer peaks were driven primarily by large numbers of migrant White-winged Terns (*Chlidonias leucoptera*): mean summer count =707 or 30% of total count. Resident species dominated from December to April, intra-African migrants were most abundant from October to December while Palearctic migrants peaked from December to March. Ducks and geese were most abundant from December to April, and resident waders and grebes peaked from April to July. Flamingos peaked in October and November, with another small peak in June. Gulls and terns had two peaks, one in November-March driven by migrant White-winged Terns, the other in July and August driven by abundance of resident Hartlaub's Gulls (*Larus hartlaubi*). For total waterbirds, summer trends showed an overall decline, notably in the numbers of White-winged Terns. A stable, resident waterbird population was present during winter. Ducks and geese showed an upward trend for both summer and winter while resident waders seemed to increase in abundance in winter over years. Gull and tern numbers declined in both seasons over years, while grebe numbers remained stable rear-round. The Paarl Sewage Works is ranked as the second most important sewage treatment works for waterbirds in the Cape metropol, supporting globally and regionally important numbers of 11 species which should qualify it for global and/or regional IBA status.

Hayashi Y

Life history of the endangered Blakiston's Fish Owl in Japan

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Blakiston's Fish Owl (*Ketupa blakistoni*), one of the largest owls in the world and declining through loss of habitat, occurs in the forests of coastal northeast Asia, including Japan. Although widely distributed throughout Hokkaido until the 1950s, it has become restricted and local, and the present population is estimated at no more than 120 individuals, including 35 breeding pairs. On Hokkaido, the owl depends on riparian forest where it hunts fish in shallow waters. Destruction of much of that forest and depletion of fish stocks have caused it to decline to a critical levels of endangerment. Most of the breeding pairs on Hokkaido now nest in artificial nest boxes and are dependent on artificial feeding programs. Here I present a review of the life history of the owl based on long-term research of marked individuals from 1987 to 2005. Like most owls, Blakiston's Fish Owl is sedentary and territorial throughout the year. Pairs start breeding as early as February, laying 1 to 2 eggs in nest holes in large tree cavities or in artificial nest boxes. Incubation takes 35 to 37 days. Young owls leave the nest when they are about 51 to 60 days old, although parents continue to feed them for a further several months. After prolonged association with parents, young males disperse from the natal area before they are two years old, while females may remain in the natal territory for much longer. One young female that had acquired a mate came home repeatedly until it was five years old. Parental tolerance could present opportunities for inbreeding should one parental partner disappear: in fact, father-daughter and mother-grandson matings have occurred.

Düttmann H[1], Groothuis T[2], Bergmann HH[3], Dieleman S[4]

Bill characteristics reflect hormonal status in a sex-specific way in the Common Shelduck

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In the Common Shelduck (*Tadorna tadorna*), both sexes are alike in plumage but differ in that, during spring, only the male develops a cherry-red bill with a bill knob. Testosterone-propionate applied to sexually inactive birds in summer induced a conspicuous fleshy bill knob and cherry-red bills in both males and females. This effect correlated strongly with actual blood plasma levels of androgens, indicating that these secondary sexual characters are reliable signals of hormonal status. Sub-adult males and females never grew as large bill knobs or intensely colored bills as adult males. Furthermore, when the actual blood levels of testosterone were taken into account, the increase in bill knob height and yellow coloration was significantly greater in males than in females and sub-adult males. This indicates that the three classes of birds differ in their sensitivity to testosterone, probably due to their hormonal history. The application of estradiol to partly castrated males in spring caused changes in bill features opposite to those of testosterone; dosed females remained unaffected. Whether estrogen exerts its effect directly, or indirectly via suppression of testosterone production, is not yet known. The data are discussed in a comparative and evolutionary framework.

Henderson I, Clark N

The relative impact of landscape variables, crop composition and low pesticide inputs on the rate of increase in bird populations on arable farmland

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On a 60 ha experimental arable farm in England, under a 6-year crop rotation regime, we show strong 5-year increases in populations of many bird species, in both winter and summer. These changes have resulted from mixed rotation of crops and reduced pesticide loads. We report on the magnitude and speed of the response of birds to experimental treatments, relative to static landscape variables and crop complexity, assessed against an agronomic framework. The results quantify an instructive differential response to treatments by different groups of birds, and examine the relative impact of marginal and whole-field habitats as quantifiable components of the landscape.

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Double-brooding in a raptor population: The Black-winged Kite in central Spain

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Double-brooding is infrequent in raptors. This study presents the first confirmed cases of double-brooding in the Black-winged Kite (*Elanus caeruleus*) in a population in central Spain. Four attempts at second clutches were recorded during the 2005 breeding season, involving four different pairs of breeding birds out of a total of five under observation. Females began a second clutch in the same nest as the first when fledglings from the first were 35 days old. In these circumstances, the male alone fed the fledged young. Three of the pairs attempting a second brood failed during incubation, but the fourth reared young. Although successful double-brooding seems to have only a marginal influence on annual productivity, it is a strategy that could become widely established in this species. In the study area, Black-winged Kites feed solely on seasonally cyclic prey such as voles and other small mammals. In years of high food abundance, the potential increase in fitness incurred by pairs that fledge two broods of young in a single season could explain the amazing expansion in the breeding range of the kite in Mediterranean areas of the Iberian Peninsula.

Herold B

The birds of the walnut-fruit forests in southern Kyrgyzstan - an example of applied ornithology in Central Asia

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For the first time, a Central Asian ecosystem has been systematically investigated for its avian communities and their habitat associations. The unique walnut-fruit forests of Kyrgyzstan, consisting of walnut and various fruit trees are an isolated deciduous forest system 2,000 km from European and East Asian deciduous forests. Despite their economic value, very little attention has been paid to questions of biodiversity. This work examines the breeding birds and describes their habitat associations in terms of altitudinal distribution, forest structures and human impact. In a four-month study, relative abundance, determined by point-stop counts, was compared between habitat types and related to habitat features. The observations show an insular distribution of a deciduous forest bird fauna within the treeless, arid Central Asian region. The belt of walnut-fruit forests was found to harbour 85 breeding bird species. The arid lower belt and the cold alpine belt harbour less species. The dominant tree *Juglans regia* plays a central role as provider of wood structures and foliage insects. Currently, human activities, such as fire wood gathering and cattle grazing, are impacting forest cover. Since walnut-fruit forests are inadequately protected in Kyrgyzstan, Central Asia's only deciduous forest bird fauna is seriously endangered. Our study stresses the high value of the walnut-fruit forests as a hot spot of Central Asian biodiversity and provides important information for regional forest managers. We also make suggestions for future regional bird monitoring and research.

Herranz J, Traba J, Justribó JH, Malo JE

Nest monitoring in steppe passerines using transponders: Who contributes to parental care and when?

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Tagging birds with passive, integrated transponders (PITs) is an almost unused system in field study, despite its capacity to record massive datasets at low economic cost and minimal human interference. Its use should be especially valuable for intensive monitoring of the nests of elusive bird species. We present the results of a PIT implementation project carried out on a number of steppe species, many of them classified as vulnerable in Europe. Birds were caught at the nest during incubation or when feeding chicks and tagged with a PIT attached to a plastic or metallic ring. An electromagnetic antenna was also installed around the nest, and connected to an automatic data logger (maximum capacity >6000 data). The system maintained itself in the field for the whole nesting period, and nests were visited only to replace batteries and download data every 2 or 3 days, at incubation- and nestling- phases respectively. Our results verify the high efficiency of this system for monitoring steppe bird nests, revealing unknown traits in reproductive biology such as alternative chick care by female (day) and male (night) in the Short-toed Lark (*Calandrella brachydactyla*) and Tawny Pipit (*Anthus campestris*).

Heuermann N, van Wieren SE, Prins HHT

The functional response of small grazing herbivores and its consequences for competition and facilitation

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Geese are among the smallest endothermic herbivores and they have to cope with a food source that is generally low in quality. As they have to spent most of their time foraging, optimization of food intake is expected to be of great importance. We studied the instantaneous intake rate of Canada Geese (*Branta Canadensis*) of different body mass foraging on grass turfs. Bite mass was found to reach a plateau at low to intermediate grass biomass while the intake rate reached an optimum and then declined at high biomass. This dome-shaped functional response was caused by an increase in the time to locate bites in dense swards and an increased handling time for bites consisting of long leaves. Differences in the optimal biomass between geese of different body mass indicate a potential for resource partitioning, which has been tested in field experiments.

Heyers D[1], Manns M[2], Luksch H[3], Güntürkün O[4], Mouritsen H[1]

A putative magneto-sensory pathway in migratory birds

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Long-distance orientation in migrating animals has been studied for centuries; yet the mechanisms that enable migratory birds to sense the Earth´s magnetic field have remained elusive. Recently, it has been suggested that birds detect the direction of the magnetic compass direction through modulation of radical-pair processes based on photo-excitation of light-sensitive molecules, the cryptochromes. Our group has shown that cryptochromes are expressed at night in retinal ganglion cells, and displaced ganglion cells are expressed in birds migrating at night. Furthermore, both the cryptochrome-containing retinal ganglion cells, as well as a newly found region ("Cluster") in the telencephalon, show strongly increased neuronal activity when the birds are performing magnetic orientation at night. With a combination of neuronal tracing techniques, behavioral experiments and immuno-histochemical analysis, we show that these two neuronal populations are linked to each other via the thalamofugal pathway and thus are likely to form parts of the magnetosensory circuit in migratory birds. A thorough morphological and biochemical analysis of "Cluster N" using markers against calcium-binding proteins and glutamate receptor type I is presented to put this hitherto unrecognized area within the framework of the telencephalic pathways. On the basis of these findings, it can be speculated that the magnetic field is perceived as a visual pattern, since the areas involved appear to comprise parts of the pathways used for normal vision described in other avian species.

Higuchi H

Conflicts between humans and crows in Japan

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Crows have caused various problems in urban Japan, from scattering garbage on streets, attacking people in residential areas and placing stones on railroad tracks to causing electrical outages by nesting on power poles, starting fires by carrying candles into forests and colliding with aircraft. Such events are becoming more serious, particularly in and around Tokyo where the mass media often covers the incidents as curiosities or important news stories. In response, there has been an exponential increase in the number of applications to Government to address the crow problem. These human-crow conflicts are associated with growing numbers of crows in urban areas, an increase probably linked to greater quantities of discarded food in garbage on which the crows feed. The number of crows in any one area may also be related to garbage collection systems during the day. If garbage is removed at night or early in the morning, crows cannot easily get to it and soon leave the area. Governments and companies now spend huge amounts of money in controlling crows. Many such efforts, however, are not based on scientific evalution of the conflicts, on how crows can be controlled, or on the effectiveness of measures. Under such circumstances, there has been no significant decline in the problem anywhere. In this presentation, I detail the present source and state of the conflicts between crows and humans in urban Japan, focusing on scattering of garbage in streets, attacks on people in residential areas, placing stones on railroad tracks, and causing fires by carrying candles into forests.

Hill K, Hüppop O, Coppack T

Behavioral responses of nocturnal migrants to artificial light: An experimental approach

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Nocturnally migrating birds are often attracted by anthropogenic light sources, particularly under conditions of low visibility caused by low clouds, fog or drizzle. Once within the arc of illumination, birds often fly towards or circle around the light source, consequently risking injury or even death by colliding with obstacles. Many observations have been reported of migratory birds reacting to artificial lights, but we know little about the underlying behavioral and physiological mechanisms. Knowledge about the reaction of birds to different qualities of lighting is also vague. Accordingly, we investigated phototactic responses of nocturnally-migrating passerines to different colors and intervals of light experimentally in orientation cages. The results to be reported are helpful for assessing potential threats from artifical lights to migrating birds and for finding technical solutions. Supported by the Freunde und Förderer der Inselstation der Vogelwarte Helgoland.

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Offshore wind farms: A new threat to migrants?

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Germany is the world leader in the use of wind energy. Since sites for the erection of wind turbines have become scarce on land, ambitious plans have been proposed for the offshore areas. So far, there are applications for 32 sites within the German Exclusive Economic Zone (EEZ) in the North and Baltic Seas; these involve establishment of up to 12,000 wind turbines. If all are realized, more than one quarter of the German EEZ (>13,000 km^2) will be occupied by wind farms. Nine pilot projects have been approved, but two others were rejected because their sites were used by large concentrations of resting birds. Birds are potentially endangered by offshore wind farms through collisions, barrier effects, and habitat loss. To assess these potential risks, the occurrence of birds in space and time as well as details on their behavior in general (migration, influence of weather) and behavior when confronted with wind farms (flight distances, evasive movements, influence of light, collision risk) need to be known. Furthermore, the influences of construction and maintenance works have to be determined. The Institute of Avian Research investigates bird migration over the North Sea. Its main objectives concerning offshore wind farms are to assess data on the annual and daily phenology, flight altitudes and species composition of bird movements. These data can contribute to estimations of collision risks on offshore wind farms, the possible impacts on bird populations and possible mitigation measures. Results from measurements with different methods, including remote sensing techniques on a research platform, give insights into bird migration across the North Sea under different weather conditions and into the potential risks of wind turbines to migrating birds. Supported by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

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Obligate siblicide in the Brown Booby: An experimental test of the insurance hypothesis

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Early mortality among offspring is prevalent in most organisms, and various mechanisms have been proposed as tools for minimizing the negative impact of such mortality on parental fitness. Bird species practising obligate siblicide lay two eggs, but almost never raise more than one young because the first hatched chick kills the second as soon as it hatches. According to the insurance hypothesis, parents may be able to protect themselves from raising an under-sized brood (or no young at all) by laying an extra egg; it buffers them against complete reproductive failure from early loss of eggs and chicks. We tested this hypothesis experimentally in a breeding colony of Brown Boobies (*Sula leucogaster*) on the coast of Jalisco, México. The experiment was performed during egg laying by removing one egg from experimental clutches while leaving adjacent 2-egg clutches unmanipulated as controls. As predicted, the experimental nests produced fewer hatchlings on average, and retained fewer chicks at 10 days post-hatch than controls: 34% versus 61% respectively ($p<0.001$). The difference had increased three-fold by 60 days, with 12% fledging success for experimental clutches and 31% for controls. As noted in earlier studies of this species, no nest produced more than one fledgling. The insurance benefit of the second egg seemed to be most significant during fertilization and incubation phases, because no differences in fledging success were found between control parents that had hatched one or two eggs. Among nests that were deserted during chick rearing, however, parents that had hatched two eggs tended to remain longer. We conclude that the most important insurance benefit of a second egg is against egg hatching failure.

Hinsch T

The White Stork in Hamburg: Protection strategies and population development in a growing metropolis

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From the beginning of the last century to the 1970s, the population of White Storks (*Ciconia ciconia*) in the state of Hamburg gradually declined from about 200 breeding pairs to only ten, an alarming trend that pressed the regional section of Bird Life International-partner Naturschutzbund Deutschland (NABU) to initiate a program for its protection. The program had as its primary aim the stabilization of the remaining population of storks by redressing the pressure of urbanization on natural environments around Hamburg. Provision of sufficient nests was the first step. Surviving sites were protected and artificial nests introduced; today there are about 50 nests available. Foraging grounds also needed protection and management, given the four kilograms of amphibians, insects and small mammals required by one family of storks per day. Towards developing a long-term strategy, NABU Hamburg started to make arrangements with farmers to guarantee extensive cultivation of farmland for forage in the 1970s. It also purchased key blocks of land which it returned to original state by raising water levels, thereby creating feeding resources not only for the storks but also natural habitat to increase biodiversity in general. The following data underline the success of the program. The number of breeding pairs of storks fledging young grew from an average of 5.5 in the 1980s and 6.9 in the 1990s to 9.3 in the period between 2000 and 2005. Over the last 30 years, an average of 26 storks has fledged annually; even in bad years there have been at least ten. Thanks to the regional protection program and to better conditions for White Storks in Germany in general, there is a stable population of this beautiful bird in Hamburg today. If you would like to learn more about the work of the NABU Hamburg protection program, meet us at the IOCongress.

Honarmand M, Naguib M

Effects of stress on sexually selected traits in Zebra Finches at different stages of development

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The phenotype reflects the numerous influences experienced throughout life, in which the early period from conception to developmental maturity is crucial for individual trajectory. Stress then can have profound and long-term fitness consequences on biometry, metabolism, immunocompetence and fecundity. To test the hypothesis that sexually selected traits reflect nutritional condition during different developmental stages, and to address the question whether long-term effects are reflected in ensuing generations, we conducted two breeding experiments on Zebra Finches (*Taeniopygia guttata*) in which subjects were exposed to nutritional stress at different times between hatching and subadulthood. Results reveal the extent to which differential nutritional treatment affects behavioral and fitness-relevant traits, and whether such effects impact on the next generation. This study contributes to the understanding of trans-generational epigenetic influences on phenotypic plasticity.

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The relationship between size of egg and young in the Common Pochard

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As offspring survival and consequently fitness is usually assumed to increase with offspring size, the relationship between egg size and size of young (hereafter EYR) has attracted much attention. Available data show that egg size is often a poorer predictor of structural size than body mass. The role of egg size in determining offspring quality is more pronounced in precocial birds, since in altricial species the effects of egg size can be mediated more easily by more intensive parental feeding and care. The Common Pochard (*Aythya ferina*) is a precocial species that does not provide young with any demanding parental care post-hatch. Hence, egg size as a characteristic of life history can be expected to play a crucial role in the consequent performance of young. Data on EYR in the pochard is provided here, and inter-individual differences in the relationship described. Field work was carried out from mid-May to mid-July during 2001 and 2002 in the Trebon Basin Biosphere Reserve, Czech Republic. In total, 113 young from 29 nests were used in the analyses. Egg mass had no effect on the structural size of ducklings ($F_{1,111}$=0.022; p=0.883, r=0.014). We found a statistically significant positive correlation between duckling body mass and fresh egg mass ($F_{1,111}$=178.187; p<<0.001; r=0.785) which explained c. 61.6% of observed variability. In spite of the trend, the proportion of variability explained by EYR differed among nests. Further analyses revealed female body mass as the most important factor affecting changes in variability: the heavier the female, the higher the proportion of variability explained ($F_{1,8}$=7.133, r=0.687, p<0.05); and the effect of female body mass on mean young mass was confirmed after egg mass effects were removed ($F_{1,9}$=5.519, r=-0.617, p<0.05).

Hõrak P, Ots I, Saks L, Ulvi K

Immune function, carotenoids, and antioxidant defenses in captive Greenfinches

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Due to its complexity and tight integration with other physiological mechanisms, immune function should be costly and therefore is assumed to play a significant role in life-history trade-offs. Oxidative stress, resulting from the production of reactive oxygen during the immune response, is currently believed to be one of the main currencies used for paying the costs of activating antiparasite defenses. To combat oxidative stress, organisms rely on antioxidants that deactivate free radicals by donating missing electrons. Endogenous antioxidants, including several enzymes, uric acid, albumin, and vitamin C, are synthesized by the animal whereas exogenous antioxidants, such as fat-soluble vitamins and carotenoids, have to be obtained from food. Among the latter, carotenoids have been the particular focus of many avian studies because of their dual role in maintaining health and in producing conspicuous red and yellow ornamental traits. Yet the questions as to whether carotenoid-based traits signal primarily foraging efficiency, immunocompetence or anti-oxidative condition, and what the relative importance of carotenoids and endogenous antioxidants is in trade-offs linked to immune function, have remained largely unsolved. We addressed those issues in an experiment with captive Greenfinches (*Carduelis chloris*) where the birds received a carotenoid supplementation and SRBC-induced immune challenge treatment in a 2x2 design. Here we report how those treatments affected various parameters of general health and immune function, indices of total antioxidant status and lipid peroxidation in blood, as well as the levels of different exogenous and endogenous antioxidants in Greenfinches.

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The influence of point-of-departure climate variables on the arrival dates of two long-distance migrants in Eilat

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We examined the influence of point-of-departure climatic variables - surface temperature anomaly, number of wet days, and length of growing season (GSL) - on the arrival dates of two, primarily insectivorous, long-distance migrants, the Lesser Whitethroat (*Sylvia curruca*) and the Bluethroat (*Luscinia svecica*), at Eilat in Israel from 1985 to 2004. The temperature anomaly on the breeding grounds of Lesser Whitethroats increased at a rate of 0.147°C/year, but there was no anomalous change in temperature on the breeding grounds of Bluethroats. We found no change in the number of wet days or the GSL on the breeding grounds of either species. The median arrival date of Lesser Whitethroats in Eilat in autumn was delayed by 21.5 days over the study period, or by 5.35 days for every 1ºC increase in the temperature anomaly at their breeding grounds. The arrival date of Lesser Whitethroats at Eilat in autumn was also negatively correlated with the number of wet days at their breeding grounds. There was no change in median arrival date of Bluethroats in Eilat then. In spring, neither of the species shifted their arrival times in Eilat, nor was there any change in the temperature anomaly at their wintering grounds. We conclude that the variations in resources, probably insect abundance in this case, that follow changes in climatic variables may serve as a mechanism for modifying migration phenology.

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Bill knob size in the Mute Swan: Evidence for a sexually selected trait?

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Sexual selection theory predicts that sexually selected ornaments are costly to maintain and, as condition-dependent signals, are likely to vary in splendour. Mute Swans (*Cygnus olor*) possess a black, fleshy knob at the base of the bill, which is present in both males and females and for which no function has been identified. We tested whether this trait might be a sexually selected ornament by monitoring changes in the size of the bill knob in individual swans throughout the course of the breeding season. We did this by taking measurements from images of over 700 individually marked birds photographed at four key points during this period: when birds were pairing up and establishing territories, when cygnets were hatching, when adult birds were flightless due to the annual molt, and once family groups had dispersed and adult birds were no longer engaging in parental care. We found ornament size to be a sexually dimorphic trait, with males displaying larger bill knobs than females. Breeding males consistently displayed larger ornaments than non-breeding males, but ornament size varied considerably throughout the breeding season. In females, breeders had larger bill knobs than non-breeders, except after incubation of the eggs, when body condition was also assumed to be poor. Ornament size was significantly related to weight in both males and females, and also to age in males. Our findings suggest that the bill knob ornament in the Mute Swan is a condition-dependent trait, which is indicative of a sexually selected ornament. The differences in the changes in bill knob size over the course of the breeding season between males and females may reflect the specific pressures on each sex as a result of their differing parental roles.

Hudson M-A, Bird D

Reproductive performance of breeding birds on golf courses and green spaces around Montreal, Canada

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In an increasingly urbanized landscape, golf courses have the capacity to serve as important sanctuaries for wildlife. As the average 18-hole course covers approximately 54 ha, and there are well over 31,500 golf courses worldwide, the potential area of relatively undisturbed habitat available for wildlife on them is immense. Several studies have already documented avian diversity on golf courses, yet few have examined the reproductive performance of birds there. Accordingly, the objectives of this study were to: (1) calculate and compare reproductive success and predation rates of open-cup nesting passerines on golf courses and nearby green spaces, (2) compare avian species richness across sites, (3) identify variables that affect nest success at local and landscape scales, and (3) test a new computerized camera system designed to monitor nests in densely-leafed trees, shrubs, and emergent vegetation. The camera system enables quick capture of high-quality color images that are easily archived. During the 2003-2005 breeding seasons, over 800 nests of 18 open-cup nesting species were located and monitored at four golf courses and two green spaces in Montreal, Canada. Breeding status was also assigned to all species observed on site. Preliminary analyses of 2003-2004 data for Red-winged Blackbirds (*Agelaius phoeniceus*) indicated that nest success, initiation date, clutch size, and number of young hatched and fledged were similar between sites and years. Nest success rates were calculated using the Mayfield method, and various breeding parameters were evaluated for the most numerous of the breeding species. Additional data were collected in 2005 to increase sample sizes and to enable GIS habitat analysis of all study sites.

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Breeding birds in Finnish old forest remnants: Effects of forest area and source

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We examined the effects of the mature forest zone or "green belt" along the Russian border with Finland on the numbers of bird species in reserve areas of old-growth forest in Finland. We conclude that this large forest zone is a source area for many bird species specialized for life in old-growth forest, a forest type now fragmented into small pockets in Finland, each well isolated from one another through the effects of habitat fragmentation. Thus the source zone in Russia can be expected to help in maintaining bird populations in old forest fragments in Finland. This may occur via continuous dispersal from the source zone to fragments that otherwise may be too small to maintain viable populations of old-growth forest species. Our results show that the numbers of bird species in both managed and virgin forest are associated positively with the extent of forest habitat in reserves. The species-forest area regression predicted the occurrence of old-growth bird species in reserves better than those of managed forests. Populations of managed forest species may well be affected by landscape structure surrounding reserve areas, whereas for populations of virgin forest species, the extent of forest habitat within reserve areas is much more critical. When examining the influence of the source zone, we found that the numbers of managed forest bird species in reserve areas remained constant irrespective of distance from the Russian border. In contrast, the numbers of virgin forest bird species in those reserves declined westwards with increasing distance from the border. The rate of decline is approximately 1 species in every 25 km, such that reserves at 100 km west of the border have lost four virgin forest species. Such declines are the same in both small and large reserves.

Husby M

Predation rates on bird nests by predatory birds and mammals around refuse dumps

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Refuse (garbage) dumps attract scavenging gulls, crows and mammals that are opportunistic foragers prone also to rob the nests of birds in the vicinity. To determine the extent to which the availability of food at refuse dumps mediates such predation, we placed one Common Quail (*Coturnix coturnix*) and one plasticine egg in a total of 1793 artificial nests in 34 different areas at, and up to more than 30 km away from, one refuse dump in central Norway. The nests were placed in the same positions in the same habitat at the same height above sea level. By 10 days, 36.2% of nests had been attacked; and in about half of these it was possible to distinguish between bird and mammal predator because of marks on the plasticine egg. The depredation rate by birds decreased significantly with distance from the dump, at 13 km becoming half that at 8 km. For mammals, variation in the rate between areas was too great to show any significant correlation between depredation and distance. Breeding performance for natural open nests around three refuse dumps was more than four times better in control areas than in areas close to the dumps. Winter tracking on snow around the three dumps, and yields from hunting before and after the establishment of one of the dumps, revealed the same trend: a marked increase in the number of Red Foxes (*Vulpes vulpes*) close to the dumps and a corresponding decrease in the numbers of fox prey.

Iddi KN, Cheke RA, Kenyon L

Phylogenies of the sunbirds (Nectariniidae) and flowerpeckers (Dicaeidae) based on analyses of vocalizations

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Sunbirds of the family Nectariniidae occur throughout the Old World tropics from Africa across southern Asia to Wallacea and northern Australasia, reaching the Solomons. Primarily tropical Asian, flowerpeckers of the family Dicaeidae are absent from Africa; only one species reaches Australia and another two northern Melanesia. Songs are simple in flowerpeckers but very complicated in some sunbirds, providing opportunities for detailed analyses and comparative studies. In order to clarify whether sunbirds originated in Asia, as suggested by DNA data, or Africa, as indicated by some morphological analyses, we derived phylogenies from analyses of their vocalizations using AVISOFT software. Phylogenies derived from data for maximum frequencies, note interval, note duration, amplitude, band width, range of frequencies, entropy and other parameters will be presented for 148 species of sunbirds, together with phylogenies from equivalent data for 36 species of flowerpeckers. Results for the latter suggest that the genus *Prionochilus* is basal.

Ilyas O

Status, distribution and conservation of the Himalayan Monal in the Gharwal Himalayas, Uttranchal India

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The Monal (*Lophorus impeyanus*), the state bird of Uttranchal and the national bird of Bhutan, occurs throughout higher altitudes in the Himalayas. Due to its brilliant plumage, it has been exploited for its feathers as well as for food, and from 1970 to 1976 a total of 13 million birds was exported from India. Although the export of live birds was banned in 1990, and Monals are now protected from capture by national and international legislation, molted feathers and some reportedly plucked from killed birds are still either exported or traded locally for decoration and use in handcrafts. Due to decrease in the Monal population over time, reliable information on its status, distribution, and threats are needed for developing appropriate conservation strategies. Accordingly, an intensive survey was conducted at six sites in the Gharwal Himalayas, including Kedarnath Wildlife Sanctuary and the Nanda Devi Biosphere Reserve, between 2500-4000m a.s.l. Indirect as well as direct methods were used to record numbers, finding maximum abundance of 2.64±2.2 birds/km^2 at the Himtoli site, followed by 0.96±1.29 at Madhmaheshwer and 0.75±1.4 at Saukhark. Maximum numbers actually sighted were 0.26±0.59/km^2 in Tungath, followed by 0.14±0.43 at Bansinarayan and 0.14±0.44 at Madhameshwer. Due to illegal poaching and hunting, the populations of Monals have continued to decline and are now confined to a few small fragmented patches in urgent need of conservation.

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Determinants of bird diversity in a highly fragmented oak forest in Morocco

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Investigations were undertaken on spatial variation in bird richness in the Marmora oak forest, a highly fragmented ecosystem in Morocco. They allowed us to test the relationships between local species richness and patch size, vegetation diversity and distance to the nearest large forest. The study was based on a statistical analysis of the spatial distribution of data from a sample of forest patches, which enabled location of patches in the models that related bird richness to patch characteristics. We found that species richness exhibited significant spatial autocorrelation, suggesting that there were no differences between neighboring bird communities. After controlling for spatial covariance in the data by using a regression model which assumed that the error covariance is a decreasing function of distance between patches, we found that local bird richness was positively correlated with patch size and negatively correlated with the distance between patch and nearest large forest. However, given that vegetation structure was highly homogeneous in different patches, it was not a significant predictor of local bird richness in the system. Our work indicates that species exchange between patches close to one another seems to play an important role in shaping bird communities in the patch system. It also stresses the importance of considering spatial issues when attempting to understand diversity patterns in patchy landscapes.

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Avifaunal distribution and endemism in the Togian Islands, Gulf of Tomini, Central Sulawesi

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The study seeks to characterize the bird fauna of Togian Islands, C. Sulawesi. Further considerable effort was made to draw comparisons with distribution of restricted-range species in mainland Sulawesi, and the Banggai Islands. The thesis draws the results of field observations in the three “islands” (eastern peninsula, Togian and Banggai), intermittently, between 1991 and 2003, combined with studies of museum specimens and registers. The surveys added 40 species, including six as yet unconfirmed. Discoveries included new species of Hawk Owl (*Ninox burhani*). Another taxon, a white-eye, (*Zosterops*) awaits description. The Togian Islands appear to be connected to the eastern peninsula, more than it does the north peninsula. However, there are shared distributional records at the subspecies level between Togian and the north peninsula, therefore indicating a possible degree of faunal affiliation. The proportion of Sulawesi endemic species is declining as one goes from Sulawesi, Togian, Banggai, and Sula, which happened despite the fact that each of the Banggai and Sula island-groups are larger-sized than the Togian Islands. On the other hand, point endemic species and subspecies are increasing in the Banggai and Sula Islands. The Togian Islands also showed an equal proportion of widespread species to those in the Sulawesi mainland. The study includes explorations of the fauna of the active volcano of Una-una, which has exploded in recent times and thereby undergone self sterilization. Eventually, the biogeography of the Togian Islands provide for practical conservation implications.

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Milestones and lessons learned from the initial establishment of the Indonesian Ornithologists' Union

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This communication summarizes the milestones and lessons learned from the initial establishment of the Indonesian Ornithologists' Union (IdOU). The core business of IdOU is publication of Indonesia's scientific ornithological Bulletin, known as Kukila. IdOU has started engaging with R & D Biology LIPI (Indonesian Institute of Sciences) on the formulation of species-based policies. A national ornithological seminar, attended by ornithologists from the regions of Indonesia as well as overseas has been established. One of the most ambitious projects being mounted by IdOU is to revise the Kukila Checklist of Birds of Indonesia (Andrew 1992) by creating a substantial contemporary taxonomic database. IdOU has also embarked on an information program designed to anticipate confusion that might result regarding the AI outbreak and the role played by migratory wildbirds in spreading the disease in Indonesia. Lessons learned have been drawn mainly at the operational levels. Firstly, given the growing number of members, pro-active measures must be developed to increase the interests (and capacities) for taxonomic research. Secondly, there is a need to establish a stronger scientific framework and methodology for ornithological research in Indonesia. Thirdly, in connection with the development of scientific writing from within the country, there are three procedures that need to be mainstreamed, namely: proper desk studies, peer review and improved understanding of thecode of ethics in scientific publishing. Fourthly, planning of activities must be based on sound recognition of existing capacities. Eventually realization should be fostered of the voluntary nature of the Union.

Indykiewicz P

The Brda River as the most important site for protecting bird species diversity in the "Tuchola Forest" Biosphere Reserve, north Poland

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The Brda River drainage is the main hydrological feature of the Tuchola Forest, the largest intact complex of dry pine forest in northern Poland with an area of c. 3400 km^2. The Brda basin, covering c. 4718 km^2, is shallow and retains some 72 lakes. Between 1993 and 2004, 122 bird species representing 38 families bred in the basin, comprising 86% of breeding species in the Tuchola Forest area. As evidence of its conservation value, the basin supports breeding populations of such globally threatened species as *Milvus milvus, Haliaeetus albicilla* and *Crex crex*, and such European endangered species as *Ciconia nigra, Ciconia ciconia* and *Perdix perdix*, as well as other species seriously threatened at a national scale in Poland: *Mergus merganser, Bucephala clangula, Circus aeruginosus, Accipiter gentilis, Grus grus, Tringa ochropus* and others. Moreover, the Brda river is an important bird migration corridor used by over 80 bird species. Between 1902 and 1999, a number of breeding species - *Circaetus gallicus, Aquila pomarina, Falco peregrinus, Falco tinnunculus, Coracias garrulus, Tetrastes bonasia* and *Picus canus* - disappeared from the river valley; but over the same period, others arrived to breed: *Pandion haliaetus, Haliaeetus albicilla, Milvus milvus* and *Pernis apivorus*. Factors favoring diversity in breeding birds on the Brda River are the high stability and richness of ecosystems in the immediate basin. The mosaic character of this environment, with broad river banks and widely meandering streams surrounded by wet meadows, fallen trees and riverside woodlands rich in tree holes provides, together with extensive forest biotopes nearby, favorable habitats for many bird species.

Innes J

Predation on nests of New Zealand forest birds: Review of evidence from time-lapse video

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Non-stop, time-lapse video recording has been used to identify predators at nests of New Zealand forest birds since 1991. The technique has been spectacularly effective at identifying predator species, clarifying which sign is diagnostic for each predator, and revealing the complexity of interactions between birds, predators and scavengers. Video sequences have played crucial roles in focusing pest control programs in New Zealand; and examples are given of where this has led directly to successful recovery of threatened populations and species. Two key attributes of the video medium are responsible for the success of the technology. First, unambiguous identification of predators allows conservation managers to target pest control effort precisely. Secondly, video sequences of pests killing birds have a powerful impact in convincing sceptics and local communities that pest control may be worthwhile. Disadvantages of the technique are that video units can be expensive to construct and to run in the field, and that sample sizes of filmed predations are usually small for any one project. To attempt to redress the latter, this paper (1)collates data from c. 20 projects in which interactions between predators and nesting forest birds have been filmed with time-lapse video, (2)contrasts predator identification in beech *Nothofagus* spp. and podocarp-broadleaved forests, (3) describes time of day and nest stage at which predation by different predators occurs, and (4)documents defense behavior in endemic birds that may have been effective against primeval avian predators but not against contemporary introduced pest mammals, especially Black Rats (*Rattus rattus*), Brushtail Possums (*Trichosurus vulpecula*) and Stoats (*Mustela erminea*).

Iovchenko NP

Overlap of breeding and molt in a food specialist, the White-winged Grosbeak

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Among cardueline finches, the White-winged Grosbeak (*Mycerobas carnipes*) is one of most specialized in diet, feeding almost exclusively on the seeds of junipers (*Juniperus spp.*). I investigated the timing of its breeding and molt using field observations, physiological measurements of trapped birds, and observations and experiments on captive birds. Field studies were carried out in the Tien Shan, at Ala-Archa Narrow, 2100-2300 m a.s.l. In captivity, I determined the interval from photo-stimulation until the onset of molt, the "conventional reproductive period" (CRP). Photoperiod determines the length of the CRP in those circumstances, but in wild breeding birds, sexual activity responds to the local cropping of the main food plants, junipers. CRP under a 16L:8D photoperiod is shorter (78.5±2.8 days, range 62-91 d, n=11) than the duration of the egg-laying period found in nature (90–110 days). Moreover, although a day-length of 13 h is sufficient to stimulate sexual activity, early breeding in the wild is limited by low temperatures. In the study population, breeding started in mid May, with the majority of females laying from late May to early June. In the last ten-day period of June, some adults trapped near the nest or feeding fledglings were already molting. As a result, regular overlap of breeding and molt occurs within individuals. Because juniper seeds ripen every one and a half years, a good crop in the previous and/or current year leads to a prolonging of sexual activity or full recrudescence of gonads in molting birds, with clutches being initiated in late August-early September. All breeding birds at that time are molting, and we have found that females can start laying when in stage 5 or 6 of molt. Ssupported by RFBR grant 04-04-48998.

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Ecosystem management for endemic species on Amami Island, a hotspot in the southwest Japanese archipelago

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At the northeast fringe of the Oriental region, Amami Island, with a wet, warm, subtropical-rainforested environment and mountainous terrain, has had a long history of make-and-break connections with the Asian mainland to become a global center of avian endemism. The Amami Thrush (*Zoothera major*), Lidth's Jay (*Garrulus lidthi*) and Amami Woodpecker (*Dendrocopos leucotos owstoni*) are confined to it, and the Amami Woodcock (Scolopax mira) occurs as well on only a few neighboring islands. Most endemic species are threatened by forest fragmentation and predation by invasive mammalian predators, including the Java Mongoose, Black Rat, feral cat and domestic dog. Amami Woodcocks have declined much in areas of mongoose infestation. The Ryukyu Robin (*Erithacus komadori*), also present on other southwestern islands in Japan, is similarly affected; it is much more abundant on adjacent Kakeroma Island where biodiversity is lower but mongoose are absent. The Amami Thrush, the occurrence of which is not correlated with mongoose distribution, seems to be recovering its very small population. Lidth's Jay and the Amami Woodpecker are affected mainly by forest fragmentation. The Japanese Ministry of Environment has been carrying out measures to control the mongoose since 2000, but such action has side-effects: Black Rats (*Rattus rattus*), an important food source for mongooses in winter, may rapidly increase following release from predation, finding ready food in the rich acorn crop produced by forests on the island. More research is needed to understand the dynamic interactions between indigenous and invasive species in order to manage the biotic community on Anami ecologically and adaptively for the benefit of endangered species.

Jagolkowska-Tkaczuk P[1], Rutkowski R[1], Keller M[2]

Taxonomical consequences of genetic diversity of Polish Hazel Grouse

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Hazel Grouse (*Bonasa bonasa*) is widely distributed in Euroasia and there are 11-12 subspecies described for this area. Before Second World War Hazel Grouse inhabited almost the whole Poland, except of its central regions. Its present distributions is restricted to North Eastern area, Middle East area and mountains: Carpathian and Sudety. Until now distribution of subspecies of *Bonasa bonasia* in Poland hasn't been explain. The NE populations of Polish Hazel Grouse belong to the nominate subspecies and birds from mountain to *B.b.styriaca* or *B.b.rupestris*, though according to another authors there occurred two subspecies in Polish mountains: *B.b.styriaca* and *B.b.rupestris*, respectively in Carpathian and Sudety. One more hypothesis is that Vistula river creates the natural boundary between populations from western (*B.b.rupestris*) and eastern Poland (*B.b.bonasia*). Mentioned hypothesis are based on morphological features. The aim of this study is to describe the genetic differentiation of Hazel Grouse in Poland on the grounds of molecular genetics data. There were mitochondrial DNA control region and microsatellite data analyzed for 10 Polish populations of Hazel Grouse. The results have shown significant genetic differentiation between populations of NE Poland and Carpathian Mountains. Genetic differences are so pronounced that occurrence of two subspecies in Northern and Southern Poland seems to be confirmed by our analyses. Genetic data also suggest that Middle East forms the hybrid zone between two subspecies.

Janaus M, Stipniece A

The White Stork in Latvia from 1934 to 2005

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The size of the breeding population of the White Stork (*Ciconia ciconia*) in Latvia has been followed since 1934. Data were collected for the whole country by international counts in 1934, 1958, 1974, 1984, 1994/95 and 2004/05. Since 1989, breeding success has also been recorded on 6-22 sample plots, covering up to 4% of the Latvian population. Information about nest occupancy and production, as well as the location of nests and human help in their construction, was gathered during the counts. The data show that the size of the breeding population has undergone considerable change over the last 70 years, from 6750 occupied nests in 1934 to an all-time low of about 5770 occupied nests in 1974, followed by an abrupt rise after 1984 to about 12000 in 2004. Today Latvia preserves one of the highest densities of breeding White Stork populations in the world, with an average of 19 occupied nests per 100 sq. km of territory. There have also been considerable changes in the siting of nests. Thus at the beginning of the study, most nests, or even all in some districts, were built in trees; but now at least half of them are placed on electricity poles. Human help in erecting nests has declined as well, from 87% to less than 30%. Possible reasons for such changes are discussed.

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Vision and feeding in Blue Ducks and Pink-Eared Ducks

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Blue Ducks (*Hymenolaimus malacorhynchos*) live in headwaters of New Zealand rivers and feed primarily on aquatic insects. Whether such food items are detected by tactile or visual cues, nevertheless, is unknown. That Blue Ducks may use tactile cues when foraging is suggested by the presence of specialised flaps of thickened, keratinised epidermis containing Herbst's corpuscles along the ventral margins of the upper mandibles near the bill tip. Similar bill flaps are found in only one other duck, the Pink-eared Duck (*Malacorhynchus membranaceus*) that surface filter-feeds in turbid waters in inland Australia on a range of planktonic organisms. Using an ophthalmoscopic reflex technique, we determined the visual fields of both species. We conclude that Blue Ducks are primarily visually-guided foragers. The eyes are frontally placed to provide a wide field of binocular vision into which the narrow tapering bill intrudes, and there is a large blind area to the rear of the head. The topography of this visual field is similar to that in other visually-guided amphibious birds that capture mobile prey, e.g. penguins. In contrast, the visual field of the Pink-eared Duck resembles that in other tactile-feeding ducks: a narrow frontal binocular field with the bill falling at the periphery, and comprehensive visual coverage of the celestial hemisphere. If Blue Ducks are primarily visual feeders, their foraging may be disrupted significantly by changes in water clarity, introducing a previously unconsidered factor into the selection of sites for population enhancement or re-introduction, a current conservation focus.

Jeong-Yeon YI

Status of migratory shorebirds and the habitat of their staging grounds in Korea

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Recent surveys of migratory shorebirds in Korea have shown that more than twelve percent of the estimated shorebird population of the East Asian-Australasian Flyway use the intertidal habitats along the west and south coast of Korea. It implies that there are major staging sites of international importance in Korea as well as in the Yellow Sea Eco-region. Preliminary multivariate analysis of environmental factors operating at the Korean staging sites suggests that geographical and landscape variables of inland habitat lining the coast can affect habitat selection and inter-site movement among migratory shorebirds. This result provides the basis for further habitat analysis.

Jeong-Yeon Y[1], Seok-Won L[2]

A pilot study of landscape impact on habitat use by songbirds in fragmented urban forests in Korea

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To examine landscape ecology methodology and habitat fragmentation, the status of songbird populations indexed against habitat fragmentation was investigated on 16 study plots in low to highly isolated urban forest patches in Korea. Population densities in plots in large, natural continuous forest were highest, followed by those in semi-natural forests and lastly isolated small patches of urban forest. Relationships between songbird population densities and indices of forest fragmentation showed significant positive correlations among forest areas, mean proximity indices and mean nearest neighbor distances. From the results of this pilot study, it is expected that a landscape ecological approach can be used to provide guidelines for the creation of artificial urban forests and mitigation of natural habitat.

Jerome MI

The birds of Lake Tele Community Reserve, Congo

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The Lake Tele Community Reserve is a site of strategic importance for conservation of the forests, lake-side environments and fauna of the Congo, and a trump tourist attraction. Characteristic habitats are 'terra ferme' forest, permanent and seasonal swamp forests, mosaic savanna woodlands and surface waters. Together they support such a rich fauna, particularly in waterbirds, that the area was placed on the list of internationally important wetlands under Ramsar in June 1998. The reserve holds a diversity and abundance of birds unique to the Congo. January to March is the main period of migration. Two species discovered at the lake have just been added as new to the list of Congo birds: *Ciconia ciconia* and *Egretta ardesiaca*. The local community, mostly fisherpersons and farmers, play an important role in bird conservation, notably in the protection of nests and roosts of different species despite such negative impacts as bush-fires; in some villages, local groups are even organized into conservation committees. For the last ten years, the waterbirds of the lake, comprising over fifty species, have been the subject of annual counts under the DOEA program of Wetlands International. With forest and landbirds included, more than 350 species occur in the area. My objective in this presentation is to bring to the attention of the scientific community the biological importance of Lake Tele, its birdlife and the activities of the local communities, and to seek support for much further research.

Jia C-x, Sun Y-h, Wang Z

Hypothermic tolerance in the eggs of the Slaty-blue Flycatcher

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Many avian parents leave off incubation temporarily, exposing eggs with their developing embryos to ambient thermal conditions for up to several consecutive days with little or no effect on hatchability. Hypothermic tolerance in the eggs of passerines is poorly known. Three abnormally long off-bouts (4.6, 1.2 and 5.3 hours, respectively) were recorded in an incubating Slaty-blue Flycatcher (*Ficedula tricolor*) female at the Lianhuashan Natural Reserve, Gansu Province, China. Nest temperature was measured and recorded by a temperature data logger at 50 second intervals. During female absences, nest temperature dropped to a minimum of 7.7^{o}C, and included two periods of 3.8 and 4.6 hours when nest temperatures remained below 10^{o}C. Nest attendance resumed thereafter and continued normally until the eggs hatched.

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The ecological impacts of tourism: The case of the Golden Eagle

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The expansion of tourism into natural areas may have negative effects on disturbance-sensitive species like the Golden Eagle (*Aquila chrysaetos*). Such negative effects may be direct, as in disturbance close to nest sites leading to failure to breed, or indirect, by preventing eagles from hunting in certain areas. We studied the ecological impacts of tourism on Golden Eagles at twelve tourist sites in Finland, analyzing how territory occupancy and nesting success was influenced by proximity to a site. The distance of each territory from tourist sites was measured by GIS. Data for 138 territories was collected between 1990 and 2004 by volunteers and organised by the Finnish Forest and Park Service. Territory data was grouped into four categories: (1) unoccupied, (2) occupied, (3) territories with failed nesting attempts, and (4) territories with successful nesting attempts. We found that both the occupancy rate of territories and nesting success were dependent on year and varied between tourist sites. However, proximity to the tourist site did not affect either of them. Moreover, the size and area of the tourist site, and extent of human activity (skiing, snow-mobiling) had no significant impact as well. Annual impact on nesting success probably results from climatic fluctuations affecting prey availability between years. Golden Eagles mainly prey on hares, the densities of which vary greatly with season. The differences in nesting success for different tourist sites are probably due to differences in landscape structure around the tourist location: landscape structure around some tourist areas may provide better hunting. Funded by LANDSCAPE LAB, EU LIFE Environment.

Julian I, Bird D

Impact of chemical spraying on selected avian species feeding on golf courses

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Golf is now one of the most widespread sports in the world, and generally splits public opinion over its value to birdlife. One view perceives golf courses as relatively undisturbed green spaces that provide habitat for a variety of birds and serve as havens for wildlife, particularly in suburban areas. The other sees golf courses as harmful because of widespread use of chemical pesticides that contaminate food subsequently ingested by birds. Neither perception has been tested adequately: there is little information about the impacts of current spraying programs on feeding birds, or on the extent to which non-waterfowl species use golf courses as feeding grounds. Accordingly, this study was undertaken to examine feeding behavior in selected bird species on suburban golf courses and to predict risk of pesticide exposure based on foraging behavior and current spraying regimes. Over two summers, the proportion of time spent feeding by the birds was found to vary among golf courses, habitat type and month. Most species were observed more frequently in natural than highly maintained areas, and in the morning rather than afternoon. Based on spraying data, our target species seemed to be at little risk of exposure to pesticides: their foraging patterns and preferences precluded direct contact.

Kaatz M

Satellite-Telemetry of the White Stork

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The White Stork (*Ciconia ciconia*) is the national bird of Germany. In the 1990s satellite-telemetry of the white stork was developed and tested under the overall control of the Max Planck Research Center for Ornithology – ornithological center at Radolfzell (Baden-Württemberg) in cooperation with the stork center/station Loburg (Saxony-Anhalt). By means of a miniature transmitter tied to the back of the migratory birds it was made possible to determine their daily whereabouts. The method made possible to track for the first time the storks´ migration routes even across national borders. The results of this research have been appeared in several articles published in *Journal of Ornithology* as well as one doctoral dissertation. They serve as the basis for the development of a new safety-concept along the migrations routes on an international scale. The female White Stork “Prinzeßchen” from Loburg, who was first equipped with a transmitter in 1994, has already migrated to South Africa, the farthest known distance known for storks of about 11.000-12.000 km, several times. For years she has been mating with “Jonas”, a male stork migrating on the western route to Spain. In April 2004 Germany issued a special edition stamp in honour of “Prinzeßchen”, the first time a migratory bird has been honoured in such a way. The German TV ZDF followed “Prinzeßchen” on her passage across Eastern Europe, the Middle East and parts of Africa. So far two documentaries have been broadcasted. These films show how the migration of storks connects continents, countries, nations, and people.

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Sexual dimorphism in the bill of a seabird: Sexual selection or ecological adaptation?

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Two mechanisms have been proposed to explain sexual differences in body size in birds: sexual selection and ecological divergence. The bill is a structure implicated in numerous functions, including feeding, territory defense and mate acquisition. Here we examined the morphology of the bill and feeding strategies in a size-dimorphic petrel, Cory’s Shearwater (*Calonectris diomedea*), using both multivariate and geometric morphometric methods. Males are bigger than females in all bill dimensions, which did not, nevertheless, deviate significantly from isometry in their scaling with body mass except for depth at the base which was found to be hypermetric in males. Shape differences between the sexes include deformation of the anterior part of the bill and the area surrounding the nostril: males have a more inflated superior unguicorn and a more spaced structure of the posterior region of the bill. Such differences in shape, however, are largely a reflection of differences in size. Both sexes were observed foraging in the same waters on similar food items. As foraging strategies and trophic ecology did not differ between them, we discarded the foraging-niche divergence hypothesis, concluding that bill size in this species is related to an as yet unknown sexual function.

Kalyakin V

Specific trophic adaptations in family Timaliidae, babblers

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Trophic adaptation in a species is interpreted here as a combination of morphological and behavioral features that provide effective food detection, collection, processing and swallowing. Such adaptations have a heritable phylogenetic component, are part of the complex of other biological features characteristic of a taxon, and are molded by the environment of origin. Here I evaluate specific trophic adaptations in the babblers, Timaliidae, using data on the ecology of the majority of their genera collected in Vietnam from 1989 to 2005. The results of a study of the morphology and function of the jaw apparatus are also included as a key reference for analyzing trait evolution among the species. Analysis of feeding in babblers, and other parameters of their biology (habitat, elevation, geographic distribution) allows formulation of hypotheses about basic trophic adaptations and the circumstances in which they could have arisen. In brief, the trophic adaptation characteristic of Timaliidae is a mix of insectivory and seasonal frugivory. Babblers are specialists in collecting sluggish invertebrates, particularly those lodged in any substrate that is easy to pull apart or penetrate with the bill. Construction of the jaw apparatus enables them to manipulate each jaw independently to collect fruit or extract food from leaf litter, soft soil, dry leaves, small rotten branches, epiphytes, and moss, as well as to prepare food in the beak. Such trophic adaptations originated in mountains (Himalayas) where a seasonal monsoon climate provided a subtropical to warm temperate environment with a cool winter, seasonal availability of fruit and variation in invertebrate activity.

Kalyakin MV, Voltzit OV

Are we in Europe? Results of the first six years of the ongoing program "Birds of Moscow and the Moscow Region"

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Ornithological clubs active in the study of their local bird fauna is common throughout Europe. But in Russia, the situation is different: a big territory, sparser population and economic constraints, leading to a deficit of birdwatchers. The Moscow Region, however, has a moderate population of ornithologists, making it possible to organize community programs for bird monitoring there. Such a program was started in 1999 with a project to gather together all observations of birds for Moscow and its Region. Data in standard form are included in annual reports entitled "Birds of Moscow and Moscow Region", the purpose of which is to add to a new version of a book on the birds of the region. In its first phase, the project has produced a bilingual "Atlas of Birds of Moscow and Moscow Region", the result of cooperation from more than 400 persons who observed birds at more than 700 points, with breeding and winter records, and hundreds of photos for illustration. Shortcomings in the data will be eliminated in the next phase of the program. Attention is focused at present on collecting precise information about the breeding ranges of species and bird abundance about Moscow. Apart from the scientific issues involved, we have found it important to develop procedures for cooperative work on such a large project. Here the experience of other European ornithological societies, which we hope to tap during the Congress, will be instructive - so that Russian ornithologists really become part of ornithological Europe.

Kanetsuki Y, Nagata H, Tsubaki Y

Molecular analysis of the population genetics of the Japanese White-eye in Japan

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The Japanese White-eye (*Zosterops japonicus*), which occurs widely in Japan and East Asia, comprises six subspecies in Japan and four in neighboring countries. Because all Japanese subspecies have been kept in captivity in Japan and sometimes accidentally released outside outside their natural regions, it has become necessary to develop molecular markers that can distinguish between the subspecies, identify the sources of local populations and their genetic mix, and assess genetic erosion in those populations. Accordingly, I analyzed DNA sequences of 1149 base pairs from the mitochondrial control region in 72 samples of populations of *Zosterops japonica* from Japan and east Asia. Subspecies-specific haplotypes were found in the six subspecies, but were impossible to separate because they were common to so many samples. When mitochondrial cytochrome b gene was sequenced as well, the subspecies could be discriminated.

Karaardic H[1], Erdogan A[1], Vohwinkel R[2], Pruente W[2]

The relationship between biometry and migration time among nine species of warblers in southern Turkey

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Ringing studies in Turkey have been ongoing since 2002. Before then, ringing was so sporadic that only data since 2002 can be analyzed meaningfully. During the years 2002, 2003, 2004 and 2005, ringing data were limited to the spring migration season near the Manavgat River, not far from the Mediterranean Sea. Thereafter, data have been collected during autumn migration in the same area. Tape lures with the songs of 15 species were used to attract birds to mist nets for ringing during the first three spring seasons. From this, ringing data and biometrics for nine species of warblers (*Sylvia*) were analysed to compare inter- and intra-specific timing of migration.

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Results of bird banding in spring at Titreyengol, Manavgat, Turkey, since 2002

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Ringing studies began regularly in Turkey in 2002. In the springs of 2002, 2003, 2004 and 2005, 43236 birds of 120 species were captured and ringed with the help of more than 50 volunteers near the Manavgat River, not far from the Mediterranean Sea. We used tape lures with the songs of 15 species to attract birds to nets during the first three seasons, but stopped the practice in 2005 to assess their effect. For the first three seasons, 108 meters of mist netting was set in fields along a hedgerow, but in 2005, only 51 meters of netting was used. In the first two years, moreover, an additional 120 meters of mist net was set in the field on the other side of the hedgerow to trap wagtails and pipits, and a special 'high net' (5 meters high and 24 meters long) added to trap swallows. Measurements were taken of most birds and the molt of rare species examined. Trapping records and the dates of all retraps, including those of 63 birds ringed in other countries, are analyzed.

Karev E

Developing bird gardening: My experiences with birds and ornithology in Russia

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By 2006, I will have spent 40 years working for ornithology and gathering observations on birds. I have traced trends in the bird fauna of Ufa, Russia, over the last 100 years, and from 1966 to 1983 I studied the ecological preferences of 77 bird species for 29 tree species, 20 bushes and 21 herbs of garden plants, working out a scientific basis for bird gardening in Ufa and finding that birch trees (*Betula*), with visits from 47 species, were the most attractive to birds. This information was collated in my degree papers for Moscow State University in 1885, entitled: *Big city ornitho-complexes structures and bird population management problems*. Beginning in 1974, I have been recording bird sounds from the Urals and elsewhere, and have spent time leading a young ornithologists' club and introducing children to birds, creating a psychotherapy garden through perception of bird song. My experiences and publications lay the foundations for bird gardening, an enterprise that has yet to develop in the world around us.

Karlsson O, Lilja C

Is the shell of an egg adapted to support different rates of calcium removal by developing embryos?

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The shell of an egg contributes to successful embryogenesis in many ways, such as in protection, respiration and water exchange. The shell is also the major source of calcium for the development of highly calcium consuming organs in the bird, such as the skeleton. Some studies show moreover that growth rate may play a fundamental role in the pattern of skeletal development: the faster the growth the less ossified the skeleton becomes. We predicted therefore that slow (precocial) and fast (altricial) growing bird species should lay eggs encased in shells with different structures adapted to support different rates of calcium removal by the developing embryos. We tested this prediction by comparing the fine structure of the inner egg shell surface (mammillary layer) from 25 different bird species belonging to 13 orders ranging from Struthioniformes to Passeriformes. Using scanning electron microscopy we compared the mammillary layer of both preincubated eggs and eggs by the time of hatching, i.e. before and after embryonic development and accompanying calcium removal. Results are consistent with the prediction. The number of mammillary tips per unit of surface area (mammillary density) was associated with mode of development and growth rate. The number was higher, and calcium removal was also more extensive, in shells from precocial species than in shells from altricial species. These findings leads us to the conclusion that the shell is designed to support different rates of calcium removal by developing embryos and suggest yet another adaptation associated with growth rate and mode of development. From the evolutionary point of view it obvious that these modes of development evolved in response to different functional demands. The altricial mode of development required changes in anatomy, physiology and behavior of the bird. This enabled calcium to be saved both by the mother and her progeny.

Karu U, Saks L, Hõrak P, Ots I

Parasite resistance and immunocompetence in a Greenfinch-coccidiosis model system

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The theory of parasite-mediated sexual selection suggests that coevolutionary arms races between parasites and their hosts are responsible for the evolution of conspicuous ornamental traits used as signals of individual quality in sexual selection in birds. To test this idea, much work has focused on assessing the relationships between ornamental traits and parasite counts or indices of immunocompetence. However, information about the relationships between actual parasite resistance and indices of immunocompetence, such as SRBC and PHA response, remains scarce. We present data about such relationships in a Greenfinch (*Carduelis chloris*) - intestinal coccidiotic parasite (*Isospora lacazei*) model system. It has previously been shown that isosporan infection affects condition and carotenoid-based ornamental plumage coloration, a sexually selected trait in Greenfinches. Moreover, ornamental feather coloration has also been shown to reflect health and immunocompetence, measured as SRBC response, in Greenfinches. We show whether and how indices of individual humoral (SRBC antibody titer) and cellular (PHA wing web swelling) immunocompetence are associated with individual levels of resistance to isosporan infection in captive male Greenfinches.

Kawaji N

Mortality of released Copper Pheasants in Japan

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The number of hunted Copper Pheasants (*Syrmaticus soemmerringi*), a species endemic to Japan, has been decreasing for the last three decades. In recent years, about 5000 birds have been raised in captivity and released each year by mainly local government organizations to restore wild populations. But the numbers of birds in the wild have not yet returned to pre-hunting levels. The rate and cause of mortality among released Copper Pheasants have since been investigated by radio tracking in a wildlife refuge in Tochigi Prefecture, central Japan, between 1997 and 2004. Nearly 80% of the birds were found to have died within two months after release, and only about 7% survived for some 200 days or more. Mean survival periods were 39.2 days for males and 54.2 days for females, even though there was no significant difference between sexes. Young birds less than one year old had significantly lower survival rates than older birds. Birds that were released in summer also lived longer than those released in other seasons. There was no difference between vegetation habitats at sites where birds were released. The pheasants usually established a home range within a month after release. Average home range was 1.46 km^2 (0.3-3.7 km^2) for males and 0.99 km^2 (0.1-4.0 km^2) for females. Over 70% of the birds were killed by predators, i.e., carnivorous mammals and raptors, and only 3% were shot by hunters after they had moved into surrounding hunting areas following release.

Keiss O[1], Mednis A[2]

Impacts of land use on the Corncrake population in Latvia: Trends and population structure

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Data to compare the effects of agricultural land use on Corncrakes (*Crex crex*) were collected from 68 freely-chosen survey plots of 0.7–44.4 km^2 (mean=8.42, SD=7.46) in Latvia between 1984 and 2004. The annual TRIM index of Corncrake numbers increased in Latvia over the study period (p<0.003). At the same time, the combined area of abandoned agricultural lands increased, and the areas of cultivated pasture and intertilled crops decreased on the survey plots. Meadows both under cultivation and uncultivated first increased between 1989 and 1998, then decreased up to 2004. Habitat-specific annual TRIM indices of Corncrake numbers were correlated positively with the TRIM indices of area of uncultivated meadow, all meadows combined, uncultivated pastures, and abandoned agricultural lands, but negatively with intertilled crops. The TRIM index for total Corncrakes correlated positively with total rainfall in the Corncrake breeding season between May and July. The highest breeding density, averaging 3.05 males/km^2, was recorded in abandoned grassland, followed by uncultivated meadow > abandoned arable land > cultivated meadow > miscellaneous habitat > uncultivated pasture > shrubland > winter crop > cultivated pasture > spring crop > intertilled crop. More Corncrakes were observed in abandoned grasslands, uncultivated meadows and abandoned arable lands than expected (p<0.001), but their numbers were low in winter crops, cultivated pastures, spring crops and intertilled crops (p<0.001). Despite the recent increase in Corncrake numbers in Latvia, projected long term dynamics since 1940 show a significant long-term decline (p<0.0001) due to the contraction and alienation of optimal meadow habitat. Population structure was assessed from biometrical analyses of 674 birds and DNA analyses of 174 birds.

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Do females trade copulations for food? An experimental study in Black-legged Kittiwakes

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Females of many bird species copulate more frequently than necessary to fertilize their eggs. Because copulations are costly, adaptive explanations have been sought to explain why females copulate with several males or repeatedly with the same male. In many species, males provide nutrients to females during egg production; and so it has been suggested that females trade copulations for food. We test the hypothesis that females engage in this trade because they are dependent on the nutrients provided by the male for successful reproduction. In several seabirds, including Black-legged Kittiwakes (*Rissa tridactyla*), the rate of courtship feeding correlates positively with copulation rate. This has been interpreted as support for the hypothesis; but experimental corroboration is lacking. In a breeding colony of Black-legged Kittiwakes, we provided 50% of pairs with food *ad libitum*. The hypothesis predicts that fed females will copulate less frequently than control females. Our results show, nevertheless, that the opposite was true. Although females in fed pairs begged significantly less for food, they received more courtship feeding and copulated more often with their mate than females in control pairs. These data suggest that females do not trade copulations for food, but use courtship feeding as a signal of male quality.

Kerimov A, Ivankina E, Bushuev A, Ilyina T

Different responses of conspicuous and pale male Pied Flycatchers to falls in temperature

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The breeding plumage of male Pied Flycatchers (*Ficedula hypoleuca*) varies between conspicuously pied and cryptically pale brownish. Recently, conspicuous males (CM) were found to be more tolerant of cold spring weather than pale males (PM). Singing activity dropped in PM in cold weather, whereas CM performed full-scale advertising behavior within a wide range of temperatures. This asymmetry corresponded to differences in energetics: basal metabolic rate (BMR) in CM tended to be higher than in PM. In PM, moreover, advertising activity under low temperatures (<10°C) was confined to males with high BMRs; those with low BMRs sang actively only in warmer conditions. BMR in CM, however, was not related to ambient temperature. To explain the mechanisms involved, two hypotheses have been proposed: (1) BMR is a stable trait that expresses susceptiblility to cold and/or competitive quality such that temperature-dependent patterns in advertising reflect differences between males in BMR, or (2) contrary to CM, PM have to increase BMR under medium low temperatures at the expense of advertising activity. To test these hypotheses, we caught and temporarily removed wild males of both forms from their breeding areas around Moscow soon after arrival in spring. The BMR of each male was measured twice: on the first night after capture and then three days later after a period in a cold (~5 °C; n=33) or warm (~25°C; n=31) chamber. The experimental treatment increased BMR in both CM and PM, that in birds kept in cold chambers rising higher than in those in warm chambers. The effect of plumage color was pronounced when ambient temperature on the day before capture was taken in account. In birds captured after a warm day, exposure to cold led to a marked increase in BMR in pale but not conspicuous males. The results fit the second hypothesis better that the first, and suggest that medium low temperatures, which are common in spring in the study region, may act as a cold stress factor on the energetic regime of pale males.

Kilgas P[1], Mänd R[1], Tilgar V[1], Mägi M[1], Leivits A[2],

Physiological costs of egg production and effects of habitat indicated by state of hematological health in incubating Great Tits

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To understand habitat-related variation in the reproductive strategies of birds, better knowledge is needed of the ecological constraints that act at different phases of the breeding cycle. The costs of reproduction may vary at different stages across habitats. Great Tits (*Parus major*) lay more eggs in their preferred habitat, deciduous forest, than in coniferous forest, yet final reproductive success tends to be higher in the latter. To explore whether this discrepancy is caused by higher egg-laying costs in deciduous habitat, we manipulated females to lay more eggs than normal, and assessed female condition at an early stage of incubation by measuring body mass and several hematological parameters: hematocrit, plasma proteins, and triglycerides. Incubating females in coniferous habitat maintained better condition than those in deciduous habitat. Although female condition was independent of original clutch size, the manipulation caused a decrease in hematocrit and plasma albumin concentration with increasing clutch size. This study demonstrates how measurement of hematological parameters in birds at particular stages of the breeding cycle can shed light on the causes of spatial variation in breeding parameters.

Kim M, Nager RG, Furness R

Consequences of accelerated embryo development in the Lesser Black-backed Gull

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The last-hatched chicks in asynchronous broods usually have lower growth rate and higher mortality than their older siblings. In gull species, last-laid eggs have a smaller amount of albumen rather than yolk. Hormone and carotinoid content in last-laid eggs differ from other eggs. We focused on embryonic developmental rate of last-laid eggs. Accelerated embryo development may benefit the last-laid eggs in terms of reducing size and age differences with older siblings after hatching. We studied 1) whether the last-laid eggs can accelerate embryo development and 2) whether accelerated development has any costs. Laying interval between the second-laid eggs and last-laid eggs was manipulated by swapping freshly-laid eggs between clutches; in experimental nests, the last-laid egg was placed in the nest 4 days after the second egg was laid compare to 2 days in control nests. Last-hatched eggs were cross-fostered into other nests and their post-hatch development monitored to test for costs of accelerated embryo development. We recorded the onset of incubation by placing temperature loggers into the nest on the day the first egg was laid and estimated the timing of the initiation and the duration of the hatching process. Experimental last-laid eggs accelerated embryo development by 1.5 days compared to control eggs and had higher embryo mortality. These results show that embryo developmental rate has some plasticity and benefits, but might be costly to the hatchling. Observations on the onset of incubation and the hatching process will allow us to distinguish when the difference in the hatching intervals between experimental and control nests occurred.

Kipper S, Hultsch H

Individual song characteristics and hidden repertoires: A study on song type-knowledge of male Common Nightingales

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Male Common Nightingales (*Luscinia megarhynchos*) possess large song-type repertoires comprising some 180 different song-types. These songs are generally acquired as juveniles, but, from learning experiments conducted in the laboratory, we have evidence that birds can modify the composition of their repertoires in later years. Here we present data on repertoire composition and song-type use in a population of individually marked nightingales in Berlin, Germany. In this population we studied the repertoire characteristics of males over several years and investigated how songs are used in vocal interactions with neighboring individuals. The males had interacted before and often, and were thereby well exposed to knowledge of the song-type repertoires of their neighbors. Based on an analysis of individual repertoires, we conducted playback experiments to test whether territorial males differed in their responses to familiar song-types, such as those shared with neighbors, and to unsung song-types, such as those that neither they nor any neighbor sang, but which were nevertheless 'normal' song-types of nightingales. We found differences in the timing of vocal responses to the two playback categories. Nevertheless, even for locally unsung songs, we found cases of song-type matching, pointing to the existence of 'silent song-types' in free-living nightingales. In a second experiment, we tested whether nightingales discriminated between familiar song-types performed by a neighbor or a stranger, using the same response measures given above. The results suggest that repertoires performed in a given situation are only a subset of the song-types memorized by a bird. We discuss how vocal interactions among neighboring males may be crucial in shaping the song-knowledge of individuals.

Kirsch E, Heglund P

Species composition of spring-migrant songbirds in upland and floodplain forests along the upper Mississippi River, USA

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Floodplain forest on the upper Mississippi River, USA, and adjacent upland forests, form a habitat corridor for migrating forest birds in a part of the USA extensively cleared for agriculture. The corridor links southern wintering and northern breeding grounds for may neotropical and short-distance migrant songbirds. The floodplain and upland forests have fundamentally different floristic composition and edaphic conditions. Further, conservation and management challenges differ due to different effects from human activity on the respective habitats. In 2005 we began a study of spring songbird migration along the upper Mississippi. Surveys were conducted in random forest locations on both floodplain and uplands within 10 miles of the river; and two banding stations were established, one in each habitat. Results of area searches revealed differences between the habitats in species composition of spring migrants. Thus Rose-breasted Grosbeaks (*Pheucticus ludovicianus*) and Tennessee Warblers (*Vermivora peregrina*) were recorded more frequently in upland forest, and American Redstarts (*Setophaga ruticilla*), House Wrens (*Troglodytes aedon*), Great Crested Flycatchers (*Myiarchus crinitus*) and Song Sparrows (*Melospiza melodia*) more abundantly on the floodplain. Mist netting also reflected the partitioning. White-throated Sparrows (*Zonotrichia leucophrys*) and American Redstarts dominated at the floodplain site, whereas Rose-breasted Grosbeaks and Eastern Towhees (*Pipilo erythrophthalmus*) were netted almost exclusively on the upland site. We discuss implications for management of floodplain and upland forests for maintaining habitat for migrating songbirds.

Kissling WD[1], Rahbek C[2], Böhning-Gaese K[1]

Food resources as broad-scale determinants of avian frugivore richness

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Despite a century of debate about the primary determinants of broad-scale species richness patterns, the causal mechanisms behind the patterns still remain vague. Most recent work in macroecology claims that available energy generates and maintains species richness directly, with little evidence that biotic systems, such as plant-animal interactions and diversity and distribution of food resources, influence animal diversity at broad spatial scales. To tease out the issues, we used a geographic database for 1772 breeding birds in sub-Saharan Africa to investigate determinants of avian frugivore richness at a continental scale of 1° latitude-longitude quadrats (n = 1923). We demonstrate that, with increasing fruit specialization, frugivore richness correlates increasingly with richness patterns in figs (*Ficus* spp.), one of the major food resources for frugivores in the tropics. In contrast, apparent congruence with overall bird richness increasingly diminishes. Our results suggest that patterns of frugivore species richness at broad spatial scales are determined mainly by the diversity and distribution of food resources, and that commonly found correlations between animal richness patterns and energy-related variables do not adequately reflect the underlying mechanisms. This highlights the need for more cautious and careful analyses of factors determining species richness patterns at broad spatial scales.

Kiziroglu I

The importance of birds in biological control: A case study on Great Tits

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Turkey has a rich song bird fauna which could be used extensively in the biological control of harmful forest insects. This study found that 52.4% of Great Tit (*Parus major*) diet in Turkey comprises *Tortrix viridana* (13.1%), *Euprochtis chrysorrhea* (24.3%) and *Diprion pini* (15%), evidence of how song bird species consume of harmful forest insects and can function in biological control.

Kiziroglu I, Turan L

The diversity of woodpeckers in Turkey and their role in biological control

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A wide variety of birds occur in the natural forests and diverse plant communities of Turkey. Altogether, 450 different species have been recorded in the country, 8 of them woodpeckers. This study provides information on the geographical diversity of woodpeckers in Turkey, based on a three year study between 2002 and 2004. Grid mapping was the main tool used in recording and analysis. Our research also provides background information on the role of woodpeckers in the biological control of species of *Ips* and other harmful forest bugs that threaten old growth forest patches and aged trees.

Kloskowski J

Egg desertion in precocial birds: Matching brood size to food supply?

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In most birds, the number of offspring is constrained by available food. Brood reduction is even obligate in many species, the last-hatched chicks serving only as replacements for elder brood members that fail to hatch or die prematurely (insurance-egg hypothesis). Elimination of redundant offspring usually occurs in the post-hatching stage, but it may also happen from neglect of late eggs after partial hatching of the clutch. Egg abandonment has been reported anecdotally in those species that combine two prerequisites for this behavior: asynchronous hatching and dependence of young on parents for food. I experimentally increased the hatching interval between early and late eggs from 1-2 to 3-4 days in clutches of Red-necked Grebes (*Podiceps grisegena*) by exchanging eggs between clutches; the total period for incubation was not manipulated. Territories occupied by the experimental pairs were either good - stocked with small fry and abundant aquatic invertebrates and tadpoles - or bad - stocked with fish too large for grebes to eat. All pairs in 'good' territories incubated over the increased hatching interval, whereas a significant number of both experimental and unmanipulated 'control' pairs nesting on 'bad' ponds abandoned the nest before the last egg hatched. The results provide support for the insurance-egg and resource-tracking hypotheses. Desertion of late-laid eggs reduces the brood before substantial resources are invested in marginal offspring at the expense of inclusive fitness of all family members. Such a strategy, however, requires parental ability to assess optimal brood size relative to food availability when the first eggs hatch.

Koboroff A, Kaplan G

Predator inspection by birds

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Defence against predation is fundamental for survival, yet paradoxically, some animals approach rather than flee from predators. Approach can take several forms, one of which has been termed predator inspection, a behavior that has received little attention in avian species. Inspection involves closing the distance with a predator when lacking capacity for effective self-defence, raising the question: does such high-risk behavior have adaptive functions? To investigate the issue, two Australian species were chosen in which this behavior had been observed: the Australian Magpie (*Gymnorhina tibicen*) and the Zebra Finch (*Taeniopygia guttata*). The former is a ground-feeding territorial species living in small groups, and the latter, also a ground-feeder, is a mobile flocking nomad. A number of stimuli in the form of taxidermic/realistic models of predators were presented in the field to magpies and in the laboratory to Zebra Finches. Behavior scored included latency to inspect, duration of inspection events, distance kept from the predator, direction of approach, and the eye(s) used for inspection. Results so far show clear differences in the response of magpies to aerial and ground predators. During breeding, magpies consistently mobbed aerial predators but usually approached ground predators more quietly, perhaps inspecting them. They differed significantly in their approach and responsive vocalizations to different predators, and modified risk-taking according to the characteristics of predator models presented. The results for Zebra Finches also take into account sex, age and social position of the inspecting bird, and, together with those for Australian Magpies, will be discussed in the context of risk-taking, visual lateralization and anti-predator strategies.

Kohl I, Schulze CH

Habitat use by a local population of the Red-spotted Bluethroat in the Austrian Alps

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The Red-spotted Bluethroat (*Luscinia svecica svecica*) occurs throughout much of Siberia and Scandinavia. In the 1970s, a small breeding population was discovered in the western Austrian Alps at Hundsfeld Moor, followed by discoveries of several further smaller populations on other mountains in central Europe. These highly isolated populations appear to result from recent colonization. We analyzed patterns of habitat use by the bluethroat on Hundsfeld Moor as a contribution towards understanding its patchy distribution on a small geographical scale. The local population there is the largest in central Europe and varies between 16 and 21 breeding pairs per year. A comprehensive survey of the moor and its environs was conducted between May and August 2005. All territories were mapped, and detailed notes were taken on behavior and microhabitat use at all observation sites. Habitat parameters measured included vegetation characteristics, abundance of soil arthropods sampled by pitfalls, and the distribution and density of ant (Formicidae) colonies. The data gathered will contribute towards developing more effective strategies for protecting small populations of Red-spotted Bluethroats outside their main, continuous distributional range.

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The effect of ethanol odor and ethanol ingestion on food choice and food intake in the Yellow-vented Bulbul

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Although sugars in fruit provide energy for the numerous frugivores that disperse seeds, these carbohydrates also serve as a substrate for alcohol-producing fermentation by ubiquitous yeasts. Fermentation occurs as the fruit ripens, yielding a number of different alcohols among which ethanol is predominant (~80%). Frugivorous animals can potentially use ethanol vapor as a sensory indicator of resource location. Yet it is unlikely that passerine birds use ethanol as an olfactory cue for locating food, as they generally have a poor sense of smell. Therefore we hypothesized that the odor of ethanol is not a food-locating cue for them. Given the competition among frugivores and the ubiquitous association of ethanol with valuable nutritional resources, one possible correlate of ethanol ingestion may be to increase the rate of food intake. We hypothesized that food intake in passerine birds is influenced by ingestion of ethanol according to its concentration, and predicted that the intake would follow a bell-shaped curve from low to high ethanol concentration, with a maximum level at 0.1%-1.0%; under natural conditions, ripe fruit may contain 0.1%-1% ethanol. Accordingly, we examined the effect of odor and ingestion of ethanol on the feeding behavior of the frugivorous Yellow-vented Bulbul (*Pycnonotus xanthopygos*) in a series of feeding trials over a range of ethanol concentrations (0.01% - 3%). We found that food choice and food intake in this passerine was not affected by the odor of ethanol or its presence in food when the concentrations of ethanol were close to those found in naturally ripe fruit. Bulbuls decreased their intake when food contained 3% ethanol and we suggest that this drop results from natural selection against ingestion of fruit containing potentially intoxicating levels of ethanol.

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Extraordinary sexual differences in foraging niche in the Okinawa Woodpecker on a subtropical island

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There are various sexual differences in co-adapted morphology and foraging behavior in woodpeckers: males are often larger, have longer bills, and forage in larger trees and on thicker trunks and branches. Use of different types of food, however, is uncommon. The Okinawa Woodpecker (*Sapheopipo noguchii*), one of the rarest woodpeckers in the world and critically endangered, is confined today to mature subtropical evergreen forests in the north of the main island of Okinawa, Yambaru. Like many other woodpeckers, males are heavier than females and have longer bills. Both forage on dead or live trees and fallen logs on the ground, but, as we have found, differ in their pattern of resource utilization. Males commonly forage on the ground, searching out and eating soil-dwelling arthropods such as trap-door spiders and the larvae of cicadas. Females, however, almost never touch soil arthropods, in common with species of the woodpecker genus *Dendrocopos*. Although the Okinawa Woodpecker has usually been assigned to a monotypic genus (*Sapheopipo*), a recent molecular phylogenic study suggested that it is in fact a member of *Dendrocopos*, most closely related to the White-backed (*D. leucotos*) and Great Spotted (*D. major*) Woodpeckers. Yet the question remains: why is there such an extraordinary sexual difference in its foraging niches? A likely answer is that the niche in males evolved towards ground-feeding in response to warm, moist subtropical evergreen forest habitat, in which a high biomass of soil-dwelling arthropods was available. Moreover, pressure from ground predators on Yambaru has been historically low, because originally, the island was devoid of predatory animals.

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La Niña vs. El Niño: Differences in seabird abundance and utilisation of fishery waste in two fishing harbours in northern Chile between two different years

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Fishery waste, i.e. discard and offal, is a major food resource for seabirds in areas with extended fishing activities. We conducted seabird censuses and carried out so-called discard experiments in two fishing harbours in northern Chile in the summer 1999 (La Niña) and 2002 (El Niño) using fishery waste items regularly discharged by local fishermen. The study involved quantitative experiments with various kinds of fish and offal. The seabirds exploited discards with different success in the two harbours and between the two years. In 1999, the most abundant species in the fishing harbour in Coquimbo was the Kelp Gull (*Larus dominicanus*), followed by the Franklin´s Gull (*Larus pipixcan*). But nearly no Peruvian Pelicans (*Pelecanus thagus*) could be observed. The two gull species were also the most successful species in consuming both discarded fish and offal. In 2002, the situation was quite different in this harbour. The most abundant species was the Kelp Gull but the second most abundant species was the Peruvian Pelican. The most successful species in obtaining discards in the fishing harbour in Coquimbo was the Peruvian Pelican. Kelp Gulls almost never succeeded in obtaining discards in this harbour in 2002. In the small fishing harbour of

Guayacan, Kelp Gulls had the highest foraging success index closely followed by the Peruvian Pelican in 2002. Franklin´s Gull played only a minor role in both harbours in 2002. In this poster we examine the differences between the two years and present information on abundance, foraging success index and robbery index for each seabird species. Additionally, we evaluate oceanographic parameters to explain these substantial differences.

Kragten S

Nest success in Northern Lapwings on organic and conventional arable farms in The Netherlands

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Previous studies have shown that organic arable farming leads to higher territorial densities of ground-breeding farmland birds such as the Northern Lapwing (*Vanellus vanellus*). Higher densities of breeding territories, nevertheless, do not necessarily translate to higher reproductive rates. Nests and chicks can be lost either to farming activity or other factors such as predation. There are fundamental differences in practise between organic and conventional farming, such as mechanical weeding on organic farms and herbicide spraying on conventional farms. By destroying nets, mechanical weeding could depress breeding success in lapwings on organic farms and serve as an ecological sink for ground-breeding farmland birds. Accordingly, this study compared nesting success of Northern Lapwings on organic and conventional arable farms. Field surveys were carried out on 20 organic and 20 conventional arable farms in The Netherlands, where 136 lapwing nests were found: 88 (12.3/100ha) on organic farms and 48 (6.0/100 ha) on conventional farms. On organic farms, less than half of all nests hatched, lower than the percentage hatched on conventional farms. Farming activity was the main cause of nest loss on organic farms, but only affected a small number of nests on conventional farms. Predation rates were more or less equal on both types of farms. Future studies should show if chick survival rates are high enough on organic farms to avert their being categorized as ecological sinks for ground-nesting farmland birds.

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Nest predation in Mallards: The role of crypsis and parental behavior

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Crypsis is a mechanism used by many species to escape nest predation. Little effort has been made, however, to evaluate its role in the context of other anti-predation strategies. Towards elucidating their interaction, we analyzed separately the impact of parental activity (nest defense vs. nest disclosure), vegetation cover around the nest site, and crypsis (color of incubating female, concealment of eggs) on the nest success in Mallards (*Anas platyrhynchos*) under the watch from visually-oriented predators: Hooded Crows (*Corvus corone*) and Marsh Harriers (*Circus aeruginosus*). To filter out the effects of parental activity from crypsis, two artificial nests (ART) containing four chicken eggs each were ascribed to each active Mallard nest (AC), n = 58. The clutch of the first ART was covered by nest material taken from the paired active nest, and the second left uncovered. Two controls for each nest group were performed, after 6 and 12 days respectively. Covered ARTs survived better than uncovered ARTs, but worse than ACs. Moreover, the effectiveness of crypsis, measured as the time required to identify nest sites randomly located on photographs by volunteers, did not differ between clutches covered by incubating females or nest material, but was much lower for uncovered clutches. We interpret the difference in the success of ACs and covered ARTs to effective nest defense. That nest disclosure from parental activity has negative effects, however, has yet to be demonstrated. Concealment of the clutch by the brooding female or nest material thus reduces the risk of nest predation, and compensates effectively for the absence of cryptic markings on the eggshells of waterfowl.

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Patterns of behavior and adaptation in breeding Marsh and Montagu's Harriers in various landscapes in European Russia

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We are evaluating the adaptative capacities of ground-nesting birds of prey, their habitat needs and prospects for successful reproduction under growing anthropogenic pressure. For this, we have been studying the behavior of breeding Marsh (*Circus aeruginosus*) and Montagu's (*C. pygargus*) Harriers in the Tula, Kaluga, Ivanovo and Moscow regions of central Russia since 1998. Information is gathered by field observation, involving log-keeping, nest site mapping, describing and measuring biotopes, recording nest parameters, prey remnants, eggs and fledglings, and observing breeding pair behavior. We graded the nesting biotopes for the harriers according to the extent of landscape transformation, as well as the frequency and intensity of human presence. Most nests of Montagu's Harrier (85%) were found within the borders of human settlements, at a distance of 5-300 meters from the nearest occupied or abandoned hous or construction. Marsh Harriers nested further away. The balance of advantageous nesting factors for them is such that their breeding density is growing, and they are now nesting in extremely small patches of reed. We anticipate that human activities are having a significant impact on fundamental aspects of harrier behavior, affecting habitat and site selection. The main behavioral responses in harriers to the presence of humans along territory borders are seen in inflected acts of prey-passing, lack of vocal communication, reduction in flights over the nest, evident unrest and concealment.

Kriegs JO, Matzke A, Churakov G, Brosius J, Schmitz J

Retroposons as phylogenetic markers in bird genomes

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Transposable elements of the RNA-mediated class that propagate via a copy-paste mechanism constitute large portions of vertebrate genomes. The chicken genome includes about 200,000 such elements that belong to the CR-1 family of retroposons. Retroposons that have inserted into a genomic locus in an ancient founder taxon can be found at orthologous genomic positions in its decendants, compared to outgroups which lack the corresponding retroposon at this position. Such presence/absence patterns can be used as homoplasy-free phylogenetic markers in birds.

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Fluxes and flight altitudes of birds flying over the North Sea

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We measured fluxes, flight paths and flight altitudes of birds flying over the North Sea, 10 km off the coast of Noordwijk, Netherlands. To date, such flight patterns, especially of nocturnally active birds, are largely unknown. This is due mainly to the methodological difficulties of measuring flight patterns at sea, during day and night, for an extended period of time. We used a new technique involving automated registration of flight movements recorded by horizontal and vertical radar, developed and installed by DeTect Inc., FL, USA. This was combined with visual observation techniques such as panorama scans, fixed point counts, sound registration and moon watching. This allowed registration of birds 24 h per day, year round. The study, commissioned by RIKZ, was carried out in order to establish flight patterns under ‘natural’ conditions, to which effects can be evaluated of a wind farm that will be built off the Dutch coast at Egmond in 2006. Flight altitudes during daytime were mostly low, up to 100 m, reflecting altitudes of gulls (consituting ca. 90% of all birds at daytime), other seabirds, geese, swans, ducks, waders and diurnally migrating passerines. At night, flight altitudes were much higher, ranging from 150 m to 3 km, reflecting mostly migrant passerines and waders. Nocturnal fluxes off shore were in most months much lower than over land, also during autumn migration, when high fluxes occur along the coast due to leading line effects. Clutter from waves is a major issue in radar measurements at sea. The vertical radar worked well to establish flight altitudes and fluxes in the vertical plane, as clutter was limited to the lower 1.5 m. Clutter did form a problem in the horizontal radar, as it filled a large fraction of the horizontal plane especially when waves were high, and because echo characteristics of birds and of waves could not be distinguished successfully.

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The role of landscape context in body mass gain in songbirds during migratory stopover

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Many bird species need to gain considerable body mass at stopover sites prior to migratory flight, which is in turn related to local habitat conditions and food availability. Stopover migrants often congregate in large numbers at small sites, so competition for food may become an important factor. Such small sites may be isolated habitat patches within the landscape, but this context has been neglected in previous studies. Accordingly, we evaluated the influence of landscape context on habitat quality for stopover migrants, using data collected in the spring and autumn of 1994 and 1995, as part of the European Science Foundation Scientific Network “Western Palaearctic-African Songbird Migration”. More than 50 ringing sites participated, and data were sampled in a standardized format to facilitate comparative analyses. Gain in diurnal body mass calculated by regressing mass at first capture on hour of day was used as an estimate of the fuelling quality of stopover sites. The relative availability of suitable habitat within a 5 km radius around each trapping site was derived from Landsat TM satellite images. For most species, gain in diurnal body mass during autumn migration exhibited a positive logarithmic relationship with availability of surrounding suitable habitat. Migrants from sites with restricted habitat did not exhibit increasing body mass, but daily gain in body mass was considerable at sites with extensive habitat cover. During spring migration, however, this relationship was absent, suggesting that habitat cover and probably densities are not the main limiting factors at that time. Our data indicate that habitat availability around stopover sites has a pronounced effect on body mass gain; and therefore, body mass gain at a particular site cannot be evaluated properly without considering landscape context.

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Functional traits determine predator avoidance behavior in corvids in urban areas: Visual and motor abilities and limitations

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We describe and predict niche differentiation in corvids in urban habitats based on a systematic and theoretical consideration of their functional traits. Our survey of their functional traits integrates not only on ecomorphology but also physiology and behavior. These functional traits explain sensory and motoric abilities and limitations which then determine the selection of habitat. The relationship between functional traits in corvids and characteristics of habitat will be analyzed using the formal concept analysis, a method of discrete mathematics based upon the lattice theory. In particular, we address the questions: what functional traits determine habitat selection by corvids in urban areas, and which functional traits favour settlement in new environments? First results are presented on the selection of specific habitat by corvids that results from predator avoidance behavior during nesting and foraging. Predator avoidance behavior is explained by sensory abilities and limitations in detecting predators, and is thus determined by visual sensitivity, visual resolution and visual fields. A second factor for corvids lies in their motor abilities and limitations in escaping from predators, as determined by their hindlimb and wingshape morphology and thus by their take-off and flight capabilities.

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A primitive and specialized avian brain from the late Cretaceous of Russia

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A small avian brain endocast (20.6 mm long and 13.6 mm wide) has been found in middle Cenomanian (c. 93 mya) deposits in the province of Volgograd, Russia, along with small fragments of the skull. It is the first-found near-complete fossil avian brain of Cretaceous age. The endocast was formed by calcium-silicon-phosphoric fossilisation replacing the soft brain tissue. CT-scanning using 1022 X-ray sections allowed inspection of the interior of the brain and the differentiation of brain tissue from skull structure. The brain shape is tropibasal, in the characteristic form for birds. Cerebral hemispheres are large, but their surfaces are devoid of sulci, except for a shallow interhemispheric fissure. Rostrally, the telencephalon consists of long, thick olfactory tracts terminating in olfactory lobes, indicative of well-developed smell. The epiphysis and pineal gland are well developed. Auditory tubercles are prominent on the tectum of the mesencephalon. Optic tubercles underlie auditory tubercles, located caudoventrally from the hemispheres. The size and shape of these tubercles indicate well-advanced hearing and sight. A complete cerebellum is not preserved, but its vestiges indicate it to have been relatively small and extended dorsoventrally. Compared with brain/body ratios in modern birds, the body weight of the new fossil bird is estimated at around c. 40 g. Its brain differs from brains of recent birds in lacking an advanced neostriatum and in the morphology of the mesencephalon, resembling those of *Archaeopteryx* and *Ichthyornis*, except for highly advanced hemispheres, olfactory lobes and tectum of the mesencephalon. Considering its advanced characters in comparison with *Archaeopteryx* and its primitive features in comparison with the brains of ornithurine birds, we suggest that this fossil bird was related to the Enantiornithes. Such a distinctive brain structure has no parallel in modern avian groups and reveals yet more unique diversity in Mesozoic birds.

Kurosawa R

Foraging specialization in birds in early successional habitats

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Bird species diversity has been well studied in forest habitat, and is known to increase with foliage structural diversity. The mechanism of species coexistence, as expressed in niche partitioning, is presumably best demonstrated where resources are limiting. In this context, foraging behavior was studied in three stages of early vegetational succession - bare land, grassland and shrubland - to test a hypothesis that species would coexist in resource-limited habitats by fine partitioning of their foraging niches. The following variables were recorded for 19 bird species: microhabitat (part of vegetation), substrate (foraging surface), search mode (fly, walk, perch, pounce, etc), acquisition mode (glean, engulf, lunge, sally, etc), manipulation mode (bite, extract, flick, etc), and availability status of prey (flying, hopping, sedentary, etc). Outlying Mean Index analyses of each variable revealed foraging specialization in all species observed. Rate of specialization was highest in grassland species for most variables: 91.7%. Bare land and shrubland species, on the other hand, were less specialized: 45.8% and 73.3%, respectively. The greatest degree of specialization was found in the acquisition mode (18/19 species), followed by the search mode (16 species). All species were specialized least in prey taken (status), probably because almost all fed on arthropods in varing degrees. The data suggested that bird species in grassland communities coexist by fine partitioning of their foraging niches. Different mechanisms, neverthelss, are expected to operate in other habitats, such as foraging generalization in bare land and spacial partitioning in shrubland communities.

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Female traits and diet effects on reproductive performance in captive Greater Rheas

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The effects of age, weight and diet on the reproductive success of female Greater Rheas (*Rhea americana*) was investigated as part of a project on rhea conservation and sustainable use. Over three breeding seasons between 2001 and 2004, eggs from 15 number-tagged females of 18, 24 and >36 months of age were identified. Laying date, and weight, length, width and volume of each egg were measured, and up to nine eggs from each female were randomly selected for analyzing the specific weight and proportions of yolk, albumen and shell, protein and lipid contents, and fatty acid composition. The remaining the eggs (n=180) were artificially incubated and monitored until hatching. Females of higher weight started ovipositing early and laid more eggs, which were bigger and heavier than those from females of lower weight. The latter, nevertheless, produced eggs with a greater percentage of yolk and lipids, which had higher hatchability. No differences were found between light and heavy females with respect to survival of chicks produced. Diet, regardless of the weight and age of the females, produced variations in almost all the egg traits and reproductive parameters. Changes in hatchability produced by diet, in particular, were inversely correlated with chick survival. Age of females had an influence on specific weight and percentage of albumen and arachidonic acid only, but not on hatchability or chick survival. Among the variables analysed, weight and diet were the determinants of female reproductive success.

Lading ND, Thompson CF

Why don't birds lay more eggs? An investigation of the costs of reproduction in the House Wren

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Brood-enlargement experiments have shown that many species of altricial birds are capable of producing more high-quality offspring per nesting attempt than they usually do. This contradicts the prediction of Lack's hypothesis that the most frequent clutch size in a population should be the one that produces the most fledglings. Such results have shifted the focus to the costs of egg production and trade-offs between increased reproductive effort and future reproductive success and mortality, possibly mediated by reductions in adult immunocompetence. We induced female House Wrens (*Troglodytes aedo*) in central Illinois, USA, to lay supernormal first-brood clutches of 9-10 eggs; the modal clutch size for the first brood of this population is 7 eggs. Females laying more eggs produced more offspring in the first brood, and second-brood production was not affected by the manipulation. Females nevertheless may have suffered lower overwinter survival, as measured by return rates. These results are in accord with the hypothesis that increased investment in current reproduction may reduce future survival and, thus, may affect lifetime reproductive success, an accurate estimator of fitness. We are continuing experiments that focus on the underlying mechanistic basis for this putative trade-off between increased reproductive effort and subsequent adult survival.

Lebedeva N

Birds as factor in the biodiversity and biogeography of soil microfauna in Arctic and Antarctic regions

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It has now been found that oribatid mites and other non-parasitic soil micro-arthropods occur regularly in the plumage of birds of different taxonomic and ecological groups. About 5000 birds of 180 species from Palearctic, Arctic and Antarctic regions were investigated between 1998 and 2005, and more than 190 species oribatid mites (Acariformes, Oribatei) and other soil micro-arthropods at different life-cycle stages were recovered from their plumage. For the first time, proof has been found that bird plumage is a basic substrate for these micro-arthropods, not only for living but also reproduction. The discovery has been generated by patterns of biogeographic distribution in soil micro-arthropods which could otherwise not have been explained easily due to geographical barriers. Transport by birds appears to be the primary means by which the organisms have been carried around the arctic, to islands and to oases in deserts. From 2000 to 2005, I undertook research in Arctic regions to investigate the process of transfer by waterfowl and shorebirds (Anseriformes, Charadriiformes), finding that the micro-arthropods got into the soils of polar zones from plumage and nests. Examination of ornithogenic soils at breeding colonies enabled me to complete an inventory of the oribatid mite faunas of the Russian sector of the Arctic and Spitsbergen. Living soil micro-arthropods have also been found on Antarctic birds, including the Emperor Penguin (*Aptenodytes forsteri*) which has no contact with soil on land. Because birds are biomarkers for the geographical populations of the micro-arthropods and their tracks of dispersal, the Antarctic material is of particular biogeographic interest. Research supported by the Russian Fund of Basic researches (No 01-0564557, 03-05-64184, 04-04-48343, 04-05-79083).

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Why do Black Grouse females not mate multiply?

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In both monogamous and polygamous bird species, females usually mate several times with each breeding attempt. However in Black Grouse (*Tetrao tetrix*), a lekking species in which sexual selection is particularly strong, females typically mate only once with one male. This behavior could be explained by the potential costs of mating multiply, but preliminary results suggest that the prevalence of some sexually transmitted diseases (*Salmonella* spp. and *Candida* spp.) is low. Moreover, predation risk on the leks is also very low. Possibly, the advantages of mating multiply are small in Black Grouse. Fertility does not seem to be a problem, since all the eggs of almost 200 clutches were fertilized. This suggests that females can ascertain the sperm transfer and fertility of the male. A large scale study using microsatellite markers revealed that females mate mostly with unrelated lekking males. Mating between relatives does occur, but as frequent as expected from random mating. Therefore, female-biased dispersal is the more likely mechanism for inbreeding avoidance. Females usually choose one of the males that have performed well on the lek over several years. Therefore, intense male-male competition probably helps the female to assess male quality. If there is little variation among high quality males exhibiting traits preferred by females, then the genetic quality of these males may be similar. Thus, it may not pay for females to mate multiply as long as they avoid males of lower quality (yearlings and less ornamented adults).

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Foraging behavior and food resources of Black-faced Spoonbills wintering in Korea

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We recorded the foraging behavior of the endangered Black-faced Spoonbill (*Platalea minor*) and sampled potential food resources during the wintering seasons of 2002/2003 and 2003/2004 to gain information on its foraging ecology in two different environments in Jeju province, Korea. A total of 15 prey items from six classes were recognized as potential food resources, and six prey items from 3 classes (fish, crabs, and insects) were confirmed by observation. Main food resources differed according to foraging site: spoonbills fed on shrimps and amphipods in the turbid waters of abandoned fish-farms, but also took fish in the clear waters of coastal areas; total prey biomass per unit area did not differ between the two environments. Foraging efficiency and success rate were higher on abandoned fish-farms, and were also higher in shallow waters with the depth of <15cm. According to previous studies, the Black-faced

Spoonbill feeds in turbid water with depths of 10-20cm, where fishes are primary prey. Our observations show, nevertheless, that spoonbills also feed in waters that are clear and shallower, and take shrimp and amphipods actively and efficiently with considerable success when the food items are small but abundant. Black-faced Spoonbills are thus not only tactile feeders in waters of moderate depth but also visual predators in clearer shallow waters.

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Is mulching a suitable method for improving the nesting habitat of the Northern Lapwing?

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The Diepholzer Moorniederung in northwest Germany comprises drained and cultivated bogs which are today being restored. In protected areas, pastures have been abandoned, leading to higher vegetation that reduces their suitability as nesting habitat for the Northern Lapwing (*Vanellus vanellus*). Accordingly, we explored whether winter mulching - cutting and leaving the shredded vegetation *in situ* - could improve the pastures for lapwing nesting. In the winters of 2002/03 and 2003/04, five nature reserves covering 100.6 ha in the study area were mulched. In the breeding seasons 2003 and 2004, we mapped the distribution and abundance of nesting lapwings in both mulched and control areas and recorded habitat parameters such as vegetation height and density, surface water, and soil moisture to assess lapwing habitat preference. Vegetation in mulched areas was significantly shorter and less dense during April and May. During the pre-breeding phase, lapwings showed a preference for areas with short vegetation, high percentage of surface water and high soil moisture, but there was no significant difference in the density of lapwings between mulched and control areas. For the selection of nest sites, however, lapwings did prefer mulched sites over control areas, and we found more nests in mulched than control areas. Lapwings preferred nest sites with a high density of litter, high percentage of temporary surface water and high soil moisture. We therefore conclude that mulched areas provide suitable nest sites, presumably due to the presence of litter and the delay in vegetative regeneration caused by it. Mulching of abandoned pastures in winter thus appears to be a suitable management tool for improving lapwing nesting habitat.

Lei F-M, Gao X-B, Yin Z-H, Jia C-X, Sun Y-H

Avian influenza virus in China: A serological and virological survey of wild birds in the HPAI-virus infected regions

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A field survey of wild birds in the 2004 AIV-infected region was conducted from March to June 2004. 776 individuals of 93 species from 25 infected sites in 9 provinces were collected, representing 14 orders, 29 families, and 63 genera. Of the species, 47 are residents and 46 migrants. Among the migrants, 31 (67.4%) are long-distance migrants that breed as far north as north China, and the remaining 15 are either local south China species that shift partially to north China to breed, or species that breed, winter or migrate in south China. Concerning occurrence and abundance in the different infected areas, the Tree Sparrow (*Passer montanus*), Chinese Bulbul (*Pycnonotus sinensis*), Azure-winged Magpie (*Cyanopica cyana*) and Eurasian Blackbird (*Turdus merula*) were widespread and common in all terrestrial habitats, while the Little Grebe (*Podiceps ruficollis*), Common Kingfisher (*Alcedo atthis*) and Spot-billed Duck (*Anas poecilorhyncha*) were common in all wetlands. H5N1 AIV was isolated from some of these species in the wild.

Lein MR[1], Haines VA[2]

Evolution of song in the flycatcher genus *Empidonax* (Tyrannidae)

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New World flycatchers of the genus *Empidonax* comprise 15 species that are notorious for their morphological similarity. The genus contains several pairs of sibling species that were recognized only recently, and which are extremely difficult to distinguish, even with specimens in hand. All forms, however, are readily separable on the basis of differences in song and other vocalizations. Like most suboscine birds (suborder Tyranni), *Empidonax* flycatchers have songs that are rather simple in comparison to those of most oscinine birds (suborder Passeri). Moreover, current evidence suggests that these birds do not require learning or tutoring for normal development of song, in marked contrast to oscinine passerines in which some form of song learning seems universal. The recent availability of a well-resolved phylogeny by Johnson and Cicero for all species in the genus, based on sequencing of mitochondrial DNA, provides an opportunity to examine song evolution in this group. We used recordings of songs of 12 of the 15 species to examine patterns of change in song repertoire size, song syllable morphology, and song syntax in relation to the molecular phylogeny. We demonstrate that some song characteristics have been gained or lost repeatedly during the history of the group. This finding is perhaps surprising in view of the assumption that "innate" songs should be less labile over evolutionary time than "learned" songs as found in oscinine passerines.

Leitao P[1], Osborne P[1], Moreira F[2]

The use of large-scale remote sensing and map data to determine steppe landbird distributions in Baixo Alentejo, Portugal

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The cereal pseudo-steppes of Iberia, resulting from a rotating low intensity farming system, maintain significant numbers of several threatened steppe landbird species, such as the Great Bustard (*Otis tarda*), Little Bustard (*Tetrax tetrax*) and Calandra Lark

(*Melanocorypha calandra*). Loss and degradation of habitat related to recent land use practises, such as agricultural intensification, have resulted in a general decline in the populations of these species and a contraction in their distribution. GIS-based Habitat Suitability Index models were used to determine the potential distribution of five critical species in the Baixo Alentejo region: Great Bustard, Little Bustard, Calandra Lark, Montagu's Harrier (*Circus pygargus*) and Stone Curlew (*Burhinus oedicnemus*). For this purpose, presence and absence data was collected for all five species and combined with AVHRR satellite imagery data, a Digital Elevation Model, and road, river and town map data in a GIS matrix. As a result, habitat-based distribution modeling techniques can now be used for monitoring changes in the distribution of these species and their habitats.

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Sex, age and survival differences between adjacent functional units of tropical wintering habitat in a flocking long-distance migrant shorebird

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What happens to a bird in one season at one site may affect its state and behavior in subsequent seasons and at distant sites. At the individual level, such carry-over effects are very hard to establish, simply because individuals are difficult to follow throughout the year, and measuring the environmental conditions an individual experiences in the wild is all but simple. Recent studies on American Redstarts (*Setophaga ruticilla*) and Black-tailed Godwits (*Limosa limosa*) have suggested that birds from low-quality wintering habitats perform relatively poorly during the subsequent breeding season due to their suboptimal reproductive timing and/or the use of suboptimal breeding habitats. In the major wintering area of the Afro-Siberian Red Knot (*Calidris canutus canutus*), the Banc d'Arguin, Mauritaniawe, we found that birds differing in age, sex and molt characteristics seemed to segregate into different areas (high tide roosts with connected intertidal foraging habitats, i.e. "functional unit") which were only a few kilometres apart. In each of the four study years, one wintering area contained a greater proportion of juveniles and males. Additionally, making a few untested but reasonable assumptions, the annual survival of adults in the area with more juveniles and more males was 20% lower than in the other area. This suggests that these two adjoining areas are of different quality. We are surprised that in a flocking species without documented dominance hierarchies, this difference was upheld. The contrast between the two apparently similar areas may enable us to evaluate seasonal carry-over effects of differences in the quality of wintering habitats that may lead to survival differences. We are now in the process of developing tags that will enable us to find out how differences in wintering habitat quality influences other stages of the annual cycle, especially during northward and southward migration.

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Utilizing single nucleotide polymorphism and mitochondrial DNA to monitor genetic introgression between Melodious and Taiwan Laughing-thrushes

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Admired for their rich songs, Melodious Laughing-thrushes (*Garrulax canorus*) have been introduced in large numbers to Taiwan since the 1970s. Since then, occasional individuals of the Taiwan Laughing-thrush (*G. taewanus*) have been observed with *canorus*-like plumage. Because there is no behavioral evidence for hybridization, we adopted a genetic method to detect it, using a set of interspecific single nucleotide polymorphic (SNP) loci from both nuclear and mitochondrial genomes. From one of each of nine unlinked anonymous nuclear fragments, we chose 9 interspecific SNP loci to genotype 58 Taiwan Laughing-thrushes and 10-15 Melodious Laughing-thrushes collected over the entire range of the species in southeast China, Laos and Vietnam. We found that eight individuals of Taiwan Laughing-thrushes (14% of samples examined) were either F_2 or backcross progeny between the two forms, indicating that reproductive isolation between them might not be complete. Moreover, mitochondrial SNP sites indicated that the Haldane's rule might not hold either: three introgressed individuals carried Melodious Laughing-thrush mitochondrial genotypes. Our data imply that hybridization between the two laughing-thrushes may result, from the aspect of conservation, in a worst-case scenario: the formation of a natural hybrid swarm leading to the genetic extinction of an island endemic. Thus, for formulating an appropriate conservation plan for the Taiwan Laughing-thrush, monitoring of the temporal and spatial dynamics of its introgression with the Melodious Laughing-thrush is urgently needed.

Licheri D, Benciolini G

From old-style interactive datasets on the Euring domain to an ontology-driven open hypermedia

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The Euring community collects an impressive body of data about marked animals to address queries connected directly with the biology of populations and individuals. Further knowledge is needed as well to specify and constrain the values of the complex biological data stored in its national and sub-national federated databases. Starting from the 1960s, a standard coding system was introduced to set accepted rules for digitizing the information that flows through well-established sharing channels between ringing centers and the Euring databank. This Euring exchange code lives on today in three different, fixed ASCII text formats, two of which, released in 1966 and 1979, are old vintage indeed. Our first aim has been to solve the opacity of conversions between different schema structures of the code, modeling an ontology-based representation that will be able to achieve inter-operability despite clashes between local data versions while, at the same time, maintaining the differences. Moreover, the EURING codes and their updated releases are now available only as textual description on a fixed-length string. In order to provide a more flexible tool, we are modeling the ontology with

RDF/RDFS/OWL dialects of XML-based standards for describing resources, vocabularies, hierarchies and relationships that characterize domains of knowledge. This semantic annotation enables (1) easy modifications in the restructuring of metadata, (2) linkages to the information stored in the federated databases, and (3) machines to make logical connections and take autonomous decisions about formally explicit relationships between distributed data resources. The resulting ontology-driven open hypermedia is available on the EPE website: http://www.infs-epe.it.

Lilja C, Blom J

Developmental origins of anatomical requirements for begging behavior

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Comparative studies of embryonic development in birds with different modes of development are rare. One recent study nevertheless shows that selection for late ontogenetic characteristics, such as the size of the brain, eyes, organs of locomotion and digestion, which characterize the neonates of precocial and altricial birds, is established at early embryonic stages. In addition to these findings, we here present results suggesting that yet another neonatal characteristic - the anatomical requirements for extensive begging behavior - may be established at early embryonic stages. Using embryos of the precocial Common Quail (*Coturnix coturnix*) and the altricial Fieldfare (*Turdus pilaris*), we compared the development of the vicheral arches and the cervical somites by combining scanning electron microscopy with classical staging techniques that use, as well as morphological measurements, developmental landmarks to categorize embryonic maturity. We found that the mandibular process of the first arch and the cervical somites were relatively larger in the Fieldfare than the quail, in contrast to the maxillary process which was larger in the quail. This is of particular interest because arch and somites contribute to muscle and bone formation in the feeding apparatus and neck, respectively. Such different patterns of development illustrate different functional demands, consistent with establishment of the anatomical requirements for extensive begging behavior at early embryonic stages.

Limmer B, Becker PH

The influence of parental experience and age on brood care, foraging efficiency and chick growth rate in Common Terns

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The breeding cycle is a period of high energetic demand; and reproductive effort has been shown to increase with parental age and experience in several species. Two hypotheses have been proposed to explain these increases: either a decrease in residual reproductive value (the 'restraint hypothesis' or 'residual reproductive value hypothesis'), or improvement in skills ('constraint hypothesis'). From 2001 to 2004, we studied individual variation in parental care in Common Terns (*Sterna hirundo*) in a colony at Wilhelmshaven on the German Wadden Sea coast, comparing food quality, foraging effort, foraging success, feeding rate and nestling growth rate between first-time and experienced breeders of known sex. Transponders identified individuals throughout the breeding season, and in successive years, through a system of special antennas. We were thus able to obtain longtitudinal data from some individuals. From related observations, we also investigated whether older males and females were more successful in feeding young. Our data show that there is an individual increase in food quality and quantity between first-time breeders (recruits) and experienced breeders: experienced breeders brood more intensively, catch larger fish of higher energy content, and fledge more chicks with higher growth rates and fledging mass than recruits. We assume that with increasing experience and skill, birds are able to forage more efficiently and thus to cope better with the physiological constraints of reproduction. Supported by the Deutsche Forschungsgemeinschaft BE 916/5.

Loneux M

Global climate warming and decline of the Black Grouse in western Europe: Are predictions reliable?

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For two or three decades until 2000, the population dynamics of the Black Grouse (*Tetrao tetrix*) from six different breeding areas in Germany, The Netherlands, Belgium, and Great Britain was modeled by the same method using climatic parameters only. These gave significant results that made sound biological sense. The climatic factors were mean minimal temperature and total rainfall for crucial monthly, or three and four week periods, in the Black Grouse life cycle: winter, incubation and brooding, chick rearing, and autumn. This contribution will analyze model data for several of the breeding populations for a few years more, improving the quality of the modeling through a longer time-period of analysis, and the quality of the explanative variables by shortening the crucial periods so that they do not overlap. Concordant results will be discussed in relation to global climate change detected by variables in the modeling and in relation to other factors affecting population fluctuations. Continuous spring census data on Black Grouse extending back to 1967 are used.

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Why hummingbirds require little protein

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Maintenance of protein balance depends on both organism requirements and the chemical composition of ingested food. Hummingbirds are specialized for feeding on floral nectar, which is rich in energy but extremely low in protein. Several studies indicate that nectar-feeding birds have low nitrogen requirements and are adapted to low protein diets. Here we present new data, and review the patterns of nitrogen requirement in nectarivorous species and the proximal and ultimate factors that explain it. We measured minimal nitrogen requirement (MNR) and total endogenous nitrogen loss (TENL) in four hummingbird species: Oasis Hummingbird (*Rodophys vesper*) at 4.5 g, Green-backed Firecrown (*Sephanoides sephaniodes*) at 6.0 g, Andean Hillstar (*Oreotrochilus estella*) at 7.0 g, and Giant Hummingbird (*Patagona gigas*) at c. 20 g, the largest hummingbird in the family. MNR values were 1.08 mg N/day for the Oasis Hummingbird, 1.42 mg N/day for the Green-backed Firecrown, 1.81 mg N/day for the Andean Hillstar, and 4.71 mg N/day for the Giant Hummingbird. Using literature and our results, we compared MNR values among hummingbirds, other nectarivores and other non-nectarivores. All nectarivores had lower values for MNR than expected allometrically for birds of their size, a disparity probably explained by their dilute, non-abrasive watery diet. MNR values, however, were even lower in hummingbirds than in other nectarivores, revealing that hummingbirds have barely 20% of the nitrogen requirements expected for their body size. We discuss whether this is due to metabolic adaptation minimizing nitrogen loss, or to post-renal modification of the urinary tract in the lower intestine.

López-Victoria M[1], Estela F[2], Wolters V[1]

Threatened birds on Malpelo Island, Colombia: Relevance of criteria at global and regional scales

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A national program for categorizing threatened species according to IUCN criteria has been operating in Colombia, South America, since 1996. A Colombian Red List is now available, in which 112 species of Colombian birds - 6% of the bird fauna - are identified as endangered. Three of the species occur on Malpelo, an oceanic island in the east Pacific some 500 km off the coast. Based on our observations, at least four additional species on the island should be added to the Colombian list when IUCN criteria are applied rigorously at regional level: Brown Noddy (*Anous stolidus*) - category VU D2, Black Noddy (*A. minutus*) - VU D1, White Noddy (*Gygis alba*) - VU D1, and Sooty Shearwater (*Puffinus griseus*) - NT. Globally, however, only one of the seven susceptible species on Malpelo could be considered threatened, as the rest have world-wide or pan-Pacific distributions. Such issues of variable status at different spatial scales create serious problems for local authorities, as decision-making for conservation management that is not backed up by both national and international criteria comes up against an impasse: "too much to do, with very few resources". Our investigations on the breeding ecology, foraging behavior and distributional ranges of birds breeding on Malpelo therefore lead us to recommend a number of priority actions at the community level, such as direct control of anthropogenic impacts, invasive species, and interactions with fisheries, which can be implemented independently of threats at other temporal and spatial scales.

Losekoot M

Leach's Storm Petrel does not require vocalizations for nest relocation

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Leach's Storm Petrel (*Oceanodroma leucorhoa*) spends most of its life far out at sea, coming to land only once a year to breed. It nests in colonies on remote islands, and is active only at night. Because of nesting in underground burrows, nesting behavior is difficult to observe and many basic questions remain unanswered. During incubation, parents incubate the egg in turn for several days at a time. When a partner returns from a foraging trip, it is somehow able to locate its burrow. As birds respond to recordings of conspecific calls played outside the nest, it has commonly been assumed that partners rely to some degree on vocalizations from their mates to find the nest. Other evidence suggests that olfactory cues play a role. In this preliminary study, I explored vocalizations as cues for finding the nest. I recorded behavior inside a burrow during the incubation period using a miniature surveillance camera fitted with infra-red illumination and a microphone. A total of four changeovers were observed over 15 sequential nights. On three of the four occasions, the changeovers started in total silence; no vocalizations were emitted by the incubating bird before the returning bird entered the nest. Vocalizations instead commenced once birds were together in the nest and engaged in mutual grooming. Incubating birds also vocalized alone in the nest on nights when no changeovers occurred. On two occasions, incubating birds emitted a screech following a call produced outside the burrow; but no bird entered the burrow in response. These initial results indicate that mate vocalizations are not required to guide storm petrels to their burrows, and suggest that other cues are involved. Supported by NSF IBN-0212467.

Louchart A[1], Stidham T[2]

African birds: A historical perspective in the light of the Tertiary fossil record

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Since the last review of the African Cenozoic (Tertiary) record of fossil birds thirty years ago, a wealth of new data have emerged from the discovery of new localities, new fossils, and new interpretations, all shedding increasing light on the history of the African avifauna. Much of the finds are from the Late Miocene and Pliocene, but significant new material has come from the Paleocene Epoch as well. Using the new fossils, we compare the records of various clades with those in the European Cenozoic record through time, and with the avifauna of Africa and Eurasia of today. Africa has experienced intervals of avifaunal change and extinction that do not appear to coincide with shifts recorded outside. After possible biases from preservation are accounted for, the comparisons provide broad but useful information on original differences in the composition of avifaunas across Africa, and data for qualitative interpretation of biogeographical links between Africa and other regions. The fossil data are also important in elucidating Afrotropical (Ethiopian) endemism in birds through time, and demonstrate that the traditional use of endemism for defining biogeographical regions has had a constraining effect and needs to be replaced by a more dynamic model. New questions regarding the evolution and extinction of some groups are opened. The Cenozoic record of birds in Africa is indispensible to understanding the evolution and historical biogeography of birds not only in Africa but also Eurasia, because African avifaunal composition has been so historically labile: many groups currently endemic to Africa have fossil records outside in Eurasia (e.g., Coliiformes), and many groups absent from Africa today still have fossil records there (e.g., swans and pheasants).

Louette M, Meirte D, Mergen P

The African bird data at the Royal Museum for Central Africa in the era of biodiversity informatics

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The Royal Museum for Central Africa (RMCA) holds about 150,000 historical bird specimens, mainly from DR Congo, Rwanda and Burundi and also keeps datasets of observations, notably from the Comoro islands. It contributes actively to biodiversity information projects, and data from certain collections were among the first Belgian data presented to the Global Biodiversity Information Facility network. RMCA is also the leading partner in feasibility studies funded by the European Network of Biodiversity Information Facility, which include, for birds, the Albertine Rift databases. It is associated with the activities of the Consortium of European Taxonomic Facilities as well, and an active collaborator in the Belgian Generalized Natural Sciences Online and Spatial Information System project, based, among other things, on a decentralized solution and open GIS standards. We present some of our activities in the field of biodiversity informatics for bird data, among which are projects on the altitudinal occurrence of Albertine Rift Endemics (in collaboration with Marc Herremans), the Congo Peacock distribution (in collaboration with Emile Mulotwa and Townsend Peterson), and the Comoro Endemic Bird Atlas (in collaboration with Jan Stevens, Yahaya Ibrahim and Hamidou Ali). These examples demonstrate the importance of geo-referenced data based on well-documented historical collections and reliable field observations. Applied quality checks and quality improvement strategies are incorporated as essential for use of these data in study and conservation.

Lovette I

The power of complete phylogenies: Evolutionary inferences from a comprehensive species phylogeny for the wood-warblers (Parulidae)

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The wood-warbler family Parulidae includes more than 100 species of small songbirds that have diversified throughout much of North, Central, and South America and the West Indies. This group is particularly well-known from its use as a model for classic studies in community ecology, acoustic behavior, and foraging niche differentiation. By sequencing >6kb of mtDNA and >5kb of nuclear introns from almost all species, and shorter DNA fragments from the remaining species-level taxa and representatives of most geographic populations, I have assembled an unusually well supported and phylogenetically comprehensive picture of diversification in this New World family. The results suggest that traditional parulid genera are not a reliable guide to phylogenetic relationships, and I identify a number of evolutionary affinities that are not reflected in current taxonomy. I also add to the phylogenetic information by exploring the temporal pattern of radiation in the Parulidae, testing hypotheses for the geographic patterns associated with speciation and subsequent divergence, and comparing how different morphological and behavioral characters have changed during the history of this group.

Luna-Jorquera G[1], Cortés M[1], Garthe S[2]

Hypometabolism in a seabird: The case of the Peruvian Diving Petrel

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Nesting in burrows or rock crevices is considered a strategy to escape predators and to protect against extreme climatic conditions. There are, however, constraints: air exchange can be limited, oxygen low and CO_2 concentrations high. Most petrels and shearwaters nest in burrows or cavities with limited air exchange, yet little is known about the mechanisms that they use for tolerating hypoxia and hypercapnia. Here we examined metabolism, body temperature and thermoregulatory response to changing air temperature in Peruvian Diving Petrels (*Pelecanoides garnotii*) in natural and artificial nests. The structure and variation of the internal temperature of the nests was also analyzed in relation to climatic variables. This diving petrel is endemic to the Humboldt Current, yet, in spite of its critical conservation status, little is known about its basic biology. The birds excavate their nests in mainly soft soils, digging extensive burrows up to 130cm long and 30cm deep. Temperature in natural nests remains stable throughout the day, with a mean value of 24ºC; fluctuations in external temperature do not affect it significantly. Basal metabolic rate in the petrels at air temperatures of 10-20ºC in natural burrow nests was 228.5mLO2/h, and increased to 277.9mLO2/h at 25-30ºC. Metabolic rate in artificial nests at 24ºC was 138.6±33.72mLO2/h, and body temperature remained around 37.3±0.78ºC. These results suggest an adaptative response to burrow nesting. The reduction of basal metabolism and body temperature may help to diminish the risk of blood acidification, as well as overheating due to an increase in thermal conductance.

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The Danish Bird Migration Atlas

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The Danish Bird Migration Atlas, presenting the results of 100 years of Danish bird ringing, will be published in the spring of 2006. The Atlas is based on all recoveries of birds either ringed or recovered in Denmark. About 250 bird species have been ringed Denmark and the presentations and analyzes, including many figures, of each species are the backbone of the book. With the Danish Bird Migration Atlas, all Danish data are presented in one publication for the first time, including data collected by H.C.C. Mortensen from Viborg, the founder of scientific bird ringing. Included are more than 180,000 recoveries of birds ringed in Denmark and more than 62,000 recoveries of birds ringed abroad and recovered in Denmark. With the Atlas we have a great opportunity to look at the current results to make sure that also in the future we will have the best available data to describe and manage nature responsibly. The Atlas is written in Danish with English summaries of species accounts and English subtitles to tables, figures and maps.

Maggini I, Bairlein F

Endogenous control of migratory behavior in Northern Wheatears

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The Northern Wheatear (*Oenanthe oenanthe*) breeds from north-eastern Canada across Europe and north-western Africa through Siberia to western Alaska. It is migratory, although the north African race is probably only partially so, and all birds migrate to sub-Saharan Africa. Consequently, the species shows a variety of different migration patterns with respect to distance and direction. In order to investigate if the migration strategies are underlain by population-specific endogenous control, we conducted cage experiments with first-year hand-raised birds from northern Germany, south-western Norway and Iceland. Birds were kept indoors in controlled conditions, and we measured fattening, nocturnal restlessness and orientation. All wheatears showed an increase in body weight coinciding with the autumn migration period. However, the seasonal patterns of body mass change were different between the birds originating from the different populations. Body mass increase was later but steeper in the birds from Iceland than in the ones from Germany and Norway,. Final body mass was similar in the continental birds, but significantly higher in the Icelandic birds. Nocturnal activity was high in all three populations until the first week of November, and then decreased to a lower level. In the German and Norwegian birds, a short period of lowered activity was observed between late September and mid October, which was not so in the Icelandic birds. Instead, they showed maximum nocturnal activity, at a level higher than the other populations, during the second half of October. This may reflect different migration strategies, with stopover prior to the crossing of the Sahara desert in the continental populations, and later but more speedy migration in the Icelandic birds. They appear to be under endogenous (genetic) control.

Makhado AB[1], Crawford R[1], Underhill L[2]

The impact of seal predation on Cape Gannets at Malgas Island, South Africa

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Cape Gannets *Morus capensis* are endemic to southern Africa, where they breed at just six localities. Following large decreases in Namibia, they are categorized as Vulnerable. The gannet colony at Malgas Island, South Africa, which with some 35,000 pairs is the second largest for the species, was stable through the 1990s but has recently decreased. In the early 1990s, Cape Fur Seals Arctocephalus pusillus pusillus began feeding on large numbers of gannet fledglings as they left to sea. Observations were conducted over two breeding seasons (1999/00 and 2003/04) to quantify the loss of fledglings to seals. It is estimated that seals kill some 10 225 fledglings each year, about 80% of the annual production. The impact of this predation is for the colony to decrease at about 11% annually. This results in a 100% probability of extinction in 100 years. If mortality attributable to seals can be reduced by half, the colony still decreases but the probability of extinction reduces to 2%. If mortality caused by seals is decreased by 90%, the colony remains approximately stable on average. As most mortality is inflicted by young bull seals, it is expected this can be achieved through a small annual cull of seals around the island.

Malaki P[1], Muchane M[1], Balakrishna M[2]

Population status and behavior of the Grey-crested Helmet-shrike in Naivasha, Kenya

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The Grey-crested Helmet-shrike (*Prionops poliolophus*) is an east African endemic. It inhabits the Serengeti-Mara woodland and grassland ecosystems of north Tanzania and south Kenya. Despite its current listing as near threatened, little is known about its ecology and conservation status. Accordingly, the population status, distribution, behavior and habitat use of the helmet-shrike were investigated in Naivasha, Kenya, from August 2003 to January 2004. Vegetation composition of habitat was assessed and compared among different study sites. The helmet-shrike lives in permanent groups; and eleven family groups with group sizes ranging from 5 to 17 individuals (mean 9.6±4.4) were located. Mean bird density was 0.15±0.03/ha in *Tarconanthus camphoratus* bushland and 0.04±0.01/ha in *Acacia xanthophloea* woodland. The groups are territorial and cooperative breeders. Territory size ranged from 0.02ha to 0.98ha. Eighteen breeding attempts were observed. The helmet-shrikes have low nesting success (29.9-33.3%) due to nest predation. Within *A. xanthophloea* woodland and *Tarconanthus camphoratus* bushland, areas of dense vegetation were mostly preferred for nesting. Results from a questionnaire revealed an alarming decline in preferred habitat, due to conversion of natural woodlands to agriculture, settlements and urban development. Predation and habitat destruction were the major factors limiting the population of this species. Measures to stop habitat destruction and promote conservation are needed if the Grey-crested Helmet-shrike is to survive. Results from this investigation contribute baseline information from which conservation and monitoring strategies can be developed.

Malher F

The House Sparrow in Paris: a center of persistence?

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Over 2003-2004 and less frequently in 2005, I surveyed the House Sparrow (*Passer domesticus*) across five sectors of Paris, from the periphery of the city to its centre. Large parks were excluded. My procedure was to walk along streets and count sparrows seen or heard : the results were calculated in individuals per kilometre (i/km). Counts ranged 11 to 32 i/km in the breeding season, depending on the sector. Given that 70% of the birds were recorded within a band 50m wide, the resulting density is 3 to 9 birds/ha, far greater than in London, Brussels or Hamburg. A considerable difference was found in numbers between central (13 i/km) and peripheral boroughs (27 i/km), many more sparrows occurring in streets with bushes and open ground. Old trees with holes also seemed to provide favourable habitat. There were considerably fewer sparrows in streets with heavy traffic and a high density of buildings. Population demography was followed over the annual cycle: a dramatic decrease occurred (50-66%) between mid August and early September, followed by an increase during the winter. This suggests that sparrows leave the streets of Paris in late summer; but it is not yet known where they go. The city's larger parks are a possible destination, though Parisian suburbs are more likely. Though the data are too short-term for assessing long-term population trends, there is no evidence that the House Sparrow has suffered a marked decline in Paris.

Malzof SL, Quintana RD

Diets of the South Polar Skua and the Brown Skua at Cierva Point, Antarctic Peninsula

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The South Polar Skua (SPS; *Catharacta macormicki*) and the Brown Skua (BS; *Catharacta lonnbergi*), the most common Antarctic skua species, have been considered as opportunistic predators, scavengers and kleptoparasites on a wide variety of organisms. In sympatric situations, BS monopolize the terrestrial food source of penguin eggs and chicks, and SPS forage almost exclusively at sea. Regurgitated pellets from sympatric SPS and BS at Cierva Point, Antarctic Peninsula, were analyzed for diet items. A total of 212 (56 from BS and 156 from SPS) and 201 (92 from BS and 109 from SPS) pellets were collected during 1992-93 and 1995-96 breeding seasons, respectively. A total of 375 and 682 food items were found from the analised BS and SPS pellets for 1992-93. For 1995-96, the food item numbers were 427 and 579 for BS and SPS, respectively. Pellet compositions were correlated between both skua species in the same season (r_s=0.62, n=22, p=0.0022 and r_s=0.87, n=24, p<0.0000001, for 1992-93 and 1995-96, respectively) and between each skua species in both seasons (r_s=0.71, n=25, p=0.00081 and r_s=0.83, n=25, p<0.0000001, for SPS and BS, respectively). As for SPS and BS diets in the same season, there was equal occurrence of fish (c2=0.055, p<0.81 and c2=0.075, p<0.78, for 1992-93 and 1995-96, respectively), penguins (c2=0.04, p<0.84 and c2=0.67, p<0.41, for 1992-93 and 1995-96, respectively), and total birds (c2=0.055, p<0.81 and c2=0.075, p<0.78, for 1992-93 and 1995-96, respectively). BS trophic niche breadth was wider than SPS one (BA(BS)=0.28 and BA(SPS)=0.24; Mann-Whitney test: Z=7.67, n=50, p<0.00000001). We recovered 304 fish otholits (210 for SPS and 94 for BS) and 403 fish otholites (246 for SPS and 157 for BS) for 1992-93 and 1995-96, respectively. Despite the presence of a trend in which BS fed mainly on penguins and SPS fed mainly on fish, there was not a clear segregation in the use of food resources by both skua species in the study area.

Malzof SL, Quintana RD, Branzini A, Caridad P

Habitat selection by the Dusky-legged Guan in the “Delta del Paraná” Biosphere Reserve, Argentina

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The Dusky-legged Guan (*Penelope obscura*), the southernmost species of the family Cracidae, inhabits riparian forests as far south as northeastern Argentina, reaching the biosphere reserve on the Paraná River delta. Due to a long history of human intervention, the forests of this region comprise a complex mosaic of willow and poplar plantations, secondary forest and some relict patches of native forest. We set out to analyze guan habitat selection at macrohabitat scale by estimating the relative abundance of guans on different categories of water courses in the delta during autumn and spring in 2005. Water courses were classified into five categories according to width and depth. We explored 309 km of streamside in autumn and 302 km in spring, sighting 120 and 62 guans respectively, at an average of 0.4 guans/km in autumn and 0.2 guans/km in spring. Analysis of habitat selection was carried out by the method suggested by Manly *et al*, and the expected and observed proportions of guans were recorded for each category of water course. Our results show that in autumn, guans selected category 3 streams (41-60 m wide and 1-3 m deep) in proportions greater than availability, and in spring selected category 2 streams (21-40 m wide and <1m deep) also in proportions greater than availability. Other water courses were used according to availability, except for large rivers (category 5) which were never used. This shows a clear need to conserve and manage the smaller streams to maintain the guan population in the delta, something that is especially urgent because forestry activities continue to degrade forest along their banks.

Mandel J

Migration and energetics in the Turkey Vulture: untangling the biological solution to unpowered flight

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Whereas energetic costs of flight have been quantified in captivity and in the wild, the physiological costs of migration in a large, soaring migrant are poorly studied. Ample observational evidence suggests that in some soaring migrants such as the Turkey Vulture (*Cathartes aura*), the biological equivalent of unpowered, directed flight is achieved. Turkey Vultures are notoriously poor "athletes" in flapping flight, and what is known about their migration suggests that they accomplish nearly all of the journey by non-flapping soaring and gliding. To understand better this impressive achievement, we monitored energy expenditure in migrating Turkey Vultures using implanted heart rate and body temperature loggers as well as on-bird GPS units. This, combined with personal observations en route and experimental tests of energy expenditure and thermoregulation, should bring us closer to understanding the complex relationship between soaring, weather and geography that makes unpowered, directed flight possible.

Marcin P

Habitat preferences of breeding Great Bitterns: Implications for conservation of a vulnerable species

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Due to loss of beds of the reed (*Phragmites australis*) and the drainage of wetlands in many parts of Europe, the Great Bittern (*Botaurus stellaris*) has become a high-priority species for conservation action. Bitterns are poorly-studied and secretive, and there is little precise information on their habitat requirements. Accordingly, my poster presents results from a study of habitat use and reed bed selection by breeding bitterns on fishponds in the Lublin region, east Poland, from 2003 to 2005. I investigated habitat characteristics at 60 nest-sites in 23 territories. Males occupied small, isolated patches of reed bed around ponds, dominated by reed, Reedmace (*Typha angustifolia*) and sedges (*Carex*) sp. Females built nests well within reed beds; water depth beneath nests during the egg-laying period varied between 10 and 97 cm (mean = 43.9±20.1 cm, N=60). Five types of vegetation within 20 m around nests were identified as important for concealment and success; they are prioritized here: pure *Phragmites* - 30 nests (50%), pure *Typha* - 13 nests (22%), mixed *Typha/Phragmites* - 12 nests(20%), mixed *Phragmites/Carex* - 4 nests (7%), and mixed *Juncus/Typha* - 1 nest (2%). *Phragmites* and *Typha* thus appear to be essential elements. Females nested in patches with high densities of old stems. The results show that bitterns prefer old, un-cut reedbeds in ponds of medium water level at the beginning of breeding.

Markones N[1], Garthe S[1], Mundry R[1], Hüppop O[2]

Habitat choice by seabirds in the southeastern North Sea: Effects of spatial scale and temporal variation

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The relationship between hydrography and seabird distribution in a shallow sea-shelf region, the southeastern North Sea, was analyzed for different seasons by comparing seabird distribution patterns with the occurrence of different hydrographic phenomena. Several species showed a significant, or at least positive, response to hydrographic factors at different spatial scales. At a larger scale, distributions were correlated with water masses of differing salinity and water transparency. Within these habitats, frontal features such as those created by river plumes and local upwelling influenced distribution patterns at a smaller spatial scale. Comparison over different seasons also revealed temporal variation in the habitat preferences of several species. Some prefered a particular water mass year-round, varying only in the strength of their ties to it. Others correlated with water mass only seasonally, and here similar patterns of habitat preference were found in the same season across years. Temporal variation in the North Sea thus seems to be correlated more with season than with year.

Marova-Kleinbub I

Distribution of song dialects in sympatric Siberian and European Chiffchaffs

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Siberian and European Chiffchaffs (*Phylloscopus collybita tristis*, *P. c. abietinus*), are similar morphologically but differ markedly in song. Geographic overlap between them, discovered by Snigirevski (1938) in the southern Urals, has since been found to extend northwest to the Kanin Peninsula (Marova and Leonovich, 1993). The width and limits of the zone of overlap, and the actual distribution and interrelations of the two forms in it, still remain little known. Both tape recordings of mixed song and specimens with intermediate features in different parts of the overlap zone suggest extensive introgressive hybridization between *tristis* and *abietinus* throughout the area of overlap, represented by the so-called form "fulvescens". Our research in the forested southern Urals at the west and east limits of overlap, nevertheless, reveals a mosaic of interaction (Marova, 2005). In some regions, both forms meet only during spring migration, for example in the Zhiguli hills. At the distributional boundaries of the both forms in the southern Urals, the typical habitat of *tristis* is river valleys with some firs, and of *abietinus* pine woods with some firs on both hills and rolling downs; neither nests in pure deciduous woods. The density of both forms at the limits of their ranges is very low, about 2-3 males every 1 km; and the territory of each male is large, about 10,000 sq.m. Moreover, the actual overlap in a study area of 100 km in the southern Urals was only about 5-7 km wide: to the west of this zone, only *abietinus* nested, and to the east only *tristis*. Within the zone, furthermore, both forms were found together at only two points, both at the conjunction of fir-pine woodlands with river valleys of willows and alders. There males of *abietinus* and *tristis* both react to one another's songs.

Martin G[1], Jarrett N[2], Tovey P[2], White C[1]

Determinants of visual fields in flamingos: chick-feeding versus filter-feeding

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According to conventional thinking, the position and extent of binocular vision in birds is determined by feeding ecology, a critical determinant being the degree to which vision is used for precise positioning of the bill when pecking or lunging at prey. In birds that do not require precision (probe- and filter-feeders), the bill falls outside the binocular field which extends above and behind the head, thus providing comprehensive visual coverage of the general environment instead. Flamingos (Phoenicopteridae) are highly specialised filter-feeders. They employ a unique technique that does not require accurate bill positioning, one in which the inverted head is placed between the feet. Feeding flamingos often walk forwards with the head pointing “backwards”. Here we show that the visual field of the Lesser Flamingo (*Phoeniconaias minor*) is in fact the same as in birds that feed by precision pecking, and that feeding flamingos are blind to the direction of their walking. We suggest that this is due to the requirement for accurate bill placement when flamingos feed their chicks with “crop-milk”, and possibly when building their nest. We propose that chick feeding may be the ultimate determinant of visual field topography in birds, not feeding ecology.

Matsui S, Takagi M

Sexual differences in provisioning of nestlings in the Bull-headed Shrike in relation to nest-site characteristics

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The sexes of many monogamous bird species share roles in breeding activity, both male and female providing food for their nestlings. To test whether nest site affects such partitioning of labor, we investigated breeding Bull-headed Shrikes (*Lanius bucephalus*) on Minami-Daito Island off southwest Japan in the northwest Pacific in 2003 and 2004. About 60% of total land on the island is under agriculture. Bull-headed Shrikes are monogamous. Females alone incubate and brood, but both sexes feed the nestlings. We examined whether nest site characteristics at small and large spatial scales in trees and habitat around the nests affected parental provisioning rate. Males increased their food provisioning rate in areas where pasture and fence lines were more extensive, probably because the extra wiring on fence lines increased the number of perches that shrikes typically use for hunting. Food provisioning rate in relation to habitat type did not increase, however, in females. Females did nevertheless increase their provisioning to nests placed well out from and above tree trunks and lower branches, sites that were ravaged more often by predators. Thus female but not male provisioning rate was related nest position in a tree and predation, possibly because females spend more time at the nest than males.

Mazgajski TD, Rejt L

Predation of artificial nests in a highly fragmented landscape in Poland

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Forest fragmentation leads to an increase in the number of patches and their isolation, a decrease in patch size, and a proportional increase in ecotonal edge zones. As edge zones are used for vantage resting by predators from unforested areas, especially corvids, the breeding success of potential prey in the zone can be expected to be lower. Yet some predators may be affected negatively by forest fragmentation too, and occupy only those forest patches that exceed a particular threshold in size. Thus landscape composition, and the ratio of forested to unforested area, may influence the densities of predators in unforested habitat, thereby implying that studies of nest predation need to take account of landscape effects. Accordingly, the effects of landscape on predation of artificial nests were examined in Poland in areas that differ in the amount of forest cover. Preliminary data were collected in a mainly agricultural area with 6% forest cover and highly fragmented woodland. Artifical nests, resembling those built by thrushes (*Turdus spp.*) and each containing one domestic quail egg, were placed at three heights: on the ground, among shrubs up to 1.5 m high, and in saplings and trees at about 3.5 m. Nests were checked after 13-14 days. The highest predation rate was found in medium-sized patches of forest. Comparison of our results with those of other studies suggests that the way in which forest patch size is classified can affect the outcome significantly. This, in turn, may explain different results in different studies of the same issue.

McKechnie A, Erasmus B

Climate change and birds in hot deserts: The impacts of increased demand for thermoregulatory water on survival and reproduction

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Avian responses to global warming are often determined by complex interactions between physical, physiological and ecological factors. In some cases, however, climate change can be linked directly to population dynamics and range limits by simple physiological models through seasonal bottlenecks in water and/or energy balance. For birds living in hot deserts, survival and reproduction during summer are constrained by high water demand and/or limited water supply. Rates of evaporative water loss (EWL) increase rapidly when environmental temperature exceeds body temperature, and even small increases in air temperature lead to large increases in water requirements. We developed a model linking EWL rates to body mass and environmental temperature, and then combined it with global air temperature data to predict changes in the water requirements of desert birds during very hot weather. Birds in nearly all major desert systems will experience a marked increase in demand for water during very hot weather. By 2080, 5g birds will experience increases of more than 3.5% of total body water per hour on very hot days, 50g birds will experience increases of around 1%, and 500g birds will experience more moderate increases of less than 0.5%. Increased demand for thermoregulatory water will have major consequences for the ability of birds to maintain water balance during extremely hot weather events, and will severely constrain survival and reproduction. Seasonal bottlenecks in water balance are predicted to become even more severe with declines in precipitation, and hence water availability, in many desert regions. Since mass-specific EWL, and hence fractional water turnover, is strongly dependent on body size, bottlenecks in water balance arising from higher air temperatures will be most pronounced in small birds. The body mass dependence of these effects suggests that we can expect significant changes in the species composition of desert bird communities.

McWilliams S[1], Pierce B[2]

Seasonal changes in composition of lipid stores in migratory birds: Causes and consequences

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It is well established that birds use fat stores to primarily fuel migration; however, few studies have focused on the causes and consequences of observed seasonal changes in fatty acid composition of fat stores in birds. We propose and test two hypotheses that address the causes of these seasonal changes: (1) diet composition determines fatty acid composition of fat stores, and (2) birds selectively metabolize and store certain fatty acids during migration in lieu of changing their diet. When we offered Red-eyed Vireos (*Vireo olivaceous*) choices between diets that differed only in fatty acid composition, vireos preferred diets with more triolein over those with more tristearin and tripalmitin; these preferences were similar across seasons. We also collected fat samples six times throughout the year from captive Red-eyed Vireos fed one of two diets differing in fatty acid composition. Results showed that fatty acid composition in stored fat differed by diet and changed over time, although these changes were not season-specific or consistent with the selective-metabolism hypothesis. Thus, fatty acid composition of stored fat was primarily a product of diet composition; selective metabolism possibly played a minor, though important, role. Given recent evidence that fatty acid composition in birds affects their energy expenditure during intense exercise, there is an implication here that birds at stopover sites can influence the fatty acid composition of their body fat by selective feeding, which can affect significantly the energetic cost of migration.

Medeiros de Almeida E, Santos Alves MA

Do males and females of the Violet-capped Woodnymph (Trochilidae) use different feeding resources? A study from an Atlantic forest in southeast Brazil

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The aim of this study was to investigate pollen load in the bill of a hummingbird and to examine differences of floral resource use between sexes. The study was carried out in an Atlantic forest at Ilha Grande in southeast Brazil from March to June 2004. Hummingbirds were caught using 10 mist nets in the understory and 10 in the sub-canopy. From their bills, we sampled pollen picked up by clear Scotch™ tape fixed on a glass microscope slide for analyses of pollen morphology and identification. Pollen grains preserved on tape were counted and measured using a light microscope, and then assigned to distinct morphospecies based on size, shape, pores, presence of tetrads, and any distinctive exine sculpturing. Four female Violet-capped Woodnymhs (*Thalurania glaucopis*) were captured in the sub-canopy and five in the understory; seven males were also caught in sub-canopy and one in the understory. A total of 993 pollen grains from 10 different morphotypes was recorded. All morphotypes were found in the samples of females, but four were not recorded for males. The most abundant morphotypes on female bills were, in order, VII (247/379), II (71/379), I (24/379) and III (19/379), and on males they were II (376/614), III (180/614) and VII (47/614). The results indicate that males and females of this hummingbird are probably partitioned in their use of forest strata and the flowers on which they feed. In a parallel study of over 22 months in the same area, males were captured mainly in the sub-canopy (33/43), while females were captured equally in the sub-canopy (14/33) and understory (19/33). In this study too, the main pollen morphotypes found on hummingbird bills differed between sexes. Females seem to visit a wider range of forest levels and plants than males, suggesting that males defend feeding territories such that females need to visit other plant species to gain sufficient resources for maintenance. Supported by CEADS/UERJ, CAPES, CNPq, IdeaWild.

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Contrasts in the innate immune response in different shorebird families

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Differences in habitat and host behavior may lead to variation in parasite prevalence between species. Because the immune system is the most generalized defence mechanism that vertebrates have against pathogens and parasites, one could hypothesize that species at higher risk of infection would invest more in the immune system. Nevertheless, such a relationship remains ambiguous insofar as not all heavily-infected species invest highly in an immune system. The migratory shorebirds that use the East Atlantic Flyway are good subjects for investigating questions relating disease risk and immune investment as they show a very clear pattern of geographical and habitat susceptibility to avian malaria. Furthermore, the Ruddy Turnstone (*Arenaria interpres*), of unique scavenging habits, seems to be affected particularly by avian influenza. Here we used a hemolysis-hemagglutination assay to describe patterns of variation in two innate immune components - natural antibodies and complement-mediated lysis - in 18 species of shorebirds from four different families. While we found almost no variation in the levels of natural antibodies, complement-mediated lysis varied significantly between and within families. We also established that variance in complement-mediated lysis may be related to phylogenetic constraints, as none of the six species of plovers (Charadriidae) tested presented detectable levels of activity. No clear relationship between habitat use and innate immune response was found either, even though many shorebirds using inland habitats suffered from a much higher prevalence of avian malaria. Ruddy Turnstones had the highest levels of complement-mediated lysis, leading us to conclude that their scavenging habits exposes them to a broad range of pathogens which can be fought with complement-mediated lysis.

Metzger B, Bairlein F

Trying to link birds' immune system, parasites and carotenoids: Do Garden Warblers have the ability to self medication?

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Birds in the wild serve as hosts for many different species of parasites and individuals often have to deal with a high infestation rate as populations have to with a high prevalence of e.g. coccidia or haemosporida. Non-lethal influences of parasitic diseases on birds such as energetic costs are poorly investigated. Yet negative effects of parasites to their hosts especially in time of high exertion as during breeding period or on migration are very likely. Carotenoids and antocyanins are ingredients of the natural food of many bird species. They are noted for some anti-oxidant capability and stimulating effects to vertebrate immune system. Therefore they are often discussed to work as enhancers of immune system facilitating birds ingesting carotenoid rich food to deal with parasitic diseases. In a food choice experiment with the Garden Warbler (*Sylvia borin*) we checked the ability of birds to self medication. We expected birds infected with coccidia and hence under immune pressure to favour carotene rich food. Under controlled conditions we tested the preference of *S. borin* for food of two different dose rates of added beta-carotene over standard food and against each other. Different proportion of food intake was measured pre- and post artificial infection with coccidia of the species *Isospora sylviaxanthina*. The majority of birds favoured the medium dosed carotene over standard food and in addition avoided high dosed carotene food. Contrary to our expectations, the infected birds did not take more of the carotene enriched diet. This suggests that the carotene enriched food in our experiment provide the birds already with sufficient carotenoids so that further enhancement of dietary preference may be irrelevant or even harmful. Avoidance of highly carotene enriched food may indicate that there could be an antidromic effect of carotenes for health at high dose rates.

Mey E

Johann Matthäus Bechstein (1757-1822): A pioneer of ornithology

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Between 1791 and 1820, the development of ornithology in Germany was shaped by the educator, forester and zoologist, J. M. Bechstein, from the small town of Waltershausen near Gotha, to such a degree that the time is known as the "Bechstein period". In many publications as numerous as they were successful, including translations from English and French, Bechstein attempted to collate the ornithological knowledge of his time and to combine this with his own experience gained from captive birds and observations in the field, mainly in his native Thüringer Wald. He was called by his contemporaries, and by many of his successors, "the father of German ornithology". Bechstein's *Gemeinnützige Naturgeschichte....* [Practical natural history] (1791-1795, 2nd edition 1805-1809) is the first modern handbook of the birds of Central Europe and contains a wealth of information unsurpassed at the time. It is simultaneously the first avifauna of Thüringen. The monographical treatment of all known German bird species, ordered according to various characteristics such as morphology, behavior, breeding biology and usefulness, included for the first time details of their parasite fauna. His *Ornithologisches Taschenbuch von und für Deutschland....* [Ornithological Pocket Book of and for Germany] (1802-1803, 1812) can be regarded as the world's first ornithological field guide. Bechstein, who consistently employed binominal nomenclature, is the author of the still valid scientific names of 29 avian taxa: 5 genera, 18 species, and 6 subspecies. He exercized a lasting influence on the German naming of European birds, creating around 30 names in use today. The Bechstein period was the dawning of the "Golden Age of Central European ornithology"; - the Naumann-Brehm period - that followed.

Mikhantyev A, Selivanova M

Long-term population dynamics of nesting ducks in the south forest steppe zone of the Novosibirsk region, Russia

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Using 30-years of breeding biology data, we examined whether the reproductive performance of ducks varied with environmental factors, and whether spring conditions influenced the numbers breeding. The study was carried out at Krotovaya Lyaga Lake, Western Siberia (53.72 N; 78.02 E), where nest-initiation dates, clutch size, nest fate, and hatching success were recorded in Mallards (*Anas platyrhynchos*), Pochards (*Aythya ferina*), and Tufted Ducks (*A. fuligula*). Ten-day mean weather over the month prior to nest initiation explained some of the variation in the timing of breeding, clutch size, and nest (egg) survival. Clutch size for Mallards, Pochards, and Tufted Ducks in seasons of good weather averaged 8.1±0.2, 10.1±0.3 and 9.8±0.2 respectively, compared to 7.2±0.3, 7.2±0.4 and 7.4±0.3 respectively in bad. Predation was the primary factor affecting nest success. At 6.3, 7.7 and 7.8 ducklings per attempt, nest success was again highest in seasons of good weather for Mallards, Pochards, and Tufted Ducks respectively, and lowest in bad: 2.2, 1.1 and 0.9 ducklings per nesting attempt per respective species. The numbers of ducks breeding increased in the years that followed a good season and fell in those following a bad. 31%, 34%, and 35% of the variation in the numbers of nesting Mallards, Pochards and Tufted Ducks, respectively, was explained by spring temperatures in the previous year. Only for diving ducks, however, were the numbers breeding on the Lake related to the presence of other wetlands in area: 17% and 21% of the variation in numbers of nesting Pochards and Tufted Ducks, respectively, was explained by annual fluctuations in water conditions, and diving ducks became concentrated on the Lake in dry years.

Millet S, Klasing K

Immunology as part of life-history physiology: Quantifying constitutive immunity

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Allocation of resources to, and within, the immune system is an important component of life history, for which a panel of assays that permits a comparative approach to immunology is needed. We optimized three tests for quantifying constitutive immunity in small birds of diverse taxa using small sample volumes of blood. The first, bactericidal assay, measures the capacity of whole blood to kill micro-organisms and is a general indicator of the elements composing constitutive immunity, including cellular and humoral elements. The second, phagocytosis assay, measures the capacity of macrophages in whole blood to recognize and intern bacteria. Assaying the third, the concentration of lysozyme which is an antibacterial protein in the blood, provides information on constitutive investment in an important humoral factor. Stressing Clay-colored Robins (*Turdus grayi*) by placing them in a cloth bag for 30 minutes lowered their phagocytic and bactericidal capacity. Stimulating the immune system of three-week old chickens by LPS injection increased killing, phagocytosis, and lysozyme concentration. The use of whole blood for assays is advantageous because it requires very small sample sizes (<50 microliters) and better reflects the *in vivo* state; the tests do not rely on species-specific reagents and are therefore a useful tool for inter-species comparisons; and the procedures are practical in field conditions and can be performed in field laboratories with limited infrastructure.

Miyaki C, Ribeiro de Oliveira-Marques A

Molecular phylogeny and characterization of the mitochondrial DNA control region of species of the genera *Ara* and *Primolius* (macaws and allies, Psittaciformes)

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The neotropical region is rich in psittacids, the phylogeny of which has been the subject of much study. Here we present a molecular phylogeny of the eight species of the genus *Ara* (macaws) and six other closely related taxa. A total of 3700 bp of mitochondrial DNA sequence (12S and 16S rDNAs, control region, and cytochrome b) was analyzed by maximum parsimony, maximum likelihood, and Bayesian procedures. The results indicate that the genera *Ara* and *Primolius* are reciprocally monophyletic sister clades which diverged at the end of the Pliocene. All splits within the genera seem to have occurred during the Pleistocene. The relationships found within the genus *Ara* were: ((*A. ararauna, A. glaucogularis*), *Ara severa*), (((*A. militaris, A. ambigua*), (*A. macao, A. chloroptera*)), *A. rubrogenys*). The relationships found within the genus *Primolius* were: ((*P. auricollis, P. maracana*), *P. couloni*). *Orthopsittaca manilata*, formerly included in *Ara*, and *Cyanopsitta spixii* are closely related to both *Ara* and *Primolius*. *Diopsittaca nobilis*, also formerly included in *Ara*, consistently grouped with *Guarouba guarouba*. This clade and *Aratinga aurea* are sister to the other taxa. *Anodorhynchus hyacinthinus* (Hyacinth Macaw) was treated as an outgroup. We also sequenced almost the entire control region in all these taxa. An undescribed conserved segment (bases 1041 to 1045) was observed in all of them. At the 5’ and 3’ ends of this region, triplets (TGG, bases 1026 to 1038; GGG, bases 1043 to 1045, respectively) were observed exclusively in *Diopsittaca nobilis, Guarouba guarouba, Aratinga aurea* and *Anodorhynchus hyacinthinus*, which are the taxa not so closely related to *Ara* and *Primolius* in our sampling. Financial support: FAPESP, CAPES, CNPq.

Mizuta T

Parental response to the risk of nest predation is affected by nest-site characteristics and predator type in the Madagascan Paradise-Flycatcher

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Playback experiments were conducted at the nest of the Madagascan Paradise-Flycatcher (*Terpsiphone mutata)* to investigate whether parents modify nest attendance behavior in response to the vocalizations of potential nest predators, and whether the response is affected by nest-site characteristics, predator type, and conspicuousness of male plumage. Parents delayed nest visits when they heard the voices of both mammalian and avian predators, and were more cautious in approach when their nests were located in denser vegetation, probably because of uncertainty about the whereabouts of the predator. They were also preferentially cautious in response to calls of small avian watch-and-wait predators when nests were located high in forest, at sites more vunerable to such predators. Conspicuous male plumage did not affect response to playback. Overall, parents responded immediately to increased risk of nest predation perceived from auditory information, their reactions influenced by nest-site characteristics and predator type.

Mokoko IJ

The birds of Lake Tele Community Reserve, Congo

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The Lake Tele Community Reserve is a site of strategic importance for conservation of the forests, lake-side environments and fauna of the Congo, and a trump tourist attraction. Characteristic habitats are 'terra ferme' forest, permanent and seasonal swamp forests, mosaic savanna woodlands and surface waters. Together they support such a rich fauna, particularly in waterbirds, that the area was placed on the list of internationally important wetlands under Ramsar in June 1998. The reserve holds a diversity and abundance of birds unique to the Congo. January to March is the main period of migration. Two species discovered at the lake have just been added as new to the list of Congo birds: *Ciconia ciconia* and *Egretta ardesiaca*. The local community, mostly fisherpersons and farmers, play an important role in bird conservation, notably in the protection of nests and roosts of different species despite such negative impacts as bush-fires; in some villages, local groups are even organized into conservation committees. For the last ten years, the waterbirds of the lake, comprising over fifty species, have been the subject of annual counts under the DOEA program of Wetlands International. With forest and landbirds included, more than 350 species occur in the area. My objective in this presentation is to bring to the attention of the scientific community the biological importance of Lake Tele, its birdlife and the activities of the local communities, and to seek support for much further research.

Momose H, Yoshida H, Yamaguchi Y

Nest site selection in Carrion and Jungle Crows on the northern Kanto plain, central Japan

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Carrion Crows (*Corvus corone*) and Jungle Crows (*Corvus macrorhynchos*) are common breeders found all around Japan, where they cause serious damage to agriculture. The Jungle Crow, especially abundant in urban areas, has also become a problem in cities such as metropolitan Tokyo, attacking people near its nests and opening up bagged garbage in streets. Nesting in the two species was investigated at five different locations over an area of 58 km^2 in the Ibaraki prefecture north of Tokyo in the breeding season of 2005 to document selection of breeding habitat. About 260 nests and their locations were recorded for both species in the study area: 160 nests of Carrion Crows and 100 of Jungle Crows. Carrion Crows tended to nest in forest patches both small in area and low in height, some even nesting on single isolated trees or electrical pylons. In comparison, Jungle Crows nested in significantly higher trees in larger forest patches. Land-use around the nest also differed between the two species: Carrion Crows tended to select areas that had more farmland, especially paddy fields, whereas Jungle Crows used more heavily populated areas.

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'Summer trips', or how some birds cope with Mediterranean seasonality

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Some bird species of Iberian Mediterranean ecosystems shift regularly to areas north of their breeding grounds in summer where they stay for a variable period of time before migrating to their usual wintering areas. Such species are associated mainly with open, simplified habitats, subject to high fluctuations in productivity. Here, based on long term studies, we revise published evidence for summer movements in four well-known species: the Great Bustard (*Otis tarda*), Lesser Kestrel (*Falco naumanni*), Montagu's Harrier (*Circus pygargus*), and Little Bustard (*Tetrax tetrax*). New information is provided, in particular, for Montagu's Harrier and the Little Bustard. Summering sites can be grouped into two main environmental categories: localities to the north of breeding areas, usually at higher altitude, and localities where birds gather irrespective of latitude and altitude. Sites of the first category are all found in the northern third of the Iberian Mediterranean region, at high altitude or close to the area of transition to Atlantic Iberia, where they are subject to delayed and milder summer drought and so are more productive. Evidence compiled on the four bird species suggests that summer shifts in response to food shortage due to summer drought may be more widespread in Mediterranean regions that previously thought.

Mori S

Maintenance mechanisms in a Great Spotted Woodpecker population in a fragmented landscape in Japan

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Parameters estimating population sustainability for the monogamous Great Spotted Woodpecker (*Dedrocopos major*, GSWs) in a mosaic of semi-isolated forest patches in a strongly fragmented landscape were assessed in central Hokkaido, Japan. Breeding success, mortality, immigration, emigration and the body condition of trapped and marked individuals were monitored on a study site of 40km^2 at 5 km from the nearest large forest. Forest occupies 6% of the study area, and narrow shelterbelts of larch and small stands of deciduous trees are scattered among agricultural fields; two thirds of the stands are smaller than 1 ha. This environment is advantageous for locating GSWs and their nests, where I recorded breeding birds in 1999-2002 and 2005, and captured and ringed 36 and 35 breeding males and females respectively. The numbers of nests fluctuated between 17 and 30 a year, and fewer than half were renewed in the next season. Annual survival rates ranged from 22% to 61% for ringed birds; 41% of 44 nest sites were used in a year, and 9% were used every year. Two males ringed in 1999 and 2000 bred in 2005.

Moriguchi S[1], Amano T[1], Ushiyama K[2], Fujita G[1], Higuchi H[1]

Patterns of fat deposition and time-stay by White-fronted Geese at a staging site on spring and autumn migration

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At staging sites on spring migration, capital breeders such as geese lay down fat reserves for reproduction. They are also constrained by time at staging sites then, because they need to arrive on their breeding grounds in time to reproduce. There are no such constraints, however, on autumn migration. Accordingly, we hypothesized that: (1) birds deposit as much fat as possible before departure deadlines during spring staging, to enable them to breed, and (2) birds lay down similar fat stores for on-going migratory flight at staging sites in autum. Based on these hypotheses, and after controlling for initial fat condition and arrival date, we made the following predictions: (1) in spring, earlier arrivals would have greater fat stores, and that the better the body condition on arrival, the better it would be on departure, and (2) in autumn, the earlier the arrival, the earlier the departure, and the better the body condition on arrival, the earlier the departure. We tested these predictions on marked White-fronted Geese (*Anser albifrons*) at Lake Miyajimanuma, the largest staging site in Japan. We recorded the arrival and departure of marked geese and their fat condition using an abdominal profile index (API). In spring, early arrivals layed down more fat than later arrivals. Contrary to our prediction, however, geese in good initial condition did not always maintain that advantage over geese in poor condition early. In autumn, geese arriving earlier left the site earlier than birds arriving later, but neither showed tendencies to deposit similar quantities of fat.

Moskvitin S, Kilin S

Sex and age Structure and reproduction indices of *Emberiza aureola* in western Siberia

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The information has been gathered in the Ob-river flood-land not far from the village of Krivosheino where the yellow-breasted bunting lives in the high flood land fields. The information has been gathered for just three years (1981-83 y.). The age of the nest birds in defind by visual means (n=457) on their ways. 144 birds have been caught, 51 pairs have been caught in their nests. Age ratio changed by years not considerably. The most variability in males (up 38 to 53%) and females (up 36 to 53%) was revealed for Ad1 age group. The most of breeding specimen consisted of adult birds in the next number: females – 76, 72, 78% and males – 69, 76, 68% in 1981-1983 relatively. Their contribution to reproduction was encreased at the expense of higher reproductive parameters of adult group in comparision with subadultus group. The Sad (n=19) femal group of birds had the least number of the average egg laying (4.40±0.23). It ($p<0.05$) greatly differed from that of Ad1 (n=27) – 4.96±0.14 females. The elder age group (n=8) as well as some young females had the lowest average size of egg laying (4.75±0.24). The number o flight per a pair was reliable ($p<0.05$), the least number of them belonged to Sad (2.47±0.44) female birds as compared with the Ad1 (3.44±0.35), Ad2 and elder bird groups. In the pairs with the participation of grown-up males the average size of egg laying and the number of slight are higher than connected with the reproducing male birds. The analysis of the nest pairs age groups according the Xi2 criterion does not theoretically correspond to the expected distribution. It tells as about the fact that *Emberisa aureola* is enough choosy and assortative to find a partner. Both male and female birds mostly prefer partners of various age groups. Thus, SadFFxSadMM have been formed in (the) 20% of cases, Ad FFxAd MM pairs have done it in 53% cases. This tendency becomes evident each year in spite of the age size groups changes.

Muck C, Goymann W

Effects of male and female removal on the feeding behavior of the remaining partner in a polyandrous and a monogamous coucal species

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Varying results of removal experiments in birds (from nest desertion over remating to successful chickraising) raise the question why bi-parental care is important in some species, but not in others. In general, ecological constraints such as cold, heat, predation pressure and/or food requirements of the young are considered to necessitate bi-parental care for the offspring. We conducted removal experiments in the African Black Coucal (bc) and the White-browed Coucal (wbc). These similar sized and closely related species share the same habitat and food resources, breed during the same period of time, and produce clutches similar in size. The bc is classically polyandrous: males typically raise their altricial young with no help from the female. The wbc is socially monogamous with both partners participating in parental care. A comparison of the two species provides an ideal opportunity to study the importance of bi-parental care while controlling for a number of ecological factors. We either removed the male or the female partner during the early nestling stage for two days and recorded the feeding frequency of the remaining partner during this time. Preliminary data suggest that bc males fed the young at the same rate independent of the presence of the female. Female bc did not participate in parental care even when their mate was absent. All other females abandoned their broods and mated with other males. In contrast, both female and male wbc increased their feeding frequency when their partner was absent, even to the same level of broods with bi-parental care. Therefore, in wbc bi-parental feeding of the young may not be required to successfully raise the brood. However, other factors such as predation risk or a trade-off between current and future reproductive success may favour bi-parental care. In the bc, the reproductive success for females may be highest if they remate with new partners instead of raising the young by themselves.

Mukherjee A, Borad CK

Impacts of landscape change on waterfowl populations in India: Twenty years of monitoring

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The canal-linked reservoirs of India play an important role in sustaining both human and bird life in the dry lands of the subcontinent. The populations of waterfowl on the three man-made reservoirs at Gujarat (23°1'N, 72°41'E), western India, have been monitored since 1984. Observations are made in January each year when the migratory elements of the populations congregate. Eurasian Coots (*Fulica atra*) are the most abundant of the 115 species recorded. Habitat size and complexity are important factors influencing species diversity at particular sites. Factors attracting waterfowl to the reservoirs include an abundant food supply and safe sites for roosting. Studies carried out during 2000-2001 reveal that changes in land use pattern have had an immense effect on concentrations of waterfowl in the region: in addition to the reservoirs, flooded areas set aside on surrounding farmlands at times support more than 30,000 individuals of up to 66 species. Data suggest that the fallowing of inundated fields serves as supplemental habitat for these birds, especially during the dry season. Both site-specific and broad-based strategies have been suggested for future waterfowl management in the region, where monitoring studies indicate that, so far, the ecosystem is healthy overall.

Mukhin A[1], Grinkevich V[2]

Post-fledging movements in Eurasian Reed Warblers: Not just dispersal

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In the annual cycle of birds there are several periods of increased mobility related directly to dispersal. We studied several such periods in the Eurasian Reed Warbler (*Acrocephalus scirpaceus*). Analysis of natal dispersal distances showed that, in spite of considerable movement during the post-fledging period of up to 30 km (mean 6.97±8.76 km, n=21) and more, reedwarblers preferred to settle back close to the natal site after migration (1.64±4.87 km, n=16). The fact that the scale of post-fledging movements is greater than the distance of natal dispersal (Mann-Whitney U-test: z=3.56, p=0.0004) suggests that post-fledging movements are a more complicated phenomenon that just for selecting a future breeding site. Active nocturnal life in juvenils during the pre-migratory period also supports this idea. Some avian navigation hypotheses assume that to create a navigation target for return migration, impending migrants need to study the environs of future breeding sites by exploratory sorties. For this, the navigation target needs to be much larger than a reed stand used for breeding. During wide post-fledging movements through different patches of suitable habitat, a reed warbler memorizes all of them; but only one, possibly the one closest to the natal site, will become the breeding site. More remote patches nevertheless still remain potential sites, to be used if the breeding attempt at the first site fails. Therefore, differences in the distances between juvenil and realized natal dispersal may well be due to the complex role of exploratory post-fledging movements.

Müller C, Jenni-Eiermann S, Jenni L

Effects of a stress response on post-natal development in the Eurasian Kestrel

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Birds respond to unpredictable environmental events with a physiological stress reaction that serves to maintain or regain homeostasis and which involves the release of the stress hormone corticosterone. If the stressor persists and stress hormones are elevated over long periods, negative effects result, such as reduced growth and development, impeded immunocompetence and lowered reproduction. Recent studies have shown that stress during post-natal development can hamper ability to learn and cope with new challenges even weeks or months after the stressful situation. In newly fledged raptors, this may compromise the ability to learn to hunt and, in turn, may reduce post-fledging survival. We investigated possible short- and long-term effects of a stress response during post-natal development in Eurasian Kestrels (*Falco tinnunculus*). During the nestling stage, we elevated circulating corticosterone levels moderately for a few days by inserting self-degradable corticosterone implants. In this way, we uncoupled the effects of a physiological stress response (elevated corticosterone levels) from food shortage, the most common stressor in altricial nestlings. We found that growth and T-cell-related immunocompetence was compromised in birds with elevated corticosterone compared with sham-implanted siblings. Corticosterone-implanted nestlings stayed longer in the nest than their siblings. We then followed the fledged young by telemetry until independence to investigate long-term effects on their ability to learn to catch prey and on survival.

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Tri-trophic effects of plant defenses: Chickadees consume caterpillars based on host leaf chemistry

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Few studies have addressed how plant chemical defenses that directly affect herbivores in turn affect consumption patterns of vertebrates at higher trophic levels. We studied how variable foliar chemistry of Trembling Aspen (*Populus tremuloides* Michx.) affects the diet preferences of an avian insectivore feeding on an introduced herbivore, the Gypsy Moth (*Lymantria dispar* L.). Black-capped Chickadees (*Poecile atricapilla*) were offered paired choices of Gypsy Moth caterpillars feeding on one of three genotypes of Aspen that differed in chemical composition. Chickadees chose to eat caterpillars fed Aspen foliage with low levels of both condensed tannins and phenolic glycosides, or caterpillars fed foliage with high levels of tannins and low levels of phenolic glycosides, over caterpillars fed foliage with low levels of condensed tannins and high levels of phenolic glycosides. In addition, diet choices of the birds were affected by their previous experience. These findings are consistent with the "extended phenotype" concept, in that genetically-based chemical traits in an ecologically dominant plant influence the feeding behavior of third trophic level organisms, whose efficacy as regulators of herbivore populations may in turn be modified.

Mullers R[1], Navarro R[2], Underhill L[2], Visser H[1]

Foraging behavior and chick growth in Cape Gannets: The role of behavioral flexibility

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Traditionally, the breeding ecology of marine birds is considered to be adaptive to sparse, patchy and unreliable food. The breeding season of Cape Gannets (*Morus capensis*) on Malgas Island, South Africa, extends from the end of September until the end of March, at a time when oceanic conditions and fish abundance around the colony change dramatically. The unpredictability and variability of food resources on both a temporal and spatial scale demand great behavioral flexibility from the gannets. During two breeding seasons, we investigated the behavioral consequences of oceanographic changes by relating feeding behavior in the adults to growth and survival in the chicks within and between seasons. Adult birds were deployed with GPS-dataloggers, which record the position of the birds at 10 second intervals, providing detailed information about their foraging behavior. Average trip duration was 23.5 hours (n=78, sd=11.7) in the first season and 24.6 hours (n=87, sd=13.1) in the second, varying between 3.1 hours and 54.0 hours. Mean distances covered during those trips were respectively 439 km (sd=197) and 465 km (sd=256), with a maximum trip length of 1221 km. During both seasons, chicks of different ages, and therefore different energetic requirements, were measured for growth at weekly intervals. As foraging conditions around the colonies showed high short-term variation, an effect on growth performance in the chicks was expected on a colony wide scale. We calculated an average growth index for every measuring period, and indeed found large fluctuations in growth performance during the breeding season. High variability in both foraging behavior and chick growth seems to reflect oceanographic changes within and between seasons. Our data support the view that marine birds possess high levels of behavioral flexibility in order to react to fluctuating conditions.

Mulsow R[1], Mitschke A[2], Kondziella B[1], Tschierske J[1]

The Bird-Life of Hamburg

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This poster offers: 1. A general characterization of geographic position and topography of the Hamburg area and a description of the main landscapes and marine influences towards explaining the high number of species in the area due to complex juxtaposition of water and land; 2. A map of Hamburg, showing some important habitats and their proportional size; 3. Two typical habitats and their bird communities, highlighting characteristic and dominant species, and the number and abundance of species; 4. The results of current projects being undertaken by the study group at the "Staatliche Vogelschutzwarte Hamburg" concerning the monitoring of breeding birds (e.g., increases in Winter Wrens *Troglodytes troglodytes*, and declines in House Sparrows *Passer domesticus*), mapping of territories to establish trends in abundance, mapping of population density in House Sparrows, water bird cencusing, garden bird censusing in winter, assessing migration and counting bird migrants, trapping and ringing at the "Reit-station", the Atlas of Hamburg breeding birds with distribution maps of some species, assessment of size and variation in the local breeding population of European Shags (*Phalacrocorax aristotelis*) over the last ten years, and occupation of the Hamburg Townhall by the Twite (*Carduelis flavirostris*) in winter. 5. A review of regional changes in birdlife over the last 100 years, covering extinct, adventive, declining and increasing species. 6. A comparison of present birdlife in at least three European cities: London(?), Hamburg, Berlin(?), and Warsaw. For more specific information on these topics, see *Hamburger Avifaunistische Beiträge*, Special 24th IOC - vol. 34.

Munclinger P[1], Albrecht T[2], Javurkova V[1], Honza M[2], Kreisinger J[1]

Non-invasive molecular analysis of reproductive strategies in Mallards

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Phenomena related to reproductive history (e.g., fidelity, re-nesting) and secondary reproductive strategies (nest parasitism, EPC) have become a hot topic in bird study in recent decades. Marking or genetic sampling of captured individuals are traditional methods in such research, but do not provide samples of satisfactory size. Newly emerging non-invasive alternatives may now be able to overcome such drawbacks. Waterfowl are particularly suitable candidates for non-invasive approaches as their nests are often left with both egg remnants of hatched young and feathers from incubating females that can be used as sources of individual DNA. Since such studies are still scarce in waterfowl, we tested the appropriateness of non-invasive techniques on the Mallard (*Anas platyrhynchos*). Nests were sampled throughout the breeding seasons of 2004 and 2005 around selected fishponds in the southern Czech Republic. Feathers of females, and egg membranes and dead embryos of young were collected and subsequently used for DNA extraction. Fragment analysis of polymorphic microsatellite loci revealed unequivocal evidence of conspecific nest parasitism, extra-pair fertilizations and female fidelity. As DNA contamination was surprisingly low and practically every nest and breeding female in the subpopulation was able to be tested, such non-invasive methods can yield data almost unobtainable by traditional methods.

Musil P, Nachtigalova M, Horak D, Brozova M, Musilova Z

Survival and movements in relation to condition in individually-marked broods of diving ducks on South Bohemian fishponds

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Survival and movements of broods of Common Pochards (*Aythya ferina*) and Tufted Ducks (*Aythya fuligula*) were investigated in relation to their condition on fishponds in South Bohemia between 2001 and 2005. Females of both species were caught on the nest using drop-door traps or flushed into mist nets nearby, then measured, weighed and color-marked; trapping was carried out late in incubation to prevent desertion. From this sampling, dispersal of about 45 female pochards and 35 females of Tufted Ducks, with their broods, was documented in 2005, reaching 2.8 km in the former and 3.2 km in the latter. The interactive effects of female condition, clutch investment, timing of breeding, weather condition, food availability and movements were also analyzed for both species. Preliminary results show that females of both species moved their broods preferentially to fishponds with clearer water, younger fish stocks, and rich supplies of invertebrate food. Duckling mortality was highest in the first week after hatching, and its daily rate was higher in larger broods. Mortality was nevertheless unaffected by the distance that broods moved; and older ducklings survived better during movements.

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What causes the changes over the winter in interference free intake rate in Oystercatchers: mussel quantity or quality?

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We explored how interference free intake rate changed over the winter in mussel feeding wintering Oystercatchers (*Haematopus ostralegus*). Birds were studied on the mussel (*Mytilus edulis*) beds of the Exe estuary, SW England during 1996-1997. We also investigated the prime factor that determines seasonal change in intake rate. Intake rate was measured as the mass of flesh consumed per unit time, a key variable in investigating starvation and wintering survival. Intake rate was significantly correlated with competitor density, season (quadratic effect), and the interaction between them. Interference free intake was 1.475g AFDM/10m on 26th September and declined to 0.679g AFDM/10m on 7th March, a reduction of 54%. This overwinter decrease may have been due to the decrease in the flesh content or depletion of the mussels. Intake rate might decrease because (i) the length of mussels taken decreases, (ii) the numbers of mussels taken per unit time ('feeding rate') decreases, or (iii) the flesh content of mussels of a given length decreases. To investigate the relative importance of these three factors, we regressed the intake rate against mean mussel length, feeding rate, and flesh content across the winter, and then calculated the Standardized Partial Regression Coefficients. By far the largest coefficient was the one for the flesh content (measured as Ash Free Dry Mass of mussels of a standard 45-mm length). From this it was inferred that this was the most influential factor on intake rate. In contrast, mussel length was only on the margins of significance, and feeding rate did not have a significant influence at all. Therefore most of the observed overwinter decrease in interference free intake rate occurred because the flesh content of individual mussels decreased by about half. Only a small part of the decrease (some 12%) could have been due to other changes in the food supply of the birds.

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Territory defense in Common Nightingales: effects of territory quality and time of residency

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Male songbirds defend their territories with a vigor that can vary substantially among individuals. Yet there is little information on the extent to which such variation is linked to the quality of either male or territory, or to time of residence. If males in better territories are aware of territory quality or if they are of intrinsic high quality, then it might be expected that defense of territory is linked to such qualities, traits that are likely to be correlated. These factors, moreover, can be important for males aiming to obtain information about the status or quality of another resident male or the quality of its territory. To investigate this, we conducted playback experiments on male Common Nightingales (*Luscinia megarhynchosi*) in territories of putatively different quality. Using our long term data on territory occupation, we rated territory quality by the number of previous years that the territory had been occupied. Moreover, we determined pairing success for each male. Subjects were challenged by playback simulating a singing intruder. As reported, responses by resident males provide insights into the extent to which intensity of territory defense is linked to male or territory quality.

Nakamura E, Yoshioka S, Kinoshita S

The origin of two-color iridescence in the neck feathers of the Rock Dove

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The neck feathers of the Rock Dove (*Columba livia*) exhibit metallic green and purplish colors. These brilliant colors are good examples of structural color, which has a physical, not pigmentary origin. Structural color is usually produced by optical interference by a periodic structure of submicron size. The color varies when the viewing or illumination angle is changed under conditions of optical interference. The appearance of the neck feathers of the dove is very specific here, because only green or purplish colors are shown and the other colors of the spectrum do not appear even when the viewing angle is changed. To investigate the origin of such two-color iridescence, we performed microscopic observations using scanning and transmission electron microscopes, and measured the reflectance spectrum of the feathers quantitatively. What we found inside the feather is a surprisingly simple structure comprising a thin-film, which nevertheless exhibits the optically specific characteristics described above. It is clear that the two-color iridescence registers with the spectral characteristics of human vision, and possibly also to avian vision. Yet its reflectance spectrum is somewhat different from a thin-film interference in the intensity of its distribution. We discuss the origin of two-color iridescence in the Rock Dove both from a purely optical aspect and from the physiological aspect of vision.

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Iridescent plumage color, individual quality and reproductive success in Black-billed Magpies

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Structural coloration produced by feather microstructure is associated with environmental condition during feather formation. We tested the hypothesis that iridescent plumage color is an honest signal of individual quality in Black-billed Magpies (*Pica pica sericea*), which are socially monogamous and presumed to be sexually monochromatic. We investigated iridescent plumage color of secondary and tail feathers with a spectrophotometer just after the molting season, and measured physiological characteristics and breeding success in the ensuing year. We found that plumage color differed between age and sex classes, tail color in particular being brighter in males than females. Tail brightness in adult male magpies, moreover, was related to their condition. Size and relative length of tail correlated positively with tail brightness, supporting the prediction that tail brightness represents a burden. Successful males in the ensuing breeding season tended to have brighter tails than males that failed and non-breeding males which did not occupy territories. Tail brightness was also associated with earlier breeding, and so potentially advantageous for offspring. It thus appears that tail color in male magpies is an indicator of quality and a sexually selected trait.

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Effects of thiourea, cyproterone acetate and enheptin on plumage pigmentation and steroid dehydrogenase activity in the crown skin of breeding male Baya Weavers

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Plumage pigmentation and steroid dehydrogenase (17B- and 3B-HSDH) activity under the influence of thiourea, cyproterone acetate and enheptin were investigated in the crown skin of breeding Indian male Baya Weavers (*Ploceus philippinus*). Thiourea administration resulted in production of dull yellow feathers with decreased pigmentation; intensity of pigmentation in the bill also fell. The activities of both 17B-(T & E) and 3B-HSDH(P & D) - with testosterone (T), estradiol-17B (E), pregnenolone (P) and dehydroepiandrosterone (D) as respective substrates - declined in the crown skin. Cyproterone administration resulted in higher concentration of melanin pigments in crown feathers; but again bill pigmentation paled. While the activity of 17B-HSDH(T) and 3B-HSDH(P & D) activity increased in the crown skin, that of 17B-HSDH(E) declined. Enheptin administration to breeding males brought about a loss of both carotenoid and melanin pigmentation in regenerating crown feathers; but no pigmentary changes were registered in the bill. Both 17B-(T & E) and 3B- HSDH(P & D) activities in the crown skin decreased in comparison with control birds.

Navarro J, González-Solis J

Experimental increase of foraging effort in a pelagic seabird: Effects on biochemical, hematological and muscular parameters

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How birds budget the resources needed for flight, particularly fat, protein and water, has been the subject of much study. Less consideration, however, has been given to the influence of other, non-resource-based effects of flight on foraging strategies. Here we explored the consequences of an experimental increase in flying costs during one foraging trip on several physiological parameters in Cory's Shearwater (*Calonectris diomedea*). We handicapped 11 females by increasing their body mass by 7%, and compared their different muscular, hematological and biochemical parameters with those in 11 control females on a single foraging trip during the incubation period. Furthermore, we also measured the effect of the treatment on foraging effort over time and on the immune system by phytohemagglutin immune assay, PHA. Muscular enzymes produced - lactate dehydrogenase and creatinine kinase - and foraging effort were higher in handicapped birds. Hematological and biochemical measures, however, did not differ from those in the controls, nor did immune response.

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Size dependence of morphological integration in the true finches, Fringillidae

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Size is a key factor in the evolution of morphological diversity in the true finches, Fringillidae. In PCA analyses of the osteometrics of 43 species using 42 skeletal characters from 313 specimens, 85% of variability was found due to changes in overall size, and only nine percent contributes to variation other than size. Skeletal elements are highly intercorrelated and combined into coevolving functional modules. Single linkage cluster analyses extracted two main units or modules of highly integrated character complexes and several unintegrated single elements. The first main module combines parameters of the flying apparatus, and the second parameters of skull and hindlimbs. Within the second module, several subunits of covarying traits are identified that are fused at high levels of intregration. We addressed the questions of whether and to which extent single characters and integrated modules and their subunits are size dependent. To test hypotheses about the impact of size, log-transformed species means of body mass were taken as predictors and extracted from log-transformed species means of osteometrics by partial regression analysis. Single linkage clusters of body mass-controlled characters illustrate the degree of their morphological integration. All 42 skeletal characters prove to be highly size dependent, regardless of their functional origin. The two main modules and most of their subunits are identified in the body mass-controlled data set in identical positions. The fundamental pattern of the modules, and character composition within the modules, remain intact. Sole fusion levels, measured by coefficients of determination, are generally lower than in original data. Thus we conclude that the impact of body mass reflects the strength of morphological integration but has only minor effects on modularity itself.

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Are European Starlings that breeding in the Azores genetically different from mainland Europe birds?

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The European Starling (*Sturnus vulgaris*) has the largest geographical range of any species of its genus, extending across several natural barriers considered to have generated a number of subspecies. Morphological differences between the subspecies are nevertheless subtle, and there is considerable overlap among them. The occurrence of the European Starling in the Azores archipelago is itself intriguing because the species does not breed in mainland Portugal nor in the other Macaronesian archipelagos, such as Madeira and Canaries, begging the questions: how did starlings reach the Azores, naturally or via human agency? And if they arrived naturally, have they differentiated from other European populations, by how much and when? This study addresses the phylogenetics of the Azores population by comparing sequences of the mitochondrial DNA gene ND2 from four populations: *granti* from the Azores, nominate *vulgaris* from Spain, *zetlandicus* from northwest Scotland, and nominate *vulgaris* again, from southwest England. ND2 seems to offer potential for resolving relationships among different subspecies of European Starlings. Our preliminary results show no genetic variation among samples from the Azores individuals, and indicate that birds from northwest Scotland share haplotypes found in populations of the nominate subspecies, raising doubts about their subspecific status. Broader sampling of other populations might provide clearer clues to the closest relatives and source of the starlings in the Azores.

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Improving estimates of breeding success in the Titi, a burrow-nesting seabird

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The burrowscope has been used as a key tool for assessing burrow occupancy in the *Kia Mau Te Titi Mo Ake Tonu Atu* Research Project, a long term study to assess the sustainability of the Titi or Sooty Shearwater (*Puffinus griseus*) harvest by Rakiura Maori people. In population modeling, breeding success is often assumed to be one of the easier demographic parameters to measure. Yet this is an assumption that is highly questionable for burrow-nesting birds like the Titi because issues of burrow occupancy can be confounded by biases in detectability. To overcome such bias, we accordingly compare and contrast basic estimates of breeding success from nine years of monitoring using two alternative approaches. In the first approach, we use a burrowscope "correction factor" to adjust the raw data for those breeding attempts that were missed by burrowscope checks at either hatching or fledging. In the second approach, we use a Bayesian inference approach to utilise as much information as possible from repeated burrow checks throughout each season. Preliminary adjustments to the raw estimate from the two approaches produced similar increases in breeding success, which did not, however, differ significantly, indicating merit in both. In this presentation, the usefulness and utility of the two approaches is compared with raw estimates using the full nine year dataset, and their implications for the population model being developed by our research team is discussed.

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Song dialect boundaries in the Yellowhammer: Do they restrict gene flow?

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The Yellowhammer (*Emberiza citrinella*) occurs in open habitats throughout most of Europe. It also exhibits geographic variation in song structure, learning local dialects from neighbors yet maintaing species-specific song elements such that information exchange remains possible between dialects. Yellowhammer song consists of two parts, the first a repetition of double elements, and the second comprising different elements in combinations characteristic of a dialect. Previous studies indicate that the geographic distribution of dialects and their boundaries have been constant over time. We recorded songs and collected blood samples along a north-south transect covering three different dialects in eastern Germany to test whether (1) populations singing different dialects are genetically homogeneous (panmictic), or (2) their pattern of genetic structuring coincides with the geographic distribution of dialects. Bioacustic analyses corroborated previous studies in confirming the maintenance of the three dialects along the transect over the last 50 years. Yet microsatellite DNA data for 6 polymorphic loci did not reveal any genetic separation between the dialect groups, leading us to conclude that gene flow has continued across dialect boundaries notwithstanding.

Nilsson ALK

Partial migration: A Blue Tit perspective

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Partial migration is common among birds and includes two fractions: passage migrants and locally-moving residents. I compared the responses of locally migratory Blue Tits *Parus caeruleus* and more regular long-distance migrants to weather variables, finding a striking negative correlation between cloud cover and response in the tits. Moreover, weather explained more of the variation in blue tit response than for regular migrants. Thus it seems that Blue Tits prefer to move only when conditions are safest, in calm weather under clear skies when all cues for orientation are available. What then determines the decision to migrate or remain resident? Dominance has been shown to be a factor, as dominant individuals force subordinates off territories to migrate. I performed a test of dominance on migratory and resident Blue Tits to evaluate whether dominance continued during migration. No consistent effects were found. Cloud cover, nevertheless, altered dominance status between migrants and residents. Under clear skies, migrants dominated residents, perhaps motivated by migratory restlessness caused by favorable conditions. Environmental change caused by global warming is predicted to be selectively disadvantageous for migrants: as the environment becomes milder, more individuals become resident, such that the ratio of migrants to resident breeders is expected to decline. This, nevertheless, is contradicted by a constant ratio of migratory to resident breeding individuals in Blue Tits, contrary to predictions about how global warming will affect populations comprising both migrants and residents.

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Genetic divergence and phylogeography in Styan's Grasshopper Warbler: Cryptic species, subspecies or just populations?

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Phylogeographical analysis can uncover cryptic species, but the final taxonomic decision is not always easy. Styan's Grasshopper Warbler (*Locustella pleskei*) is listed as a vulnerable species, and is a very local summer visitor to small islands in the extreme south of the Russian Far East, Korea and Japan. It was formerly considered conspecific with *Locustella ochotensis*, its counterpart form in the northern Russian Far East and Hokkaido, but the two are currently considered geographical replacement species. We sequenced the partial control region, ND2 and cytochrome b (cyt b) genes (total 2.8 kb) in the mitochondrial DNA of *L. pleskei* from islands covering nearly all of its breeding range: a small island in Peter the Great Bay, Ulleung-do (Dagelet Island), small islands off south-western Korea, and small islands around Kyushu, southern Honshu and the Izu Islands, Japan. The data were then compared with comparable sequences from *L. ochotensis*. We found two lineages in *L. pleskei*, the divergence time for which is estimated at 0.7 million years (MY) ago on the assumption of a constant rate of substitution of 2 %/MY in the cyt b gene. One lineage comprises the populations on Peter the Great Bay and Ulleung-do, and the other occurs in south-western Korea and all locations in Japan. The latter is more closely related to *L. ochotensis* in its mtDNA than to the former (0.9% and 1.5% differences in cyt b, respectively), but both are very similar to one another morphologically. The results suggest that *L. pleskei* comprises two subspecies which are not very closely related, and from which *L. ochotensis* was apparently derived.

Nittinger F, Gamauf A, Haring E, Pinsker W

Phylogeography, phylogeny and population genetics of falcons of the *Hierofalco* complex

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The *Hierofalco* complex comprises the Lanner (*Falco biarmicus*), Saker (*F. cherrug*), Laggar (*F. jugger*) and Gyr (*F. rusticolus*) Falcons, a group of morphologically and ecologically similar raptors. The phylogeographic history, phylogenetic relaytionships and role of interspecific gene flow among members of the complex were investigated using mitochondrial DNA sequences. We determined sequence variation in a section of the mitochondrial control region, and also analyzed nuclear DNA markers (microsatellites) covering all species from all parts of their ranges. In the mitochondrial haplotype network, all species were closely related without clustering into subclades, suggesting rather recent radiation in the complex; and pattern of haplotype distribution and high intra-specific diversity in *F. biarmicus* suggests, moreover, that the group originated out of Africa. Microsatellite markers confirm little genetic differentiation among the four species, in particular between *F. cherrug* and *F. rusticolus*. The occurrence of common microsatellite alleles in different *Hierofalco* species and the distribution of mitochondrial haplotypes may be explained either by ancestral polymorphisms or by sporadic gene flow, both of which we assume are responsible for the observed pattern. In central Europe, moreover, gene flow mediated by artificial hybrids that escaped from falconry may be involved.

Nomoto S

LPS fever and its final mediator in pigeons (Rock Doves)

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It is well known that injections of bacterial endotoxin (LPS: lipopolysaccharide) induce fever in mammals. Little, however, is known about the febrile response of birds. Furthermore, conflicting results have been reported questioning the ability of birds to respond to LPS with fever. To investigate ability to develop fever in birds, pigeons (*Columba livia*) were injected intravenously with LPS. Prostaglandins have been considered to be a final mediator of fevers in mammals. To investigate involvement of prostaglandins in fevers in birds, pigeons were also injected intravenously with either indomethacin (INDO) or aspirin, blockers of prostaglandin synthesis, at various times before and after LPS injections. The animals were housed in individual cages in a climatic chamber at 26±1°C with light on at 09:00 and off at 21:00 hours. Core temperatures (Tcore) were measured by a biotelemetry system (DATAQUEST LabPRO, Data Science Inc., USA). A battery-operated transmitter was implanted intraperitoneally. LPS at a dose of 10 µg/kg was injected at 13:00 through a chronically implanted catheter. INDO at a dose of 10 mg/kg was injected either 30 or 15 minutes before LPS or 2 or 4 hours after. Aspirin at a dose of 100 mg/kg was injected 15 minutes before LPS. Injection of 10 µg/kg LPS at 13:00 hours evoked a biphasic rise of Tcore in pigeons, inducing, with a latency of 30 minutes, first a decrease, and then, after 90 minutes, an increase, reaching maximum values from 18:00 to 20:00 hours. When INDO or aspirin was injected 30 or 15 minutes before LPS, it diminished the initial decrease of Tcore by more than 50%, whereas intravenous injection of these drugs 2 or 4 hours after LPS administration did not affect the febrile rise of Tcore. These results suggest that pigeons were able to develop fever following intravenous injection of LPS, and that prostaglandins are not involved in the febrile elevation of Tcore, but appear to participate in the decrease of Tcore which follows shortly after injection of LPS.

Noske R

Biannual breeding seasons in monsoon-tropical Australia: Why do it?

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Whereas most passerines in temperate Australia breed during the austral spring and molt in late summer, many species of the strongly seasonal monsoon tropics in northwest Australia breed during autumn and winter, and begin their molt in early spring. Several such species breed biannually, with peaks in April-May and September-October, corresponding to the beginning and end of the 6-month dry season. All are small insectivores and occur in mangroves, but their phylogeny and breeding biology varies. Their reproductive seasonality corresponds to the bimodal seasonality shown by mangrove-dwelling insects, but generalised linear modeling suggests that nest predation may constrain the timing of breeding in at least some species. The potential role of biotic and physical factors is explored in this poster.

Numata S, Takeuchi K

Breeding site preferences of the Japanese Marsh Warbler in managed reedbeds in Japan

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Over the past three decades, the reedbeds of the lower Iwaki River, Japan, have become well known as a breeding area for the Japanese Marsh Warbler (*Megalurus pryeri*). People in this region use reeds and manage the reedbeds by cutting stems in winter and burning parts of the reedbed in spring for regrowth. Such activities seem to create suitable habitat for the marsh warbler. Our investigation examined the interaction between reedbed management and breeding site selection in this species. In spring, Japanese Marsh Warblers arrive on their breeding grounds on the lower Iwaki and settle in unburnt areas wherever patches of dead reeds remain. Not all unburnt areas are occupied by territorial males however. Instead the warblers selected patches in which some sedges and other bottom weeds are present, suggesting that bottom weed rather than reeds are essential breeding habitat. As well as burning, we conclude that microtopography and soil moisture content are also important for the development of such habitat. Unburnt areas were used continuously by large numbers of warblers until the end of the breeding season, and only as that time approached, over summer, did the birds begin to disperse gradually to burnt areas where new reeds had grown. The burning of the reeds was carried out in different areas in 2002, 2003 and 2004, with the result that the territories of marsh warblers shifted about. These results highlight the importance of unburnt areas for breeding, yet also suggest that reedbed management by burning to prevent vegetational succession contributes to the maintenance of breeding and habitat for the Japanese Marsh Warbler as well.

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The endemic and threatened avifauna of the Malindang Range, Philippines

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From October 2003 to December 2004, the bird fauna of Mt. Malindang on Mindanao, Philippines, was surveyed to assess faunal diversity for better understanding and management of critical natural resources in the region. Mist-netting and line transect recording were carried out between 120 and 1700 m asl in eight different forest types, in sequence from high to low altitudes: mossy, montane, almaciga, submontane, dipterocarp, lowland dipterocarp, mixed dipterocarp, and plantation forest. The local agroecosystem was also surveyed. The combined dataset revealed an avifauna of 162 species, 66 of which were endemic, including 16 restricted to Mindanao. Nine threatened species were recorded, including three vulnerable and two endangered. Species richness was highest in the agroecosystems but endemism and species diversity were highest (H'=1.775) in submontane dipterocarp forest. Despite habitat degradation in the agroecosystem, a substantial number of endemic and threatened species was found there too. Most endemic and threatened species, nevertheless, were confined to relatively undisturbed forests at higher elevations at submontane and montane levels. Several species on the IUCN Red List were found to be threatened locally due to resource extraction practise. Our results show that the higher altitude forests are the critical habitats for the more distictinctive and endemic elements of the regional bird fauna. Yet in formulating a conservation plan for the Malindang Range, attention should also be given to the agroecosystems and forests in the lowlands, as these areas support a considerable number of endemic and threatened species too.

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The Myanmar Bird and Nature Society

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Myanmar (Burma) has recently made ornithological news as the site of rediscovery of a substantial population of the critically endangered Gurney's Pitta (*Pitta gurney*); and there are also reports that the Pink-headed Duck (*Rhodonessa caryophyllacea*), thought to be extinct since the 1930s, might still survive in its remote northern valleys. Myanmar still preserves large areas of relatively undisturbed habitat. Due to the political isolation of the country during the latter half of the 20th century, these areas have remained relatively intact for a long time. But, with their opening to the west in recent years, they have come under increasing pressure. Even though there are 38 protected areas in the country, the concept of nature conservation is relatively new to the people of Myanmar, and thus protected areas there cannot be compared with similar areas in more developed countries. Most national parks have only limited resources for enforcing conservation laws, and threats from hunting and logging are common. In the 1990s, several international organizations, notably BirdLife International and the Wildlife Conservation Society, started to work with the forest department of Myanmar to survey and protect as many important sites as possible. Yet success in protecting natural resources depends ultimately on support from the people directly involved, and accordingly the Myanmar Bird and Nature Society (MBNS) was founded in 2000 with the aim of creating the first conservation NGO working within Myanmar. Besides serving birdwatchers and ornithologists, the MBNS is concerned with raising awareness about the natural riches of Myanmar among its general public, thereby creating a broader basis for environmental work. Among the projects the society has been involved with are an education program for schools, bird surveys, and open birdwatching workshops in Yangon. Our poster gives an introduction to the work of the MBNS.

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Phylogenetic relationships of the cotingas (Passeriformes: Cotingidae)

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The phylogenetic relationships of the family Cotingidae were investigated using >2100 bp of sequence data from two nuclear introns (myoglobin intron-2 and G3PDH intron-11) and one protein-coding mitochondrial gene (cytochrome b). A monophyletic clade corresponding to Cotingidae *sensu* Remsen et al. 2005 (www.museum.lsu.edu/~Remsen/SACCBaseline.html) was recovered both in analyses of the individual genes and the combined data set, and was further supported by three synapomorphic indel events. Both Tityrinae and *Oxyruncus* fall outside of Cotingidae, but their position in Tyrannoidea is still unclear. Within Cotingidae, four main clades were recovered: (1) the fruiteaters, (2) *Rupicola* and *Phoenicircus*, (3) *Ampelion*, *Doliornis*, *Phytotoma* and *Zaratornis*, and (4) a large clade consisting of the remainder of the cotingas with *Snowornis* in a basal position. Clade 4 itself comprises three well-supported sub-clades. The first includes four genera of fruitcrows, the second six genera of canopy-living cotingas (e.g. *Carpodectes*, *Procnias* and *Gymnoderus*), and the third *Lipaugus* and *Tijuca*. Their inter-relationships and the position of *Cotinga* and *Haematoderus* are not resolved. Although results are not conclusive, polygyny and elaborate male display appear to arisen twice in Cotingidae. Due to poor resolution at the deep nodes in the family clade, only preliminary conclusions can be drawn about biogeographic history. There is a clear ecological and geographical disjunction between three of the four clades: clade 1 occurs in humid montane forest, clade 3 in semi-arid and tree-line habitats, and clade 4 in humid lowland forest; the distribution of clade 2 overlaps those of clades 1 and 4.

Okafor C[1], Mwansat G[1], Manu S[1], Ottosson U[2]

Bird activity level related to temperature and wind velocity in the tropics

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Energy transfer between birds and their environment is effected mainly by change in climatic factors such as temperature, wind velocity, precipitation and humidity. Energetic costs should be influenced by ambient temperature, which could bring about changes in survival, breeding and population dynamics. In the tropics, very little has been documented of the effects of climatic variables on bird activity. Accordingly, the effects of temperature and wind velocity on bird activity were studied in the Amurum Forest Reserve, Jos Nigeria, between February and April 2004. Effects were determined from 300 counts at 10 points distributed across four habitat types: rocky outcrop, gallery forest, open savanna, and a mixed habitat comprising a combination of all first three habitat types. A total of 2,511 birds and 109 species where recorded. Fourteen activities where recorded, but due to insufficient data, only four were analyzed: calling (songs inclusive), flying, foraging, and perching. As temperature increased towards midday, the number of birds foraging, perching and calling declined. In the tropics, midday heat may impose great costs, and to avoid overheating, birds retreat to shade, reducing activity. Birds were also heard less whenever the speed of wind increased. During high winds, birds tend to take shelter; and side effects then, as from rustling leaves, can also affect sound detection.

Nesterenko O

Use of DNA analysis for sexing birds in breeding programs

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The breeding of endangered species in zoos and breeding centers is important for the conservation of such species insofar as it can complement and support their conservation in natural habitats. Yet one reason for the many unsuccessful attempts to breed endangered bird species in captivity is incorrect sexing, making the development of sex-identification techniques a valuable aid in breeding programs. Sex identification is especially important for juveniles, because they potentially pair and translocate more easily than older birds. To develop a method for sex identifcation in them, we used a test based on the two conserved chromo-helicase-DNA- binding genes (CHD-W and CHD-Z) that are located on the avian sex chromosomes. Two PCR primers (P2 and P8) are employed. The gene products of CHD-W and CHD-Z differ in size, for which gel electrophoresis (6%, 8% and 15% acrilamide gel, 8% denaturing acrilamide gel) shows one band for a male and two for a female. The method can be used to sex birds throughout the class Aves, except in the ratites. Between 2001-2004, we successfully sexed about 400 individuals of 33 species, including cranes, raptors, storks, swans and parrots, from breeding centers and zoos in Russia. The method is amenable to storing feather and blood samples for long periods as well as to their transport over long distances.

Olson CR, Vleck CM, Vleck D

Plasticity of embryonic growth rate and metabolism in the face of periodic cooling in House Wrens

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Thermal fluctuations in egg temperature are common in passerines that incubate intermittently. Resultant periodic cooling varies in amplitude and duration, and contributes to lower mean egg temperatures over the incubation period. We periodically cooled House Wren (*Troglodytes aedon*) eggs to investigate consequences of cooling on growth rate and metabolism. Eggs were kept either in a constant temperature environment (37.5°C) or briefly cooled to 20°C at 15 times a day. Cooled eggs experienced a mean temperature of 35.2°C. Oxygen consumption of individual eggs was measured at two day intervals in metabolism chambers at 37.5°C. We terminated incubation at 12 days and measured embryo mass and remaining yolk mass. Embryonic development in cooled eggs was then compared with a baseline growth curve for eggs incubated at constant temperature. Embryos from cooled eggs were 43% smaller than those incubated at constant temperature, and were ~2 days behind in growth, based on our growth curve. Remaining yolk mass was not detectably different between the two groups, suggesting that greater yolk reserves had been used up in the cooled eggs for the size of embryo produced. After 12 days of development, the metabolic rate of periodically cooled eggs was 16% less than that in eggs held at constant temperature. However, periodically cooled eggs had a mass-specific metabolism that was ~20% higher than in constant temperature eggs. Costs associated with periodic cooling thus include extended development time prior to hatching and increased mass-specific energy consumption, suggesting lower efficiency in growth and possibly a reduction in yolk reserves. Along with predation risk and adult energy requirements, the effects of cooling on embryo growth and metabolic physiology should be considered as constraints on adult nest attentiveness.

Opaev A, Marova I, Ivanitskii V

Sequential organization of song in the Great Reed Warbler

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We examined the advertizing songs of the Great Reed Warbler (*Acrocephalus arundinaceus*) in the area of the Sea of Azov, discriminating four levels of organization. At the first level are single notes, of which there are about 15-20 note types in the repertoire of a single male. These notes can be grouped into tonal, harmonic and broadband notes. Broadband notes are the most common, comprising 64.8% of all elements in the song. At the second level are homotypic series, comprising up to 8 identical notes (mean 3.46±1.29). Most notes in homotypic series are generated from broadband notes, 67% of which make up homotypic series of different length in the song. At the third level are elementary phrases of 2-4 different elements, the majority of which are generated from tonal and harmonic notes. Altogether, 18 such stereotypic phrases were identified, but the three most common contain 27.3% of all tonal and harmonic syllables in the song; the other phrases are much scarcer. At the fourth level are complicated phrases. Complicated phrases are generated from combinations of the most common types of stereotypic phrases of tonal and harmonic notes and homotypic series of broadband notes. Altogether we identified only 5 types of complicated phrases. Complicated phrases were usually uttered at the beginning of song: 81% of songs began with one of them. As complicated phrases are each only 1.6±0.17 seconds long compared to 3.31±1.06 seconds for the whole song, they rarely form the whole song. According to our investigations, the structure of Great Reed Warbler advertising song seems to be more complex than that of the closely-related Oriental Reed Warbler (*Acrocephalus orientalis*. Supported by the Russian Fund for Basic Research (04-04-49602, 04-04-49276).

Oschadleus H-D

Roosting behavior in Southern Masked Weavers (Ploceidae) in South Africa

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Roosting behavior in Southern Masked Weavers (*Ploceus velatus*) was monitored at 25°44’S 28°16’E in suburban Pretoria, South Africa. Observations, counts and ringing were conducted from July 1995 through the breeding season until August 1996. Roost sites varied within the study area. After foraging in nearby parks and gardens during the day, small groups of weavers start arriving in the area of the roost about an hour before sunset, becoming very active in trees around the final roost site. Activities include flying from twig to twig, preening, stripping leaves from branches, partial nest-building and calling. As the numbers of birds increase, so does the volume of song. The main retreat into the final roost site occurs around 20 minutes before sunset. By the time the sun sets, all the birds are in the roost where calling continues until after dark. In the mornings, the weavers start calling half an hour before sunrise and leave the roost within about 10 minutes, flying to the tops of nearby trees in a nearly continuous stream. From there they fly off in small groups of 5 to 15 birds, dispersing in different directions. By sunrise, the birds have departed, over a much shorter time than in evening arrival. Weavers are thought to roost communally in order to share information about good food sources. The behavior observed fits this hyphothesis.

Owen J, Moore F

Seasonal variation in the immune function of two species of nearctic-neotropical landbird migrants, the Veery and Wood Thrush

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We investigated seasonal variation in immune function in two species of nearctic-neotropical landbird migrants, the Veery (*Catharus fuscescens*) and Wood Thrush (*Hylocichla mustelina*). Birds were captured during the breeding season in Michigan and Pennsylvania, and immediately prior to and after crossing the Gulf of Mexico on autumn and spring migration, in Alabama and Louisiana respectively. To assess the strength of the immune system, we examined absolute and differential leukocyte count, relative spleen mass, and the distribution of lymphocytes in the spleen. Assuming these measures to be reliable indicators of immune function, we address the following questions: (1) are birds immunocompromised during migration relative to the breeding period? (2) is immunosuppression greater in spring after birds have crossed an ecological barrier than before it in autumn? (3) and do peripheral leukocyte counts correspond with variation in relative spleen mass and lymphoid activity in the spleen? We further examine variations in the parameters associated with migratory distance, energetic condition, age, and sex. Migrating birds had lower lymphocyte counts and higher H/L ratios than breeders. Moreover, birds captured during spring migration were more immunocompromised than in autumn. Wood Thrush, a medium-distance migrant, had higher leukocyte and lymphocyte counts and larger relative spleen mass than the Veery, a long-distance migrant. Relative spleen mass was positively correlated with overall leukocyte count, particularly lymphocyte count. These and other results to be presented will provide a comprehensive picture of the seasonal variation in the immune system of two nearctic-neotropical landbird migrants.

Pagán Abellán I, Martinez JE, Palazón JA, Calvo Sendín JF

Use of habitat by Booted Eagles in a Special Protection Area: Implications for conservation

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Using radio-tracking methods, we analyzed habitat use by Booted Eagles (*Hieraaetus pennatus*) in a Special Protection Area in southeastern Spain. Six adults, four females and two males were trapped between 1999 and 2003, and radio-tagged. Home ranges, estimated from recorded signals using the Minimum Convex Polygon method, were large, varying between 4542 to 14266 ha; a substantial proportion of most extended outside the protected area. For hunting, the eagles showed a marked preference for scrubland ecotones and dryland crop field, but nested in forested land, implying that their conservation depends on the protection of both forest areas and wide buffer zones that include traditional agricultural systems. Thus an effective conservation strategy for this forest raptor should comprise in its design a network of protected areas based on broad-scale criteria, in which traditional agro-ecoystems are included.

Pam GB, Ottosson U

Habitat selection in the Rock Firefinch

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Observational studies of the Rock Firefinch (*Lagonosticta sanguinodorsalis*) were carried out during the dry season in the Amurum Forest Reserve Jos, north central Nigeria, between February and April 2004. The study focused on determining the habitat variables that affected spatial distribution, habitat preferences and utilization, and daily foraging routines. Line transect and radio-tracking methods were used. Five individuals were radio-tagged and tracked to document the range of habitat use within the Reserve. Habitats with extensive canopy cover and subshrubberies were preferred, and those most utilized were rocky outcrops, woodland and gallery forest. The findings of this study suggest that cover and water availability are among the factors that determine the choice of habitats in the firefinches during the dry season. This has implications for the conservation of this species which is endemic to the Jos Plateau.

Pampus M

How to pick fellow peckers: Social structure in flocks of feeding tits

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Feeding patterns of color-marked tits and Eurasian Nuthatches (*Sitta europea*) at an artificial feeder were analyzed for intra- and inter- specific coherence, dominance, and flock cohesion. Observations were carried out in a mixed deciduous forest near Schlüchtern, Hesse, in Germany. Flock structure was found to be correlated with temperature and day-length. Flock composition changed constantly during the day because individuals failed to form groups of constant composition. Results from using an Artificial Neural Net to determine relations among individuals are described.

Pap PL[1], Tökölyi J[1], Vágási CI[1], Barta Z[2]

Adaptive allocation of condition-dependent feather abnormalities during ontogeny and molt in the Great Tit

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Stress-induced abnormalities encountered during growth have serious effects on the quality of flight feathers, as the lag in deposition of keratin reduces resistance to wear and increases the probability of feather breakage during the annual cycle. Birds are thus under strong selective pressure to reduce deformities in feathers. Preliminary results from our studies show that fledgling Great Tits (*Parus major*) reared in the same environment have similar feather quality and abnormalities that are related to their condition and immunocompetence during ontogeny. Fault bars developed during the post-fledgling period were significantly more common on tail and inner wing feathers than on primaries more important in flight, indicating an adaptive partitioning of stress-induced abnormalities in the remiges. During post-juvenal molt, the frequency of fault bar occurrence dropped significantly due to replacement of tail feathers and tertiaries. Here the decline in the number of fault bars is condition-dependent, emphasizing the role of immunocompetence in determining feather quality during molt and indicating that the effects of condition on feather quality during ontogeny and molt are correlated and additive. The roles of condition and immunocompetence in determining feather quality during annual molt in adults, and the role of feather quality in determining fitness through timing of reproduction, are also discussed.

Park C-R[1], Lee C[2], Lim J-H[1], Kim YK[1]

Prey distribution, foliage structure and foraging behavior of insectivorous birds in temperate deciduous forests in Korea

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We hypothesized that different foliage arrangement and prey-size distribution would affect foraging efficiency and maneuvering in four parid passerines: the Great Tit (*Parus major*), Varied Tit (*P. varius*), Marsh Tit (*P. palustris*) and Coal Tit (*P. ater*). Data on foliage arrangement, prey-size distribution and foraging niche were collected in a 10 ha plot of temperate deciduous forest during the breeding season from 2003 to 2005. We calculated four indices of prey-size distribution on five major trees: *Quercus serrata* (Qs), *Carpinus cordata* (Cc), *C. laxiflora* (Cl), *Acer* *pseudo-sieboldianum* (Ap), and *Styrax obassia* (So). Qs supported high total biomass of insects, Ap had high average dry weight of leaf per area, So had average dry weight per leaf, Ap showed elevated type, and Cc and Cl showed the flatted type; in Qs, the type of foliage arrangement was mixed. Although Cc and Cl were alike in foliage arrangement, tits utilized the hanging maneuver more frequently when foraging in the leaves of Cl. Tits also used the hanging maneuver predominantly in the leaves of So for picking out lepidopteran larvae enrolled within relatively large leaves. We discuss inter-specific interactions in foraging maneuvers in tits, prey-size distribution and foliage arrangement in temperate deciduous forests.

Park HC, Park JY, Cha JS, Kim JW, Lee HJ

Wintering pattern of birds at the Ramsar site, Upo Wetland, in Korea

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We surveyed wintering bird species at the Upo Wetland, a Ramsar site in Korea, from October 2004 to June 2005 as part of a long-term ecological research program. Bird counts were carried out at 13 sites in 5 areas, recording a total of 13,083 individual birds of 81 species in the first year of survey. Bean Goose (*Anser fabalis*) was the most abundant species at 32.2% of numbers recorded. Accordingly, we selected the Bean Goose, as well as the Eurasian Spoonbill (*Platalea leucorodia*), Whooper Swan (*Cygnus cygnus*), Falcated Teal (*Anas falcata*), and several herons and egrets as target species for the long-term ecological research. Eurasian Spoonbills used a local site, at Sajipo, for roosting throughout the whole winter. The most important requirements for wintering birds on the wetland were vegetational forage in farming areas, water levels in the wetland, and human activity such as fishing.

Partecke J, Schwabl H

Long-lasting effects of yolk testosterone on brain function, physiology and behavior in adult House Sparrows

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The transmission of maternally-derived sex steroid hormones in the yolk of eggs is a common phenomenon in various oviparous vertebrates. These yolk hormones are said to provide a hormonal link between generations. Maternal steroids are known to affect embryonic and nestling development, but less is understood about their long-lasting organizational effects on adult phenotype. Such permanent organizational effects - reminiscent of those involved in differentiation of the sexes - may be mediated by mechanisms similar to or distinct from those of embryonic steroids during sexual differentiation. The project presented here investigated to what extent and how exposure to maternal testosterone in the egg causes long-lasting organizational effects on adult phenotype. The basic hypothesis of this study was that exposure to maternal steroid hormones during embryonic development permanently alters brain anatomy, physiology and behavior. House Sparrows (*Passer domesticus*) originating from testosterone-manipulated and control eggs were hand-raised and monitored until their first reproductive year under identical conditions. We will present data for specific brain areas of 9-day old nestlings and adults, and hormone profiles covering corticosterone stress responses and behavioral experiments during various stages of the annual cycle, to test this hypothesis.

Pascotto MC[1], Höfling E[1], Donatelli RJ[2]

Phylogenetic relationships of the Coraciiformes: Inferences from osteological characters

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We investigated the phylogenetic relationships within the order Coraciiformes, based on 262 osteological characters. Our findings indicate that the order as conventionally circumscribed is polyphyletic, and comprises two monophyletic orders, the Upupiformes and Coraciiformes. The latter includes the families Galbulidae, Bucconidae (=Galbulidae), Coraciidae, Brachypteraciidae, Meropidae, Todidae, Momotidae, and Alcedinidae. Among the Coraciiformes *sensu stricto*, the pairs of families Momotidae and Alcedinidae, Coraciidae and Brachypteraciidae, and Galbulidae and Bucconidae form consistent, definite monophyletic clades. Osteological data do not support the monophyly of the rollers Coraciidae, Brachypteraciidae and Leptosomidae, the latter being sister to Upupidae, Phoeniculidae, and Bucerotidae within the order Upupiformes. Contrary to traditional classifications, moreover, the order Piciformes were found to be paraphyletic, with the Galbulidae clustering with the Coraciiformes instead. The osteological data established the order Trogoniformes as the sister group of the Coraciiformes, and that species of Passeriformes sampled were basal to the Upupiformes. Even so, separate monophyletic origins for the Coraciiformes and Upupiformes did not receive unambiguous bootstrap support.

Patricelli GL[1], Dantzker MS[2], Bradbury JW[2]

Differences in acoustic directionality in male Red-winged Blackbird vocalizations are related to function in communication

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Studies of animal acoustic communication have found that the frequency and temporal structure of acoustic signals can be shaped by selection for efficient communication. The directionality of acoustic radiation may also be adapted for communication, but we know virtually nothing about how directionality varies with signal function, sender morphology and the environment in which the sound is transmitted. We tested the hypothesis that directionality of vocalization is adapted to function in communication. This hypothesis predicts that vocalizations signaled generally to neighbors and mates, for example in advertisement and alarm, will be relatively omnidirectional, whereas those signaled to particular individuals will be relatively directional, because that maximizes detection by the intended receiver and minimizes eavesdropping. To test these predictions, we measured the directionality and amplitude of vocalizations in the Red-winged Blackbird (*Agelaius phoeniceus*) in the field by recording vocalizations simultaneously on eight calibrated microphones encircling a bird. We found significant variation in directionality among vocalizations. Supporting our predictions, we found that the most omnidirectional were those used to alert conspecifics to danger, and the most directional those used during courtship and solicitation of copulation, when the costs of eavesdropping are likely to be high. These results suggest that the directionality of Red-winged Blackbird vocalizations is shaped by selection for effective communication. This study presents the first measures of acoustic directionality in a passerine in the field, and is the first to provide statistical support for the hypothesis that vocal directionality is related to communication function.

Pavlova DZ, Pinxten R, Eens M

Presence of males and nest boxes affects song rate in captive female European starlings during the breeding season

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Although bird song has been an important model system for studying seasonal changes in behavior, nearly all studies have focused on males and studies on seasonal patterns of song activity in females are scarce. Previous studies have shown that female European Starlings (*Sturnus vulgaris*) sing both during and outside the breeding season, although song production was found to decrease dramatically during the breeding season. In the present study we experimentally investigated the effect of the presence of males and nest boxes on song production in captive female starlings during the breeding season. Spontaneous song activity of two experimental groups of female starlings and one control group (housed with nest boxes, but no males) was observed daily between 24 March and 28 April 2004. Our results show that song production significantly decreased with the progressing of the breeding season. Experimental removal/addition of nest boxes, males or both in the experimental groups showed that nest boxes promoted song production in females, as has previously been found in male starlings, while the presence of males negatively affected song rate. The latter effect was stronger when nest boxes were present and females had the opportunity to start breeding. These results demonstrate that with the progressing of the breeding period the positive effect of nest boxes on song rate appears to interact with behavioral responses on other factors such as photoperiod and the mate's presence, which lead to an overall decrease in female song production during this time of the year.

Pazderová A, Exnerová A

Mobbing behavior in male House Sparrows varies with badge size

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Mobbing is a potentially dangerous anti-predatory behavior associated with considerable costs. The throat patch of black feathers in male House Sparrows (*Passer domesticus*) serves as a signal of dominant status in aggressive encounters. We tested a hypothesis that mobbing is more intensive in large-badged than small-badged males. We presented stuffed predators - a Common Magpie, Eurasian Sparrowhawk and Little Owl - to three separate flocks during the breeding season. Responses were recorded by camera, and the badge areas of 67 males were measured and recorded. We used the "risk index" to assess the intensity of individual mobbing reaction. The value of the index increases with duration of mobbing and rank value of the reaction, but decreases with distance of the predator. We distinguished a silent approach (rank value 1), and a more risky approach with vocalization (rank value 2). Risk indices correlated positively with badge area in all tests involving all predators, including those carried out separately on each predator; the correlation for the sparrowhawk, however, was not significant. Neither the risk index nor averaged badge areas differed significantly among the three flocks. The more intense reaction of large-badged males supports the presumption that such males are in a better physical condition and more certain of their paternity: they benefit more from nest defence. We suggest that large-badged males occupy better nest sites, but invest less in incubation and chick feeding. Since nest defence can affect breeding success, the size of badge may be an important signal of male value for sexual selection by females.

Peace J, Brunton D

Diet and foraging behavior of native insectivorous birds in New Zealand native and exotic pine plantation forest

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Monterey pine (*Pinus radiata*) plantations are now extensive in New Zealand, often fragmenting or completely replacing native forest. Due to their wide coverage, it is important to address their impacts on native bird species that make use of forest habitat. In this study, the diet and foraging strategy of insectivorous native birds are compared in pine plantation and native forests near Auckland in the North Island, New Zealand. Focal individuals were banded to enable individual identification, and observations of their foraging strategy and area covered during foraging were made. Captured individuals were held until scat was produced, and prey items dropped at nest sites were collected for dietary analyses. When predation events were observed, prey items were noted if visible; in addition, when adults fed chicks or mates, food type was recorded. Presence and availabilty of invertebrates was determined by pitfall and flight intercept trapping. By comparing invertebrate availability, diet, and foraging behaviors within each ecosystem, this study aims to elucidate the quality of foraging opportunities that exotic pine plantations offer the native insectivorous birds of New Zealand.

Pehlak H

Artificial nest experimentation suggests equal predation pressure on waders in coastal meadows and mires

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Estonia supports a substantial proportion of the European breeding populations of several wader species. In the 1970s and 80s, several typical meadow-breeding waders, such as the Black-tailed Godwit (*Limosa limosa*) and Dunlin (*Calidris alpina*), moved into areas of mire there, a shift thought to be related to the degradation of coastal meadows due to an increase in predation pressure. Yet valid quantitative data in support were unavailable. In order to compare the quality of managed coastal meadows and inland mires for breeding waders and the effects of predation, an artificial nest experiment was carried out in 2004 and 2005 in western Estonia. Eight pairs of adjacent coastal meadow and mire sites used by breeding waders were selected, the sites of each pair averaging 20.8 km apart (SD±9.9 km). At each site, ten artificial nests containing quail eggs were set and surveyed at 5–7 day intervals over 21 days; searches were also made for the real wader nests. No statistically significant differences in nest survival could be established between the two habitats (paired *t*-test: p=0.70). Average survival rates were 90.7% per day in meadows and 92.0% in mires. Although such a difference could have some biological significance, its exact quantification remains complicated due to high variability among the results. That the difference is not significant in any case is supported by (1) a doubling of the sample size would only reduce the confidence intervals of the differences two-fold on a substantially representative study area of coastal meadow, perhaps 20% of that habitat in Estonia, and (2) survival rates of real wader nests were similar, even though sample sizes were too small for analysis.

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KuşBank: Citizen Science for Bird Conservation

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KuşBank is an internet based databank where the bird watchers can store their bird observation data as a “citizen scientist” to contribute the conservation of birds. KuşBank Project is executed by Doğa Derneği and Erciyes University with the support of RSPB (The Royal Society for the Protection of Birds). KuşBank is a part of the World Birds Project which is carried on by BirdLife and RSPB. Worldbirds is a project which aims to compile all national bird databases and use these data for conserving the birds throughout the world. Turkey is a rich country in terms of bird diversity and hosts 456 species. 362 (79%) of those have been seen and entered into the KuşBank database during 2004. Among those species, 158 are under a threat category in Europe. During 2004, 2000 field observations by 400 birdwatchers were collected in KuşBank which include a total of 28,140 bird sightings.The majority of the observations and sightings in KuşBank date from spring and autumn. The breeding data was used to prepare breeding distribution maps of Turkish birds. KuşBank has become the most important source of information to update information on the states of birds, their habitats and the threats on IBAs. Many sightings come from Important Bird Areas (IBA) and 53% of those source from Central Anatolian IBAs. Mogan Gölü (Lake Mogan) in Central Anatolia is the most frequently visited IBA. KuşBank 2004 report was published in 2005 and it has been compiled from the data collected in KuşBank by the birdwatchers from different provinces of Turkey during 2004. In KuşBank, birdwatchers can store their sightings in a standard way and share with other birdwatchers. KuşBank, as a citizen science project for bird conservation, has shown that volunteers can contribute to not only scientific work and but also Turkey’s Site Protection strategies while Turkey is on the way to EU membership.

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Endocrine and neuroendocrine regulation of reproductive timing in an opportunistic breeder

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Opportunistically breeding species regulate their reproductive physiology according to immediate environmental conditions. Instead of slowly preparing for seasonal breeding each year, such species are thought to maintain an activated hypothalamo-pituitary gonadal axis to initiate breeding very quickly whenever favorable conditions occur. We present data from wild Zebra Finches (*Taeniopygia guttata castanotis*) captured in southern and central Australia during periods of breeding and non-breeding to investigate whether reproductive physiology, measured by gonadal volume and reproductive hormones, mirrored environmental changes characteristic of each location: highly seasonal in the south and aseasonal in the center. We found that periods of non-breeding did not result from simple inhibition by drought, as indicated by low plasma concentrations of the hormone corticosterone, because baseline concentrations were low in both populations. We are now investigating the endocrine and neuroendocrine regulation of reproductive physiology by manipulating supplementary cues in controlled conditions in the laboratory. Specifically, we will discuss the influence of food and water restriction on various gonadotropin-releasing hormone peptides in the brain, on circulating reproductive hormones, and on sexual behavior. These findings will improve our understanding of nonphotic cue use and how these environmental signals are transduced in opportunistic breeders.

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Comparative phylogeography of the Rufous Gnateater (Conopophagidae) and Lesser Woodcreeper (Dendrocolaptidae): Congruent history of two passerines from the South American Atlantic Forest

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The distribution of taxa and their intra-specific genetic structure can be influenced by diverse historical events, such as vicariance and range expansion. To examine this, we studied and compared phylogeographic patterns in the Rufous Gnateater (*Conopophaga lineata*) and Lesser Woodcreeper (*Xiphorhynchus fuscus*) in the southern Atlantic rainforest of South America. Sequences from the mitochondrial DNA control region (467 and 576 base pairs for each species, respectively) were obtained from samples of 73 and 92 individuals of each species, respectively, collected from Bahia in Brazil to Misiones in Argentina. The sequences were analyzed by maximum parsimony trees and networks. Nested clade analysis (NCA) was also used to examine the demographic history of populations. Congruent phylogeographic patterns were recovered for the two species, each with three distinct phylogroups: a northern clade from southern Bahia and northeastern Minas Gerais in Brazil, and two clades towards the south: one from southern Rio de Janeiro to northeastern São Paulo in Brazil, and the other from São Paulo to Misiones. NCA was only used for samples from southern clades, its results suggesting a main historic vicariant event along the border of São Paulo and Minas Gerais partly coincident with the Paraíba do Sul valley. In this location, contact between clades was observed in the Lesser Woodcreeper. A more subtle break was also found separating populations between Misiones and São Paulo, but there is no evidence of a past geographic barrier there today, suggesting that historic habitat fragmentation could have isolated ancestral populations that later diverged. Supported by FAPESP, CAPES, CNPq and WWF-US.

Peter H-U, Buesser C, Mustafa O, Pfeiffer S, Ritz M

Assessment of seabird breeding parameters towards the management of the Fildes Peninsula, King George Island, Antarctica

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Between 2003 and 2006, we conducted a research project “Risk assessment for the Fildes Peninsula and Ardley Island, and the development of management plans for their designation as Specially Protected and Managed Areas in Antarctica” at the south-western end of King George Island, South Shetland group, Antarctica. To gather base-line data, the breeding sites and areas of the following species were mapped by GPS/GIS systems: penguins (*Pygoscelis adeliae, P. antarctica, P.papua*), skuas (*Catharacta maccormicki, C. antarctica lonnbergi*), Kelp Gull (*Larus dominicanus*), Antarctic Tern (*Sterna vittata*), Southern Giant Petrel (*Macronectes giganteus*), Snowy Sheathbill (*Chionis albus*), Cape Petrel (*Daption capense*), and storm petrels (*Oceanites oceanicus, Fregetta tropica*). Of particular interest were changes in breeding numbers, breeding success and the distribution of selected bird species in relation to human activities nearby, because the study area is used intensively for scientific, logistic and tourism-related activities. We collected data on the frequency and distribution of air traffic, land vehicle use, movements of ships and visitor traffic to quantify the potential impact on wildlife. Disturbed Southern Giant Petrels, in particular, had shifted their breeding sites to areas of low human activity. The existing protection area at present covers only one high-biodiversity island. We recommend extending protection measures by introducing a zoning system within a ‘Antarctic Specially Managed Area’ to separate and restrict facility and tourist zones from more sensitive areas. Tourist facilities are already established in seabird breeding sites, and control of habituation effects will be needed. Supported by the German Research Council: DFG Pe 454/13.

Peters DS

The ridge-glider model for the origin of flight - arguments and evidence

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Debate about the early history of birds is usually reduced to the two alternatives of "trees-down" versus "ground-up" generation of flight. However, neither model is conclusive. The "trees-down" hypothesis fails through anatomical inconsistencies brought about by the incompatibility of adaptations for stem-climbing and flight: the specialized features of the avian wing could hardly evolve in a limb used for climbing. *Archaeopteryx*, the oldest known airworthy theropod, does not provide, in its wing morphology, evidence for the "trees-down" theory. New studies, moreover, have revealed unequivocal similarities between *Archaeopteryx* and cursorial relatives, especially the dromaeosaurs. On the other hand, the "ground-up" hypothesis fails for aerodynamic and energetic reasons. Another alternative, the ridge-glider model, was casually outlined about 20 years ago. The specified and supplemented version of this model not only avoids the shortcomings of the "trees-down" and "ground up" hypotheses, but also helps to explain why a fossil record of the earliest pre-birds, from beyond *Archaeopteryx* in the early Jurassic or even Triassic, is still lacking. According to this model, birds evolved as bipedal feathered cursors in a rugged and probably xerothermic environment in which erosion exceeded sedimentation. The evolutionary sequence from jumping downwards, gravity-supported gliding, and active flapping flight might have been paralleled by wing-assisted uphill running which facilitated the development of bilateral symmetric wing flapping. The exciting, newly found fossil record of birds and related dinosaurs from the Cretaceous represents a rich and diversified radiation with multiple evolutionary pathways not only towards flight but also its loss. This radiation, however, occurred well after the first stages in avian evolution.

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The ORNIS network: a broad virtual data resource with tools for the ornithological community

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North American museum collections house ~5 million ornithological specimens, yet it is currently impossible to access, retrieve, and integrate data efficiently across these collections for biodiversity research. For example, tracking and anticipating the emerging disease West Nile Virus has been impeded by lack of efficient access to avian collections for tracing the seasonal distribution and migratory movement of vector bird species. Although distributed database technology was originally developed for ornithological collections (The Species Analyst), this community has lagged behind other vertebrate groups (e.g., FishNET, MaNIS, HerpNET) in broadscale development and implementation. The ORNIS network, now funded by NSF, is designed to unite the ornithological collections community via a distributed database that will encompass nearly 4 million specimens (including sound recordings and eggs) from 30+ institutions in the USA, Canada, and Mexico, as well as many millions of observational records. Specifically, this project will couple support for database networking with development of novel web-based software tools for error-checking and data improvement. The community network created by ORNIS will enable geo-referencing of all North American locality data in ORNIS institutions, and, hopefully, data from other regions as well. In addition, ORNIS will make spatial applications (e.g., mapping) possible via these geo-referenced data, and will lead to improved data quality by developing new tools for cleaning up inconsistencies in taxonomy, nomenclature, locality, and date. The enriched data from the ORNIS network will serve as a test-bed for the software tools, and will be served to the broader community to enable many exciting research applications in ornithology.

Pfeiffer S, Peter H-U

Effects of human activities on Southern Giant Petrels and skuas in the Antarctic

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Birds are adapted to unpredictable events, avoiding stress by temporary adjustments to behavior and physiology. The increase of anthropogenic stressors in the Antarctic, through on-going construction of research stations and the rise in tourism, has led to growing concern about the efficacy of existing management. In long-lived seabirds, a change in the allocation of resources between reproduction and survival may have a lasting negative effect on population size. The Southern Giant Petrel (SGP, *Macronectes giganteus*), has been characterized as highly sensitive to human disturbance and is classified as "vulnerable" in the IUCN red species list. In contrast, the Brown Skua (*Catharacta antarctica lonnbergi*) and South Polar Skua (*C. maccormicki*), associate with Antarctic stations and are thus considered less sensitive. Using non-invasive methods, we studied the behavioral and physiological responses of breeding SGPs and skuas, comparing individuals according to their experience with humans. Close visits and irregular air traffic were current stressors for both SGP and skuas in the study area. Scientists cause the strongest physiological and behavioral reactions when specifically working on skuas or monitoring breeding success in SGPs. But unguided station personnel, scientists in their free time and tourists also increase vigilance, fleeing or defence behavior. Aircraft approaching at low altitude or from unpredictable directions changed the behavior of sensitive individuals in all species. Management recommendations drawn from the results emphasize increasing the minimum approach distance for breeding SGP from 15 m to 50 m. As well as present protected areas, further zoning is advocated to enhance the protection of this species. Existing air traffic recommendations for flights over wildlife colonies need to be enforced more rigorously as well.

Pierre J, Norden W

Reducing seabird bycatch in fisheries using natural olfactory deterrents

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Seabirds can have fatal or injurious interactions with fishing gear throughout the world. We experimentally tested one possible solution to seabird – fisheries interactions that was proposed by a New Zealand longline fisherman, and involved dripping school shark (*Galeorhinus galeus*) liver oil on the ocean surface behind fishing vessels. We tested the efficacy of shark liver oil in reducing the numbers of seabirds attending fishing vessels and the number of dives seabirds executed in pursuit of pilchard (*Sardinops neopilchardus*) baits. We conducted trials in northern New Zealand where seabird assemblages include the globally vulnerable black petrel (*Procellaria parkinsoni*). Shark liver oil was effective in reducing both seabird numbers and dives on baits, compared to canola oil and seawater control treatments. Comparisons of seabird responses to shark liver oil and vegetable oil suggest that shark liver oil acts as an olfactory deterrent for seabirds. Further work will include testing with additional seabird species and identifying effective ingredients in the oil. Future work should also consider habituation of seabirds to the oil, to inform assessments of wider opportunities for long-term use of shark liver oil for reducing seabird bycatch.

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Factors affecting rates of predation and parasitism on nests of grassland passerines in North Dakota, USA

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Declining populations of grassland passerines that breed in north-central USA have catalyzed effort to better understand the factors that influence nest-site selection, nest predation and parasitism by cowbirds. Brown-headed Cowbirds (*Molothrus ater*) reach high breeding densities on the northern Great Plains and probably evolved here, but few studies have examined the relationship between rates of parasitism and landscape features in this region. Data from mammal surveys and miniature video cameras used to identify nest predators show that predator communities can differ markedly from site to site, thus affecting observed nest survival. Studies of nesting passerines, nest predators, and cowbird parasitism in North Dakota suggest that: (1) nests of most grassland passerines are less likely to be parasitized by Brown-headed Cowbirds when the proportion of tree cover in the landscape is great enough to provide cowbirds with woodland hosts as alternatives, (2) the relationship between nest survival and distance to woodland edge differs among study areas, apparently reflecting distribution and habitat use of different species of predators, and (3) small to mid-sized mammals collectively dominate the highly diverse list of nest predators in the grasslands, and thus are most likely to influence findings related to nest predation in this region. Identifying important nest predators and cowbird hosts is therefore critical for interpreting relationships between nest survival and landscape variables. Spatial and temporal variability in predator communities, and in the availability of alternative cowbird hosts, are likely to lead to conflicting results among studies that are limited in space and time. Whenever possible, conservation and management decisions should be based on current, locally obtained information instead of broad extrapolations.

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The development of adaptive immunity during the nestling period in the Common Magpie

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Immune function in bird hatchlings is highly dependent on antibodies received from the mother via the egg. Onset of their own immunoglobulin production varies from a few weeks to several months, according to species. The relationship between these two immune systems in young birds has been poorly studied, especially in wild birds. The quantity of maternal antibodies received may affect the development of the immune system in the young. Moreover, the developing immune system might compete for resources such as those needed for growth. Thus there can be trade-offs between developing antibody production and other important life history traits. We studied the relationship between maternally transferred antibodies and the development of nestling immunity in the Common Magpie (*Pica pica*), an altricial monogamously breeding passerine, first carrying out a supplemental feeding experiment on the parents to find out whether levels of potentially transferable maternal antibodies are affected by resource limitation. We also studied the relationship between immunoglobulin production, hatching position, growth, and survival in young during the nestling period. The level of antibodies produced by the nestling was highly dependent on the level received from the mother. We also found that resource limitation affected the level of the maternal antibodies transferred to offspring, and that there are within-nest differences according to hatching order, which is correlated, in turn, with laying order. There was a significant trade-off between immunoglobulin production and growth during the nestling period. We found no significant relationship, however, between antibody levels in nestlings and their survival until fledging.

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Patterns of change in body composition of small migrating birds staging in Eilat, Israel

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When small migrating birds arrive at migratory staging sites to refuel, their body mass (mb) initially decreases for a day or two, and then rapidly increases. One hypothesis offered in explanation is that the decrease in mb is attributable to gut protein catabolized during flight, and that the hiatus in mb increase is the time taken to rebuild the gastrointestinal tract, a prerequisite for rebuilding fat stores. We examined the relationship between changes in mb and body composition in small migrating birds at Eilat, Israel, by measuring the body composition of over 600 individual birds of 21 species, using dual-energy X-ray absorptiometry. Analysis of four passerine and one wader species supports the view that when birds increase mb while staging, fat-free mass is replenished first; only after it asymptotes does fat mass increase. From correlations of body composition with mb, we carried out a "reverse" analysis of body composition in the five species. Frequency distributions of mb in birds caught in spring and autumn indicate that most *Sylvia atricapilla* and *S. borin*, species which are frugivorous during migration, arrive at Eilat in spring with fat mass at its lowest and non-fat mass on the rebuild. In autumn, by contrast, south-bound *S. atricapilla* arrive at Eilat in the final stages of rebuilding fat-free mass. In invertebrate-eating species (*Calidris minuta, Acrocephalus scirpaceus, Phylloscopus collybita* and *Luscinia svecica*), we observed no seasonal differences in mb and body composition. We suggest that species which have different diets use different refueling strategies during migration. Frugivores might accumulate larger fuel stores before onward flight because distances between fruit-rich patches are large, whereas invertebrate-eaters may feed on the way during both spring and autumn because insects, although temporally unpredictable, are present in both seasons.

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Genetic variability and sex ratio in the Kelp Gull: Implications for management and conservation of seabirds

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The Kelp Gull (*Larus dominicanus* is a generalist forager that ranges widely around the cold temperate and subantarctic lands of the southern hemisphere. Growing anthropogenic activities in the region have increased food sources available to it, resulting in significant growth in its populations and consequent displacement of other seabirds through competition. Factors implicated in population growth and viability are sex ratio and genetic variability, the evaluation of which was the object of this study of Kelp Gull populations along the Brazilian coast. Among 83 individuals from eight different localities along 2000km of coastline, only one Cyt b haplotype and three ATPase 6 and 8 haplotypes were found in mitochondrial DNA. Nor did the sex ratio deviate from the expected 1:1 proportion (chi-square test) at the two sites screened over two years. The mitochondrial DNA data suggests that the Kelp Gulls along the Brazilian coast comprise a single population, and that their low genetic variability could increase the probability of extinction from stochastic events. On the other hand, ecological data show that the gull is a well-established and successful breeder in the region. Low genetic variability could have resulted from past bottlenecks, recent colonization or a selective sweep, and analysis by nuclear markers will needed to determine which.

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Greylag ganders show active and passive dominance styles

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Dominance styles are defined by the presence or absence of aggressive behavior in a dominant individual: “active dominance” is expressed during aggressive interactions, and “passive dominance” mainly through affiliative behaviors. Our study aimed at investigating whether dominant male Greylag Geese (*Anser anser*) differed consistently in dominance style when exposed to two types of social stressors: group feeding competition and social density. We defined dominance styles by the individual frequency of aggressive behavior in the social context. We tested males of two social categories: paired with or without offspring. During winter, when the hierarchy is relatively stable (Phase 1: November-December), we characterized the males as showing either active or passive dominance styles, based on dominance rank, wins, social involvement, vigilance and fecal immunoreactive corticosterone (CORT) and testosterone (TM) metabolites. Behavioral observations were repeated 5 times per phase per individual. During breeding (Phase 2: February-March), we monitored the same behavioral and physiological parameters of social performance as in winter, and additionally measured distance to the partner and group plus several types of vocalisations. We found significant individual consistency in dominance style over the two periods. Dominance style correlated with distance to the partner, excreted CORT and vigilance, as well as excreted CORT - TM metabolites and social involvement. The results indicate distinct individual dominance styles in male Greylag Geese, which are consistent over time and context. For financial support we thank the FWF, “Herzog v. Cumberland Stiftung”, “Verein der Förderer” and the Erasmus Project.

Polakova S, Fuchs R

Where to breed? Advice for Eurasian Blackbirds in Ceske Budejovice, Czech Republic

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Eurasian Blackbirds (*Turdus merula*) have declined in urban areas in Europe in recent decades, probably due to low reproductive success caused by nest predation. We investigated predation pressure on blackbirds by placing artificial eggs in authentic nests in three different urban habitats - an old and new housing estate and a park - and in different nest sites in trees and shrubs, including conifers and deciduous angiosperms, in Ceske Budejovice in the Czech Republic. Even though there was a wider range of predators in the park, most nests were destroyed on the housing estates, with much the highest intensity of predation in the old estate. Predators preferentially searched both pine and spruce trees there, because they are the sites preferred most by nesting blackbirds; in effect, the conifers on the old estate have become an ecological trap. Although there was comparable predator pressure in the park and new housing estate, both vegetation cover and blackbird numbers were higher there, particularly in the park, leading us to conclude that nest predation in the new housing estate and park is now largely accidental. The most important nest predator was the Common Magpie (*Pica pica*) which invaded the area during the last 15 years. It shuns big parks where the predatory Eurasian Jay (*Garrulus glandarius*), which arrived earlier in the 1970s, replaces it. It seems likely that blackbirds originally tried to avoid predator pressure in parks by shifting to residential areas, only to be faced there with more nest predation from the newly arrived magpie. Urban avian populations are thus undergoing significant changes in distribution, abundance and breeding biology due mainly to invading avian predators.

Polakova S, Fuchs R

How nest predators search for nests of the Eurasian Blackbird

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One of the most important decisions in the life of birds is the choice of nest site. It is a classic arms race between parents looking for the best site for hiding the nest and predators looking for the best cues to find them. The Eurasian Blackbird (*Turdus merula*) and its nest predators provide a good model for studying the system in urban ecosystems, because blackbird nests are a rich resource target due to their abundance and the ease with which they can be found. Ways of finding nests, however, vary between different urban areas according to blackbird numbers and the distribution of potentital nest predators. We developed a "diagnostic image" for identifying avian and mammalian predators in an old and new housing estate and park in Ceske Budejovice, Czech Republic, from signs left after predation on plasticine eggs in authentic blackbird nests in natural nest sites. Predatory birds found nests mostly by optical cues and commonly searched outside foliage, whereas mammals did not depend on their eyes and explored inside shrubbery. But the visibility of nests in vegetation was not the only factor. Birds, especially Common Magpies (*Pica pica*), were dominant nest predators in the housing estates in response to high abundance in blackbirds, and attacked nests among buildings there that they glimpsed at a distance. Rates of predation in birds and mammals were comparable in the park, but bird predators had greater effect in the housing estates because, even though they are less tolerant of human proximity than mammals, only a few squirrels were present in the old estate and none in the new.

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Territory size and density in the Dartford Warbler across post-fire succession in Spain

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Territory size and quality are important for breeding success in passerines. In the Mediterranean region, frequent firing creates excellent opportunities for investigating territory variability in relation to habitat gradients. We examined variation in territory size and population density in the Dartford Warbler (*Sylvia undata*), a species of conservation concern, across post-fire succession in Catalonia. More than 200 Dartford Warbler territories were mapped and monitored over several years on five plots between sea level to subalpine altitudes. We documented habitat structure, measured overlaps among neighboring territories of conspecifics individually, and calculated areal overlap with potential interspecific competitors, mainly the warblers *S. melanocephala* and *S. cantillans*. Dartford Warbler densities varied from 0 to 17.3 breeding pairs/10ha, on territories of mean size of $4781 m^2 \pm 2830 m^2$ (n= 209). Preliminary analysis indicates that mean territory size and species density are correlated negatively, although variation in density was the greater across the succession. Territory size was adjusted best to a foliage cover between 0.5 and 1 m, which was maximal from six years post-fire on. This result is consistent with the structural cues hypothesis for territory size adjustment in a middle-successional shrub-dwelling specialist. In contrast, species density was affected negatively by high tree canopy cover. Interspecific territory overlap was much greater than intraspecific overlap, supporting the ecological segregation of congeneric warblers but not the interspecific territoriality hypotheses.

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Distribution of Guillemots and Razorbills in relation to abiotic factors and abundance of pelagic fish in the Dutch North Sea

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Hardly any information is available about the distribution of wintering seabirds in the Dutch North Sea in relation to ecological and physical factors. For two weeks in November 2003, a ship-based survey was conducted in that area, focusing on the distribution of Guillemots (*Uria aalge*) and Razorbills (*Alca torda*) in relation to the abundance of pelagic fish and physical parameters of the seawater. The study was conducted within the framework of a long-term monitoring program on seabirds in the Dutch North Sea by the National Institute for Coastal and Marine Management (RIKZ). A total of 6 transects at right angles to the coast were surveyed out to a maximum of 55 nautical miles by two observers counting seabirds by strip transect methodology according to ESAS standards. At the same time, distribution of pelagic fish was estimated by echo integration; fish were also sampled with a pelagic trawl to validate the acoustic observations. Physical parameters such as temperature and salinity were measured with a CTD measuring device, and turbidity by a sechi-disc. More than 95% of all observed alcids were Guillemots. Results are presented to show how densities of alcids correlate with concentrations of fish, and salinity and turbidity of seawater.

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Correcting detection loss in observations on bird migration with vertical marine surveillance radar

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Quantitative information on the volume of flight movements of birds and flight altitudes is necessary in order to be able to estimate collision risks with wind turbines. This information is often insufficiently known, both of local bird movements and of seasonal migration. Marine surveillance radars positioned vertically can be used to gather this information, allowing measurements of altitude profiles of bird flights. For the assessment of the potential effect of wind turbines on bird migration, especially the study of migration at low altitudes (<200 m) is most relevant. Information on migration at higher altitudes however does place migration at low altitudes in a broader perspective and for this reason is often studied as well, although here detection loss takes place due to limitations of the radar (power). The combination of wave/pulse length, the power of the radar, and weather conditions determine the detection of birds by radar. On the other hand detection is dependent on 'bird aspects' as well. Detection loss occurs in relation to the combination of species/size of the birds, the distance or height of birds, but also heading and flight direction of birds plays a role. Birds that are beamed head-front by the radar are less visible than birds that are beamed from the side (largest radar cross section). This aspect can substantially affect the recorded fluxes. In this paper, based on studies performed at different locations in the Netherlands, the consequences for the recorded Migration Traffic Rate are shown and the necessary corrections are suggested.

Portugal S, Green J, Butler P

Seasonal variability in body composition, physiology and energetics of Barnacle Geese

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Svalbard Barnacle Geese (*Branta leucopsis*) are migratory birds, breeding in the high Arctic and wintering 1500km south in western Scotland. During their time in Svalbard, the geese have to breed and molt before laying down sufficient fat reserves to survive the return journey south. Just prior to and during their autumn migration, the geese undergo a period of hypothermia which, rather than aid in fat deposition prior to departure, would appear to play a more important role with fat utilization during migration and with its replacement on wintering grounds. Captive

Barnacle Geese have a distinctive annual cycle in body mass and composition that coincides with important annual events in their wild counterparts. Mass increases significantly prior to molt in July and migration in September, and, although not as dramatically as in wild geese, abdominal temperature (T_{ab}) also drops during late September and early October, despite no actual physical migration. We used heart rate data loggers to estimate year round field metabolic rate in the captive Barnacle Geese to examine the relationship between metabolic rate and the observed changes in body mass, composition and T_{ab}. Because of the seasonal variation in mass and other factors, suitable calibrations of the relationship between heart rate and oxygen consumption were made at appropriate times throughout the year. The hormone melatonin was studied to determine what role it plays in the regulation of body mass, composition and T_{ab} in response to various environmental stimuli, in particular day length, light intensity and temperature. We also examine non-invasive techniques for analyzing body composition in birds, in particular the use of body condition indices, morphological characteristics and isotope dilution techniques employing deuterium oxide.

Prada J

Areas in Colombia: The endemic and endangered Northern Screamer as a focal indicator species

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ESRI implementation of Geographical Information Systems (GIS) is a tool for developing databases on the spatial distribution of birds, plants and other interactive features of ecosystems at landscape scale for identification of conservation areas. Two areas identified by this procedure in Colombia have now been incorporated into the Directory of Important Bird Areas (IBAs) for that country: Mompox in the El Garcero reserve and El Corchal Mono Hernandez close to Cartagena. Programs for the identification of IBAs in Colombia have focused on regional wetlands and waterbirds, for which the endangered Northern Screamer (*Chauna chavaria*) has been found a focal indicator species. Regional diversity in two families of waterfowl - the ducks (Anatidae) and screamers (Anhimidae) - is reviewed, with special attention to the screamers, a small ancient family of large stream-side birds endemic to South America.

Prager M, Andersson S

Molecular phylogeny and evolution of tail ornamentation in the African Widowbirds and Bishops

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To provide a framework for phylogenetic and comparative analyses of male plumage ornamentation (elongated tails and carotenoid coloration) in the Afro-tropical Widowbirds and Bishops (*Euplectes*), we reconstructed a molecular phylogeny of the genus and its placement within the *Ploceinae* subfamily. Parsimony, likelihood and Bayesian methods of phylogenetic analysis were performed on 2559 bp of mtDNA (ATP6, cyt b, ND2 and ND3) and a nuclear intron (G3PDH). All 17 *Euplectes* species and 31 of the 51 recognized subspecies were included, as well as eight representatives of the genera *Quelea*, *Foudia*, *Ploceus* and *Amblyospiza*. Nuclear and mitochondrial sequences contained concordant phylogenetic information, and different analyses of the combined data set resulted in congruent and robust estimates of the *Euplectes* tree. Monophyly of the genus was convincingly supported, but as regards the intrageneric distinction of Widowbirds from Bishops, based on their nuptial black tails, there was one notable exception: The Redcollared Widow *E. ardens* belongs to the Bishop clade and has most likely independently gained its tail ornament. The evolution of long tails was reconstructed both as a discrete and as a continuous trait, and tested for phylogenetic signal and directionality. Unlike recent studies, showing labile evolution of plumage ornaments, our results show that the nuptial tails of *Euplectes* are phylogenetically conservative (gained twice and never lost) and, once evolved, directionally exaggerated (relative length correlated with total branch length). This supports the generalised (open-ended) sexual selection through female mate choice as demonstrated in earlier experimental work.

Prior H

How birds perceive space: The role of right and left brain hemispheres in orientation

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Birds use a variety of cues for guidance when orienting in environments at different spatial scales. Although the sensory systems involved in this multi-component task have been examined in detail, knowledge of how spatial information is processed by the brain is still rudimentary. Recently, research on hemispheric asymmetries in the brain has led to new insights. Most of the studies have used techniques of monocular occlusion or targeted lesion of presumptive neural correlates of spatial information processing. Contrary to earlier belief, it is now clear that the left hemisphere of the brain plays an important if not predominant role in avian spatial orientation. Strong lateralization favoring the left hemisphere has now been demostrated for all major navigational systems: the magnetic compass, the sun compass, navigational map learning and olfactory orientation. In pigeons, contribution from right and left brain hemispheres is equally important for purely visual orientation, but each hemisphere processes different aspects of visuospatial information. Comparisons among the species most studied, the chicken and pigeon, reveal common features as well as interesting differences that correspond to differences in the neurophysiology of the major visual pathways. I suggest that rearrangement of the pattern of lateralization has played a central role in the evolutionary adjustment of the avian brain to different patterns of space use.

Prior H

Social intelligence in Common Magpies: On the brink of "theory of mind"

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Birds of the crow family, Corvidae, exhibit complex mental skills, many resembling cognition in primates. In the social context of such skills, the question arises as to what extent corvids comprehend endowment of thought and knowledge among their members. Such comprehension has been called "theory of mind". Although first proposed to explain the apparent understanding of purposeful behavior in apes, the presence of 'theory of mind' in non-human animals has been questioned. We investigated whether food-hoarding Common Magpies (*Pica pica*) would, in addition to general sensitivity to the presence of conspecifics during storing and retrieval, constrain behavior out of concern for what the conspecifics might learn. In circumstances where two observer birds watched food-storing by a focal bird in consecutive sequences, but only of the observers was present during later retrieval, the focal bird preferentially retrieved those caches that it had hoarded in front of that particular observer. Thus, food-hoarding Magpies can not only encode and recall the location of caches, but also 'personalize' their memories to remember those food-items stored in the presence of individual conspecifics. Such an adjustment is an essential feature of 'theory of mind'.

Quaisser C[1], van den Elzen R[2], Frahnert S[1]

A digital catalogue of primary type specimens in German ornithological collections - a three-year project running within GBIF

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The Global Biodiversity Information Facility (GBIF) is an international initiative aimed to facilitate the worldwide exchange of biodiversity-related data. Within a three-year project funded as a German contribution to GBIF, information about primary types of birds and other vertebrates in German collections has been made available through the internet at http://www.gbif-vertebrata.de. This information includes the original description and current taxonomic classification, and data concerning each individual type specimen such as type status, collecting data, mode of preparation and current location of the material, as well as digital images. So far, nearly 500 specimens in 2500 of the expected 4000 type taxa of birds have been investigated and digitised. Up to now, the project has demonstrated that the expected number of types has been underestimated significantly. Information about the types and their application is now more precise and comprehensive, effected through collating the scattered information in different museums. It is expected that by the end of the project in December 2005, 50 to 75% of all primary types held in German collections will be digitised. In future, this information will be linked with other type catalogues and biodiversity databases through the GBIF network to build a global "virtual museum".

Quan R-C[1], Cui L-W[2]

Wintering behavior and social rank in Ruddy Shelducks at Lashihai Lake, China

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Ruddy Shelducks (*Tadorna ferruginea*) are monogamous, forming and maintaing pair bonds on their wintering grounds. Pairing at such a stressful time might be thought to accrue mutual advantages that would be adaptive. By monitoring of their time budgets at Lashihai Lake, southwest China, we found that the ducks undertook five main types of daily activity during winter: feeding, resting (including sleeping), preening, drinking, and warning. Feeding and resting were predominant, the time spent feeding by paired males and females increasing from 62.6% and 52.4% in January to 76.7% and 72.4% in March, respectively. In contrast, the time spent resting and warning decreased in both over the same time. Ruddy Shelducks with mates were more successful in aggressive encounters with single birds, indicative of higher social status and accruing benefits especially for mated females because of the extra time that they spent on feeding. Males invest more energy in warning and defending preferred feeding sites, but at the cost of reduced time for feeding. We suggest that the trade-off for lost foraging time is the gain of a mate for the next breeding season early in winter, as the sex ratio in this species at Lashihai Lake is male-biased (1.44 males:1 female) and many males can be left unmated by the end of winter.

Rabenandrasana M[1], Sama Z[2]

The population size, distribution and habitat of the Sakalava Rail in the western Malagasy wetlands

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The Sakalava Rail (*Amaurornis olivieri*) is an endangered Malagasy endemic. From August 2003 to April 2004, we surveyed the potential habitats of this species during dry and wet seasons in western Madagascan wetlands between the Betsiboka and Mangoky rivers, the known distributional limits of the rail. Seventy nine birds were found, all in the northern sector: 67 individuals at lakes in the Besalampy region and 12 at Lake Kinkony. Although more southerly areas may hold a few birds, we recorded none. Surviving populations appear to be very small and fragmented: the maximum concentration was of 22 birds, recorded on Lake Amparihy near Besalampy. Essential habitat for the rail is marshland covered by dense swards of the reed, *Phragmites mauritianus*, with a floating layer of pond weed, *Salvinia hastata*. Major threats are habitat loss and disturbance, caused by wetland conversion to rice fields and a reduction in the area of *Phragmites*; at Lake Kinkony, much of the area apparently covered by reeds 50 years ago is now open water. The reasons for the loss of *Phragmites* are not well understood; cutting for human use probably contributes but other ecological changes need investigation. There is an urgent need for more surveying in the wetlands of western Madagascar, combined with GIS analysis to predict total population size using data on occupied sites and abundance extrapolated into unsurveyed areas. Such data, including information from population ecology to account for the rarity of the rail, will be needed to establish a national conservation plan.

Raherilalao MJ[1], Hackett S[2], Bates J[2], Goodman S[2]

Phylogeography of *Bernieria* greenbuls in Madagascar

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Bernieria (formerly *Phyllastrephus*) greenbuls are widespread in Madagascar. We gathered data on morphological and genetic variation in this genus and have uncovered striking striking patterns of differentiation. In the Long-billed Greenbul (*B. madagascariensis*), two subspecies have been recognized: *B. m. madagascariensis* in the eastern humid forests and a paler form, *B. m. inceleber*, in drier western scrubs. Neither measurements of museum specimens nor mitochondrial DNA (mtDNA) sequences, from ND3 and ATPase 6 genes, distinguished the two subspecies. There is, nevertheless, substantial mtDNA differentiation at >10% sequence divergence in populations of *B. m. madagascariensis* from the extreme southeast corner of the island. Based on the molecular data, we consider this population a phylogenetic species; however, there are currently no characters other than mtDNA sequences that distinguish it.

Rainio K, Lehikoinen E

Changes in the progression of spring migration through Finland

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Climate change has already changed the timing of life-history events of birds. For example, the timing of spring migration has generally advanced. However, there seems to be considerable geographical variation in the responses of birds to climate change. Moreover, the effect of climate change has been predicted to be more pronounced in higher latitudes. Using first arrival dates collected by the Finnish local ornithological clubs, we studied whether the progression of spring migration within Finland has changed during the last three decades and whether the patterns of progression depend on variation in climate. Taking into account the changes in the number of observers, we try to also to separate the effect of climate change from other factors affecting the first arrival dates in boreal birds.

Rakotomanana H[1], René de Roland L-A[2]

The breeding ecology of the Velvet Asity, a Madagascan endemic

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The breeding ecology of the Velvet Asity (*Philepitta castanea(*), endemic to Madagascar, was investigated in the rainforests of Ranomafana in the south and on the Masoala Peninsula in the northeast from October 1990 to January 1991 and October 2000 to February 2001 respectively. The three pear-shaped nests discovered during our study were all suspended at the ends of hanging branches of *Tambourissa* spp.(Monimiaceae) and *Cryptocarya* spp. (Lauraceae). Two female-plumaged birds participated in building the single nest found in Ranomafana, whereas one adult black male and one female did so for each of the two nests on Masoala. Such reduced paternal investment at Ranomafana, where male-male interactions are common, may be a strategy for avoiding harassment from male conspecifics. However, in both study areas, only one adult female incubated and cared for the young. During the nestling period, the young were fed with prepared fruits of the shrubby trees, *Tambourissa* spp. and *Aphloya theaformis*.

Ramenofsky M[1], Moffat J[1], Jensen J[1], Coverdill A[1], Bentley G[2]

Endocrine response to prolonged bouts of migratory restlessness in captive White-crowned Sparrows

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Baseline corticosterone is elevated in association with migratory flight in free-living birds and bouts of migratory restlessness (MR) in captives. Such elevations increase availability of fuels to support the large energy expenditure of migratory flight. Under strenuous conditions of prolonged MR, we hypothesized that plasma corticosterone (cort) increases in response to heightened energy demand. As a test, we extended the dark phase of the 18L:6D light cycle for varying lengths. Under continuous dark, White-crowned Sparrows (*Zonotrichia leucophrys*)persist with MR until exhausted. We assessed hormone profiles of baseline and handling-induced cort at specific times throughout the 24h period under a 18L:6D light cycle. Next, we exposed sparrows to varying lengths of the dark phase. Experimental birds (group D) were exposed to dim light (<1 Lux); controls (group O) were held in complete darkness to control for activity, as birds in such an environment show minimal MR. Plasma levels of cort were measured at specific times over 48 hours throughout the extended dark phase, by which time MR in group D was subsiding rapidly. Baseline levels of cort remained elevated throughout the continuous dark phase, at levels above those measured during the subjective day under 18L:6D conditions. Plasma cort in group D was significantly greater than in group O birds, but only within the first two hours of the dark phase, consistent with the hypothesis that energetic demands of MR are associated with elevated cort. All birds lost body weight and reduced fat deposits throughout the extended dark phase. In summary, birds prepare for long distance flight by increasing available energy, aerobic capacity, and muscle mass. These adjustments support capacity to sustain flight for long periods of time. But if flight activity is prolonged, baseline cort elevates in response to the increased energy demand.

Ramos R, Ramírez FJ, Sanpera C, de Jover L, Ruiz X

Feeding ecology of Yellow-legged Gulls in four colonies along the western Mediterranean: An isotopic approach

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The Yellow-legged Gull (*Larus michahellis*) is a considered a pest species throughout its Mediterranean range, either due to its interactions with human populations or because it disturbs, preys on, and/or displaces other seabirds from their breeding areas. Most of these problems can be attributed to overabundant populations of Yellow-legged Gulls resulting from opportunism and capacity to exploit a wide range of resources, including garbage and fishery discards. To manage its numbers, comprehensive information on its feeding habits is needed over and above conventional dietary analyses, which can be biased by different sampling methods. We turned to stable isotope analysis (SIA) for this because it provides an integrated record of individually-assimilated diet. We combined analyses of stable isotopes of carbon (δ13C), nitrogen (δ15N) and sulphur (δ34S) from feathers of nestling Yellow-legged Gulls from four colonies along the western Mediterranean coast, together with significant samples of prey from regurgitates. δ13C and δ34S discriminated food of marine, freshwater and terrestrial origin quite well, and a depleted δ15N was found to correspond to exploitation of refuse tips. It is also important to point out that the isotopic variance for each colony can be used to estimate trophic niche width.

Randler C

Macro-ecological analysis of natural hybridization in birds

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Hybridization and speciation are central issues in evolutionary biology. Although birds are among the best studied of vertebrates, however, little is yet known about hybridization on a macro-evolutionary scale. Here, I present different results from different studies. In an analysis of mixed pairings, I found that Hubb's principle explained about 75% of all cases. This result was corroborated by 65 phylogenetically independent hybrid types from the western Palearctic, in which fewer hybrids were produced from sympatric species pairs than parapatric. Further, hybridizing species with high levels of male parental care produced fewer hybrids than those with low, and hybridizing pairs of endangered species produced more. A confounding factor here was detectability, which affects the number of cases reported. Two general mechanisms seem to explain how mate choice leads to inter-species hybridization: mistakes in mate recognition, and an active decision to form a mixed pair notwithstanding. Towards clarifying the mechanisms, I further analysed the occurrence of extra-pair paternity in birds, because species with high EPP rates should produce hybrids more often due to mating from mistakes in mate recognition. Detailed analyses of wildfowl showed that species with high degrees of interspecific brood parasitism (amalgamation) also hybridized more often.

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Immunological status in one-day old ostriches: Preliminary results

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Any kind of contamination in ostrich hatchlings in their first 24 to 48 hours may cause difficult infections, premature death and consequent loss to ostrich farmers. As farmed ostrich chicks under intensive breeding programs are subject to a larger number of stressful circumstances (transportation, artificial feeding; confinement in numbers, human visitors, susceptibility to micro-organisms) in their first days of life than those hatched in natural habitat, the capacity of their immune response under farm conditions needs to be understood. Accordingly, we investigated such capacity using the blood of 10 clinical healthy, one-day old unsexed ostriches of the captive form of *Struthio camelus*. We found granulocyte phagocytic activity of 82.1%, granulocyte activity of 2.53%, granulocyte intracellular microbicidal capacity at 9.2%, monocyte phagocytic activity of 78.2%, monocyte activity of 1.35%, monocyte intracellular microbicidal capacity at 33.4%, total leucocyte count at 7.6 x 109/L, percent heterophils of 85%, lymphocytes at 11.2%, eosinophils at 0.3%, monocytes at 2.6% and percent basophils at 0.9%. From this we conclude that determination of total differential leucocyte count and of phagocytic and monocytic activities provides appropriate diagnostic indication of the health status and immune response in one-day old ostriches. We expect that further investigations on larger sample sizes of ostriches will confirm this preliminary assessment.

Reif J[1], Storch D[2]

Spatial scaling of bird species richness and community composition in a central European landscape

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Patterns in species richness and the composition of species assemblages are scale-dependent. We attempted to demonstrate such correlations using data from a continuous range of spatial scales. We mapped bird distributions and abundances by the point count census method along a 400 km transect across the Czech Republic, using 768 mapping points 0.5 km apart and visiting each point 5 times. We then analysed patterns of species richness and composition at various scales differing in length based on the number of consecutive sample points included, i.e. 1, 2, 4, 8, 16, 32, 64 and 128 points. Species composition was affected most by type of habitat cover within the finest scale (1-2 points), but mainly by altitude at broader scales (4-64 points). At the largest scale, differences in assemblage composition were attributable to the east-west biogeographic gradient reflecting Hercynian-Pannonian distribution. Local species richness (number of species occurring on one point) was related strongly to the total number of individuals present, and was positively affected by the presence of solitary trees and bushes, and negatively by the presence of fields and coniferous and beech forests. In contrast, species richness at larger spatial scales was weakly related to the total numbers of individuals and most strongly affected by habitat heterogeneity. Therefore, variability of species richness at larger spatial scales is not driven by variability in numbers of individuals, but by beta-diversity attributable to differences in habitat heterogeneity in the landscape.

Relton A

Capturing, killing and trading in wild birds in Tamilnadu, India

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Capturing, killing and trading in wild birds is universal. Birds are captured and killed for various reasons, for food, for medicinal and ornamental purposes, and for keeping as pets. Even though India has banned almost all trapping, killing and trading in birds through its Wild Life Protection Act, 1972, these practices are still prevalent all over the country. Tamilnadu, the southernmost state in India, has a remarkable diversity of ecosystems and habitats, from high altitude shola-grassland to arid lowland plains. In an area of over 130,00 km^2, some 22,845 km^2 is still forested. Almost 500 bird species are recorded for the State, which includes 19 wild life sanctuaries, 5 national parks, and two biosphere reserves. Wild birds, nevertheless, continue to be captured by different methods, some traditional but others new and dangerous, including poisoning and snaring at roosts. Old methods, such as trapping, misnetting and shooting, are still the most common. Francolins, quails, ducks, shore birds and wagtails are usually captured for food, and parakeets, mynas, starlings and finches for keeping as pets. Some people, especially a nomadic tribe, the Kuruvi Karan or Bird People, live entirely by trading in birds; others capture birds for sport or as a seasonal occupation when birds are more abundant during winter. In this paper I illustrate and explain the various methods used for capturing birds in Tamilnadu, the market value of different species there, and measures needed for regional bird protection in the future.

Reynaud PAI

Are ticks main arbovirus vectors for birds?

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Ticks are the vectors of arbovirosis that infects humans, and may also infect birds, contributing to arbovirosis dissemination. We analyzed tick infestation in the avifauna of Senegal and in corvids in southern France. A total of 10,160 birds from 130 bird species covering 36 families was examined to record the number, stade, and distribution of ticks. Sixty four species were found carrying ticks, with a mean infestation level of 13%. Of 24 species from which more than 50 individuals were screened, all were infested by ticks. The level of infestation varied markedly: highest rates were recorded in the Woodland Kingfisher (*Halcyon senegalensis*) (38% of 51 individuals) and the lowest in the Golden Sparrow (*Passer luteus*) (0.7% of 546 individuals). Rate of infestation was not related to foraging habits. As an exemple, the Red Bishop (*Euplectes orix*), which exhibited an infestation rate of 33%, was caught in abundance at the same time and in the same nets as the sparingly infested Golden Sparrow. Among trophic groups, infestation was highest in omnivorous birds (15.5%) and lowest among frugivores (6.6%). Of 1108 blood samplings analyzed, arbovirus was isolated in only a single bird; 5.3% were positive to arbovirus in Elisa tests. In the 423 corvids from France, 11 were positive to sero-neutralization. None of the 32 ticks pool-tested were positive to arbovirus; nor was there any correlation between tick infestation and bird sera positive to arbovirosis. We nevertheless found that tick infestation had an impact on reproduction and mortality in three species: *Euplectes orix, Euplectes afer,* and *Phalacrocorax carbo*. Our results suggest that (1) tick infestation in birds is widespread and dependent on abiotic factors, seasonality, ethology, and morphology of the host, and (2) the correlation between tick infestation in birds and arbovirus dissemination is not as general as currently thought.

Rezaian M, Hamedi S

Histological study of the cecal tonsil in the cecum of 3-6-month old White Leghorn chickens

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The cecum is the largest part of the large intestine of the chicken and plays an important role in digestion and water absorption. Due to masses of diffuse, nodular lymphatic tissue in the lamina propria and sub-mucosa, it is a defensive organ as well. Activity of the cecal tonsil has been shown to be related to the activity of the bursa of fabricius and thymus. Since both bursa and thymus undergo involution with age, we set out to determine whether parallel changes occurred in the cecal tonsil. Accordingly, we selected 18 healthy White Leghorn chickens at 12, 20, and 24 weeks of age. Samples were taken from the cecal tonsil of the cecum of each immediately after death and fixed in 10% buffered formalin. Routine histological methods were used to analyse them: 6 µm sections stained with the hematoxylin-eosin procedure and examined under light microscope. Heights of mucosa, villi, sub-mucosa, the muscularis layer, depth of mucosal crypts, and width of the villi in the cecal tonsils were measured by linear graticule, and analyzed by an ANOVA. Results showed an increase in the depth of the mucosal crypts through accumulation of lymphatic nodules and diffuse lymphatic tissue up to five months and a decrease at six months. Some lymphatic tissues were replaced by intestinal crypts and smooth muscle with increasing age. As these changes match those in the bursa of fabricius and thymus, we conclude that the activity of the cecal tonsil is related to that of the bursa and thymus.

Riedler B, Fritz J, Kotrschal K

New opportunities for the study of bird migration: Tracking the flight patterns of sub-adult migratory birds with GPS data loggers

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Studies with human-raised birds and the use of GPS technology offer new opportunities in migration research. This study focuses on flight patterns of independent juvenile Northern Bald Ibises (NBI; *Geronticus eremita*). Every spring since 2004, groups of human-raised NBI were guided by ultra-light planes from their breeding area in Upper Austria to the wintering grounds in southern Tuscany, Italy. There, the birds were released into independence. As in other migratory species, juvenile NBI remain on their wintering grounds until sexual maturation. We tracked the behavior of two generations via sightings. The data indicated a seasonally changing spatio-temporal pattern of flight activity with a peak occurring in spring. This pattern was influenced by age-dependent changes. The birds covered considerable flight distances of several hundred kilometres, even though they did not reach the breeding area north of the Alps. Birds were oriented along the route they had acquired during their first autumn migration after following the ultra-light plane. This pattern was consistent with observational data from wild NBI populations. In spring 2006, birds were equipped with GPS data loggers. This technique allows precise tracking of movements with a resolution of only seconds. We present preliminary data in a three-dimensional terrain model.

Ritz MS[1], Phillips R[2], Ryan P[3], Peter H-U[1]

Phylogeography of the great southern skuas (*Catharacta* spec.)

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The great southern skua (*Catharacta*) complex comprises five described taxa in a phylogenetically young genus. Cytochrome b variation was found to be low in a former study, and failed to resolve the phylogeny of the complex. Accordingly, we set out to investigate its phylogeography by sequencing a hypervariable region, HVR I, of the mitochondrial DNA D Loop. The marker contained enough informative variation to resolve population differences. DNA samples of 10-25 individuals per breeding location were used and covered the breeding range of all taxa. The analysis to be presented reveals the phylogeny and age of the five taxa, as well as population history and potential range changes. The prediction that climatic oscillations reduce phylogeographic structure in high-latitude taxa will be tested by comparing populations of South Polar (*Catharacta maccormicki*) and sub-antarctic great skuas. The project also enables comparisons of speciation in arctic gulls and antarctic skuas, and reveals the importance of glaciation in shaping genetic structure in these seabird populations and past speciation events.

Robledano Aymerich F, Pagán Abellán I

Waterbirds as indicators of agricultural intensification: Local response to effluents in the Mar Menor Lagoon, southeast Spain

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Under an EU-funded project for managing the Mar Menor lagoon and its watershed in southeast Spain, analysis of a census of wintering waterbirds revealed a general positive response to nutrient input. The Mar Menor is a 135 km^2 coastal wetland complex surrounded by an irrigated agricultural plain of 330 km^2 and a dense urban belt. During the winter of 2004-2005, we studied the distributional response of waterbirds around the main effluent, Rambla del Albujón, formerly a derelict ephemeral channel. The effluent collects drainage water from agricultural fields and refuse water from sewage and desalination plants. We counted birds and recorded their activity inside the lagoon, along a stretch of undeveloped shoreline on both sides of the channel outlet. The entire shoreline is affected by diffuse drainage discharge, which ultimately reaches the lagoon through a saline steppe. After dividing the adjacent waters into sectors located at different distances from shore and outlet, we compared waterbird numbers among them and in sections of the lagoon not affected by agricultural drainage. There was a marked aggregation of the three most abundant species, Great Crested and Black-necked Grebes (*Podiceps cristatus, P. nigricollis*) and Eurasian Coots (*Fulica atra*) around the point of discharge. The distribution of these species is discussed in relation to their trophic, ecological and physiological requirements. The case of the Coot is especially remarkable, as it had increased from virtual absence in the late 1980s to over 700 wintering birds in 2004-2005, concentrated in sectors closer to the outlet probably because of its preference for low salinity waters. Since salinity reduction and nutrient loading are the main factors controlling environmental change within the system, waterbird numbers appear to be useful indicators of potential problem areas in and around agricultural effluents.

Rodenhouse NL[1], Sillett TS[2], Holmes RT[3]

Effects of weather on a nearctic-neotropical migrant songbird: Implications for climate change

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Reproduction and survival of nearctic-neotropical migratory birds is affected by global climate patterns, but how local weather influences these parameters is not well understood. We use a 23-year study of the demography of Black-throated Blue Warblers (*Dendroica caerulescens*), including 10 years of study across an 800-m elevational gradient, to reveal how the breeding biology of this species is being affected by changing climate at the Hubbard Brook Experimental Forest, New Hampshire, USA. Weather was highly variable among years, with mean May temperatures differing by up to 6.8°C during this period, while mean June temperatures increased by 1.7°C. Mean temperatures across the elevational gradient differed by about 2°C, approximately the shift expected to occur in New England due to global warming over the next 50 years. Cool springs resulted in later nesting and little recruitment at high elevation, dramatically shifting the age structure and density of the population across elevations. Within years, mean date of completion of first clutches did not differ significantly among plots at different elevations. Biomass of Lepidoptera larvae, a primary food of migratory songbirds, varied widely among years and was significantly higher at higher elevations; but it fluctuated largely independently of local weather. These findings indicate that the usual conditions at mid- and high- elevation represent optimal habitat for the warblers, in part, because food abundance has been greatest at these locations. The projected warming trend will expand the area subject to low-elevation climate - and least food - while reducing mid- and high-elevation habitat. Such changes should have a negative impact on the distribution and abundance of Black-throated Blue Warblers by reducing annual fecundity. It can thus be expected that projected climate change will affect this and other migratory bird species through changes in habitat quality, especially food availability.

Rodríguez-Contreras V, Navarro AG

The effects of the Isthmus of Tehuantepec on biogeographic patterns in the mesoamerican avifauna

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The land separating the Atlantic and Pacific Oceans in North America comes to its narrowest point at the Isthmus of Tehuantepec in eastern Oaxaca and Veracruz, Mexico. It has been identified as an area of high speciation and population differentiation, a barrier for highland avian species, a corridor for both Atlantic and Pacific slope breeding birds, and an avenue for migrants moving between North and South America. As a result, it has long been studied in relation its vicariant effect on species differentiation to the north and south. Nevertheless, the effects of contact between populations on east and west slopes have had little attention, notwithstanding the high, contrasting levels of endemicity in the dry zone of the Pacific lowlands. Evaluating geographical patterns in the avifauna of the isthmus thus contributes to understanding processes occurring not only on this transition zone, but also in North America. To evaluate these patterns, distributions for every bird species affected by regional topography are being modeled for the area using GARP. The resulting models will be used to generate a presence/absence matrix for all quadrants screened by applying a 0.25 degree gradicule to the study area; and then species will be selected for analysis. A Parsimony Analysis of Endemicity (PAE) will be performed on with these data. Species exchange between quadrants will also be measured, in a search for areas of high exchange for comparisons with regionalization patterns obtained from the PAE.

Rodriguez Santana F

Raptor migration through Cuba: An analysis based on band recoveries, satellite telemetry and visual counts

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I describe the autumn migration of raptors in Cuba from band recoveries of birds banded in the USA and Canada, satellite telemetry and autumn migration counts, together with published and unpublished data. Ospreys (*Pandion haliaetus*) enter north-central Cuba, travel southeast to eastern Cuba and then fly to La Hispaniola and Jamaica en route to South America. Nearly 90 % of the global population of Swallow-tailed Kites (*Elanoides forficatus*) enter western Cuba from Florida and then fly to the westernmost point of the island to cross the Yucatan strait to the Yucatan Peninsula, Mexico, except for a small group that flies east to apparently winter in eastern Cuba. Peregrine Falcons (*Falco peregrinus*) and Merlins (*Falco columbarius*) reach central-western Cuba and take two routes, one to the east to the Antilles and South America and one to the west to the Yucatan Peninsula. But *Circus cyaneus, Accipiter striatus, Falco sparverius* and *Buteo platypterus* enter Cuba in smaller numbers, and mostly over-winter there. While in Cuba, these species probably migrate across a broad front without constriction, which hinders the tracking of their movements within Cuba.

Rodriguez Santana F

Status, distribution, habitat requirements and conservation of Gundlach's Hawk in Cuba

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Although there are records from every province in Cuba, the endemic and threatened Gundlach's Hawk (*Accipiter gundlachii*) occurs in natural forest or areas with well-preserved forest habitat. Highest densities have been found in pine forests, followed in order by rain forests, mixed evergreen forest, semi-deciduous forest, and other wooded habitats, from sea level to well above 1000 m asl. New localities for the species are reported. Juveniles are more abundant in suboptimal secondary habitats, territorial adults occupying natural stands of primary forest. Current laws for protecting endangered species in Cuba are still inadequate, and more environmental education and legislation are needed to conserve this species.

Romdal TS, Rahbek C

Altitudinal zonation of Afrotropical forest bird communities along a homogeneous forest gradient

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Altitudinal gradients are eminently suitable for analyzing the role of ecotones in the composition and zonation of communities. While descriptive classifications of altitudinal vegetation zones are common, tropical forest gradients have rarely been quantitatively analysed for vertebrates. Here we analyse the distribution of bird species along a single altitudinal transect in the Udzungwa Mountains of the Eastern Arc, Tanzania. Using chronological clustering, a null-model approach, we identify distinct lowland and montane bird communities within the apparently homogeneous forest gradient. Most bird species, moreover, can be categorized as belonging primarily to one of the major communities. The mechanisms causing species to settle into distinct communities are discussed, as well as the general suitability of the applied null-model to other studies.

Roos S, Siggstedt J, Pärt T

Habitat selection and breeding success of Common Magpies in farmland: The relative importance of grassland and human settlement

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Common Magpies (*Pica pica*) are frequent predators of songbird nests; thus knowledge of their habitat requirements for breeding may be essential for evaluating how magpies may affect farmland songbird communities. We investigated habitat preference and breeding success in magpies inhabiting a Swedish farmland, sampling 313 territories. Territory occupation rate was linked exclusively to within-territory characteristics, within 100 m from the territory centroid, whereas habitat characteristics at larger scales, at 300 m or more from the territory centroid, had no significant association with it. Magpies preferred sites located close to human settlement and extensive roadside. Similarly, the only predictor of breeding success was proximity to human settlement; pairs were more successful close (<50 m) to houses and farms than further away. No other habitat variables, irrespective of spatial scale, were found linked to breeding success. A review of other studies of habitat selection by breeding magpies in European farmlands revealed that our results differ somewhat. Several of those investigations found that magpies have a strong preference for farmland grasslands instead. We suggest that the absence of preference for grasslands in our study population may be explained by the need for magpies to use and defend territory year-round: grasslands in Sweden are inaccessible for foraging during the winter due to snow and frost. In support of this hypothesis, we found a preference for grasslands only in regions with mild winters, where mean January temperature is above 0°C. Thus, magpies differ regionally in preferences for breeding habitat, which may result from variation in habitat-specific food abundance and predation risk.

Ropert-Coudert Y, Kato A

The contribution of bio-logging to optimal foraging studies

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It is genuinely difficult to assess exactly when and how much food is ingested by free-ranging animals, especially in wide-ranging seabirds that feed off-shore. Here, using three examples, we review briefly the contribution of recent animal-attached remote-sensing approaches (bio-logging) to assessment of the feeding activity of seabirds, mainly penguins, in the wild. Results obtained using oesophageal temperature recorders to determine ectothermic prey ingestion, jaw movement detectors to determine specific food taken, and indirect proxies of feeding activity through fine-scale measurement of body movements, will be presented. These approaches reveal that, firstly, deep-diving penguins attack prey mainly from below, suggesting that they use counter-shading imagery, i.e. detecting the outline of their prey against the brighter background of the surface. In contrast, shallow-diving penguins foraging close to the seabed tend to drive prey against the bottom in order to limit the field for prey escape. Secondly, penguins encountering prey swim at species-specific speeds that differ from those corresponding to the minimum energetic cost of transport. None-the-less, models taking into account optimal prey processing rates and prey escape speeds have shown that the net energy gain in penguins remains at an optimum, i.e. penguins have flexible hunting strategies. Thirdly, knowing the exact time of prey ingestion allows modeling of the period that an adult should spend in the foraging zone in order to optimize the trade-off between survival and reproduction. Details of the model reveal that penguins should conduct trips of bimodal length irrespective of the distance between breeding colony and feeding grounds.

Rösner S[1], Selva N[2]

Estimating territory of Common Ravens in Poland by bait-marking

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We tested the applicability of the bait-marking method for estimating territory size in Common Ravens (*Corvus corax*) during the breeding season in Bialowieca Forest, Poland. Carrion baits were each marked with a distinctive type of plastic marker, and placed experimentally at different distances from occupied nests. A total of 1,018 pellets and 1,193 droppings from seven target nests, six neighboring nests and a roost were checked for markers. Eighty-nine percent of the baits were taken by ravens. In total, 705 markers, from 40 different baits and carrion, were recovered. The recoveries indicated that ravens fed on 63% of the experimental baits, 76% of which came from inside estimated territories. The proportion of baits taken by a pair, together with the number of markers recovered, declined with increasing distance between bait and nest. Distance from the nest explained 84.5% of variation in the taking of carrion by ravens. Territorial pairs rarely took baits and carrion further than 2,040 m from the nest, a threshold that indicated a territory size of 13.1 km^2. Taking baits beyond seemed to be governed by two particular conditions. Either several subadult ravens were present at the same time and/or the carrion was situated in open habitat. Habitat characteristics and snow cover did not affect bait taking or marker recovery. This project shows that bait-marking is an efficient, accurate and economic method for estimating territory size in scavenging birds, as well as for collecting information on local movements.

Rothgänger A[1], Wiesner J[2]

Habitat requirements of the Pygmy Owl: A basis for conservation

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The Pygmy Owl (*Glaucidium passerinum*) is cited in Annex I of the European Union Council Directive on the conservation of wild birds (79/409/EWG). Species listed in Annex I “shall be the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in the area of distribution....Member States shall classify in particular the most suitable territories in number and size as special protection areas for the conservation of these species”. For the Pygmy Owl, no specific protection area has yet been declared in Germany. For effective selection of such areas, habitat requirements need to be known. Nevertheless, because the owl is small, cryptically plumaged, and covert in life-style, its habitat requirements have been little studied. To gain insight into its needs, we investigated habitat use by 12 adult Pygmy Owls through radio-tracking in Thuringia, Germany, between 2002 and 2005. The owls had home ranges of 150±84 ha which did not differ between the sexes. Together with these results, we analyzed different parameters of habitat needs, such as habitat preference and the effect of prey density. From the data we then created a model in which the impact of single factors could be evaluated and integrated, allowing us to prepare effective proposals for conserving this critical species. Supported by the German National Academic Foundation, German Ornithologist’ Society, Thuringian Agency for Environment and Geology, and German Working Group for the Conservation of Endangered Owls

Rounsley KJ, McFadden SA

Active corneal accommodation in the Rock Dove

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There is evidence of a corneal component in the accommodating eye of the Rock Dove (*Columba livia*). Yet although a reduction in corneal radius has been elicited *in vitro*, no study has measured corneal accommodation in awake, naturally-behaving birds directly. Accordingly, this study assessed dynamic corneal accommodation in Rock Doves engaged in a controlled visual task. Five doves were trained using operant conditioning to perform a two-choice visual discrimination task that required the birds to differentiate between high contrast square-wave gratings of different orientation with a key peck response. The stimuli were placed at a series of distances behind the response keys in the frontal visual field, with total eye-stimulus distance ranging from 10cm to 80cm. Thus a change in accommodative effort was required for each of the distances. During key pecking, the birds were filmed and the refractive state of the eye measured by infra-red video-refraction and video-keratometry. Results indicated that the refractive state of the Rock Dove eye is closely matched to that required for sharp focus at eye-stimulus distances of 30cm or less. Beyond this distance a myopic error was recorded, corresponding with a dramatic reduction in visual acuity also reported elsewhere. The cornea was found to contribute almost 100% of the total refractive power of the eye at each of the viewing distances tested out to 20cm. Beyond this distance the visual system appeared to be no longer under stimulus control in the frontal field. This finding establishes the existence of active corneal accommodation in the Rock Dove.

Roxburgh L

The impacts of fuelwood collection and farming on Chaplin's Barbet, an endemic hole-nesting fig specialist in Zambia

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Chaplin's Barbet (*Lybius chaplini*) is confined to acacia savanna in Zambia. This threatened species depends on sycamore fig trees (*Ficus sycamorus*) as a source of dead branches (snags) for excavation of nest holes and as a year-round source of fruit. The majority of the barbet population is found outside protected areas where suitable habitat faces two main threats: land clearing for agriculture and cutting of trees for fuelwood. In a comparison of protected and unprotected habitats, I examined the impacts of agriculture and fuelwood collection on tree density, the availability of snags for hole-nesting, and the abundance of Chaplin's Barbets and other hole-nesting birds. The densities of fig trees were not significantly reduced in areas of subsistence farming, perhaps because fig wood has no commercial value and the fruits are a valuable supplementary stock feed. However, overall tree density and snag availability were still lower in areas of subsistence farming than in protected areas, because branches and dead wood are removed by rural communities for use as firewood. Consequently, the abundance of cavity-nesting birds was reduced in areas of subsistence farming. Removal of dead wood from fig trees was found to have a significant negative impact on barbet populations in unprotected areas despite no reduction in fig tree density.

Sacher T[1], Coppack T[2], Bairlein F[2]

Genetic structure and migratory behavior in a recently founded population of Eurasian Blackbirds

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Recent climatic change has resulted in a northward expansion of breeding ranges in many Nearctic and Palearctic passerines, yet the mechanisms underlying this adaptive process remain unclear. The Eurasian Blackbird (*Turdus merula*) is one of the most successful species judged by its ability to adapt to a wide range of environments. It has recently extended its breeding distribution to northern Europe, including Iceland, and, at lower latitudes, has rapidly reduced its migratoriness in response to climatic amelioration. On the remote island of Heligoland, North Sea (54°1'N, 07°55'E), blackbirds have establish a breeding population of 60 to 70 pairs within the last two decades. Origin, detailed demographic history, genetic structure and migratory behavior of this geographically isolated population are unknown. We analyzed microsatellite variation to infer its population structure and demographic history. We also measured trace-elements in feathers to detect potential immigrants, i.e., stranded migrants from Scandinavian breeding populations or dispersive individuals from the adjacent mainland. Furthermore, we estimated the proportion of migrants and the number of recruits within the island population through color ringing and studied migration-related traits in hand-raised island birds under laboratory conditions. Sibling-resemblance and parent-offspring comparison under natural and experimental conditions allowed us to study the relative roles of genetic and environmental factors causing natal philopatry. In this presentation, we provide first results from our multi-methodological approach towards understanding the mechanisms that underlie successful population foundation in dispersive, migratory songbirds.
Supported by the Deutsche Forschungsgemeinschaft (DFG)

Sahlman T

Effects of forestry on genetic variation in the Siberian Jay

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Over the last 50 years, modern forestry has changed the landscape composition of many boreal forests drastically. The resulting loss of habitat is of major concern for the conservation of many species, because not only do their populations decline, but the reduction can also lead to loss of genetic variation and increased inbreeding. Here I examine the effect of landscape composition on natal dispersal and kinship in the Siberian Jay (*Perisoreus infaustus*) by utilizing neutral molecular markers. The jay is a communal non-migratory species of boreal coniferous forests, each group inhabiting a territory of roughly 0.5 square kilometres. In Scandinavia, the groups consist of one

adult pair and a varying number of unrelated immigrants or retained offspring that remain on their natal territories for up to three years. Males, the more philopatric sex, disperse less than the distance across two territories in a lifetime. As forest management reduces adult survival and breeding success, the pattern and intensity of management within territories can be expected to influence population structure and genetic variation. These effects should be most pronounced in males because of their philopatry. Preliminary results suggest that males in areas with low habitat connectivity show less genetic variation than males in areas with higher connectivity.

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Deep phylogeographical divergences among Far Eastern populations of the widespread Arctic Warbler

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In contrast to the numerous phylogeographical studies of North American and European birds, very few have been undertaken in far eastern Asia. The Arctic Warbler (*Phylloscopus borealis*), a migratory passerine with a wide breeding range from Norway to Alaska, is unsettled taxonomically. Three to seven subspecies are usually recognized: *borealis* from Scandinavia to the Chukotskiy Peninsula, sometimes split into *talovka*, *transbaicalicus* and *borealis*; *hylebata* in Ussuriland and Sakhalin, although the Ussuri population is sometimes lumped with *borealis* and the Sakhalin with Japanese *xanthodryas*); *examinandus* in Kamchatka, also often lumped with *xanthodryas*); *xanthodryas* in Japan; and *kennicotti* in Alaska. These subspecies are poorly differentiated morphologically, but some have distinctive songs. We analyzed variation in 1011 base-pairs of cytochrome b (cyt b) gene sequence of mitochondrial DNA from breeding populations in Siberia, Alaska, Kamchatka, Sakhalin and Japan (Hokkaido, Honshu, Shikoku and Kyushu). We recovered four clades: clade A from Kamchatka and Hokkaido; clade B from Siberia and Alaska; clade C from Sakhalin; and clade D from Honshu, Shikoku and Kyushu. Genetic distances between the four clades ranged between 2.3% and 5.8%. Assuming substitutional rates 2% per million years in the cyt b gene, the divergence between clades A and D was estimated at approximately three million years, far greater than those among typical subspecies. In contrast, samples of *borealis* and *kennicotti* were very similar genetically. We conclude that *examinandus* and *xanthodryas* might advisedly be treated as distinct species, because they have been separated from each other and from *borealis* for a considerable time, probably throughout the Pleistocene.

Sakai S[1], Yasuda M[2], Momose H[3], Fujita G[1], Higuchi H[1]

Seasonal shifts in foraging habits of Grey-faced Buzzards in relation to spatial and temporal distribution of prey

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The Grey-faced Buzzard (*Butastur indicus*) is a diurnal raptor that breeds in the agricultural landscape of paddy fields and associated woodlots in east Asia. It is now declining, probably because its breeding habitats have been affected by deforestation and shifts to modern agricultural methods. In central Honsyu, Japan, its foraging habits were investigated with the aim of providing more precise information about the characteristics of its required habitat for conservation purposes. Buzzards used open elevated perches such as telegraph poles or tree branches to search for prey, but the habitat around the perches changed during the breeding season: paddy fields before rice planting in April to early May, short grassland in May, and grassland and woodlots in June and July. Frequent attack points also changed from paddy fields in April and May through grass levees in June to forest canopy in late June and July. Along with the seasonal shift in foraging habitat, the buzzards changed their main prey from frogs and reptiles to insects. These seasonal shifts are probably associated with a change in prey biomass and distribution, as frog abundance on paddy fields decreased and lepidopteran larva biomass in woodlot canopies increased from April to July. A combination of available paddy field, grassland, and woodlots is thus important for the foraging of buzzards during the breeding season. These landscape characteristics should be managed as a mosaic to maintain the spatial and temporal spread of prey so that the breeding habitat of Grey-faced Buzzards can be conserved.

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Molecular phylogeography of a Japanese endemic, the Copper Pheasant

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The endemic Japanese Copper Pheasant (*Syrmaticus soemmerringii*) comprises five subspecies. As well as hunting and habitat destruction, hybridization among the five subspecies and that between wild and captive-reared stocks may be affecting the integrity and survival of natural stocks of the subspecies. Accordingly, we investigated phylogeographic patterns among the five subspecies by analyzing sequences from the entire mitochondrial DNA control region. 44 haplotypes were identified in a sample of 90 individuals covering all subspecies; two haplotypes were dominant, occurring in 23% and 12% of the samples analyzed, respectively. The resulting network tree placed the dominant haplotypes at ancestral nodes, from which the remaining haplotypes, differing by 1-4 substitutions, radiated out to form a "bush". This indicates that the Copper Pheasant differentiated relatively recently by diffuse radiation. Because the dominant haplotypes were present in popultions throughout Japan, it was difficult reconcile any phylogeographic pattern with the present distribution of subspecies. We also used nucleotide sequences from the complete mitochondrial cytchrome b gene and partial 12S gene to assess phylogenetic relationships among the five species of the genus *Syrmaticus*, namely Elliot's (*S. ellioti*), Hume's (*S. humiae*), Mikado (*S. mikado*), Copper, and Reeves's (*S. reevesii*)Pheasants. The neighbor-joinging procedure placed Copper and Reeves's Pheasants as basal and divergent from a monophyletic cluster that included the remaining species.

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Wing ornamentation reveals future survival in Common Black-headed Gulls

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The size of a white terminal pattern in the wing tip of a number of gulls has been shown to be highly variable, age dependent and also sometimes sexually dimorphic, all characteristic of sexually selected traits. Despite this, the mechanisms underlying the evolution of such patterns have received little attention. Dominating present discussions are perceptions that such plumage ornaments serve as indicators of the quality of the bearer: the honesty of the signal is measured by their cost, so that individuals of inferior quality cannot cheat. Melanized feathers are known to be structurally stronger and less prone to abrasion than unmelanized ones, and abrasion to white tips on the outer primaries may reduce capacity for flight. Thus spots on the tips of outer primaries can inflict considerable cost upon the bearer, such that the larger the spots according to the honesty-of-signal hypothesis, the higher the quality of the bearer. We demonstrate that, in Common Black-headed Gulls (*Larus ridibundus*), the size of the wing spots reflects individual survival prospects and that the biggest wing spots are characteristic of birds at peak reproductive stage in life. These results indicate that white wing spots in gulls might indeed function as condition-dependent signals, revealing inter-individual variation in quality.

Sammler S

A survey of the avifauna of the wildlife sanctuary Banyang-Mbo in Cameroon

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The wildlife sanctuary of Banyang-Mbo, 662 km², is located in the tropical lowland rainforest of southwest Cameroon at an altitude between 120m and 1760m a.s.l. The area is a biodiversity hotspot resulting from an isolation event during the Pleistocene, followed by climate change. In addition to its many endemic species, it is a meeting ground for the faunas of east, south and west Africa. The sanctuary evolved out of a former forest reserve in 1996 after initial research revealed the biological richness and quality of its tropical lowland forest. At present, there is a proposal to raise its status to that of a National Park, the establishment of which requires further data on the biodiversity of the area. Such survey work is now under way, based on a preliminary estimate of about 325 bird species in the area. In cooperation with the Wildlife Conservation Society, the aim of the study is to produce an annotated list for all bird species in the Sanctuary. Extensive monitoring during March and April 2006 used mist-netting, tape recording and field observations to gather information on the composition of the avifauna to subspecies level. All birds trapped were measured, weighted and photographed. A major focus of the survey has been to learn more about the status of the 31 or more species of sunbirds (Nectariniidae) present, especially their food plant specificity and inter- and intra- specific interactions.

Sanz V

Changes in the characteristics of nests used by the Yellow-shouldered Parrot at two population densities

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The availability of suitable cavities could be a limiting factor for breeding in secondary cavity nesters. If this is so, theory predicts that with increasing population size the quality of new cavities will decrease. The population of the Yellow-shouldered Parrot (*Amazona barbadensis*) on Margarita Island, Venezuela, was under an intensive conservation and management program between 1990 and 1999 to increase its population and reduce the risk to extinction. I analyzed different cavity characteristics of nests used from 1990 to 1992 (low breeding density; average breeding population, 26 pairs; total population, 1300) and compared them with new nests used from 1997 to 1999 (almost double breeding density; average breeding population, 55 pairs; total population, 2300). I included variables at different spatial scales related to cavity, nesting-tree, vegetation patch holding nests, and the surrounding vegetation matrix. The only variables statistically different between the two periods at cavity scale were entrance height and the nest depth. Nests used by the end of the study had lower entrance heights and were shallower than those used at the beginning. They were also placed in more open positions, with fewer branches below and a more open canopy above. There were no differences in either the shape and size of the nest patch or the composition of the surrounding vegetation across the study. Although the breeding population does not seem not to have reached carrying capacity yet, given that almost 50% of total cavities available remain unoccupied each year, I observe changes in the characteristics of new cavities chosen that could make them more susceptible to predation.

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Common Quail autumn pre-migration movements in Spain

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In the last 25 years, Common Quail (*Coturnix coturnix*) males have been ringed in the northern half of Spain between latitudes 41º and 43º30'N during the breeding period. Ringed quail (N=202) have been recovered as a result of hunting activity (late summer to early autumn). Birds had been ringed the same year of the recovery, and they had moved more than 50 Km. In this study, we analyze the orientation of male quail movements during post-breeding period in Spain. Dividing the ringing area in three zones according to geographic longitude (Zone 1: west of 4º meridian, Zone 2: between 4º - 3º W meridians, and Zone 3: east of 3º W meridian) we have observed three different orientation patterns: towards the east (males ringed in Zone 1: n=81, angle=91.3º, r=0.34, p<<0.01 according to a Rayleigh's Test), random (males ringed in Zone 2; n=43, angle=153º, r=0.1 p=0.65) and towards the west (males ringed in Zone 3; n=78, angle=258º, r=0.78, p<<0.01). These results strongly suggest that male quail populations placed in the half northern part of Spain concentrates in a certain central area before migration movements to winter quarters in the sub-Saharan strip occur. The role of landscape in these movements is also discussed.

Sato M, Sakai H

When does the breeding period start? - The effect of autumnal steroid hormone secretion

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Most avian species in mid-to-high latitude areas commence breeding in spring, followed by rearing and then molting into a non-breeding period through autumn and winter. Yet some males of some species also recommence courtship display and territorial song in autumn, coincident with temporary increases in luteinizing hormone and androgen. We collected blood and fecal samples from captured birds in autumn to measure serum and fecal steroid hormones, and found a surge in testosterone secretion in males after molting. Some experimental females also showed a small and gradual increase in the amount of serum estradiol-17beta (E_2), but without any of the sexual behavior observed in males. This gradual increase started early in the non-breeding period and, in contrast to the steep rise in hormonal levels immediately before breeding, continued steadily to the next breeding period. In one of the experimental species, the Mandarin Duck (*Aix galericulata*), mating was established in late March, followed by egg-laying in April, hatching in May, and molting around August and September. The above time frame is generally thought to cover the breeding period, from beginning to end. It is significant, however, that we found a gradual increase in E_2 starting in October after molting had finished, reaching a level two to three times greater than minimum E_2 values between December and February when " loose pair bonds" were formed, and then accelerating to 50-times the level just before entering the breeding season. These data suggest that, in spite of the conventional discrimination between breeding and non-breeding periods, the non-breeding season is more realistically perceived as a long preparatory stage for breeding. Against this background, we evaluate hormonal changes in Lidth's Jays (*Garrulus lidthi*) and the Northern Bobwhite (*Colinus virginianus*) to determine precisely when their breeding periods begin.

Sautter M, Schiegg K, Pasinelli G

Reproductive success in Reed Buntings in young versus old reed patches: Evidence for an ecological trap?

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Reproductive success in birds is often influenced by the quality of the nesting habitat. Particularly important in this respect is nest concealment, which has been shown to avert predation risk in various species. Current management of wetland nature reserves in Switzerland includes annual mowing of the reed (*Phragmites* sp.) except for small bands along lakes. Further, some patches (rotation patches) are spared from cutting, the location of which changes each year. A characteristic species of such wetlands is the Reed Bunting (*Emberiza schoeniclus*), a ground nesting passerine that usually hides its nests in old reeds mixed with dense vegetation. Some individuals, however, build their nests in 1-year-old rotation patches where vegetation is rather thin. We hypothesized that breeding success would be lower in such patches, and set out to test the idea. Using data from 43 breeding pairs on three study sites in north-east Switzerland in 2005, we compared reproductive success of pairs breeding in rotation patches with success in old reed bands at least three years old. Additionally, we sampled data on parental morphology, vegetation structure and potential edge effects such as the distance to reed edge or patch size. Preliminary results indicate higher predation rates in rotation patches, but there were also site-specific effects. Should Reed Buntings continue to prefer such patches as breeding sites while suffering reduced reproductive success, rotation patches may form an ecological trap for them.

Sawara Y, Adachi T, Takatsuji Y, Isogai M

Declines in small piscivorous birds due to exotic fish in Japan, and the importance of hypoxic ponds as a feeding environment

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Small piscivorous birds that breed on ponds, such as the Little Grebe (*Tachybaptus ruficollis*) and Yellow Bittern (*Ixobrychus sinensis*), have declined recently in Japan. One of the causes is ascribed to the rapid spread of the piscivorous Largemouth Bass (*Micropterus salmoides*), a fish introduced from North America. Small fusiform fish such as the cyprinid *Pseudorasbora parva*, which are major dietary prey for the grebes and bitterns, are also vulnerable to predation from the bass, and have declined wherever bass have been introduced to ponds. In ponds where floating plants such as *Trapa japonica* are dominant, however, hypoxic conditions develop in the mornings through summer. Cyprinid fish are relatively resistant to hypoxic water, because they can use oxygen-rich levels at the surface during the hypoxic period; but bass cannot survive such in such conditions. Thus floating water plants can control the bass and ensure the survival of small fish to maintain a reliable feeding environment for small piscivorous birds. The morning rise of small fish to water surfaces on ponds with floating plants, moreoever, advantages foraging for Yellow Bitterns.

Schaefer T[1], Leisler B[1], Pulido F[2]

Two modes of clutch size determination in short-distance and long-distance migrants

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In most birds, mean clutch size varies over the breeding season. Two different mechanisms have been suggested as its determinants. According to one, clutch size is determined by the laying order in the population: depending on whether a bird lays early or late relative to mean laying date, it will lay a smaller or larger clutch. As a result, mean clutch size in the population can change independently of laying date. According to the other mechanism, seasonal decline in clutch size results from birds laying a finite number of eggs at a specific calendar date. Thus mean laying date and clutch size are correlated. We predicted that clutch size determined by relative laying date would predominate in resident species and in migrants that returned early enough from wintering quarters to assess environmental conditions on breeding grounds before laying. In species that returned immediately prior to breeding, including most long-distance migrants, we expected that clutch size would be determined by absolute calendar date. An analysis of long-term data from Blackcaps (*Sylvia atricapilla*), Eurasian Reed Warblers (*Acrocephalus scirpaceus*) and Great Reed Warblers (*Acrocephalus arundinaceus*), and a brief survey of published data for other species, confirmed our expectations. These findings suggest that long-distance migrants will probably not be able to adjust laying date and clutch size to changing environmental conditions.

Schaefer T, Leisler B

Different responses to global warming: Predation, competition and population dynamics

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Global warming has changed breeding phenology and reproductive parameters in many species. Depending on their ecology, species respond very differently to rising spring temperatures, differences that are still poorly understood. To analyze such differences, we examined long term nest records for three migratory, insectivorous open-habitat breeders that nevertheless differ in many life history traits such as migration strategy, breeding biology, nest site and diet. The species, all Old World warblers, were the Eurasian Reed Warbler (*Acrocephalus scirpaceus*) and Great Reed Warbler (*A. arundinaceus*), both of which breed in reed beds, and the Blackcap (*Sylvia atricapilla*) which nests in shrubby vegetation. The two reedwarblers share many ecological attributes and thus compete for space; and their populations showed a decline in the nest records over the study period. The Blackcaps, in contrast, suffered from high levels of nest predation. The results over time showed marked responses in all species that could be attributed to rising mean temperatures. As a consequence of the different effects, however, the patterns of response varied strongly. Our analyses demonstrate that competition, predation and population dynamics alter the responses measured, and we intend to control for those parameters in future studies.

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Choosing from a plethora of colors: The role of visual signals in the intraspecific communication of the Gouldian Finch

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The Gouldian Finch (*Erythrura gouldiae*) sports numerous plumage colors, among these carotenoid-based coloration as head color morphs and structural coloration as rump color. To elucidate the potential role of the different color types in intraspecific communication, we conducted both, intrasexual (male-male) and intersexual trials. In our study we approach the theory on multiple signalling, which predicts that multiple signals require multiple receivers. In pair-wise trials, we tested whether male social status correlated with plumage traits. We processed the spectral data through a model of avian color vision using cone output data of the Gouldian Finch to characterise the spectra according to the species' visual system. A multiple regression of plumage and morphological traits revealed that blue rump coloration, i.e. the cone outputs processing the shorter wavelength bands, explains social hierarchy among males of the Gouldian Finch. Neither head color nor other plumage traits contributed to the model. We also investigated the influence of various male plumage traits on female choice in a four-way mate choice chamber. Head color morph did not influence female choice.

Scheiber IBR, Wascher CAF, Kotrschal K

Biparental care in Greylag Geese: Heart rate as a measure of parental contribution

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In most birds both sexes share investment in raising offspring, but the division of labour is often not equally distributed. To approximate energy expenditure in free-living individuals, measurement of heart rate has proved useful, because it correlates well with oxygen consumption. Heart rate telemetry is used to monitor activity, physiological parameters, metabolic costs and social stressors. At present, twenty-five of ~170 free-ranging, semi-tame Greylag Geese (*Anser anser*) on our station are implanted with sensor-transmitter packages. These internal data loggers take continuous recordings for periods up to 18 months. Beat-by-beat data can be recorded during specific activities, e.g. chick brooding, with simultaneous observation of other behaviors. In this study, we estimated energetic costs of annual reproduction and molt in pairs of Greylag Geese from March to July as measured by heart rate. Our main focus now is interaction at the individual level, i.e. differences in performance between geese, and how this is related to physiological parameters. Accordingly, we discuss individual variations in heart rate both within and between pairs, and speculate on the resulting costs in terms of energy demands. We also consider other components of individuality, including coping style, where we found consistent differences in heart rates not only within pairs, but also between the sexes. We suggest that cooperation among pairs affects underlying physiological parameters, including heart rate, in the monogamous biparental Greylag Goose. Supported by FWF, Verein der Förderer, and Herzog von Cumberland Stiftung.

Scheiffarth G[1], Frank D[1], Bradter U[1], Thoden B[2]

Crushing shells in a stomach: more than simple mechanics

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Birds feeding on hard-shelled prey are challenged by their well-protected food. Several species of the family Anatidae live on bivalves which are swallowed whole and are crushed in the gizzard. This type of food processing is extremely energy consuming, leaving only a small margin from the energy content of the prey for other activities than food processing. Therefore, profitability plays a crucial role as a selection criterion for these birds. Besides the pure physical force needed to crush the shells, other mechanisms might be employed during mechanical food processing in the gizzard, which offer options to optimise the whole procedure. We measured energy requirements of Common Eiders (*Somateria mollissima*) for crushing cockles (*Cerastoderma edule*) in the gizzard. In addition, we measured the mechanical force to break different sized cockles. Energy required for breaking shells in the gizzard increased exponentially with cockle size. In contrast, mechanical force to break the shells increased almost linearly with size. Consequently, no linear relationship between physical and physiological breaking force existed. Profitability in terms of assimilated energy per prey item in relation to energy input to crush shells increased up to a certain shell size. Thereafter, it decreased again for the largest shell sizes tested. On the contrary, mechanical force to crush shells in relation to energy content increased continuously with shell size. Thus, Eiders seem to have the option to vary the relationship between shell size and numbers of cockles in the gizzard to optimise mechanical food processing.

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A test of experimental mosiac management for Black-tailed Godwits

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The Dutch breeding population of Black-tailed Godwit (*Limosa limosa*) has been declining for decades and this has not been slowed by conservation measures so far. A new form of agri-environment scheme was tried out in 2003-05 at 6 sites where a 'grassland mosaic' (200-300 ha) was created by collectives of farmers through a diverse use of fields including postponed and staggered mowing, (early) grazing and creating 'refuge strips' during mowing, in combination with nest protection and a slower mowing speed. We measured breeding success of godwits in one year in each of the experimental sites and nearby, paired controls (2 pairs per year). Nest success was monitored in the majority of nests present; chick survival was estimated for a smaller sample of chicks that were either radio-tagged or had a tagged parent. Breeding succes was higher (0.28 chicks fledged/pair) in mosaics than in controls, but due to lower agricultural nest losses only. Chick survival was 11% in both mosaics and controls. The amount of late-mown and other grassland suitable for chicks hardly differend between treatments during the fledging period, mainly due rainfall delaying postponing mowing in all sites. Chick survival was however positively correlated with site variation in the amount of high grass (>18 cm). The breeding success required to compensate for adult mortality (c. 0.6) was reached in only one mosaic. Chick survival was lower than in previous godwit studies, despite higher proportions of unmown grassland, indicating that additional loss factors have changed the relationship between survival and amount of suitable grassland. Increased predation (50-75% of chicks, mostly by birds) is a clear candidate, but changes in the suitability of late-mown grassland (insect abundance and sward density in grass monocultures) may also play a role. Consequently a higher management investment is needed to achieve a sustainable population.

Scheuerlein A, Ricklefs RE

The evolution of senescence in birds: Evidence from animals in zoos

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Birds are characterized by a low rate of senescence relative to mammals. However, there is considerable variation in the patterns of senescence and other life history traits among different orders. We used life history data from bird species kept in zoos, where most individuals are tracked from birth to death. In a comparative approach, we explored the variation in senescence and other life history traits at various phylogenetic levels to investigate the evolutionary plasticity of senescence. We found that its rate in birds shows greatest variation among genera within families. Moreover, we found that its patterns differ between orders, implying that different mechanisms have influenced the evolution of senescence: avian orders that are not so dependent on flight (Struthioniformes, Galliformes) tend to have patterns reminiscent of non-flying mammals. These findings have important implications for our understanding of the mechanisms and evolution of senescence.

Schielzeth H, Bolund E, Forstmeier W

Do female Zebra Finches imprint on heritable male traits?

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There are direct and indirect benefits for finding a good breeding partner, but finding a mate is also a costly, time consuming process. Here we test whether females of a socially monogamous and gregarious songbird are sexually imprinted on heritable components of the paternal phenotype. Two potentially adaptive scenarios are envisaged: (1) assortative mating, i.e. preference for the paternal phenotype, which will maintain coadaptive gene complexes, or (2) disassortative mating, which will result in avoidance of inbreeding and enhance heterozygosity. We measured mate choice behavior in 64 females from a captive Zebra Finch (*Taeniopygia guttata*) population. All experimental birds of both sexes were cross-fostered shortly after egg laying; hence they were raised by unrelated parents together with unrelated nest mates. At one year of age, females were presented with four males simultaneously, and the time allocation of their responses recorded in a choice chamber apparatus. All males were unknown to the females, but one of each four was a genetic son (SFF) of the foster father of the focal female. Since the SFF is genetically more similar to its father than a random bird, imprinting on heritable male traits should result in higher (sexual imprinting) or lower (inbreeding avoidance) time allocation scores. In spite of extensive sampling, our results do not reveal any significant pattern one way or the other. This does not rule out sexual imprinting on the paternal phenotype, because imprinting could work on acquired traits. For example, male Zebra Finches learn their songs from tutors in their first weeks of life, and as the SFF did not grow up with its genetic father, female imprinting on song traits need not result in preferences for the SFF. Inbreeding avoidance, on the other hand, could be of low relevance for a bird living in large, roaming flocks, in which it is unlikely to pair with a close relative.

Schleupner C, Schneider UA

Spatial suitability modeling of bird habitat distribution in the European Union

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This spatial analysis study contributes to a modeling project that, in combination with bird population analyses and an economic model, evaluates potentials for preserving existing habitats, potentials for restoring formerly native habitats, and potentials for creating non-native managed habitats for endangered bird species within the European Union (EU). We developed a multi-species approach for 150 threatened bird species in the EU (Annex I species of the EU Birds Directive) to determine species occurrence and habitat suitability in heterogeneous landscapes. As birds are high on the food chain, they are good indicators of the general state of biodiversity and therefore well suited for analyses of habitat condition. The potential geographic distribution of a target species can be predicted by niche-based modeling of recorded distribution in combination with a set of environmental parameters such as climate, soil, slope, aspect, terrain, land use and/or vegetation type. Probability threshold values for sites of highest habitat suitability have been evaluated for each species. Once determined, the defined areas were overlaid within a GIS to identify sites shared by all target species. Thus the model identifies land parcels of potential high biodiversity and nature conservation value. Then, another GIS-based model is generated to predict the distribution of current and past potential habitat for each species in order to evaluate the extent of reduction and/or distortion in habitat distribution resulting from clearing and fragmentation of habitat. Identification of potential areas of distribution can help locate sites suitable for reintroduction programs, or faunistic corridors, favoring success in regional conservation planning. Habitat suitability maps provide reasonable approximations of the niches of species, and, together with GIS, delimit quite well areas highly suitable for target species.

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Changing environmental conditions cause variability in individual fitness in arctic-breeding Barnacle Geese

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Opportunities to pass genes on to the next generation depend not only on individual phenotype but also the environment in which the individual has to reproduce. Fitness can fluctuate widely in an environment of marked annual variability in weather, intra-specific competition and predation pressure. In this context, we analyzed survival and reproductive success in Barnacle Geese (*Branta leucopsis*) through the breeding season on the high arctic island of Spitsbergen over a period of 15 years. The analysis is based on re-sightings of marked individuals and observations on reproduction and behavior throughout the breeding season. We demonstrate large differences in fitness between individuals and cohorts, address the environmental conditions causing the differences, and consider dispersal as a strategy to escape environmental constraints on reproductive success.

Schmidt S, Friedl T

Does the rate of telomere shortening in birds indicate genetic quality? A test in male Red Bishops

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Telomeres are short, tandem repeated sequences of DNA found at the ends of linear eukaryotic chromosomes. The repeats consist of a short, G-rich sequence which is conserved in vertebrates. Telomeres function in stabilizing chromosomal end integrity, preventing degradation and chromosome fusion. At each cell division, a small number of telomeric repeats is lost because DNA replication is incomplete at the 3' end of double strands. In continually proliferating germ and stem cells, telomeric repeats are restored by telomerase, a ribonucleoprotein reverse transcriptase, which is absent or inactive in other somatic cells. Telomere shortening has been suggested to be one of the main mechanisms underlying senescence and age-related diseases, because the loss of telomere function can lead to genomic instability and cell replicative senescence due to oxidative damage. Based on recent findings showing that longer telomeres protect cells from oxidative stress, together with results suggesting a heritable component leading to individual variation of telomere length, we hypothesize that telomere length at birth and rate of telomere shortening might be an indicator of individual genetic quality. To test this hypothesis, we determined telomere length at birth and the annual rate of telomere shortening in blood cells of male Red Bishops (*Euplectes orix*), a highly polygynous weaverbird common in southern Africa. We then examined whether telomere length at birth and annual rate of telomere shortening are related to male reproductive performance or other fitness-related traits.

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Female extra-pair mating, fitness and genetic diversity: Expression in socially monogamous Coal Tits

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Females of many bird species frequently mate with more than one male; and, accordingly, multiple sired clutches are common in most avian mating systems. One explanation for female promiscuity is the benefit confered by increased genetic diversity among offspring. Increased genetic diversity among offspring would be advantageous if (1) assessment of the genotypic quality of male partners is difficult or unreliable, and if (2) environmental conditions experienced by offspring are unpredictable. In both such cases, polyandrous matings help females to hedge their bets by not putting all eggs in the one genetic basket. At the same time, polyandrous females may themselves suffer reduced fitness compared to females mating with only a single male, leading, nevertheless, to a trade-off in which extra-pair matings favoring long-term geometric mean fitness for the population should be selected over the cost of short-term arithmetic mean fitness for females. Here we evaluated the hypothesis that the socially monogamous Coal Tit (*Parus ater*) benefits from polyandry through increased genetic diversity among offspring by testing the prediction that a higher degree of genetic diversity within clutches is associated with a decrease in the variance of female fitness. Using the Shannon-Wiener function, we calculated a brood diversity index that takes into account the number of different genetic sires, as well as the evenness of offspring assigned to each respective sire, for a sample of more than 250 Coal Tit broods. We then tested simultaneously for effects of brood diversity on the mean, and the variability of local recruitment success, by means of Generalized Additive Models for Location, Scale and Shape (GAMLSS).

Schnitzer J[1], Lundák M[1], Exnerová A[1], Munclinger P[1], Albrecht T[2],

Secondary male ornamentation as a signal of a good parent in the Scarlet Rosefinch

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It has been suggested that secondary sexual ornaments in males signal direct and indirect benefits to females. According to the "good parent" model of sexual selection, male ornaments signal potential male contribution to parental care. We tested predictions of this model in a sexually dichromatic cardueline finch with biparental care, the Scarlet Rosefinch (*Carpodacus erythrinus*), using three measures of potential male contribution to female fitness: female provisioning rate by the male during incubation, food provisioning rate by the male to nestlings, and male nest defense behavior. Our results provide mixed support to the "good parent" model in this species. The expression of carotenoid-based feather ornamentation (hue, saturation and chroma) was correlated positively with male provisioning rate only for young 5-8 days old, not earlier. Similarly, there was only a weak relation between the expression of male feather ornamentation and ability to defend the nest against model predators. The results, however, might be biased if males losing parentage in their own nests invested less effort in parental care. We test this possibilty using data on the distribution and frequency of extra-pair young in the nests of rosefinches.

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Automated recording, detection and identification of nocturnal flight calls: Results of a pilot study during autumn migration in the Netherlands

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Many migrant birds call in flight during migration, especially thrushes, geese, waders. The calls can be identified to the level of species or species group by a trained ear, which offers a means of quantifying migration during hours of darkness. In order to carry out such observations continuously, an automatic bird call recording, detection and identification system has been developed. A software program was written on the Matlab® platform to detect so-called "regions-of-interest" on continuous recordings. The program then associates bird species with "regions-of-interest" by finding a match within a pre-established flight call library using an algorithm based on a set of seven acoustic criteria such as peak frequency, bandwidth and call length. The number of calls recorded is an indication of the density of low-altitude migration. The system can also be used to aid in the interpretation of nocturnal radar observations of migrant birds and their identification. Preliminary results are presented showing the flight call library, the automated detection and identification system, and a comparison of automatic classification results with species identified from the recordings by an experienced observer.

Schröder J, Hooijmeijer J, Both C, Piersma T

Individual characteristics, timing and environmental factors influencing reproductive success in Black-tailed Godwits

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Meadow birds show, as do many other bird species, a seasonal decline in reproductive success; however, the question as to why selection pressure does not act on and eliminate late breeders remains unsolved. One hypothesis assumes that timing of breeding reflects the nonheritable condition of the parents: early breeders are good birds as a result of body condition whereas late breeders are unable to get into appropriate state in good time. Another hypothesis assumes that seasonal decline is more an adaptive response to deteriorating conditions in the environment:

later in the season, it may be less effective to invest in the demands of raising high quality chicks. Another possibility is that poorer environmental conditions later in the season might constrain reproductive success directly, e.g. through increased predation. In nominate Black-tailed Godwits (*Limosa l. limosa*), a seasonal decline in reproductive performance is also found in different populations. In a study of one such population in a well-managed nature reserve in the northern Netherlands, we measured reproductive success and several variables of individual and parental quality. The timing of northward migration and reproduction appears correlated and repeatable, and suggests a heritable component, but correlations with morphological variables were harder to find. We evaluate our results in the light of the recent and dramatic decline in numbers of breeding pairs of Black-tailed Godwits in the Netherlands.

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Vegetation structure and bird communities: Case studies in two hemispheres

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We hypothesized that bird assemblages in similar habitats in different parts of the world would be functionally similar. Accordingly, we assessed the bird communities in similar types of habitat in two different parts of the world: the southern Great Karoo, South Africa and the Tyrol, Austria. The aims of the study were to investigate the importance of habitat structure for birds, and to identify similarities in habitat utilization by birds in both study areas. From September to November 1999 in South Africa, and from March to October 2000 in Austria, circular plot point counts at radius of 25m were carried out in gardens and orchards. The results were compared to bird assemblages in parallel natural habitats adjacent: riverine woodland. Apart from essential differences between the two study areas in seasonality, bird species numbers, abundances, and diversity, a number of similarities were found in the way that birds used the habitats. Lack of total low-level vegetation cover (grass) was important for utilization of the ground surface by birds in gardens and orchards: areas of bare ground provide foraging sites where seeds and arthropods can be found. A greater range of vertical structure and strata above 4 m (South Africa) and 10 m (Austria) was correlated with higher bird numbers and species diversity. Whereas bird numbers and species assemblages were affected by the presence of attractive food resources in South Africa, habitat structure was the most important influence structuring bird communities in Austria, particularly in the breeding season. Compared to gardens and orchards, natural habitats supported a greater diversity of insectivores and species that foraged in vegetation. Although wide areas of bare ground were available in natural habitats, birds did not use them regularly as foraging sites. In general, natural areas held bird communities that were more balanced in structure, and a higher diversity of bird species.

Schwemmer P, Garthe S

Sea ducks and impacts of ship traffic in the Baltic Sea

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The southern Baltic Sea is an important migration and wintering area for four species of sea ducks: Common Eider (*Somateria mollissima*), Velvet Scoter (*Melanitta fusca*), Common Scoter (*M. nigra*) and Long-tailed Duck (*Clangula hyemalis*). Increasing ship traffic and the construction of offshore wind farms are expected to increase disturbance to their resting and foraging. Accordingly, we began experimental work to evaluate the effects of ship traffic on the four species. Flush distances were measured with 7x50 binoculars using the method of Lerczak and Hobbs, and densities of ducks were recorded before and after disturbance by a ship to assess impact on foraging. Long-tailed Ducks and Common Eider flushed for the shortest distances, followed by Velvet Scoters. Common Scoters generally flew off to more than 1 km ahead of the ship. In all four species, flush distances increased with flock size. Numerical abundance values for all four species immediately after disturbance, expressed as density, approached zero. Common Eiders and Long-tailed Ducks returned to pre-disturbance levels about two hours after; Velevet Scoters returned in about three hours; and Common Scoters kept away in numbers for more than four hours. In areas of high commercial ship traffic, flush distances were shorter for all species and densities returned to initial levels much earlier than in shipping lanes that were used less often, indicative of adaptation. Even so, the effects of enhanced ship traffic due to the establishment of wind farms on shallow feeding and resting sites may lead to significant habitat loss, especially for Common Scoters.

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Breeding biology of the Indian Pond Heron in Kerala, South India

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The breeding biology of the Indian Pond Heron (*Ardeola grayii*) was investigated from 1999 to 2002 in the province of Kerala, South India. To locate nesting colonies, regular searches were carried out early in the monsoon, and several colonies selected for detailed study. Nesting trees, characteristics of nests and eggs, incubation, and details of hatching and hatchlings were recorded. Altogether 24 plant species were used in nest construction, their segments ranging from 13.5 (mean minimum) to 29.1 (mean maximum) cm long. Clutch size varied from 2 to 5, with 3 eggs the most common. The maximum and minimum length and breadth of eggs were 48.0x32.0 mm and 33.3x24.1 mm respectively. The weight of eggs varied between 17.8 and 11.2 g. Both sexes took part in incubation which ranged from 18 to 24 days. Hatching success reached 82%. Food fed to nestlings comprised mainly fish; both parents participated in their feeding.

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The breeding status of the Cattle Egret in Kerala, south India

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Investigation of the heronries and breeding biology of the Cattle Egret (*Bubulcus ibis*) has been carried out in a number of states in India, but for Kerala there is no information other than a report of its nesting in the Palghat district in 1965. Accordingly, a survey was conducted during 2000-2004 to document the heronries and breeding colonies of various wetland birds in ten of the fourteen districts of Kerala: Malappuram (10 sites), Kozhikode (4 sites), Wayanad (2 sites), Palakkad (3 sites), Ernakulam (1 large site), Alappuzha (1 large site), Trivandrum (1 large site), Kottayam (1 large site), Thrissur (1 site), and Idukki (1 site). The other four districts were not visited because of the probability that no egrets nested there. The survey found that most wetland birds other than the Cattle Egret breed in Kerala during the southwest monsoon, from June to September. In Kerala Cattle Egrets, breeding plumage develops during the first week of April and individuals in breeding plumage can be seen throughout the state up to mid-May. Thereafter they start to leave, disappearing completely from the Kerala by the end of June, and do not return until October. At this time they also begin to appear in large numbers to breed in colonies in Maharashtra and Andhra Pradesh. Their total absence from Kerala in the breeding season, and the simultaneous development of breeding colonies in Andhra Pradesh and Maharashtra, as well as Gujarat and Orissa, indicates that the Cattle Egrets of Kerala move to these states to breed.

Sekercioglu CH, Daily GC, Ehrlich PR

Ecological implications of bird extinctions

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We present a general framework for characterizing the ecological and societal consequences of biodiversity loss and applying it to the global avifauna. To investigate the potential ecological consequences of avian declines, we developed comprehensive databases of the status and functional roles of birds and a stochastic model for forecasting changes. Overall, 21% of bird species are currently extinction-prone and 6.5% are functionally extinct, contributing negligibly to ecosystem processes. We show that a quarter or more of frugivorous and omnivorous species and one-third or more of herbivorous, piscivorous, and scavenger species are extinction-prone. Furthermore, our projections indicate that by 2100, 6–14% of all bird species will be extinct, and 7–25% (28–56% on oceanic islands) will be functionally extinct. Important ecosystem processes, particularly decomposition, pollination, and seed dispersal, will likely decline as a result.

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The genetic structure of the Ryukyu Robin, an island endemic in East Asia

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The Ryukyu Robin (*Erithacus komadori*) is an East Asian endemic centered on the Ryukyu Islands, a chain of small islands off southwestern Japan. It is listed as vulnerable on the Japanese Red List because of its narrow distribution and recent decline on some islands; and information on the genetic structure of its populations has now become necessary for its conservation. Accordingly, we investigated its genetic structure on eight islands, based on sequences of the complete mitochondrial DNA control region. Of the 1226 bp of sequence analyzed from 128 samples, 70 sites were variable, consisting of 59 transitions, eight transversions, and three gaps, together defining 29 distinct haplotypes. Two clades were evident in the haplotype tree constructed under the maximum-likelihood algorithm, each corresponding to the two recognized subspecies: *E. k. komadori* in the north and *E. k. namiyei* on Okinawajima Island in the south. The average sequence divergence between the two groups was 0.0391 (Kimura 2-parameter distance). Phi-statistics further subdivided the northern group into three island populations on the Tokara Islands, Ohshima Island, and Tokunoshima Island, although the average sequence divergence between any pair of these populations was less than 0.0040. In hierarchical analysis of molecular variance, the four population model, consisting of the above four groups, explained a significantly larger proportion of the variance among populations than random expectation (92.12%, $P<0.00001$), and a significantly smaller proportion within islands (7.26%, $P<0.05$) and among islands within populations (0.62%, $P<0.05$). These results suggest that gene flow among the four populations is restricted, and that each population should be treated as an independent management unit in conservation planning.

Serebryakov V

White Stork censuses in the Ukraine

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The first census of White Storks (*Ciconia ciconia*) in the Ukraine was conducted in 1931. The next followed in 1975, 1984, 1994 and 2004. Due to the data gathered by these well-spaced, consistent, decadal censuses, it is now possible to determine the trends in White Stork population demography in the Ukraine and to analyze the factors driving them.

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The role of molt in the development of sexual ornaments in the Rock Sparrow

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We studied the effect of molt duration on the expression of sexual ornaments in the Rock Sparrow (*Petronia petronia*), a species in which both adults and juvenils undergo a complete molt once a year after the breeding season. Both sexes develop similar ornaments, a yellow carotenoid-based breast patch and a white spot on the outer vane of rectrices, both of which are used in sexual and competitive displays. The size of the breast patch is highly variable and does not correlate with age. Previous studies have shown that early breeders of both sexes have larger patches than late breeders, but patch size is not linked with extra-pair paternity. Experiments with free-living and captive birds has shown that, in males, patch size is under cooperating pressure from inter- and intra- sexual selection. To tease out the interactions, two groups of 13 and 12 birds were exposed to artificially decreasing photoperiods from the end of the breeding season to the end of molt. In the first group, day-length decreased at 8 min/day from an 18L : 6D illumination regime, under which molt duration averaged 87 days (SD=11); in the second group, day length decreased at 2 min/day from the same starting point, under which molt duration averaged 133 days (SD=20). Breast patch size and brightness, judged by chroma and reflectance, depended on the duration of molt, being larger and brighter in association with larger tail spots in the slower molting group. Within the groups, body mass was a condition variable, correlating positively with the expression of ornaments. Thus this study reveals, for the first time, a causal link between the duration of molt and sexual ornamentation. Molt duration, at temperate latitudes, is constrained in time by the end of the breeding season and the advent of winter. Sexual ornamentation will therefore honestly reflect the timing of the previous breeding season, suggesting a further selective advantage for earlier breeders and earlier clutches.

Sethi VK, Bhatt D, Saxena V

Breeding behavior of an Indian endemic, the Brown Rockchat

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The insectivorous Brown Rockchat (*Cercomela fusca*) is endemic to the Indian subcontinent. We investigated its breeding behavior with reference to song characteristics, territory formation, nest site selection, nesting and parental care in urban Haridwar over two breeding seasons in 2003-2004. Signaled by male singing, breeding activity began during mid February and finished by August-September. The dates of onset and termination of singing varied with territorial individual. Songs were of discrete types, composed of different types of phrases, the biological function of which seemed to be defense and maintenance of territory during breeding. Both sexes participated in nest site selection and nest building. Average clutch size was 3.08±0.49 (n=10). The female alone incubated, for a period of 11.65±0.25 days (n=7). Young were cared for and fed by both parents.

Shiraki S

Foraging behavior of White-tailed and Steller's Sea Eagles during winter in Hokkaido, Japan

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Fluctuations in food abundance can affect choice of prey and foraging methods in birds. White-tailed (*Haliaeetus albicilla*) and Steller's (*H. pelagicus*) Sea Eagles obtain food by hunting live prey, scavenging, and intra- and inter- specific pirating and kleptoparasitism. I recorded and videotaped the foraging behaviors of the two sea eagles during the winter seasons of 2002-2003 and 2003-2004 on the Yurappu River in northern Hokkaido, Japan. At that time there, the sea eagles feed mainly on the carcasses of Chum Salmon (*Oncorhynchus keta*). Upstream spawning migration of the salmon peaks from October to November, and the number of post-spawning carcases begins to decrease after December. Eagles acquired food mostly by pirating (n=293) and scavenging (n=152). Comparisons of foraging methods, pirating success, frequency of physical contact, and both pirating persistence and resistance were made between early winter when slamon carcasses were abundant and late winter when they were scarce. Differences between the species in foraging methods and pirating outcomes were also examined. As food became scarce, pirating decreased and scavenging increased, although pirating success remained at similar levels. Physical contact did not happen more often during food scarcity, but persistance in and resistance to pirating tended to strengthen. One possible reason for a decline in pirating during food scarcity may be the smaller returns. White-tailed Sea Eagles scavenged more often than Steller's and lost food at higher rates from pirating attacks by Steller's. The choice of foraging methods could therefore be influenced by inter-specific interaction.

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Spatial distribution of captive-reared Capercaillies released in the Harz Mountains, central Germany

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The Capercaillie (*Tetrao urogallus*) population in the Harz Mountains, central Germany, died out in the 1930s essentially as a result of habitat loss. As part of a reintroduction project, birds reared in semi-natural conditions were released annually in the once-more suitable habitats at higher altitudes in the Harz from 1978 to 2003. An analysis of their spacing was enabled by fitting 49 cocks and 34 hens with transmitters. As expected, their activity range spread out in relation to time spent in freedom, extending from an average of 432 ha (median=148 ha) for birds up to 30 days after release to on average 2,490 ha (median=2.045 ha) for those that could be located after 60 days. Almost 80% of activity, nevertheless, was spent within 1.00 ha, although maximum values reached c. 8.60 ha for cocks and 17.10 ha for hens. Average distance traveled from the point of release also increased with time spent in freedom. Birds located up to 30 days after release had moved an average of 1.6 km (median=1.0 km), whereas those still transmitting after 60 days were found on average 3.5 km away (median=3.2 km). Birds released from *in situ* acclimatization pens dispersed over greater distances than those released directly into the wild, an effect noticeable only after 30 days of freedom. Arterial roads through the Harz Mountains were found to act as barriers to dispersal; potentially suitable habitats accessed only by crossing such roads were hardly entered, if at all. Yet although roads have a negative impact on Capercaillie distribution through the Harz, they were still secondary to the main cause of failure in the reintroduction program: physiological and ethological deficits in captive-reared birds.

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Pigeon navigation: Overland flight and the approach to home

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To address the question of how pigeons return to their home loft from distant places, we analyzed more than 150 GPS-tracks of experienced homing pigeons (*Columba livia*) released at different sites of 5 to 22 km from their home loft in Frankfurt a.M., Germany. The analysis focused on the general character of the flight and in particular on flight orientation on arrival within a 3000m circle around the loft. At the beginning of homing flight, the pigeons varied greatly in their initial headings before settling into a straight direction for overland flight to the loft. During overland flight, variation in the direction of flight was minimal until the pigeons approached to within 3000m of home. From a distance of 2000 m on, direction began to vary again, the variation increasing considerably up to the last 200 m. Some pigeons maintained their overland heading until within 500 m of the loft before changing course and head straight home. Others even passed the loft to the east or west before finally approaching from the north. Most pigeons prefered a final approach from the northern hemicircle of the compass. The direction from which the birds began overland flight also seemed to influence behavior during the flight: pigeons returning from eastern or western release sites used a narrower corridor than those returning from northern or southern sites. Why the birds use such differing procedures when returning home is not yet clear, particularly as the same landmarks nearer home, such as city high-rise, are visible to all. These experiments were conducted in accordance with animal welfare regulations.

Singh BP[1], Kumar V[2]

Photoperiodism in Indian birds: a conserved regulatory mechanism for long-term seasonal events

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Towards understanding the evolutionary aspects of photoperiodism in birds at north Indian latitudes (27°N), we compared data from light-response studies performed on four bird species: Black-headed Bunting (*Emberiza melanocephala*), Red-headed Bunting (*Emberiza bruniceps*), House Sparrow (*Passer domesticus*), and Baya Weaver (*Ploceus philippinus*). The first two are Palearctic-Indian migratory species, and the last two sedentary. All are photosensitive: long days are stimulatory, short days are non-stimulatory, and post-reproductive gonadal regression occurs even when the birds are subjected to stimulatory long day lengths. A circadian photosensitive rhythm measures day length with slight variations among species. Moreover, critical day length appears to be species- and response-specific. In the migratory species, stimulation of body fattening follows the pattern of testicular growth and development, but these two photoperiodic events are dissociated. Hence, photoperiodism in birds represents conservation of environmental control mechanisms for long-term life events evolved over a long period of time as an adaptive strategy to ensure that such events happen at the most suitable time of the year. Differences in photoperiodic responses among different species and among populations of the same species at different latitudes, as reflected in comparisons of results from our studies with those on temperate populations, could suggest specific adaptations in photoperiodic species at given latitudes.

Singh S, Rani S, Kumar V

The role of melatonin in avian photoperiodic time measurement

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In this study, we investigated the involvement of pineal melatonin in regulating seasonal responses in male Baya Weavers (*Ploceus philippinus*) and Red-headed Buntings (*Emberiza bruniceps*). Pinealectomized (pinx) and sham-operated (sham) birds were exposed to short and long day lengths, and to resonance and night-interruption light-dark cycles. We also examined the response of birds to doses of melatonin in drinking water. There were no dramatic differences in patterns of photoperiodic induction, although its amplitude differed between pinx and sham birds. These results are not consistent with the hypothesis that the daily rhythm of melatonin is involved in photoperiodic time measurement in birds. However, melatonin could still be involved in temporal phasing of the seasonal reproductive cycle since there was a difference in the amplitude of the photoperiod-induced testicular cycle between pinx and sham birds.

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Dispersal patterns within a meta-population of House Sparrows after an introduction experiment

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Introduction of alien individuals often poses considerable threats to native bird species, but can also save threatened populations from extinction. Despite this, the mechanisms underlying successful or unsuccessful introductions, and the behavior of invading individuals, is poorly known. Understanding these mechanisms is important also because some individuals in wild animal populations disperse naturally to form new populations, and may thus affect local population dynamics. Previous results from a study of a House Sparrow (*Passer domesticus*) metapopulation on the coast of northern Norway suggest that immigrant individuals that have dispersed naturally have a higher survival probability than resident individuals in local populations. In this study, dispersal patterns in sparrows were investigated in relation to status - resident or adventive - and morphological characteristics to test whether the proportions of adventive birds that establish themselves can be predicted and to determine how far and how quickly they can spread before establishment. 126 House Sparrows were translocated to farms in the Vikna Archipelago in northern Norway. The sex-ratio was maintained at 1:1 on each farm, and the number of birds on each farm remained the same before and after introduction. Bill size was previously shown to correlate with several fitness traits in the females of this population, and interestingly, preliminary results from the present study show that females with longer bills dispersed greater distances. Adventive males also migrated significantly longer distances than resident males. Results from further analyses of the dispersal patterns in this population will be presented.

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Relationships between population abundance and territory size is mediated by habitat selection: Comparisons among locally coexisting species

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Relationships between species abundance, territory size and habitat requirement are complex: local species abundance can affect territory size and vice versa, and both variables can interact with habitat preference. We studied these relationships in ten territorial species at two localities of mixed forest mosaic. Territories were mapped over two years at both localities, thus allowing inter-annual comparison. Preferences and avoidances of individual habitat types were estimated using a randomization procedure; species that used large proportions of suitable area were considered generalists, and those avoiding such areas were considered specialists. Correlation between species abundance and mean territory size was neither consistently positive nor negative. In more abundant species, however, territory sizes were consistently right-skewed in distribution, indicating proportionally more smaller territories. The lack of a systematic relationship between abundance and mean territory size seems to be due to the fact that the relationship is non-linear: species of low abundance can have relatively large territories which decrease in size when abundance increases, whereas over-abundant species are forced to occupy suboptimal habitats where they have to increase territory size again. This is supported by the finding that abundant species with large territories behaved as generalists: they ranged further more often over the study plots even though their territories encompassed smaller areas of preferred habitat. Although the directionality of the relationships between abundance, territory size and habitat preference cannot be evaluated without manipulative experiments, it is probable that local abundance is not dependent on species-specific territory size nor habitat requirements, and that the distribution of territory size reflects the interaction between abundance and species-specific habitat requirements.

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The effect of time of season on the accuracy of bird richness estimation from point-count data

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The ornithological literature often comments on the effect of time of season on the detection probability of individual bird species. However, little attention has been given to the effect of time of season on bird detectability at the level of community, nor on its possible effect on the accuracy of estimation of bird community parameters. Here we investigated the effect of time of season on the accuracy of species number estimations from point-count data collected at 28 oases in southern Tunisia. Each oasis was visited at the beginning of the breeding season and then two months later, allowing us to conduct counts at five points per oasis per visit. For each oasis, we treated the observed number of species as the total number of species recorded during each visit, and used a capture-recapture approach to estimate species numbers from patterns of detection/non-detection of species over the five points. We found that birds were more easily detected at the beginning of the breeding season than two months later, the observed species numbers showing a significant decline between the two periods. When, however, a capture-recapture approach accounting for heterogeneity in species detectability was used, estimates from data for both periods were similar. Even so, estimates obtained at the beginning of the breeding season were more precise than those got later. Overall, our results illustrate once more the need to take account of biasses due to time of season when determining species richness from count data, and stress the need for using probabilistic approaches in such investigations.

Smith HG, Bruun M

Dietary shift as a cost-saving mechanism in breeding European Starlings

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For altricial birds feeding nestlings, access to food is a major constraint on breeding success. Variation in food availability may affect the trade-off between current and future reproduction. Low quality in habitat may result in both lower residual reproductive value in parents and a reduced survival in offspring, because parents partly compensate for poorer availability of food by working harder to find and deliver it. However, parents may also change their selection of prey to maintain high delivery rates. Foraging, dietary choice, and breeding success in European Starlings (*Sturnus vulgaris*) feeding nestlings was studied in a landscape in which the availability of preferred foraging habitat, pasture, varied. A large proportion of the diet consisted of caterpillars, which have been suggested as preferred prey. Nestling growth rate was found related to the proportion of caterpillars in the diet in one out of two years. It has earlier been shown that when the proportion of pasture close to breeding colonies is low, parents search for food in more distant sites. Parents also delivered a lower proportion of caterpillars to nestlings, increasing other food instead, e.g. earthworms. This dietary shift was not caused by parents collecting additional prey of different kinds within pasture, but by their selecting to forage in alternative habitats. These habitats were on average closer to the nest than the pastures visited. Thus, parents with limited access to pasture close to breeding sites used a mixed foraging strategy, combining longer trips in search of pastures for caterpillars with shorter trips to alternative habitats where other kinds of invertebrates were collected.

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Local and landscape influences on avian communities in the playa wetlands of the Great Plains, USA

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We examined the influence of local wetland habitat characteristics and landscape factors on avian community composition in playas across the Great Plains, USA. Playas are shallow depressional recharge wetlands occurring throughout the world but are most numerous (>30,000) on the Great Plains. In the northern Great Plains, avian diversity was found positively associated with wetland area and negatively with emergent perennial vegetation. The amount of wetland habitat in the landscape also influenced diversity and abundance positively in specific wetlands. On the southern Great Plains, avian diversity, in contrast, was positively related to both wetland area and emergent vegetation. Differences in emergent vegetation structure seem to be the likely causes for the variable influence of this habitat on avian diversity in the region. When playas dried, species diversity declined such that there was little relationship between avian diversity and wetland area. Species diversity between playas embedded in highly cultivated landscapes and those in native grassland was similar, but the avian community in croplands comprised many more exotic species. Several species of concern were dependent on playas in native grassland landscape. Playas in both north and south sectors of the Great Plains had steeper species-area slopes than found in other wetlands. This appears to be related to the semi-arid nature of the landscape. Conservation efforts should focus on preserving the remaining playas within native grassland landscapes before other wetlands if high avian diversity and several species of concern are to be preserved effectively in the region.

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Big-brained birds survive better in nature

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As large brains take longer to grow than small ones, the evolution of enlarged brains is inextricably linked to life history strategies. Understanding this link is nevertheless puzzling because a long development implies important costs with no obvious direct benefits. If most selection pressures favor fast development and early reproduction, why do some animals develop large brains relative to body size? A classic explanation for this paradox is that in species with more cognitive life styles, the costs associated with brain development are compensated by the benefits that a fully-developed brain provides for surviving environmental challenges through flexible behaviors, a theory known as the “cognitive buffering” hypothesis. Although this hypothesis is theoretically and intuitively appealing, the relationship between brain size and adult mortality has not been tested comprehensively in any group of animals. Using extensive data on avian adult mortality from >300 populations belonging to over 200 species from polar, temperate and tropical regions, we show that adult birds with larger brains relative to body size experience lower mortality than birds with smaller brains. Our results not only support the general significance of the cognitive buffer hypothesis for the development and maintenance of large brains, but also highlight the function of enlarged brains as an adaptive response to environmental challenges.

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The effect of early developmental condition on song quality in Bengalese Finches

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Bird song is an acoustic ornament. According to the indicator model, a trait must be costly in order to act as an honest signal; but the cost of elaborate song is obscure. A developmental stress hypothesis has recently been proposed to explain the honesty of songs. This hypothesis suggests that song characteristics indicate male quality because the brain structures associated with learning song reflect early developmental stress. Unlike previous studies of developmental stress, we observed Bengalese Finches (*Lonchura striata* var. *domestica*) under semi-natural breeding conditions in captivity to investigate the relationship between early rearing conditions and subsequent variation in body size and song among individuals. In particular, we investigated whether individual body size and song traits reflected the conditions of rearing or current physical body condition or both. The data suggest that early rearing conditions, such as brood size and sex ratio, directly affect ultimate body condition and song complexity, while song output is determined by current physical state. These results support the developmental stress hypothesis, and suggest that the songs of Bengalese Finches consist of multiple components that reflect both rearing conditions and current physical state.

Somasundaram S, Vijayan L

Impact of habitat alteration on the globally threatened Nilgiri Wood Pigeon in the Western Ghats, India

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About 85% of globally threatened bird species are at risk due to habitat loss and degradation; most of them are habitat specialists. The Nilgiri Wood Pigeon (*Columba elphinstonii*) is one of them, and also one of 16 bird species endemic to the Western Ghats, where it occurs in tropical montane wet temperate forest and evergreen forest mainly above 1000 m asl. The Western Ghats are one of the hottest hotspots of biodiversity and Endemic Bird Areas in the world. Loss of forest cover there over the last two decades has reached 25.6%, and some 50% of wet temperate forest has been alienated since 1850. We carried out surveys there between 2002 and 2004, at Kukkal, Kodaikanal, in the Palni Hills. The Palni Hills support diverse habitats: montane wet temperate forest (39%), grassland (1%), and wattle (34%), pine (8%) and eucalyptus (2%) plantations. Agricultural fields (13%) and others (3%) make up th rest. We laid out 10 ha plots in montane wet temperate forest covering 80 ha area, and in selected monoculture plantations of exotic wattle, eucalyptus and pine. The numbers of Nilgiri Wood Pigeons were then recorded in each habitat using the circular plot method, and habitat use documented from observations of foraging and breeding. We found that the pigeon fed most frequently in montane wet temperate forest ($F=33.48$; $P<0.001$). Wattle plantation was also used frequently, but not eucalyptus and pine plantations, in which the pigeon often preened and roosted. Most sightings in plantations were close to natural forest. No nests were found in any of the plantations during the three-year study, all being confined to natural forest (n=103). Thus the changing of natural habitat into monoculture plantation has the potential to bring about local extinction in this species.

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Seasonal contact between northern and southern hemisphere populations of Little Terns through migration: Does it cause gene flow?

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Some migratory bird species have breeding populations in northern and southern hemispheres separated by the inner tropics. In most cases, northern birds migrate to southern hemisphere to winter, whereas southern birds are usually regionally resident. Southern birds, moreover, breed at sites where northern birds winter due to reverse seasonality between the two hemispheres. Does such seasonal contact have flow-through effects that affect genetic structure in the populations of both hemispheres? In this study, we analyzed the genetic structure of Little Terns (*Sterna albifrons sinensis*) by molecular phylogeographic methods. Blood samples were collected from nine sites of four countries - Japan (Tokyo, Choshi, Osaka, Miyazaki), Korea (Te-an), Taiwan (Taichung), and Australia (The Entrance, Sydney, Windang) - and partial sequences from the mitochondrial control region (453 bp) were obtained. Based on a constant rate of allelic substitution, the data indicate that northern and southern populations diverged about 30,000 years ago, and the Nested Clade Phylogeographic Analysis algorith suggest isolation-by-distance as the cause. Estimates of gene flow between the populations were slight. Thus it is likely that northern and southern hemisphere populations form different breeding groups, with little if any gene flow between them through migration.

Sommer C[1], Mundry R[2]

Predator-induced calling: The effect of social rank and predator type in the co-operatively breeding Arabian Babbler

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Many birds utter vocalizations in alarm or warning when confronted with a potential predator. In a functionally referential call system, members identify acoustically distinct call types with different predators as well as with different flight strategies. In urgency-based systems, call parameters or call use vary in intensity with the degree of threat presented by the predator. For group-living species, moreover, predator-related calling may also be moderated by social relationships within the group. Birds of different ranks may be influenced in their calling by their social position. We studied calling behavior in the co-operatively breeding Arabian Babbler (*Turdoides squamiceps*), a social species in which only high ranking birds reproduce; low ranked individuals are helpers-at-the-nest. We exposed high and low ranking males of 11 social groups individually to different predator dummies: owl and snake. We expected that calling behavior and the acoustic properties of the calls would vary consistently between ranks and predator types. We also analyzed general calling behavior, as well as the shape and acoustic structure of calls. Overall, call structure and/or calling behavior varied between individuals, rank and predator type. Concerning predator type, we found clear effects on parameters of call sequences, but not in call structure. The general shape of the call changed gradually in the course of a call sequence, and became more strident in response to the owl dummy. Furthermore, call shape varied gradually between ranks. In general, results matched expectations, though their interpretation is not straight forward. Rank and predator type did influence the overall structure of call shape and its sequential changes, but not parameters such as maximum frequency that are correlated with urgency in many species.

Sosa Lopez JR, Navarro-Sogüenza AG

Geographic variation in the vocalizations of populations of the Common Bush-Tanager of Mexico

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The Common Bush-Tanager (*Chlorospingus ophthalmicus*), a species that shows amazing geographic variation, ranges from southern Mexico to northwest Argentina in cloud forests sufficiently fragmented to repeatedly break gene flow between populations. The purpose of this study was to determine the patterns of geographic variation in the vocalizations of populations confined to Mexico. We gathered recordings from 12 different sites in Mexico and Costa Rica, and analyzed 240 vocalizations which were grouped in OGUs. Eight variables were analyzed by Principal Components Analysis (PCA) and UPGMA procedures; the latter grouped vocalizations against geographic locality in a phenogram. Three PCA components explained 80.3% of the acoustic variance. Analyses revealed at least three different regional vocal entities among Mexican populations, groups that are supported by previous morphological and genetic studies, and which suggest that the Common Bush-Tanager as currently known is a complex of a number of species. The vocalizations of two further populations, in the Sierra de los Tuxtlas and the North Chiapas, are of uncertain taxonomic meaning. Characteristics of the vocalizations indicate that neither habitat type nor body size have influenced the evolution of song types within the complex.

Spina F, Volponi S, Licheni D, Piacentini D

The Italian Bird Migration Atlas

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Bird movements described from ringing contribute to large-scale integrated bird conservation strategies and diverse applied aspects of bird management. International legislation, such as the EU Wild Birds Directive (AEWA), also requires detailed information on the seasonality of movements in bird populations belonging to the international community and requiring shared conservation policies. The aim of the Italian Migration Atlas is to describe and analyze all existing information on bird movements collected through ringing, in order to define the position of Italy within the Palearctic-African bird migration system. Data used in the analysis comes from: (1) birds ringed and recovered in Italy, (2) birds ringed abroad and recovered in Italy, and (3) birds ringed in Italy and recovered abroad. Three different archives have been used in its compilation: (1) over 150,000 computerised recoveries for the period 1906-2002, (2) over 10,000 recoveries stored on paper forms until 1980, and (3) data gathered from Italian and international ornithological literature not present in the archives of the National Ringing Centre for Italy. The data cover 316 species. Examples of the kinds of information that have been produced for each species are: (1) description of the record with historical distribution, and geographical origin and destination, (2) age at ringing, recovery conditions and circumstances, and phenology of Italian recoveries of birds ringed abroad, based on date, longevity and survival of birds ringed as adults or juveniles, (3) phenology of autumn and spring migration as well as of wintering, and (4) both broad-scale and detailed geographical maps of recoveries. The Italian Bird Migration Atlas offers a valuable and interesting contribution to the knowledge of bird migration for several reasons, notably the high diversity of habitats and birds in Italy, the geographical position on Italy as a bridge jutting into the Mediterranean, and significant historical coverage for a large number of species.

Spurr E, North H, Newell C

Enticing bellbirds into towns and cities in New Zealand

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The New Zealand Bellbird (*Anthornis melanura*), a native honeyeater, visits but usually does not breed in towns and cities in New Zealand. To investigate why, we examined bellbird nesting and feeding requirements, factors affecting breeding success, and movements inside and outside the breeding season in and around Christchurch city. Bellbirds breed in native forest remnants on the Port Hills adjacent to the city during summer and visit the city in winter. Research to date has shown that bellbird breeding habitat on the Port Hills can be predicted from the height of woody vegetation, abundance of preferred food plants, woody vegetation patch size, and distance between woody vegetation patches. Christchurch city has many tall trees and abundant nectar and fruit sources, but even the largest wood patch may be too small at 5.5 ha and too distant at 8 km from breeding areas on the Port Hills to support a sustainable breeding population of bellbirds. Bellbirds visit but do not appear to have even attempted breeding in that largest city patch, Riccarton Bush. We recommend research-by-management experiments such as (1) translocation of bellbirds into city parks and reserves, (2) creation of potential stepping-stone vegetation patches of suitable composition, structure, and size at various distances from present breeding areas to facilitate colonization, and (3) using song playback to entice bellbirds to colonize new areas.

Stefano M, Spina F

Use of ringing data: A new method for investigating seasonal habitat selection in birds

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Ringing data are provided mainly by volunteers who often select their preferred ringing site and field season, leading to biased sampling both in terms of habitat and season. A new method is described here to use ringing data collected at national scale for investigating the seasonal dynamics in habitat choice by birds. For such a purpose, Italy has been divided into a grid of 77,800 units of 2x2km. Habitat features within each of the units have been categorized based on the Corine database, and 77 habitat variables have been taken into account. A habitat category is considered to be present in a unit if it covers a minimum 5% of unit surface. The annual cycle has been divided into periods defined by cluster analyses of the overall ringing totals of passerines at the national level. Ringing data collected in the period 1982-1999 have been considered, covering a total of over 3.5 million records. Grid units where more than ten songbirds of at least two species have been ringed have been considered as sampled. Habitat selectivity has been described through the Jacobs index: $D=(r-p)/(r+p-2rp)$, with $-1\ D\ +1$, where r and p represent the proportion of available and used resource, respectively. The index is used to quantify habitat selectivity by species, both with and in the absence of sampling bias. The sum of the two indices has been used to measure real habitat selection by a given species. As an example, results from an analysis of 165,259 ringed Blackcaps (*Sylvia atricapilla*) are illustrated. The clear differences shown in selectivity for vineyards during the year correlate with the seasonal availability of olives, a well-known food resource during the coldest months, and confirm the suitability of this new method for describing seasonal variability in the use of available habitats at a broad spatial scale.

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Plasma steroid hormones in two arctic-breeding shorebirds: Implications of monogamy versus polygyny

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According to the 'challenge hypothesis', steroid hormones are predicted to vary with mating system, degree of paternal care and aggression. We measured plasma concentrations of testosterone (T) and 5a-dihydrotestosterone (DHT) in two high arctic-breeding and closely-related shorebirds, the polygynous Pectoral Sandpiper (*Calidris melanotos*) and monogamous Semipalmated Sandpiper (*Calidris pusilla*) to examine whether their androgen levels during breeding corroborated the predictions of the challenge hypothesis. Although males of both species had significantly higher levels of DHT and T than females, median T-levels were 34 times greater in male Pectoral Sandpipers compared to only a 4.9 fold difference in the Semipalmated. Moreover, testosterone and DHT correlated in Semipalmated Sandpipers and in male, but not female, Pectoral Sandpipers. In Semipalmated Sandpipers, androgen levels were highest at the beginning of the breeding season and then declined, whereas they were sustained at extremely high levels throughout the season in Pectorals. In both species, androgen levels were independent of body condition. Several incubating male Semipalmated Sandpipers had high circulating levels of T, suggesting that low T is not necessarily a correlate of paternal care. Our results are consistent with the challenge hypothesis insofar as androgen concentrations were higher in the polygynous than monogamous species throughout the breeding season. Our study also supports previous studies finding that the extremely short breeding season in the high arctic, and the importance of male care in reproductive success, may be factors leading to behavioral insensitivity to T.

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The diet of the Galápagos Penguin

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Although the endangered Galápagos Penguin (*Spheniscus mendiculus*) is one of the top marine predators in the Galápagos Archipelago, little is known about its diet and feeding preferences. To date, the only information available comes from limited and non-systematic observations. As the penguin is vulnerable to increasing anthropogenic activity in the Galápagos, including commercial fisheries, information on diet is needed urgently. Here we report new findings from on-going analyses of the diet of Galápagos Penguins based on stable isotopes of penguin bones, eggshells, and feathers, as well as stomach lavages. Field work was conducted between April and June 2005 at two main breeding sites. As well as the immediate information gained from stomach samples, analyses of bone collagen can provide a signal of average diet over lifetime. Galápagos Penguins molt all their feathers during a two to four week period, and analyses of molted feathers can provide information on diet during the pre-molt period. Eggshell formation, when initiated, is completed within a 24 h period, thus recording a dietary signal for that time as well. Analysis of the coordinated results can then provide both a seasonal and annual profile of diet, information that is crucial for assessing dietary shifts and the trophic position of major prey and for tracking temporal and spatial variation in diet. From the data gathered, we describe and analyze dietary patterns in the Galápagos Penguin.

Steinheimer F

The ornithological Babel – nomenclatorial confusion in avian taxonomy

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Modern checklists give the appearance of overcoming any confusion in avian nomenclature. *Inter alia*, the Catalogue of birds in the British Museum, Peters' Check-list, the Sibley and Monroe world list, and recently the Howard & Moore complete checklist have strengthened a stable ornithological nomenclature. Since 1961, the application and use of zoological names have been guided by the rules of the International Code of Zoological Nomenclature. Ornithology now has a system in place by which any recognizable unit in nature, such as a species, is or can be named according to a formula that is understood worldwide. Nevertheless, many of the names are not used in the way intended by original authors or are now applied to taxa other than those on which they were first based. Moreover, names of authors and years of publication often differ among checklists, accruing to an estimated 2-5% error in the names used in modern taxonomy. This paper will delve into the confusions of avian nomenclature and offer some solutions for resolving errors.

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Impact of plankton- and fish-eating seabird colonies on the Arctic tundra ecosystem – a comparison

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Arctic ecosystems function at contact zones between sea and land, where terrestrial sectors - tundra - suffer from a permanent deficiency of nutrients. At the same time, production is very high in the sea, and here seabirds have significant impacts because of the huge amounts of fertilizing nutrients that guano can import to tundra around breeding colonies. Thus in one season at Hornsund in Spitzbergen, plankton-eating Little Auks (*Alle alle*) deliver c. 60 tonnes of dry-mass guano/km^2 to the colony area. Unlike nutrients from coastal cliff-nesting Guillemots (*Uria aalge*) which wash mostly straight out to sea, we found that material from colonies of Little Auks on mid mountain slopes usually a few kilometres inland influenced tundra to a considerably great extent. Large areas of tundra were enriched with greater quantities of guano deposited both per unit time and area. In fertilized areas, tundra flora was higher in biomass and richer in taxa. Densities of tundra-nesting birds were higher as well, as were the numbers of herbivores (geese, reindeer) and predators (Arctic Fox, Polar Bear). The effects of global warming, however, may alter the balance. As a result of impending inflow of Atlantic waters in arctic seas, the food resources available to plankton-eating seabirds may decline, along with the numbers of birds themselves. With the restructuring of the food chain, fish-eating seabirds, such as the Guillemots nesting on coastal cliffs, should do better. Thus under global warming it can be expected that (1) large areas of ornithogenic tundra around colonies of plankton-eating seabirds may decline and even disappear, (2) narrow strands of nutrient-rich tundra may develop instead along cliff tops colonized by breeding colonies of fish-eating seabirds, (3) tundra fragmentation will result with negative consequences for tundra-adapted animal populations, and (4) overall diversity in tundra plant and animal communities will decline substantially.

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The breeding ecology of the Spotted Flycatcher in Britain

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Although factors on migration routes and wintering grounds may be impacting upon Spotted Flycatcher (*Muscicapa striata*) populations, this study focuses on those affecting the species on its breeding grounds in Britain. Recent changes in breeding habitats brought about by changes in management at different scales seems to have varied the abundance of invertebrate prey, or accessibility to it. This will have consequences in terms of productivity and survival, and hence population trends. We examined the habitat around Spotted Flycatcher breeding territories and nest-sites to investigate whether and how variation in habitat structure affects the breeding ecology of this species in Britain. Detailed monitoring of nesting attempts is establishing how nest success and productivity is related to habitat, the availability or accessibility of invertebrate food, and the impact of predators within different habitats. Preliminary results show that reproductive success may be related to relatively high rates of survival of nests in garden habitats. Both the number of chicks fledged per nesting attempt and the daily survival estimates for nests in gardens were significantly higher than in either of the other two commonly-used habitats, farmland and woodland.

Stjernman M, Råberg L, Nilsson J-Å

Long-term effects of nestling condition on blood parasite resistance in Blue Tits

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We investigated whether conditions experienced during the nestling stage in Blue Tits (*Parus caeruleus* could explain their ability to control parasite infections one year later. Short-term effects may be expected due to the sensitivity of the immune system to environmental conditions during development, but whether this translates into permanent resistance is unclear. By relating body condition (as mass) at the beginning and end of the nestling stage to the extent of blood parasitism in recruited birds one year later, we indeed found significant and long-term positive effects from both early and late nestling condition on the ability to control parasites. These results support the hypothesis that parasites are integral to mechanistic explanations for the trade-off between number and quality of offspring, and further point to influence from maternal effects in host-parasite coevolution.

Strewe R[1], Villa-De León CJ[2]

Conservation of bird species in tropical dry forest, the most endangered ecosystem in Colombia

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Since the 19th century, the tropical dry forests in the Caribbean region of Colombia have been modified drastically. Deforestation has reached 100% in many areas, original habitats are degraded, remnants fragmented, and only 1.5% of natural vegetation remains. The dry forest today, rich in endemic birds and an important avenue for migratory birds of the Atlantic route, is the most endangered ecosystem in Colombia and its least studied life zone. Monitoring over the last two years has documented the importance of the dry forest as a refuge for 56 migratory species and made a Colombian initiative to protect it more imperative and urgent than ever. The project is evaluating the status of the ecosystem by GIS analysis, monitoring habitats by focusing, *inter alia*, on bird indicator species, and identifying the most valuable fragments for conservation purposes. The project is also protecting and restoring habitat in close cooperation with communities in the buffer zones of three protected areas in the region, motivating land owners to protect forest habitat and change to alternative land-use systems for subsistence and raising income. ALPEC is now attempting to form a network of protected areas through the dry forests by declaring Important Bird Areas (IBAs) in cooperation with the regional National Park Unit of Colombia, environmental corporations, universities and local NGOs within the Regional Protected Area System Program (SIRAP).

Strewe R[1], Navarro C[2], Villa-De León CJ[2]

Conservation of the endemic birds of the Sierra Nevada de Santa Marta massif, Colombia

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The Sierra Nevada de Santa Marta is an isolated pyramid-shaped massif on the Caribbean coast of northeast Colombia, close to the border with Venezuela. Its twin snow-covered peaks reach 5775 m a.s.l. just 46 km from the Caribbean coast, making it the highest coastal massif in the world. It is also among the most important centers of continental avian endemism, with 18 endemic species and a further 55 endemic subspecies restricted to mostly montane altitudes. The Sierra Nevada has been declared a Biosphere Reserve by UNESCO, and is partially protected by the 3830 km^2 Sierra Nevada de Santa Marta National Park, declared in 1977. Despite such protection, nevertheless, forest loss continues almost unabated, demonstrating that formal designation is inadequate and has failed to protect ever-dwindling natural habitats. Less than 15% of forests now remain, and these are seriously threatened by banana cultivation at low altitudes, development of pasture for cattle and other livestock, and the planting of shade coffee, marijuana and coca. Severe environmental damage has also followed herbicidal spraying of illegal crops by the government. Ongoing destruction of natural habitats is threatening the resident avifauna, especially those endemics at low population densities and with specific habitat preferences. We present data from the first ornithological surveys in the region in 80 years, including one of the first regional avifaunal atlasses for South America and an evaluation of the status of endemic and threatened bird species.

Strubbe D, Matthysen E

Spread of invasive Ring-necked Parakeets in Europe: Ecological aspects and estimation of impact on native breeding birds

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A growing number of organisms transported artificially around the world are establishing themselves outside their original area of distribution. One of them is the Ring-necked Parakeet (*Psittacula krameri*), a medium-sized cavity nester originating from Asia and Africa. In India, the species is regarded as one of the most destructive bird pests in agriculture. Parakeets have been introduced into 35 countries, and in Europe, the main populations today are found in Britain, Belgium, the Netherlands, France, Germany, Spain and Italy. These growing colonies may pose a threat to native cavity nesters and to agriculture. We collected data on population growth and spatial spread from several European populations. Preliminary results show that the increase in numbers fits an exponential model of population growth. Geographical range has also increased and a regression of the square root of the area occupied versus time since establishment suggests a linear spread pattern. Until now, the smaller German populations have been concentrated in urban areas of the Rhine Valley, occurring only on the river plains and avoiding the hills. This contrasts with the bigger populations in London, Brussels and The Hague where parakeets are now invading both urban areas and countryside. Populations in central Europe have not yet succeeded in establishing themselves. As a rule, the parakeets avoid dense forests, and their distribution is governed primarily by the availability of suitable tree cavities, explaining their preference for urban parks and older forest fragments. The future aims of this project are to forecast the distribution of parakeets based on habitat mapping and measures of invasive spread, and to assess the impact on native hole-nesters in Flanders.

Sun Y-H[1], Fang Y[1], Klaus S[2], Jia C-X[1]

Incubation rhythm of the Chinese Grouse at Lianhuashan in Gansu Province, China

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The endemic Chinese Grouse (*Bonasa sewerzowi*) is the smallest grouse, yet has the highest relative egg production among grouse. During 1999-2001, we studied egg laying and incubation rhythm in the Chinese Grouse at Lianhuashan Natural Reserve in Gansu Province, China. Twenty nests were fitted with data-loggers. Our data suggest that Chinese Grouse are physiologically stressed during egg-laying and incubation. Eggs were laid at two-day intervals; and overall incubation constancy was 93.5%. Females broke off for an average of 5.0±1.0 (range 3-7) recesses a day during incubation, the recesses averaging 19.3±7.2 minutes in duration; 42.1% of them were taken in the crepuscular period. Frequency of recesses was higher than in other species of grouse, and duration was shorter; but overall constancy of incubation was similar. In the 856 recesses monitored, duration was correlated significantly with ambient temperature, and females took shorter recesses as incubation progressed. Incubation took 27-29 days, and appeared to be affected by pre-incubation behavior and predator disturbance. Chinese Grouse suffer high nest predation, the main robbers being evening- and night- active mammals.

Takagi M, Akatani K, Saito A, Matsui S

Vocal identification and territorial turn-over in the Daito Scops Owl: Evidence from spectrographic analyses of male hoot-calls

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The Daito Scops Owl (*Otus elegans interpositus*) is endemic to the Daito Islands, an oceanic group 400 km off Okinawa, Japan, at 25°50'N, 131°14'E. The insular subspecies has the lowest genetic diversity of any Elegant Scops Owl subspecies, and is listed as endangered in the Red Data Book for Okinawa. We studied Daito Scops Owls on 30 km_2Minami-daito Island, which was thickly blanketed with forests dominated by fan palms until early last century when the forests were cut down. Since then the population has been declining steadily. Casuarinas were planted in zones about 30 m wide as shelterbelts against wind, but they cover only an area of 3.4 km_2. Owls nest predominantly in natural holes in these casuarinas. This study set out to monitor the population of owls by using spectrographic analysis of hoot-calls to identify individual territorial males, assess the number of males in the casuarina zone, and estimate the turnover in territorial males. We attached radio-transmitters to males (n=10) from 2002 to 2005, and recorded their hoot-calls on more than three different nights each year to determine their home ranges. Altogether, male hoot-calls were recorded at 250 locations in 2005. Males occupied the same area over the several years of recording. A discriminate function analysis correctly attributed >95% of individual calls to particular males, based on four temporal and three frequency variables on spectrograms; only 8% could not be identified to individual. Males were found to have temporally stable hoot-calls which can therefore be used reliably for long-term censusing. We suggest that the turnover in territorial owners may be estimated by comparing known hoot-calls against male location.

Takahsi M, Okanoya K

Song syllable chunking in Bengalese Finches reared with multiple tutors

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Experiments in song learning have traditionally been carried out with one tutor, usually the paternal parent. In colonial species, however, there are usually several conspecific males around song-learning pupils. In Zebra Finches (*Taeniopygia guttata*), a multiple tutor environment resulted in learners copying different chunks of song from different males. The purpose of the present experiment was to determine whether the phenomenon also held true for Bengalese Finches (*Lonchura* sp.). Eleven males and ten female Bengalese Finches were kept in a large flight cage with 10 pot-shaped nests, and 78 chicks (39 males and 39 females) were produced in an 18 month period. We recorded the full songs of males hatched in the aviary after they had matured, and compared their songs with those of the original adult males. Most young males had learned their songs from one or two tutors and some from three. Each of the tutor songs, moreover, was copied in chunks, the order of song elements within each being the same as in the tutor male. Unlike Zebra Finches, however, the young Bengalese Finches varied the order of the chunks as they sang, in sequences that followed a finite-state syntax. Thus Bengalese Finches have an innate grammar for composing syntaxical song from multiple sources; how this capacity is coded in the brain is the next question to solved. Support from PRESTO, Japan Sci & Tech Agency, Scientific Research Grant Basic B, #1439001 and JSPS Grant for Young Researchers.

Taldenkov I, Gerasimov K

Functional morphology of the feeding apparatus of the Spoon-billed Sandpiper

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We examined the the functional morphology of the feeding apparatus of the endangered Spoon-billed Sandpiper (*Eurynorhynchus pygmaeus*, SBS) and several other calidridine sandpipers. All possess distal rhynchokinesis, lack an external jugo-mandibular ligament, and have a well-developed bill tip organ and moderately developed bill-opening muscles. These features facilitate feeding on prey that are deeply and firmly embedded in rather soft substrate. Well-developed *m. hypoglossus* and *m. branchiomandibularis pars caudalis*, in conjunction with massive salivary glands and numerous papillae on the palatal surface, enable the tongue to transport food items of small mass into the oesophagus. SBS has a broadly spatulate bill tip, which restricts its capacity to probe, especially in mossy sod. It also has the most massive tongue of the sandpipers examined, and an inflexible articulation between the *entoglossum* and *basihyale*, which implies an ability to press the tongue firmly against the palate where it can act as a piston capable of protracting against strong resistance. SBS has, moreoever, a greater development of muscles that retract the tongue and pull down the bottom of the oral cavity. Particularly numerous palatine papillae reach the tip of the bill tip in this species, and there are tactile receptor pits around the tip of the external surface of spatula. Such characteristics suggest the presence of a specific mechanism for sucking and filtering food-containing material in the bill cavity. The mechanism operates by synchronizing longitudinal motions of the tongue with up- and down-movements of the upper spatula: the spatula digs in to shovel up prey-rich liquid substrate, which is simultaneously sucked into the bill cavity by retraction of the tongue. During subsequent protraction of the tongue, water and waste substrate particles are thrown out of the bill cavity while food items are held by the palatal papillae. As the tongue retracts in the next cycle, trapped prey are dragged automatically back into the opening of the oesophagus.

Tanaka K, Morimoto G

Does a Horsfield's Hawk Cuckoo nestling deceive its host parents numerically?

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Horsfield's Hawk Cuckoo (*Cuculus fugax*), an obligate brood parasite endemic to east Asia, parasitizes small blue passerines. Cuckoo nestlings have a naked, gape-colored skin patch on the underside of each wing, which they display to host parents delivering food to the nest, thereby signaling their nutritional needs and actually gaining food by the display. Although the shape of the wing patches do not resemble the nestling gape, the host, we hypothesize, misperceives them as begging gapes because of inability to distinguish between shape of patch and gape in the darkness of the nest interior. Thus, they would overestimate the brood size, so increasing provisioning. We occasionally observed host parents attempting to place food into a wing-patch by mistake; but its frequency was too rare to analyze. So we focused on the time that host parents attended nests, because they sometimes appeared to hesitate in choosing which "mouth" to feed and gazed at their suspect young. When soliciting, cuckoo nestlings usually only raised one wing, but sometimes both or neither, so that the number of displayed patches was usually one, and occasionally two or none. The area of yellow skin displayed, including the actual gape, may diminish when both patches are exposed, because nestlings lay their bodies over on to the back to show the patch more clearly when raising only one wing. If the hosts are deceived numerically by the number of colored 'gapes', they might be expected to respond specifically to the number of raised wings, not to the total area of gape-colored skin. As anticipated, host parents varied the frequency of nest attendances in relation to the number of wing-patches displayed during each feeding visit.

Tanneberger F[1], Joosten H[1], Flade M[2]

The west Pomeranian population of the Aquatic warbler: Habitat change and restoration potential

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The Aquatic Warbler (*Acrocephalus paludicola*) is a globally threatened species; yet around 1900 it was one of the most widespread birds in the fens of central Europe. Subsequent decline resulted from the drainage of its habitats. Currently, it is stable in the Polessie region of eastern Poland, Belarus, and the Ukraine where about 80% of the world population is concentrated, but then declines abruptly in west Pomerania, dropping to as low as 64-68 singing males in 2005. Distinct genetic differences from other populations indicate that the remaining birds in west Pomerania are the last survivors of a separate, formerly large central European population. Its conservation has high priority, but is hampered by insufficient knowledge of habitat requirements. Throughout breeding in 2004-2006, we investigated all sites currently occupied in west Pomerania as well as others recently abandoned and/or potential. Data on vegetation structure, soil and nutrient conditions, insect composition and biomass, land use, and landscape structure were collected and combined with a Geographical Information System for west Pomerania. In 2005, the diets of Reed Buntings (*Emberiza schoeniclus*) and Sedge Warblers (*Acrocephalus schoenobaenus*) breeding in west Pomeranian Aquatic Warbler habitats were also investigated as surrogates for Aquatic Warbler diet. Multivariate analysis of field data indicates that litter properties, water level, and landscape structure are key factors in habitat selection, the relative impact of which is quantified by linear regression in a habitat model. Here management recommendations are presented for suitable land use techniques, and the first results are given of experimental management under a Polish-German EU-LIFE project (2005-2010) targeting Aquatic Warbler conservation in west Pomerania.

Tellkamp MP

Early Holocene mangrove and wetland birds on the arid Santa Elena Peninsula, Ecuador

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Archeological excavations at site OGSE-80 in Ecuador have revealed patterns of pre-ceramic settlement and evidence for an early origin of agriculture in northwestern South America. Analyses of the zooarcheofauna and phytoliths have also revealed patterns indicative of Early Holocene climate between 10,000 and 6600 14C yr BP. The data do not, however, resolve the question of Early Holocene climate change, in part due to a lack of taxonomic resolution of the available faunal materials. Here I present a species-level identification of the bird bones from Site 80 to improve understanding of paleoecological conditions in southwestern Ecuador at that time. Birds are especially suitable for paleoenvironmental reconstructions because of the wealth of information available on current habitat selection. I found that the composition of the bird fauna changed significantly throughout the 3500 years of Vegas occupation. During the early Vegas period (10,000-8000 yr BP), birds associated with mangroves and wetlands made up c. 50% of the archeoavifauna, whereas in the late period (8000-6600 yr BP), their numbers decreased to 10-20%. To a large extent this faunal change reflects the local disappearance of mangroves. Together with data already gathered at the site, it appears that the transition between the two Vegas phases was characterized by marine transgression followed by the gradual loss of mangroves. Although there is no clear evidence of climatic change, the presence of two species of birds, the Great Tinamou (*Tinamus major*) and Mealy Parrot (*Amazona farinosa*), suggests that conditions were more humid then than now.

Thiel D, Jenni L, Jenni-Eiermann S

How susceptible are Capercaillie to human disturbance?

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Disturbance by human outdoor activities is discussed as a possible cause of population decline in the Capercaillie (*Tetrao urogallus*) in Central Europe. So far, little attempt has been made to measure the susceptibility of Capercaillies to human disturbance. An indicator of such disturbance as would cause physiological stress is an increase of the glucocorticoid corticosterone, a stress hormone that helps animals to cope with life-threatening situations. The goal of this study was to (1) select and validate an enzyme immunoassay for the quantification of corticosterone metabolites in Capercaillie droppings, (2) evaluate stress hormone levels in Capercaillie droppings according to temporal and spatial variation in winter tourism activities, and (3) investigate whether winter tourism affects the spacing behavior of radio-tagged Capercaillies. Corticosterone metabolites excreted in droppings could be determined with a cortisone enzyme immunoassay, and reliably measured in droppings collected under field conditions during winter. Capercaillie in habitats subject to high impact from winter tourism showed higher physiological stress than those without human disturbance. Winter range use by Capercaillie was not influenced by cross-country skiing, but there is evidence that unpredictable down-hill skiing has a negative impact.

Thiyagesan K, Maheswari AS, Tamizhselvam J

Foraging ecology of the Asian Openbill Stork, at Veeranam Lake, Tamilnadu, southern India

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The foraging ecology of the Asian Openbill Stork (*Anastomus oscitans*) (Boddaert) was studied at Veeranam Lake (11°15'N and 11°25'N; 79°30'E and 79°35'E), Cuddalore District, Tamilnadu, southern India. Eight species of gastropods and two species of bivalves form the stork's staple diet. Buried prey are found by probing the mud by pecking or boring. The storks prefer gastropods with more whorls. The mean shell length of the gastropods eaten was 2.22±0.74 cm and that of the bivalves 6.07±1.60 cm. There was a significant ($P<0.05$) negative correlation between percent shell damage and shell length and width. Feeding storks damage specific regions of the shell. Shell thickness on the damaged side (valve) was greater than the same area on the other side (valve), indicating that the storks' behviour might be an energy maximization strategy. Brown or pale brown Molluscs were more often selected. A comparison of the prey taken by storks and their availability at Veeranam lake showed that prey use was 100% for planorbids and unionids. The size of stork flocks correlated significantly with the use of thiarids and viviparids.

Thompson CF[1], Sakaluk SK[1], Vogel LA[1], Johnson SK[2], Forsman AM[1]

Are nestling condition and immune response correlated in House Wrens?

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Individuals in good condition are generally able to mount more effective immunological responses than those in poor condition. This hypothesis assumes the lack of a trade-off between attainment of good condition and capacity to mount an immune response. We tested this hypothesis by using the phytohaemagglutinin (PHA) skin test to assay T-lymphocyte cell-mediated immune function in nestling House Wrens (*Troglodytes aedon*) in broods of different sizes. PHA response and measures of nestling condition - body mass, structural size, hematocrit, total serum protein content, and serum protein profiles - were compared over the course of two breeding seasons. Preliminary results indicate that immune response in nestlings varies seasonally and that some measures of condition are correlated positively with the response, a result consistent with the hypothesis.

Thompson HS, Arinaitwe J

Community participation in avian conservation in Africa

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Africa holds 1400 endemic bird species in a breathtaking diversity of habitats. About 234 (10%) of the species are globally threatened, representing 19% of the global total. Avian conservation in Africa however faces several significant problems, pre-eminent among which is its low global position on the list of conservation priorities, and lack of funding and specialised capacity. Moreover, high biodiversity sites and Protected Areas in Africa have historically been managed from the top down by centralised state authorities that are often perceived as remote and out of touch with local needs and concerns. The majority of conservation initiatives in Africa have, in fact, been driven historically by external organisations. As a result, processes for determining core issues in African conservation have frequently been dominated by outside influences that relegated the interests of local people to a secondary position. In many areas, therefore, local communities continue to resent conservation initiatives that are developed and implemented without their participation. This paper will draw from examples across Africa to show how the "Site Support Group Concept" being implemented by BirdLife International for Important Bird Areas in Africa is developing, strengthening and promoting civil society and local community participation in bird conservation across the continent. Current evidence of the impact of such work on threatened bird populations will be described and recommendations made for improvement and replication.

Thomson RL[1], Forsman JT[2], Broggi J[1], Mönkkönen M[1]

The burden of habitat selection for prey in a predation risk landscape

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Central-place foraging predators, like the Eurasian Sparrowhawk (*Accipiter nisus*), may have a profound influence on forest bird communities. During the breeding season, the spatial dispersion of such predators can form a predation risk landscape. Predator nests may either be avoided because predation risk gradients may lower success in prey breeding close to predators, or, in contrast, breeding predators may be sought as neighbours because of the protection they provide against predation from other sources. A trade-off is the most likely outcome, resulting in optimal territory location at a certain distance from the predator nest. We have shown previously that Pied Flycatchers (*Ficedula hypoleuca*) avoid nesting close to sparrowhawk nests, and that flycatcher fitness, measured as nestling size, increases with distance from them. Although the underlying reason is as yet unknown, it is likely that perception of increased predation risk in flycatcher parents reduces the quantity and quality of food that they bring to the nest during provisioning. Using both a large scale nest-box population approach (nest-boxes arranged in grids around hawk nests), and a smaller scale manipulative approach (nest-boxes moved to artificially alter habitat selection by flycatchers relative to breeding hawks), we focus on the impact of non-lethal predation risk on adult flycatchers. We examine adult provisioning rates, body mass changes, stress response and metabolic rate within predation risk gradients. Our results show that nesting in proximity to predators is detrimental to adult flycatchers, both for the current breeding attempt and for future survival. Therefore, optimizing habitat selection relative to sparrowhawks, and potentially other predators, is crucially important.

Thorup K[1], Tøttrup A[2], Rahbek C[2]

Changing annual schedules in migrating birds

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Climate is changing rapidly, and is expected to affect the timing of seasonal events. Thus timing of the annual cycle in bird migration seems to be shifting in response, as evidenced in the earlier arrival of migrants in spring overall. However, for timing of other seasonal events such as autumn migration, both advanced and delayed departures are being reported. In some cases, the shifts in timing appear to correlate with migration distance, but not in others. Similarly, time spent in the breeding area, which is assumed to be more directly linked with ecological performance, is by some reported to remain stable and by others to change significantly. After reconciling differences between species and different measures of timing used for Palearctic-African birds, nevertheless, it becomes clear that the trends in timing shifts are, in fact, consistent between studies, and that differences are correlated with migration distance. Furthermore, detailed analyses of data from a Danish study site reveal that, although the signature of phenological change is evident in almost all species, most individuals do not seem to change the actual time spent on breeding grounds.

Thyen S, Büttger H, Exo K-M, Oberdiek N

Spatial variation in reproduction of Common Redshanks in the Wadden Sea, Germany: Evidence for an ecological trap or a buffer?

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Recent studies show that Common Redshanks (*Tringa totanus*) breeding in the Wadden Sea will nest in high densities in limited areas on the mainland coast of Germany where hatching success is low due to high nest predation. In contrast, densities on Wadden Sea islands are lower but hatching success is much higher, such that populations are stable in both areas. These observations appear to conflict with the usual expectation that occupation of attractive habitat, as reflected in high breeding density, should have positive consequences for fitness. The following hypotheses might explain this phenomenon: (1) mainland breeders are caught in an "ecological trap" through mal-assessment of habitat on the mainland, or (2) good quality habitat is buffered against overuse when the total breeding population is relatively high, forcing low quality birds to breed at high density in poor sites on the mainland. To test these hypotheses, we investigated breeding success and body and health condition in adult and chick redshanks on the mainland coast of Germany (Jadebusen) and on Wangerooge Island in the Wadden Sea in 2004 and 2005. Corroborating earlier studies, we found that breeding density was lower but hatching and overall breeding success higher on the island than the mainland. We did not, however, find clear evidence that adults and young were of poorer quality on the mainland, judged by such biometric parameters as a simple index of body condition and hematocrit values. These findings suggest that the spatial differences described above may not reflect a buffer effect but may possibly be explained by source-sink dynamics involving an ecological trap.

Tizard I

Immunosuppression in exotic and wild birds as a result of viral infections affecting the bursa of Fabricius

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Recent studies in poultry have demonstrated that the development of B cells within the bursa of Fabricius differs greatly from B cell development in mammals. In mammals, for example, B cell development and diversity continue throughout the life of an animal. In poultry, however, the generation of B cell diversity is restricted to a relatively short period around hatching. Damage to the bursa at this stage will therefore not only reduce the total number of B cells available to a bird, but will also reduce the diversity of surviving B cells. Failure of bursal development thus makes birds highly susceptible to infectious, especially bacterial, diseases. Although Infectious Bursal Disease of chickens has long been recognized as a major cause of immunodeficiency in that species, other viruses can cause severe bursal damage in other birds. Thus polyomavirus infection of psittacines causes, among other lesions, massive necrosis of bursal follicles and hence significant B cell deficiency. Similarly, the circovirus that causes Beak and Feather Disease in Psittacines can cause bursal necrosis in the absence of significant beak or feather lesions. Indeed, circoviruses are increasingly recognized as a cause of bursal necrosis and immunodeficiency in parrots as well as pigeons and waterfowl. Other infections that appear to destroy the bursa include reovirus as well as tuberculosis, chlamydiophilosis and fungal diseases. Wildlife biologists should be aware of these infections and their potential to cause significant mortality in wild bird populations.

Tojo H[1], Nakamura S[2]

The breeding ecology of the introduced Red-billed Leiothrix on Mt. Tsukuba, central Japan

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The Red-billed Leiothrix (*Leiothrix lutea*), a babbler native to southern China and Himalayan region, has been introduced to the Hawaiian Islands and Japan. In Japan, the leiothrix has exploded in range and numbers in recent decades, whereas the population in the Hawaiian Islands has collapsed from unknown causes. Between 2000 and 2002, we investigated its breeding ecology on Mt. Tsukuba, its easternmost breeding area in Japan, to determine the factors affecting breeding performance. We found 147 nests in the three years, most of which were built in dwarf bamboo (*Sasamorpha borealis*). The breeding season was long, and active nests were found from late April to early October. Clutch size was 3.4±0.9 (mean±SD) and correlated negatively with laying date. Fledging success was 22.6, 14.9, and 45.3% in the three years, respectively, and most failures resulted from nest predation. Although fledging success per attempt was low, each pair was nevertheless presumed to improve annual breeding performance by nesting repeatedly during the long breeding season.

Tökölyi J[1], Pap PL[1], Vágási CI[1], Barta Z[2]

Condition-dependent feather quality and the dynamics of feather abrasion during the annual cycle in the Great Tit

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Despite the importance of feather quality for the well-being of birds, little is known about the factors that mediate it and lead to feather abrasion. We investigated year-round changes in the degree of feather wear in a non-migratory population of Great Tits (*Parus major*). Feather quality was estimated by measuring rachis width on the third outermost primary and by counting the number of feather abnormalities. The middle primaries were most affected by abrasion, whereas secondaries and tertials remained relatively unaffected. Degree of wear was positively related to feather quality, which means that individual differences in quality and investment in feathers might explain differences in durability. The rate of abrasion was uniformly low during the summer but increased towards the end of winter, resulting in moderate wear that increased exponentially during breeding. Thus most damage is accrued during reproduction but the pre-breeding interval also contributes. Juveniles prior to first complete molt differed from adults in several ways: feather quality was poorer, wear was greater and feather abrasion accelerated. The considerably higher degree of feather wear in juveniles may contribute to the different rates of survival and reproductive success between second-year birds and older individuals. Furthermore, heavily damaged feathers at the beginning of breeding could lead to delayed timing of reproduction and an earlier start of molt, shortening the length of the breeding period and ultimately reducing fitness.

Tomita N, Takagi M, Watanuki Y

The influence of interannual variation in sea-surface temperature on the first egg date of Black-tailed Gulls at Teuri Island, Japan

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Many seabirds use local environmental conditions, such as sea-surface temperature (SST), for determining the time at which to initiate breeding. Thus, by elucidating the influence of short-term fluctuations in SSTs on Black-tailed Gulls (*Larus crassirostris*), it may be possible to predict more long term effects from future change in global climate. This issue was investigated at Teuri Island in northern Hokkaido, Japan, from April 1992 to July 2004. In Black-tailed Gulls, about 60% of females lay two eggs and the maximum clutch size appears to be three. Gulls begin to gather at Teuri Island in March. The euphausiid (*Thysanoessa inermis*), which swarms on the sea surface off the west coast of Hokkaido in this time, is thought to be an important food source for gulls prior to laying. Accordingly, we tested whether March SSTs or *T. inermis* abundance affected the timing of laying in the gulls. Mean first egg dates ranged from May 4 to May 12 between 1993 and 2000, and in 2002 and 2003, but from May 21 to May 25 in other years, an average of 16 days later. SST anomalies in the years of early laying were less than 1°C, whereas those in 2001 were -2.2°C and in 1992 and 2004 were +1.2°C and +1.1°C respectively. The relationship between mean first egg dates and SSTs from 1993 to 2000, 2002 and 2003 was strongly positive for the years, with mean first egg date correlated negatively with clutch size and egg volume. In the years of early laying, most clutches were of 2 eggs (62%), followed by 3- and then 1- egg clutches. In the late years, the frequencies of 1- egg clutches were higher, and those of 2 and 3 eggs lower, which correlated with the lowest abundance of *T. inermis* in 2004. We suggest that the timing of laying in Black-tailed Gulls is determined by March SSTs. When SSTs are extremely high or low, *T. inermis* does not swarm at the sea surface, a phenomenon that appears to have negative effects on the timing of laying, clutch size and egg volume in this gull.

Tomkovich P

Contrasting population trends in waders on Chukotski Peninsula, north-eastern Russia

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Among the shorebirds that breed on Chukotski Peninsula, the north-easternmost promontory of Asia, a number of species have undergone significant shifts in distribution and abundance over recent decades. *Charadrius semipalmatus* and *Calidris pusilla* have moved into the region from the east (Alaska), *Calidris subminuta* has done so from the southwest, and *Calidris mauri* and apparently *Tryngites subruficollis* have expanded their breeding ranges, and so gross numbers, within Chukotka; locally, *Calidris ptilocnemis* and *Charadrius hiaticula* have also increased in numbers. Five of these seven species originate from and/or have migratory links with the Americas, whereas *C. subminuta* and *Ch. hiaticula* are inland Asian migrants. In contrast, *Pluvialis squatarola*, *Eurhynorhynchus pygmeus*, *Calidris alpina sakhalina*, and possibly *Eudromias morinellus* are a group of species or regional taxa that are restricted to the Peninsula and which have suffered decline. The first three species or subspecies belong to the coastal East Asian-Australasian Flyway and the last to the Central Asian Flyway. These simple statistics may indicate rather different conservation situations on the flyways. Waders start breeding in western Alaska about two weeks earlier than on Chukotka. All four species that have now expanded their ranges into the Peninsula (*Charadrius semipalmatus*, *Calidris subminuta*, *C. mauri*, *C. pusilla*) congregate and breed first around human settlements where dirty snow melts earlier than in more remote areas and where they are relatively protected from natural predators. With the ongoing amelioration of the Arctic climate, the early-arriving American waders have the advantage of occupying prime breeding habitats in parts of Chukotka. This process may be implicated in or facilitated by declines in some of the Asian species.

Touchton JM

Delayed compensatory responses in a guild of ant-following birds

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The magnitude of density or behavioral compensation following species removal experiments is considered to indicate the interaction strength between competing species. Density compensation has rarely been demonstrated in animal guilds however, possibly due to the difficulty of studying delayed responses. Behavioral compensation, a less reliable indicator of competitive pressure, is often used to infer competitive interactions, and has frequently been observed. To explore the influence of competition on the maintenance of a dominance structured multi-species avian guild, I quantified numerical and behavioral responses of Bicolored (*Gymnopithys leucaspis*) and Spotted (*Hylophylax naevioides*) Antbirds several generations after the extirpation of the dominant Ocellated Antbird (*Phaenostictus mcleannani*) on Barro Colorado Island, Panama. I compared these responses to data collected prior to the decline of Ocellated Antbirds on Barro Colorado and to a current nearby mainland control in Parque Nacional Soberania, where the complete guild of these ant-followers still exists. Populations of Bicolored and Spotted antbirds increased in density on Barro Colorado, completely compensating in combined biomass for the loss in overall biomass of Ocellated Antbirds. Historical records suggest that complete population turnover of these species occurred before density compensation was detectable. At ant swarms on Barro Colorado, the numbers of Spotted Antbirds doubled those from historical records, and in comparison to Soberania. Rates of aggression between Bicolored and Spotted Antbirds on Barro Colorado increased. Interspecific competition appears to actively maintain guild structure in this complex tropical-foraging association through direct interactions and indirect interactions mediated through more subordinate guild members. Behavioral adaptations in guilds may occur over several generations, delaying the onset of compensatory responses.

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Migratory routes and wintering behavior of NW-European Montagu's Harriers revealed by satellite telemetry

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Montagu's Harriers *Circus pygargus* breeding in NW Europe are thought to migrate via Gibraltar or on a broader front to their West African winter quarters. Ring recoveries indicate that a large part of the Sahel zone might be used. As the harriers' main food supply in the winter quarters is thought to be desert locusts, they might follow locust swarms eastward and migrate back in spring via Italy. To test these hypotheses, a satellite telemetry study was started in 2005 with a pilot on two Dutch adult female harriers. Both used different routes in autumn: one via Spain to Morocco, the other via Italy-Algeria to the Sahel zone. Both females spent several weeks migrating through known Montagu's harrier breeding areas in Germany and France, rising questions about the possibility of fattening up in combination with prospecting for future breeding sites, which may have implications for high connectivity between European breeding populations. One of the females moved to northern Nigeria after a stay of three weeks in Niger. Her locations in both countries showed a pattern of short flights within the same area. Further data from satellite telemetry will have to show which fraction of NW-European harriers might use which flyway, and whether it is common that wintering harriers stay in the same area for longer periods. This information will be complemented with field observations of Montagu's harriers' distribution, habitat use, hunting behavior and diet in Niger and Burkina Faso. Conclusions will be drawn on possible threats arising in the winter quarters as well as carry-over effects for the NW European breeding population. Possible dangers might be hunters, food shortage and use of degrading habitat. Consequences for conservation strategies of this vulnerable species will be evaluated.

Trivedi AK, Rani S, Kumar V

Day length regulates seasonal reproduction in subtropical House Sparrows: Evidence for photoperiodism as an adaptive strategy

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Because its breeding populations now occur world-wide, the House Sparrow (*Passer domesticus*) is an ideal subject for investigating latitudinal effects on the photoperiodic control of avian seasonal cycles. In the present study, we investigated whether House Sparrows at 27°N, 81°E in India employ photoperiodic strategies similar to high latitude populations in which photoperiod controls the annual reproductive cycle. We found that seasonal cycles of gonadal growth and regression, and molt, in Indian sparrows corresponded with the annual photoperiodic cycle. Further, when exposed to 9L(hours of light):15D(hours of darkness), 12L:12D and 15L:9D over a full day, those sparrows in the 12L and 15L groups underwent testicular growth and regression and molt, but not those in the 9L group. Moreover, when exposed to photoperiods with light periods extending to different phases of the daily photosensitivity rhythm (2L:22D, 6L:18D, 10L:14D, 14L:10D, 18L:6D and 22L:2D), 14L, 18L and 22L groups produced testicular growth-regression responses typical of long days; the 2L:22D group also gave a small testicular response. There was, nevertheless, a time-of-year effect from stimulatory photoperiods, as revealed in gonadal response curves in sparrows transferred in every month over a year to 16L:8D for 17-26 weeks. It thus appears that photoperiodism in the House Sparrow functions to conserve control mechanisms evolved over a long period of time, as an effective adaptive strategy that ensures reproduction in birds at the most suitable time of the year.

Tummeleht L, Hõrak P, Kilgas P

Blood antioxidants in incubating Great Tits in relation to health state and breeding habitat

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Life-history theory assumes a trade-off in resource allocation between reproductive and defence functions. Increased physical activity associated with breeding leads to increased oxygen consumption, which may cause excess production of reactive oxygen. To combat the oxidative stress that results, organisms rely on endogenous and dietary antioxidants to scavenge free radicals. Hence it can be expected that the antioxidant status of a bird is an honest reflection of its condition and state of health. A number of easily measurable hematological indices, such as leukocyte count and levels of plasma protein and lipids, have been widely used to estimate individual condition in ecophysiological studies of passerine birds. Knowledge about the association between such indices and markers of antioxidant protection is nevertheless scant. We describe how indices of hematological condition in incubating Great Tits (*Parus major*) correlate with levels of different antioxidants in the blood and measures of total antioxidant status, and how these parameters differ between birds breeding in deciduous and coniferous habitat.

Underwood M, Bunce A

Preferences for breeding habitat in the White-faced Storm Petrel on the Mud Islands in Port Phillip Bay, Australia

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Habitat loss and modification of breeding sites is a major factor driving declines in seabird populations. The White-faced Storm Petrel (*Pelagodroma marina*) is restricted to three breeding colonies in far southeast mainland Australia: the Mud Islands and South Channel Fort in Port Phillip Bay, and Tullaberga Island off Mallacoota. The numbers of storm petrels breeding on the Mud Islands have declined considerably since early last century, possibly a result of significant changes in vegetation, together with increases in local populations of other birds, most notably Silver Gulls (*Larus novaehollandiae*), Australian White Ibis (*Threskiornis molucca*), and Straw-necked Ibis (*T. spinicollis*). The breeding area available to the storm petrels appears to have been reduced by the recent arrival of the ibis which now breed on the islands in large numbers of approximately 15,000 pairs. The impact of these changes on the storm petrels is poorly understood, and knowledge of the breeding biology of this species is currently limited. Our study examined the interactions between storm petrels, ibis, and vegetation through experimental manipulation which involved removing vegetation and ibis nests to determine whether exclusion of ibis catalyzed greater breeding in storm petrels. Manipulation of habitat effected changes in both burrow density and breeding success in the storm petrels. Our study has brought to light information important for the management of this species, and has shown that manipulation of habitat can alter the effects of habitat loss for burrow-nesting seabirds.

Vallarino A

Sibling rivalry in Black-legged Kittiwakes: Does size matter?

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Competitive hierarchies among siblings are common in many avian broods. Typically, the first-hatched chick is dominant, which may be due to its age, larger size, and/or hatching from an egg of different, higher quality. It remains unclear, nevertheless, what factors underlie the differences in competitive ability. In order to discriminate among them, experimental studies are required. Accordingly, I set out to test whether the difference in size between eggs within a brood influences solicitation, agonistic behavior and survival in chicks in the Black-legged Kittiwake (*Rissa tridactyla*). Kittiwakes lay a modal clutch of two, but often only one chick fledges due to siblicide. The first-laid egg is bigger than the second, and the chick hatched from it is more aggressive and more likely to dispose of its sibling. The chick from the first-laid egg also hatches first and thus is older and larger. In order to control for confounding effects age and egg type, I swapped eggs between nests to create experimental broods of two chicks each that hatched from the same egg in laying sequence on the same day, and differed only in the size of the egg they hatched from, whether from two eggs of the same or different size. Begging and agonistic behavior, growth and survival were recorded. I found no differences in behavior between broods of chicks that were initially of the same size or which differed in size. Surprisingly, in nests where chicks differed in initial size, it was the chick from the smaller egg that won the conflict in most cases. Chicks hatched from smaller eggs may have higher survival rates because their nutritional requirements are lower; either that or parents may compensate by providing other resources important for success.

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Ruddy Turnstones rapidly build pectoral muscle after raptor scares

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To cope with changes in the environment, organisms not only alter their behavior but also adjust organ physiology and morphology. In birds, this is well established for the digestive tract. Here we present a first case of birds adjusting their flight machinery in response to predation risk. In an indoor experiment, ruddy turnstones (*Arenaria interpres*) were subjected to an unpredictable daily appearance of either a raptor or a small gull (as a control). Ruddy turnstones experiencing threat induced by a flying raptor model, longer than after similar passage by the gull model, refrained from feeding after this disturbance. Pectoral muscle mass, but not lean mass, responded in a course of a few days to changes in the perceived threat of predation. Pectoral muscle mass increased after raptor scares. Taking the small increases in body mass into account, pectoral muscle mass was 3.6% higher than aerodynamically predicted for constant flight performance. This demonstrates that perceived risk factors may directly affect organ size.

Van der Winden J, Krijgsveld KL

Habitat use and feeding ecology of the Purple Heron in the Netherlands

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In the framework of the Dutch marsh bird protection plan, special attention has been given to the habitat and feeding ecology of the Purple Heron (*Ardea purpurea*). The Dutch Purple Heron population is relatively isolated at the northwestern limit of the European distribution of this species, using around 1700 km^2 as feeding habitat. Its numbers declined significantly from around 900 in 1977 to some 450 today, mainly due to a cyclical decline in precipitation in Africa at winter quarters, as well as deterioration of reedbeds in Dutch wetlands. Purple Herons in the Netherlands have a limited breeding range, confined to lowland peat marshlands. They feed mainly in agricultural lowland peat grasslands with abundant ditches, taking insects, amphibians, fish, and especially in peak years, voles (> 60%). On one artificial floodplain, Weatherfish (*Misgurnis fossilis*) is the main prey item. In general, feeding habitat in agricultural areas is characterized by clear water with shallow edges and relatively open vegetation, but heron densities are higher on polders with higher fish diversity. Modern water management nevertheless hinders fish migration, resulting in less biodiverse waters and consequently lower numbers of herons. In optimal agricultural areas, heron density ranges from 2 to 3 per 100 ha, dropping to 0.5 per 100 ha in moderate areas. In marshland, feeding densities are higher, ranging from 3 to an exceptional $80/km^2$ at one location. Based on the characteristics of these habitats, potential feeding areas outside the existing feeding range of colonies were identified by GIS for planning new reed marshes needed by Purple Herons and other marsh birds. Recommendations for heron-friendly water management in agricultural areas are presented.

Vazquez-Miranda H

Galliform biogeography: A perspective using supertrees

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Birds of the Order Galliformes (megapodes, chachalacas, quails, guineafowl and pheasants) are worldwide in distribution, with high levels of endemism. Because a comprehensive phylogeny has not yet been constructed for the order using current phylogenetic methods, I present a supertree reconstructed from Genbank data based on matrix representation with parsimony (MRP) for use as a framework for biogeographical analyses. Phylogenetic relationships within families are concordant with previous hypotheses, and biogeographic patterns are closely correlated with geological data, indicating vicariance as the main process underlying cladogenesis at family levels and a mixture of vicariance and dispersal at lower taxonomic levels. Galliform evolution appears to have been influenced considerably by geographical barriers to dispersal, such as mountain chains and seas.

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Admixture during migration: Genetic population structuring in an inland migratory sandpiper, the Ruff

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Variance in seasonal movements, species-specific trade-offs and life histories provide insight into how migration strategies may have evolved. The Ruff (*Philomachus pugnax*), a sexually dimorphic, lekking, inland sandpiper, commutes between distant wintering grounds in Europe, Africa and Asia, and breeding grounds in Scandinavia to eastern Siberia. It also appently varies in the timing of migration and breeding. Yet no morphologically- or behaviorally- differentiated subspecies or populations been identified. Our research focuses on finding whether there are genetically different populations. Using nine microsatellite markers, we found evidence for genetic differences between breeding Swedish and Siberian populations, between which there is only partial overlap in the distribution of alleles. Furthermore, allele frequencies in Ruffs sampled in the Netherlands on spring migration in 2004 differed from those between late March and mid April. Capture-recapture analyses with MARK of color-ringed individuals in the same year yielded an estimate of a staging time of about 4 weeks. So birds of different breeding origin meet and mix at Dutch stopover grounds, and then seem to head for different breeding grounds. We present further analyses on admixture patterns in individuals that stopover in the Netherlands, relating the timing of migration to genetic population structuring. Using both microsatellite markers and mtDNA control region primers, we evaluate the following hypotheses: (1) genetic variability in Ruffs is higher because inland waders did not suffer the same severe population bottlenecks during glacial times as marine conspecifics; (2) without genetic bottlenecks, Ruffs have had ample evolutionary time for lineage sorting, and thus their populations are structured genetically; and (3) that that gene flow which occurs comes mainly from sex-biased dispersal in males.

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Population size and trends of the endangered Dupont's Lark in Europe

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Dupont's Lark (*Chersophilus duponti*) is one of the most endangered passerines in Europe. Its population size has been estimated at between 1300 and 2000 singing males according to the few incomplete censuses. During 2004 and 2005, we collated an accurate census of the main European populations, and estimated population size and trends against the results of the European census of 1988. The current size of the European population stands at between 2500 and 3000 singing males that are nevertheless very fragmented in distribution, the marginal enclaves comprising no more than 5-20 singing males. Negative trends were recorded in most areas, and the species has disappeared or declined sharply in many of them. The reasons for the declines differ between regions: in some it is due to new cultivation schemes, and in others to reafforestation and vegetation re-growth. Recently, wind farms have become a serious threat. Different measures for conservation are proposed.

Viksne J, Janaus M

Roof nesting of gulls, terns and waders in Riga, Latvia

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Six species of larids and two species of waders nested on roofs in the city of Riga, Latvia, in 2002–2005. Data on the commencement of roof nesting and recent numbers of roof nesters, both in total and as a proportion of total populations in Riga, are given below by species. Herring Gull (*Larus argentatus*): established late 1970s; no less than 625 pairs at 78% of total population, both of which are growing; mostly solitary or in small groups of 2 – 10 pairs, but two colonies comprise 85 and 120 pairs. Common Gull (*Larus canus*): established since 1985; single pairs out of about 10 pairs total population, which has declined from c. 50 pairs in the 1980s. Black-headed Gull (*Larus ridibundus*) – established since 1995; about 400 pairs on two roofs 0.5 km apart at 15% of total population; total population has declined but the number of roof nesters is growing. Common Tern (*Sterna hirundo*): established 1983; about 500 pairs on roofs at 88% of total population, both of which are growing. Arctic Tern (*Sterna paradisaea*): first recorded 1999; not more than 15 pairs at 100% of total population, on probably the only recent nesting site around Riga. Little Tern (*Sterna albifrons*: probably established 1986; about 25 pairs on one roof and one pair on another at more than 80% of total population; both together with Common Tern colonies. Eurasian Oystercatcher (*Haematopus ostralegus*): established since 2000; single pairs. Little Plover (*Charadrius dubius*): irregular since 2000; single pairs. Roof nesting has created diverse problems for both people and birds. Buildings have suffered damage to roof cover and drainage, and people have been threatened, and their cars and clothes stained. Nesting birds have had to contend with flooding, changes to make roof cover unsuitable for nesting, and interference on privately-owned buildings.

von Philipsborn V

A new theory explaining the positioning mechanism in birds: swifts as examples

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Intrigued by his 1935 observations of their flying at twilight and returning home in the morning, Weitnauer studied Common Swifts (*Apus apus*) on the wing during the night at an altitude of 1250 to 2400 m in 1952. Using radar, he measured the local wind vector, the speed vector and altitude of the birds in the air, and the vectors of the track at ground level. In 2001, Baeckman and Alerstam investigated the aerial tracks of the swifts over one hour at night, recording an average climbing speed of –0.02 m/s. Swifts flew straight into the wind, the angle of their heading becoming smaller with increasing velocity of the wind. The new theory that I present here for a positioning mechanism in birds is drawn from an analysis of these behaviors. Using physical equations and calculations, I explain that swifts roosting aerially employ three different senses, in combination, to position themselves: (1) the "Altimeter Sense" for altitude; (2) the "Hodgkin-Huxley Sense" for the direction of the nearest pole and/or the local inclination to home; and (3) the "Galvani-Faraday Sense" for two different East or West signals involving crossing the horizontal magnetic flux density. These signals are registered continually; the integral is zero along the home meridian; and the frequency of the signals is lowest when the swifts head precisely into the wind. These general findings are supported by a series of recent papers by Fraser, Baekman et al., Weitnauer and myself. The swifts scan heads to overlap the magnetic meridian and monitor their headings, a behavior also observed in migrating *Sylvia borin* by Mouritsen et al.

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Plasma testosterone and aggression in breeding sooty fox sparrows

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The Challenge Hypothesis states that males may up-regulate plasma testosterone (T) secretion in response to socially unstable situations. This transient up-regulation of T occurs in many male songbirds that display paternal care, especially during the late breeding season when maintaining continually high levels of T can interfere with parental behavior. Whether a bird socially modulates T often correlates with breeding latitude. Studies of multiple subspecies of White-crowned Sparrow (*Zonotrichia leucophrys*) have demonstrated that, during the late breeding season, males at low to mid latitudes can transiently up-regulate T, while those at higher latitudes do not. To better understand how this trait arose and whether it is linked with environmental variables, male Sooty Fox Sparrows (*Passerella unalaschcensis*) representing a closely related genus to *Zonotrichia*, were challenged by simulated territorial intrusion (STI). The STI mimics an invasion by a male conspecific, thus creating a socially unstable situation. Birds were captured in the early (territory formation) and late (paternal care) breeding season, and blood samples collected for subsequent T assay, at the northernmost extent of their range in South Central Alaska. Male fox sparrows had significantly higher average circulating T levels during early territory formation (8.6±3.6 ng/ml) than the late breeding season (3.0±1.0 ng/ml). Consistent with previous data in *Z. l. gambelii*, a high latitude breeder, male Fox Sparrows did not up-regulate T in response to STI in the late breeding season. Male Fox Sparrows were similarly aggressive in early and late breeding stages, but those in the late breeding season spent significantly more time within five meters of the decoy during the STI.

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Molecular systematics of the genus *Leucopternis* (Accipitridae) based on mitochondrial DNA markers

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The almost worldwide family Accipitridae comprises approximately 237 species of diurnal predatory birds. Despite its great morphological and ecological diversity, its evolutionary history has been little explored with cladistic molecular analysis. The neotropical region is the richest in species, and harbors several endemic genera putatively related to the buzzards, genus *Buteo*; all are usually grouped as “buteonine” hawks. The genus *Leucopternis* comprises a morphologically heterogeneous assemblage of about 10 neotropical buteonine species ranging from Mexico to southern South America. We reconstructed the phylogeny of the group, including all recognized species of *Leucopternis* and most of the neotropical buteonine genera, using approximately 2kb of mitochondrial gene sequence from 12S ribosomal RNA, ATP synthase subunit 8 and 6, and NADH dehydrogenase subunit 6. The resulting data were analyzed by maximum likelihood, maximum parsimony procedures and Bayesian analysis. Our phylogenetic reconstructions disagree greatly with traditional taxonomic arrangements, revealing several novel groupings. A major finding is the polyphyly of *Leucopternis* as conventionally circumscribed, which comprises three major independent lineages. According to our inferences, several adaptive shifts in habitat use occurred during the evolution of this group, with multiple changes between forested and non-forested habitats. Furthermore, the pied plumage common to several species of "*Leucopternis*" is a convergently repeated trait. Supported by FAPESP, CNPq, CAPES.

Walankiewicz W, Czeszczewik D

Woodpecker holes and nest-boxes as ecological traps for *Ficedula* flycatchers

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Predation on the eggs and nestlings of hole-nesters has been little studied, both in the wild and for nest-boxes. From 1989 to 2005, we monitored the breeding performance of Collared Flycatchers (*Ficedula albicollis*) nesting in woodpecker holes in old-growth forest in Bialowieza National Park, and of Pied Flycatchers (*Ficedula hypoleuca*) in nest-boxes in adjacent secondary forest in Poland. We found that Collared Flycatchers suffered predation rates of c. 20%, significantly higher than for those nesting in natural holes. The Pied Flycatcher breeding in nest-boxes also suffered more from nest predation than has been reported in other nest-box studies. Evidently woodpeckers, usually regarded as a keystone species because their provision of nest sites for the secondary hole-nesters, produce ecological traps for Collared Flycatchers under primeval conditions in the Bialowieza National Park. And provision of nest-boxes in managed stands in the Bialowieza Forest nearby creates ecological traps for Pied Flycatchers as well.

Waldeck P, Anderssson M

Host-parasite relatedness in a brood-parasitic colonial bird

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Conspecific brood parasitism, an alternative reproductive tactic where some females lay eggs in the nests of other females of the same species, occurs in many animals with egg care. It is particularly common in waterfowl, for reasons that are debated. Female waterfowl tend to return to and nest near their birthplace, making it likely that local females are relatives. Here we analyse brood parasitism in a Hudson Bay population of Common Eiders (*Somateria mollissima sedentaria*), testing predictions from two alternative hypotheses. Parasitism and relatedness is estimated with protein fingerprinting of egg albumen, non-destructively sampled from each new egg in the nest throughout the laying period. Thirty percent of the nests contained eggs from more than one female. With estimated average relatedness of about 0.14, hosts and parasites are closer kin than nesting neighbour females. The result refutes the hypothesis that parasites avoid laying eggs in the nests of related hosts and corroborates the alternative of host-parasite relatedness. It also suggests that relatedness between host and parasite is not only a passive effect of strong natal philopatry.

Wanker R, Tschage A, Schoenfeldt A

Reconciliation in Green-winged Macaws

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The social complexity hypothesis predicts that selection should convergently promote the evolution of intelligence in different animal species living in similarly complex social environments. A common method for testing the social complexity hypothesis is to examine whether specific cognitive abilities in one group-living species occur in another. Members of several primates have been shown to reconcile after conflicts with conspecifics, thus reducing social tension and the probability of further aggression. So far, conflict resolution behavior in non-primates has been found only in goats, dolphins and hyaenas. The complex social environments of all these species include stable multigenerational units, individual recognition of group members, co-operation and competition for resource access, and substantial learning during social development. Although little is known about the social system of macaws, there is evidence that they live in stable social units, co-operate and compete for access to resources and are able to learn during the socialization process. Thus we hypothesized that conflict resolution behavior may have evolved convergently in macaws as well. We investigated a group of 15 Green-winged Macaws (*Ara chloroptera*) in Hamburg, Germany, using a method well established for testing for conflict resolution. We compared, over matched observation periods of 15 minutes each on the ensuing day, whether macaws showed more affiliative behavior after conflict (pc) than in a control (mc). We found a high tendency for reconciliation within mated pairs but a low tendency between unpaired group members. Thus conflict resolution in the form of reconciliation has evolved in at least one avian species, the Green-winged Macaw.

Wascher CAF, Kralj S, Scheiber IBR, Kotrschal K

Heart rate and coping styles in Greylag Geese

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Recordings of heart rate are widely used to provide information about the effects of physical activity or arousal. Heart rate is not only influenced by bodily action, but just as much by social challenges. Such challenges can affect individuals in different ways. With the help of implanted heart rate transmitters in free-ranging, semi-tame Greylag Geese (*Anser anser*), we recorded both, heart rate and behavior simultaneously. Our preliminary data suggest that consistent differences in resting heart rate exist between individuals, probably related to their personality ("coping style" *sensu* Koolhaas et al.). We found significant differences in heart rate between three focal individuals in different behaviors, such as threat, triumph ceremony, resting, vigilance and comfort behavior. For example, resting heart rates (mean±SE) were 86.3±17.44 beats per minute in individual 1, 91±16.15 in individual 2, and 77.74±13.28 in individual 3. We present individual differences in physiology and behavior in 25 implanted Greylag Geese. Behavioral and physiological parameters (heart rate and excreted corticosterone immuno-reactive metabolites) related to coping with demands of sociality were consistent over time. We predict that reactive personalities will show a lower resting baseline heart rate than proactive individuals. Reactive individuals are expected to be less involved in agonistic interactions as well, and we expect their heart rates to increase more slowly than in proactive individuals during agonistic encounters. Our data suggest striking similarities in social physiology between highly social Greylag Geese and mammals. Support was provided by FWF (Project 15766-B03 to K. Kotrschal), "Verein der Förderer" and Herzog-Cumberland-Stiftung.

Wegrzynowicz A

Changes in House and Tree Sparrow populations in Warsaw since the 1970s: A preliminary report

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The results of censuses of House Sparrows (*Passer domesticus*) and Tree Sparrows (*Passer montanus*) in various urban habitats around Warsaw, Poland, during the breeding seasons of 2005 and 2006 are presented and compared with data gathered from the same sites in 1970-1980. Breeding productivity and ecological relations between the two species are also investigated. Here I cover only the season 2005, but will include results for both 2005 and 2006 in the Congress presentation. In 2005, censuses were carried out on 13 plots covering 184ha on housing estates (6 plots, 101 ha), parks (4 plots, 55 ha) and allotment gardens (3 plots, 28 ha). House Sparrows were recorded on 11 plots (440 pairs/territories) compared to 12 plots (656 pairs/territories) in 1970-1980; thus the total number of pairs/territories had fallen by 1/3. They had disappeared almost completely from allotment gardens, and had declined in two of four parks and on four of six housing estates. Tree Sparrows bred on 12 plots in comparison to 9 plots in 1970-1980, increasing on one housing estate and colonizing three more. An increase of 22-34% was recorded in allotment gardens, but there was no clear evidence of change in parks. The productivity of the first and second broods was 6.57 fledglings/breeding pair (N=43 broods), a significant increase from 1970-1980 figures of 4.77 fledglings/breeding pair (N=160). In summary, the House Sparrow is in general decline in Warsaw, although not as much as in London and Hamburg, whereas the Tree Sparrow is increasing and spreading into the built-up habitat.

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Conservation of the Hainan Partridge on Hainan Island, China

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The Hainan Partridge (*Arborophila ardens*), a globally vulnerable species, is endemic to Hainan Island, south China. Previous work showed that it was restricted to primary tropical evergreen forest and suggested that it had undergone a rapid decline. To provide baseline information for its conservation, surveys were carried out from November 2002 to July 2005. Several new important locations with good forest habitat were found. One of them, the Yinggeling rainforest in centralwest Hainan, appears to be particularly significant, as both the partridge population and primary forest there are in good condition. Partridges were also found in secondary forest but not in plantations. Deforestation and forest replacement with plantations of exotic tree to develop the local economy are the most serious threats to the species, even though few local people benefit from these activities. Illegal hunting also occurs, and is carried out mainly for the market trade, rather than by local people for their own consumption. Recommendations to protect the forests holding the recently discovered partridge populations have been adopted by the Forestry Department of Hainan Province in their entirety, and the Yinggeling Nature Reserve has now become the largest nature reserve on Hainan.

Weidinger K[1], Nadvornik P[2], Kocvara R[1]

Assignment of passerine clutches to individual females by albumen protein electrophoresis

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Seasonal fecundity is the product of nest success, brood size and number of nesting attempts per year. Nest success has often been used as a substitute for seasonal fecundity simply because of lack of other data. The critical missing parameter – number of nesting attempts per season per female - is difficult to measure in field studies and cannot be obtained by conventional nest monitoring. Hence, many inferences about the status (source/sink) of bird populations with respect to such variables as habitat quality may suffer from a lack of site-specific data on frequency of renesting. Our goal was to adapt the technique of "protein fingerprinting" to small passerines, in order to make it possible to assign discovered clutches to individual females without the need to catch, mark and track them. About 10 µl (< 1% of egg volume) of albumen was taken from fresh eggs by an insulin syringe and the eggshell then resealed with nail varnish, a procedure that did not reduce hatchability below that of control eggs. Isoelectric focusing (IEF) on polyacrylamide gels containing immobilised pH gradients revealed clear band patterns varying between clutches/females. Sampling of albumen is nondestructive and adds little extra effort to the standard field protocol of nesting studies; and laboratory processing is relatively easy and inexpensive. We discuss the practical applicability of this method in a study of Blackcaps (*Sylvia atricapilla*) and its efficacy relative to clutch/female discrimination based on eggshell appearance. Supported by GACR 206/04/1081.

White C, Butler P, Martin G

Vision and foraging in Great Cormorants

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Over recent years, a number of aquatic birds, including Great Cormorants (*Phalacrocorax carbo*) and Goosanders (*Mergus merganser*), have been subject to much negative campaigning for their control because of perceived damage to fishery interests, particularly commercial angling. Yet although the diets of these birds are well documented, the factors that contrain foraging dives have been little investigated. Information on the factors that constrain foraging dives, and the interaction between the energetic costs of foraging and environmental variables such as light, turbidity and temperature, are all likely to help in understanding the factors that influence fish intake in different circumstances. As a step towards generating such information, we measured the visual fields of Great Cormorants in air, and their visual acuity in water under different light levels and at different water temperatures. For the latter, cormorants were trained using positive reinforcement to perform visual discrimination tasks under water. Visual field data added information about the role of frontal and lateral visual fields in triggering and guiding behavioral responses in foraging.

Wiacek J

Behavioral consequences of semi-colonial breeding in Montagu's Harrier in Poland

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A population of 31 pairs of Montagu's Harrier (*Circus pygargus*) was monitored on calcareous marshes near Che in eastern Poland, where observations were carried out in two nature reserves, *Bagno Serebryskie* and *Roskosz*, from 1991 to 1995. Harriers were caught, ringed and individually marked by colored wing tags. Each year, observations started in April at the beginning of pair formation and continued until the end of fledging in July. The size of harrier territories, which were often clumped, fluctuated from 0.42 to 2.25 ha, with an average of 1.1 ha (n=27, s.d.=0.52). Individual territories were smaller when clumped than when solitary, differences that were statistically significant (t=3,896, p=0.01). Clumped territories were also occupied earlier than solitary ones. Harriers began egg-laying earlier in semi-colonial clumped territories than in solitary nests (Z=3.05, p=0.002); clutch sizes in clumped nests were also larger; and the numbers of young fledged in clumped territories were higher (Z=2.05, p=0.03). It thus seems that semi-colonial nesting is safer for harriers than solitary nesting. Risk of extra-pair copulations in semi-colonies are nevertheless high, and is reflected in the higher number of recorded copulations in semi-colonial nests (Z=1.97, p=0.04). Correlated with this, males from clumped nests spent more time inside their territories than males from solitary nests. Solitary nest sites, on the other hand, were chosen by the more aggressive females (Z=1.92, p=0.05).

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Sexual selection in larks: The importance of white spots in the tail of Dupont's Lark

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Many avian species possess white spots or marks in wing and tail feathers that may serve as signals, sexual or otherwise. Dupont's Lark (*Chersophilus duponti*) is a sexually monomorphic, cryptically-plumaged songbird that nevertheless has white flashes in its tail feathers. We hypothesized that these markings were important as indicators of male quality in sexual selection. Accordingly, we studied two populations in Morocco and Spain during the breeding and non-breeding season. We found a significant, positive relation between the size of the white spot corrected for feather length and the physical condition of the birds: body mass corrected for size. Neither location of population nor season affected this relationship. Moroccan birds differed from the Spanish population in other morphological features, such that the two populations appear to have diverged. Overall, the results indicate that white tail markings may be used as signals in sexual selection in cryptic avian species, with a role as indicators of quality.

Wilk T, Cichon M

To betray or not to betray – why do collared flycatcher females seek extra-pair copulations?

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Females of many bird species engage in extra-pair copulations (EPCs), but there is no general agreement about the benefits of such behavior. The "good genes" hypothesis states that females mated with low quality males tend to copulate outside the pair-bond with superior individuals. Consequently, if the extra-pair nestlings inherit better sets of genes, they are expected to have better performance. To test this hypothesis, we studied a box-nesting population of Collared Flycatchers (*Ficedula albicollis*) during 3 breeding seasons (2003-2005) in Niepolomice Forest (southern Poland). First, we checked whether any traits of adult males predict the presence of extra-pair young in the nest. We found that neither the size of sexual ornaments nor morphological features could account for the probability of being cuckolded. Secondly, we compared the performance of extra-pair and within-pair nestlings reared in the same nests. We found no differences in body size, cell-mediated immune response and survival rate between extra-pair chicks and their half-siblings. Our results suggest that females performing EPCs may look for some non-genetic benefits, e.g. fertility insurance. Alternatively, potential effects of genetic differences might be small (thus hard to detect) or come into play only during unfavourable environmental conditions, or later in life.

Wilkin T, Garant D, Gosler A, Sheldon B

Edge effects on life-history traits in a wild population of the Great Tit: Analyses of a long-term data set with GIS techniques

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Possible explanations for reduced nesting success in songbirds breeding close to forest edges include over-crowding by conspecifics, a concomitant rise in predation of nestlings and adults, microclimate modification and changes in habitat quality. Here we exploit a unique opportunity to separate out some of these processes by examining edge effects in the absence of nest predation and by effectively controling for differences in breeding density at the level of the individual. We describe an edge distance index (EDI) derived from the position of c. 1000 almost predator-proof nest-boxes relative to woodland edge at Wytham Woods, Great Britain, and the proportion of woodland to non-woodland within a given radius of each nest-box. We then use the EDI to help explain variation in the breeding density, nesting success and reproductive traits of 5270 pairs of Great Tits (*Parus major*) breeding in the nest-boxes 1965-1996. Results from linear mixed modeling showed higher breeding density, later lay-dates, smaller clutches, but heavier eggs in edge environments. The number of offspring recruited to the breeding population per breeding attempt was also reduced at woodland edges, although this effect was indirect and mediated through the change in lay-date. We found no relationship between the EDI and the mass of offspring at fledging. The edge effects were linear, were detectable up to 500 m from the woodland edge and were stronger when woodland clearings of c. 1ha were included as part of the edge. The direct effects of the EDI on lay-date, clutch size and egg mass, and its indirect effect on the number of recruits, were also detected when analyses were restricted to changes within individual females, suggesting that the effects of edge distance do not result merely from poorer quality birds being pushed into edge environments. These results have implications for conservation management of forest species in modern fragmented landscapes.

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The magnetic compass of domestic chickens

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Although behavioral experiments show that a wide range of animals use the earth's magnetic field for compass orientation, evidence from conditioning experiments has proved elusive. In birds, the only successful attempt at operant conditioning to magnetic stimuli involved responses to magnetic anomalies and changes in magnetic intensity rather than magnetic direction. The reason may lie in the difficulty of finding a conditioned directional response that is sufficiently reliable to provide a baseline for experimental manipulation. We used a social stimulus and trained young domestic chickens to locate a hidden ball on which they had been imprinted. The experiments were perfomed in a square arena with screens placed in north, east, south and west corners. Training trials were run under the local geomagnetic field. Critical tests were unrewarded and took place in random order under the following three conditions: (1) in the geomagnetic field, (2) in a magnetic field with north turned 90° to the east, and (3) in a field with the vertical component inverted. The choices of the chickens were axially bimodal, i.e. they preferred the correct screen and the opposite screen in the geomagnetic field, as well as in the two experimental fields. In the geomagnetic field, 76% of choices lay on its axis. In the field with magnetic north turned to the east, 78% of choices lay on the axis that had been shifted by 90°, with the difference highly significant ($P<0.001$). In the field with the vertical component inverted, the chickens behaved as they did in the geomagnetic field, with 79% of choices on the correct axis. These data clearly show that the choices made by the chickens depended on the direction of the magnetic field, demonstrating the first conditioned magnetic compass response in birds. Further studies will assess parallels and differences to the well-known magnetic compass of migratory birds.

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Conditioning of magnetic compass directions in pigeons (*Columba livia*)

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The magnetic field of the Earth plays an important role for spatial orientation in many birds, including homing in pigeons (*Columba livia*). Two different systems are probably crucial for magnetic orientation in this species: a magnetite-based system detecting the field intensity and a compass system, presumably based in the avian eye. In conditioning experiments, the ability of pigeons to discriminate magnetic field intensities has already been demonstrated; however, so far, it has not been possible to train pigeons to magnetic compass directions. Here we show that pigeons are capable of learning to prefer magnetic directions under controlled laboratory conditions. Using food as a reinforcer, pigeons were trained in a modified Skinner-box to one of the cardinal compass directions in the natural magnetic fields as well as in artificial fields geneerated by Helmholtz coils with magnetic north deflected. Four of nine birds tested successfully completed the task. When compared to domestic chicks (*Gallus domesticus*) that were recently trained to magnetic compass directions using an imprinted social stimulus, there are interesting differences: Chicks showed an axial choice, preferring correct direction and the opposite one, while pigeons showed unimodal preferences for their training direction. Also, the performance of chicks was more stable with an overall higher level of correct choices. Our findings, which are the first direct evidence of magnetic compass training in pigeons, provide further evidence for the magnetic compass in pigeons. The results open the possibility to study the magnetic compass in detail under controlled conditions. Furthermore, the observed differences between pigeons and chicks underline the importance to look for species-specific aspects of orientation mechanisms.

Wink M, El-Sayed A-A, González J

Phylogenetic relationships in owls: Evidence from nucleotide sequences of mitochondrial and nuclear genes and genomic fingerprinting

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We obtained sequences of the nuclear gene RAG-1 (1000 base pairs) from more than 100 species of 15 genera of owls to determine the molecular phylogeny of strigiform birds. Trees were constructed using maximum likelihood, neighbor-joining and Bayesian analyses with maximum parsimony procedures; *Gallus gallus* was the outgroup. We also compared mitochondrial DNA sequences of the cytochrome b gene against nuclear sequences including RAG-1 and LDHb using the incongruence length difference (ILD) test. The phylogenetic signal among these three genes was highly congruent and complementary, and was corroborated by the genomic fingerprinting process, Inter Simple Sequence Repeats (ISSR). Phylogenetic trees based on RAG-1 sequences show that *Ketupa* and *Nyctea* are clustered within the *Bubo* clade, confirming previous indications of paraphyly in the *Bubo* complex from cytochrome b sequences. *Otus* is diphyletic, its Old and New World members forming two independent monophyletic groups. The RAG-1 phylogenetic tree shows that *Tyto* and *Ninox* are monophyletic groups well supported at the base of the tree. *Athene* and *Glaucidium* prove to be sister taxa, and *Aegolius* and *Surnia* separate monophyletic lineages. Our approach using a multi-gene phylogeny that combines information from a maternally-inherited fast evolving gene (cytochrome b) with that from such slowly evolving nuclear genes as RAG-1 and LDHb, together with ISSR, provides high resolution at both terminal and basal branches of the owl phylogenetic tree.

Winker K

On the origin of species through heteropatric differentiation

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Differentiation and speciation without extended isolation appear to be common among migratory birds. Historic oversight of this phenomenon is probably due to temporal distortion in portrayals of distributions, and a predilection to imbue lineages with historic traits that are no longer present, such as sedentariness. Mobility among cyclic migrants makes population isolation difficult, and a diminished propensity for differentiation has been observed among avian migrants ("Montgomery's Rule"). Nevertheless, many lineages exhibit differentiation despite increased mobility, as well as a high propensity for gene flow. Populations occur in allopatry and sympatry during a migratory cycle, and this distributional pattern - heteropatry - is the focus of a model developed to explain differentiation in migratory lineages. Divergence is attributed to disruptive selection from resource competition and heterogeneously distributed cyclic resources. Heteropatric speciation is thus a form of ecological speciation in which reproductive isolation increases between populations as a by-product of adaptation to different environments despite degrees of sympatry during migration cycles. Patterns such as leapfrog migration and limited morphological divergence suggest that differentiation is driven by such ecological factors rather than sexual selection or changes in the resource itself. Migratory lineages provide a series of natural experiments in speciation on which to test predictions stemming from this model.

Winkler DW, Farnsworth A, Mandel JT, Huber G

Diurnal migrants have greater flexibility in life-history timing and distribution

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Birds vary tremendously in their annual cycles of space use, from residents to obligate long-distance migrants. These different patterns of movement are further elaborated by different modes of how and where they travel. We have been exploring the ramifications of differences in how birds move for the rest of their life histories. Specifically, we have been investigating how differences in the distance (intercontinental *vs*. intracontinental), flexibility (facultative *vs*. obligate), and timing (diurnal *vs*. nocturnal) of migration have affected the responsiveness of different bird species to global environmental change. We tested whether birds have changed their timing of breeding or migration in the 20th century, and related the proportion of significant phenological changes detected, as well as the size of reported changes, to migratory mode. The strongest effect of mode on phenology came from the timing of migration, and diurnal migrants have been significantly more likely to effect phenological changes than have nocturnal migrants. Diurnal migrants also tend to be more broadly distributed than nocturnal migrants, and we suggest that a great deal of the ecology of migrant birds can be understood from learning how birds migrate and the sources of information that migrants have available to them.

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Evolution of morphology and behavior in island passerines

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It is well known that birds on islands evolve new characteristics relatively quickly. Several authors have discussed the tendency of island birds to develop comparatively large bills. Our analyses focus on the notion that island birds tend to forage for hidden prey, resulting mainly in increased use of extractive foraging and substrates such as the ground and bark. After detailing morphological changes, mainly in the bill, we relate them to associated foraging modes and consider how morphological and behavioral traits influence the evolution of exploration and cognition. Examples are taken from groups such as acrocephaline warblers, regulids, mimids and fringillids with well resolved phylogenies, allowing us to employ quantitative comparative methods. Bill size has mainly been discussed in the context of specialized (mainland) and generalized (island) foraging. This includes the role of larger prey items in the diet. We emphasize the mostly neglected role of extractive foraging and discuss the morphological adaptations associated with feeding techniques such as probing and gaping. We argue that on islands there is an increase of feeding on hidden and difficult-to-access prey. As one consequence, island birds should search more intensively, and explore more. Island birds are thus more inquisitive and often considered as being endowed with especially well-developed cognitive abilities. We point out, nevertheless, that inquisitive behavior *per se* does not necessarily demand high cognitive skills, and that there are possible morphological constraints that hamper the necessary enlargement of the forebrain. These constraints can arise from the other morphological adaptations needed for island life and from energetic limitations.

Winter M[1], Johnson D[2], Shaffer J[3]

Does sensitivity to patch size and landscape structure depend on body size?

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In many birds, declines in populations have been linked to diminishing size of suitable habitat patches, with large-bodied species disappearing from small patches. Conservation practise therefore frequently uses large-bodied birds as indicator species for determining the required size of habitat patches for entire avian communities. Using large-bodied birds as such indicators presupposes both that changes in patch size affect the largest species most, and that patch size *per se* is the parameter to which birds primarily respond. Emphasis on patch size requirements for large birds could lead to reserving large and expensive preserves, with concomitant neglect of smaller and supposedly less important patches. We examined this issue in a grassland community on the northern tall-grass prairie in Minnesota and North Dakota, USA. We compared the effects of patch size and landscape structure on three small passerines - Savannah Sparrow (*Passerculus sandwichensis*), Le Conte's Sparrow (*Ammodramus leconteii*), and Bobolink (*Dolichonyx oryzivorus*) - and three larger-bodied nonpasserines - Northern Harrier (*Circus cyaneus*), Upland Sandpiper (*Bartramia longicauda*), and Greater Prairie-Chicken (*Tympanuchus cupido*). Body size did not influence response to patch size: densities of neither small nor large grassland birds were affected significantly by the size of a grassland patch. Both small- and large-bodied species nevertheless declined with increasing percentage of woody vegetation in the surrounding landscape, large species disappearing from prairie patches with more than 30% woody vegetation in the vicinity. These results indicate that conservation programs should include management of small grassland patches for even large-bodied birds, providing that the patches are embedded in open landscapes.

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Blackcaps at migratory stopovers compensate for reduced gut with increased paracellular nutrient uptake

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The gastrointestinal tract of small birds, inactive during long-distance migratory flights, serves as a reservoir of protein that is catabolized to fuel flight. Upon arrival at migratory stopovers, the smaller alimentary organs, together with structural changes in mucosa, may reduce capacity for active nutrient uptake and increase intestinal permeability. During stopover, there are 2 phases of body mass (mb) increase: an initial slow increase of two or three days followed by a very rapid mass gain. It has been suggested that during the first phase, the machinery of digestion is rebuilt and only then are fat stores laid down. We hypothesized that in phase 1, Blackcaps (*Sylvia atricapilla*) that had crossed the Sahara and Sinai deserts would have lower active uptake and higher paracellular, passive uptake of water soluble nutrients. To test this, we measured absorption of sugars in newly-arrived Blackcaps in Eilat, Israel, that had just re-fed. Re-fed birds were then kept in an aviary at the capture site, fed *ad libitum*, and tested as soon as their mb started to increase rapidly. Fractional absorption of actively transported 3-O-methyl D-glucose was lower in newly-arrived than in *ad libitum*) re-fed birds, indicating reduced active nutrient absorption in the former. An index of paracellular permeability, as the ratio of the fractional passive absorption of a large paracellular probe to smaller ones, attests to higher permeability in new arrivals. Further, fractional absorption averaged across all passive, paracellular probes in re-fed birds was only 74% of that in new arrivals. Higher paracellular uptake during refueling at stopovers may compensate for reduced capacity for active nutrient uptake, but it could also expose birds to higher levels of toxins in their food. Supported by NSF IBN-0216709.

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Winter territoriality and fruit defence by the Mistle Thrush and Fieldfare in southern Poland

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Population density and behavior in the Mistle Thrush (*Turdus viscivorus*) and Fieldfare (*Turdus pilaris*) were investigated over four winters (December - February) between 1996 and 2004 in southern Poland. Densities of Mistle Thrushes in forest differed significantly between winters, and thrushes in flocks declined as winters progressed without affecting numbers in occupied territories, leading us to conclude that some flock birds took over (vacated?) territories towards the end of winter in 1996-1997. Every individual territory included several clumps of mistletoe on several adjacent trees. Rates of aggressive encounters were correlated positively with bird density and negatively with the advance of winter (i.e. berries supply); but surprisingly, they were not correlated with densities of mistletoes or temperature. Of the 27 territories of Fieldfares monitored over two winters in two study areas, 22 were in gardens or orchards with apple trees. Yet only 0.5% of all individuals recorded were territorial, and only 1.7% of the gardens and orchards surveyed were occupied. The probability of the presence of occupied territory was higher in patches with a higher density of apple trees, but was not related to the size or degree of isolation of the patch. For both species, the permanence of territories was correlated positively with fruit density and negatively with disturbance. We suggest that during years of copious fruit supply, the densities of birds may be so

high that the costs of defending fruit resources against hordes of neighbors are outweighed by the profitability of feeding in flocks.

Wojczulanis K, Jakubas D, Stempniewicz L

Labour division between female and male in the monogamous Little Auk Alle alle during the breeding period

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We investigated sexual partitioning of reproductive effort in the Little Auk (*Alle alle*) at Hornsund in southwest Spitzbergen. Due lack of external dimorphism, molecular methods and individual marking were used to identify the sexes. Female and male investment differed considerably at different stages of the breeding cycle. During the pre-laying period, males engaged in nest defense and female-guarding, yet took whatever opportunities they could for extra-pair copulations. During that time females remained relatively inactive in the colonies, hiding among rock debris and avoiding sexual advances from neighboring males; but they fed intensively at sea, gaining reserves for egg production. Both parents shared incubation about equally, but females spent much more time than males in chick-brooding. Rates of chick provisioning were again similar in both sexes until about the 20th day post-hatch, although larger quantities of higher calorific food were brought by females per load. During the final week pre-fledging, females dropped their rates of feeding and attendance at the colony, leaving altogether before young fledged. From then on, males cared for the young exclusively, even after they left for the sea.

Woog F[1], Ramanitra N[2]

Site fidelity of some rainforest bird species endemic to Madagascar

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During the pre-breeding season 2003, the start of the breeding season in autumn 2004 and the breeding season in 2005 we ringed birds at five sites with a varying degree of degradation at Maromizaha, a rainforest area close to Andasibe (Perinet), eastern Madagascar at an altitude of 1000–1200 m. In 2004, we recaptured 39 birds ringed in the previous year, comprising 12 species (*Nectarinia notata*, *Nectarinia souimanga*, *Copsychus albospecularis*, *Saxicola [t.] sibilla*, *Nesillas typica*, *Newtonia brunneicauda*, *Newtonia amphichroa*, *Bernieria zosterops*, *Bernieria cinereiceps*, *Hypsipetes madagascariensis*, *Zosterops maderaspatanus*, *Foudia omissa*). In 2004, we recaptured 23 birds ringed in 2004 (with an additional four species *Vanga curvirostris*, *Bernieria madagascariensis*, *Foudia madagascariensis* and *Ploceus nelicourvi*) and 17 ringed in 2003. All these were almost exclusively site faithful regardless of habitat. Nine individuals comprising 5 species were caught every year at the same location (*Nesillas*, *Zosterops*, *Hypsipetes*, *Copsychus* and *Bernieria cinereiceps*). Bird species with high site faithfulness will be more gravely affected by forest fragmentation than those that are able to move between patches: Some Bulbuls and White-Eyes changed sites between years and within years, moving between degraded sites and primary forest. As some of the few frugivorous species in Madagascar they make use of berries from introduced plants that flourish at degraded sites. When moving back to the forest they may spread these into pristine habitat. Therefore, the few remaining Malagasy forests are not only threatened by deforestation but also by invasive plants that have already changed habitats dramatically on other islands.

Wuczynski A[1], Dajdok Z[2]

Relationships between bird population variables and the floristic and structural characteristics of field margins in southwestern Poland

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Field margins comprise most of the semi-natural habitat in intensive agricultural landscapes, playing a key role in conserving farmland birds. Although a rapid recent decline in such birds in Europe has catalyzed many ecological studies of field margins, the importance of margin attributes to birds is still not well recognized, and their value as habitat in traditional-farming landscapes has barely been considered. In 2004, we investigated breeding bird populations on field margins in southwestern Poland to tease out the relationships between vegetational components of the margins and bird species richness and abundance. Bird were surveyed on 500 m long transects in 66 margins of different structure. Habitat variables and floristic diversity were recorded in a sample of 40 transects, and related to bird indices with a stepwise multiple regression. A total of 50 bird species (4 to 23 per margin) and 1106.5 pairs (5 to 39.5) were recorded. The most common birds were Yellowhammer (*Emberiza citrinella*) at 18.3% of the community, and Marsh Warbler (*Acrocephalus palustris*) at 15.9%, but high numbers of some threatened species, such as the Red-backed Shrike (*Lanius collurio*) at 7.3% and Barred Warbler (*Sylvia nisoria*) at 3.9%, were also worthy of note. Factors describing vertical structure of the margins best explained the indices of bird populations. Abundance was influenced negatively by the number of plant species and positively by the number of adjacent fields; and bird species number was influenced positively by margin width. Habitat preferences in five warbler (*Sylvia*) species were determined by different proportions of trees and shrubs. Although wooded margins possessed the richest bird communities, a mosaic of diversified linear habitats in agricultural landscapes is needed to meet the requirements of particular species.

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Recording species diversity in agrarian landscapes: Breeding birds as exemplars

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This research project has three objectives: (1) definition of a biodiversity indicator for agrarian landscapes using breeding birds, (2) development of a procedure for surveying the bird species in agrarian landscapes within the scope of effective, random sampling-based monitoring, and (3) testing of the survey procedure in the German state of Brandenburg over two years. Dual indicator and survey approaches make possible the assessment of current condition and change in biodiversity in agrarian landscapes, the analysis of causes of any change, and the development of formulas for purpose-directed agrarian environment measures. Results should also be appropriate for monitoring birds at the level of a national sustainability strategy. Important components of the monitoring are: (1) a spatial component involving stratification based on the classification of natural regions and agrarian landscapes, (2) a data-collecting procedure based on sampling theory for mapping survey plots, and (3) suitable, standardized evaluation procedures for lanscape and habitat. The sampling areas (64 1 km² plots in a total area of 15,700 km²) are located exclusively in agricultural landscapes and are representive of the diversity of landscape types shaped by agriculture. Surveys of the avifauna are undertaken by sampling the resident species, augmented by migrants and visiting feeders, as well as regional characters of the landscape, biotope structure and land-use.This contribution presents the first results of ornithological surveys carried out so far, together with the conceptual landscape-ecological basis underlying the sampling of test plots.

Wysocki D, Idzikowska K, Jarmuszko J

Date of onset of breeding and length of breeding season in an urban population of the European Blackbird in Szczecin, northwest Poland, in 1997-2003

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Dates of the onset of breeding and length of the breeding season in the European Blackbird (*Turdus merula*) were analyzed in 1997-2003 in two city parks in Szczecin, northwest Poland. From March 1 through to the end of the last breeding event, 1-3 observers monitored the behavior of color-ringed birds over 6-hour periods. The onset of breeding was taken as the date on which the first egg was laid in the first breeding event; and breeding was taken as terminated when the first egg of the last breeding event was laid. Statistical treatment was applied to data from all nesting pairs that produced at least one egg. The average length of the breeding season shortened progressively from one year to the next: in Park Z from 54 days in 1997 to 23 days in 2003, and in Park K from 56 days in 1997 to 30 days in 2003. Total precipitation declined across all seven years of the study within March-July, from 348 mm in 1997 to 179 mm in 2003, which correlated strongly with the shortening length of the breeding season: R^2=0.97, $p<0.0001$ in Park Z, and R^2=0.81, p=0.005 in Park K. No change in the date of the onset of breeding was found during the study.

Yamaguchi Y

Patterns of migration of Brown-eared Bulbuls in Japan, and the influence of available food

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Brown-eared Bulbuls (*Hypsipetes amaurotis*) range throughout Japan in all wooded habitats from coasts to mountains. They are also one of the main seed dispersers of berries in Japan, linked to an interesting migration ecology. In central Japan, for example, bulbuls are both resident year round and migratory, shifting from the northeast to the southwest in autumn. Numbers may also increase in winter, indicative of a winter population. Little research, however, has been carried out on the migratory behavior of the bulbuls over the whole of Japan. In this study, records of movements were collected throughout Japan from September to November 2004, and then compared among ten regions, north to south: Hokkaido, Tohoku, Kanto, Chubu, Hokuriku, Toukai, Kansai, Chugoku, Shikoku and Kyusyu. Migration started first in Kansai on 9 Sept., followed by Chugoku on 14 Sept., Kanto on 19 Sept., Tohoku on 26 Sept. and finally in Hokkaido on 10 Oct.; duration was longest in Kansai and shortest in Hokkaido. In Kansai, movements peaked at the end of September, only small groups moving out after that. Contrary to the expectation that migration would begin in northern regions first and pass through Japan en route to the south, it began in southern regions first, staring in the mountains well above sea level, then at progressively lower levels in succession. The study will be repeated in 2005, and interactions between bulbuls and the abundance of food berries will be examined.

Yang S-J, Lei F-M, Qu Y-H, Yin Z-H

Intra-specific phylogeography of the endemic Tibetan White-rumped Snowfinch based on MtDNA sequences

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We analyzed variation in the mitochondrial DNA control region of *Onychostruthus taczanowskii*, and compared its phylogeographic structure to that of *Pyrgilauda ruficollis ruficollis*. There was no genetic differentiation among *O. taczanowskii* populations, which suggested recent population expansion after bottlenecks, as well as the effect of homogeneous habitat. In contrast, greater genetic divergence was found among lineages of *P. r. ruficollis*, presumably as a result of differentiation in two or more regional refugia during the Pleistocene glaciations and subsequent subspeciation. The ancestral refugia of *O. taczanowskii* and *P. r. ruficollis* are predicted, based on asymmetric analysis using Migrate software. This research was supported by NSFC 30170126 to Lei F.M.

Yasuo S, Watanabe M, Nakao N, Takagi T, Ebihara S, Yoshimura T

Reciprocal switching of type 2 and type 3 deiodinase genes triggers photoperiodic gonadal response in Japanese Quail

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In most birds that live in temperate regions, reproduction is under photoperiodic control. However, the molecular mechanism underlying photoperiodic time measurement is not well understood. The Japanese Quail (*Coturnix japonica*) is an excellent model for investigating photoperiodic time measurement because its hypothalamic-pituitary-gonadal axis responds rapidly and dramatically to photoperiod. Recently, we found that type 2 deiodinase (Dio2) plays an important role in the mediobasal hypothalamus (MBH), catalyzing the conversion of prohormone thyroxine (T_4) to bioactive triiodothyronine (T_3) to regulate photoperiodic response in the gonads. While Dio2 generates active T_3 from T_4 by outer ring deiodination, type 3 deiodinase (Dio3) catalyzes the conversion of both T_3 and T_4 to inactive forms by inner ring deiodination. Synchronization of the activity of these enzymes could play an important role in regulating appropriate concentrations of active hormone locally, varied according to specific needs. Therefore, we analyzed Dio2 and Dio3 mRNA expression during precisely-timed photoinduction. Reciprocal changes were found to occur in both genes: Dio3 expression decreased upon transfer to long days and remained low, whereas Dio2 expression increased upon transfer to long days and remained high. Such gene actions preceded the photoperiodic induction of luteinizing hormone secretion. The results suggest that the reciprocal switches regulate functional concentrations of thyroid hormone in the MBH and trigger photoperiodic response in gonads. Supported by PROBRAIN.

Yohannes E, Hobson K, Pearson D, Wassenaar L

Stable isotope profiles reveal habitat selection and site fidelity in nine migratory birds

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Some migratory birds respond to the seasonality of resources at winter quarters in Africa by performing a two-step migration in autumn. Previous studies have shown this unique strategy to be more evident along the east African flyway. Linking the staging sites of these long-distance migrants by traditional methods has been difficult. Thus stopover areas are not yet all known with complete confidence, nor is it clear whether the migrants mix or remain separate on their staging areas. Earlier investigation using multiple feather isotope signatures indicated that several species were segregated by habitat during the stopover period. It is not yet known, however, if such segregation holds for other species. Thus we examined whether stable isotope ratios in feathers of nine further species showed homogeneous profiles. In particular, we tested the extent to which species with a "two-stage" migration strategy overlapped to form mixed species aggregations at stopovers, or segregated themselves from one another at discrete sites. The repeatability that we found in feather isotope ratios over years revealed species specific habitat fidelity at stopover sites.

Yoshioka S, Matsumiya C, Kinoshita S

Organized light scattering: Cause of the blue coloration in the plumage of the Common Kingfisher

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It is well known that microstructures inside the feathers produce the brilliant color in many species of birds. Such colors are termed structural colors, and various optical phenomena such as optical interference, diffraction and scattering have been suggested as their cause. The Common Kingfisher (*Alcedo atthis*) is one of the species in which color is produced structurally. The barb of its blue feathers consists of a sponge-like structural network of comparable size to the wavelength of light. Although interaction between such a network and light has not yet been rigorously described, Fourier transformation technique has been applied to analyze the optical properties of the structure, an analysis that is based essentially on the single scattering approximation. Our recent measurements of the polarization properties of the reflection, however, suggest that the single scattering approximation does not hold well. Yet a multiple scattering process would also be effective in producing the blue color: reflected light is rather depolarized even under polarized light illumination, and the intensity of the depolarized component is stronger in the shorter wavelength region. Here we report a structural and optical investigation of the blue plumage in the Common Kingfisher, and suggest that its cause is *organized light scattering*, which is a combined effect of light scattering including multiple process and optical interference realized by precisely adjusted network size.

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Genetic structure of the endangered Java Sparrow revealed from microsatellite differentiation in nuclear DNA

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The Java Sparrow (*Lonchura oryzivora*), although widley introduced and established in captivity in many parts of the world, is endemic Java and Bali where it has declined dramatically over the last two decades because of trapping for the domestic and international cagebird trade. We investigated the genetic structure of eight of its indigenous populations within its native range and one introduced population from Kalimantan using three microsatellite loci from nuclear DNA. Genetic differentiation among them was moderate (Fst=0.066; $p < 0.001$), and the differences between populations mostly significant. There were, however, no significant differences in allele number. Conservation implications for the Java Sparrow are discussed.

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Wintering songbirds in Kerala, south India

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Songbirds wintering in Kerala, south India, comprise predominantly Old World flycatchers (Muscicapinae), Old World warblers (Sylviidae), thrushes and chats (Turdinae), and wagtails (Motacillidae). They start arriving after the southwest monsoon in September, and begin leaving by summer in March. A number of resident bird species breed when the number of migrants present is at its peak. Differences in feeding zone, micro-niche and feeding behavior seem to avert competition between residents and migrants.

Zefania S[1], Long P[2], Szekely T[2], French-Constant R[2]

Conservation biology of endangered wetland birds in Madagascar

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Despite the current focus of bird conservation on forests, Malagasy wetlands hold 118 bird species of which 18 are endemic and 14 are classified as globally threatened. Here we review the distribution of wetland habitats in Madagascar and evaluate current threats to their conservation. We also summarise the results of our research on two important wetland endemic birds, the Sakalava rail and Madagascar plover. The Sakalava rail, Amaurornis oliveri, is critically endangered and previously known from only three sites. We have recently discovered four new breeding populations; though the total breeding population is still less than 100 birds. We report the first data on breeding ecology and behavior of Sakalava rail that breeds in undisturbed bamboo marshes, and is probably limited by the availability of this specific habitat. We have also investigated the breeding ecology of the Madagascar Plover (*Charadrius thoracicus*; this sedentary plover breeds in salt marsh in coastal Western Madagascar). These salt marshes show a mosaic of sparsely vegetated areas for foraging alongside areas of raised grassland for nesting. We modeled habitat suitability using ecological niche factor analysis, and estimate the total breeding population on the west coast to be 2679±350 (SE) individuals. We suggest that low breeding success is currently limiting its distribution. Our studies of breeding ecology provide critical data for conservation of these iconic species, and also highlight the continuing lack of baseline data for the majority of Malagasy wetland birds.

Zhang Y

Semen character and sperm storage in Cabot's Tragopan

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The semen quality of captive Cabot's Tragopan (*Tragopan caboti*), the effect of frequency of collection on sperm yield, and the duration of sperm storage by inseminated females were investigated at Beijing Normal University, Beijing. The results are as follows. The average duration of the period in which Cabot's Tragopan can produce an ejaculate was 74.08±3.16 days (63 - 91days, n=13). The volume of ejaculate ranged from 0.015ml to 0.100ml, with an average concentration of $2.31\times10^{9}ml^{-1}$ and 11.69±0.77% abnormal sperms per ejaculate. Three of eleven males yielded more than 0.05ml semen per collection most of the time. Ejaculate volumes, semen concentration, total number of sperms per ejaculate, and the daily semen output, were all markedly affected by the frequency of semen collection ($p<0.01$). Except for daily semen output ($p<0.01$), no significant difference was detected, however, between the two groups subject to relatively low frequencies of collection ($p>0.05$). In effect, higher frequencies of semen collection did not yield more sperm. The average duration of the period over which females laid fertilized eggs after insemination was 19.85±3.08 days (range 9 to 32, n=7). This value was affected by the rhythm of egg laying and varied among individuals. The above results contribute to a program for gaining information on the breeding biology of Cabot's Tragopan for its conservation and rehabilitation in the wild.

Ziesemann B, Brunton DH, Castro I

Social behavior, interactions and the social mating system of a high-density North Island Brown Kiwi population

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Historical records reveal that the North Island Brown Kiwi (*Apteryx mantelli*) was once widespread throughout the North Island of New Zealand. Currently, its populations are considered to be in serious decline owing to human-induced habitat destruction and predation from introduced mammals. As a result, there is significant recruitment failure and most mainland populations are at very low densities. In contrast, population densities on off-shore predator-free islands are often much higher. Previous studies of the social mating system in mainland populations suggest that the North Island Brown Kiwi forms long-term pair bonds and is monogamous. However, the potential for polyandry is very high, as only the male incubates and provides post-hatching investment, itself minimal. Moreover, females can lay more than the clutch of two eggs during a breeding season. Kiwi social behavior in terms of pair stability, divorce and territoriality appears to be determined by population density, as indicated by previous investigations. Here we present early results on social behavior and interactions among individuals in relation to their mating system in a high density population on an off-shore island, and compare them with differences in low density mainland populations. The mating system exhibited by the study population may represent, because of its natural numbers, a true example of kiwi social structure prior to human arrival in New Zealand. Radio-tagged adult kiwi are being monitored throughout several breeding seasons using data loggers and video monitoring, and the genetics of the mating system will be verified by DNA finger-printing.

Zinoviev A

Hind limb morphology and adaptive evolution in turacos and cuckoos (Aves: Cuculiformes)

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In most classifications, the order Cuculiformes comprises two families: turacos (Musophagidae) and cuckoos (Cuculidae). Representatives of the first have the most complete set of hind limb muscles in the order, placing them at its base in adaptive evolution. In them, a well-developed *m. iliofemoralis externus*, *m. ambiens*, *m. fibularus longus*, *m. popliteus* and postacetabular segment to the *m. iliotibialis lateralis* point to adaptations for running. Field observations indeed confirm turacos as skillful runners that use almost the same mode of locomotion in trees as on the ground. They walk or run about the tree canopy, using the reversible fourth toe of their hemizygodactyl foot to better grip such uneven substrates as branches. Many members of the Cuculidae can also walk and run. However, their zygodactyly and lack of a *vinculum tendinum flexorum* indicate that they are more specialized for grasping branches. When they reach for food items, their reversed first and fourth toes effectively compensate for gravity, tending to turn them around the axis of a perch. An elongated claw on the first toe in the genus *Centropus* is an adaptation for walking through interwoven vegetation. In *Centropus*, over-extension of the claw phalanx in the first toe is prevented by a special, the *ligamentum flexorum hallucis*, while the entire toe is flexed solely by the *m. flexor hallucis brevis*. The weakness of the postacetabular segment of the *m. iliotibialis lateralis* and *m. fibularus longus*, and the disappearance of *m. iliofemoralis* in the genus *Cuculus* indicate that members of this genus are not runners or even walkers but perch-pouncers. As soon as a food item is seen, the cuckoo lands nearby and reaches for it. Such a tactic is effective in relatively open treed habitat with numerous food items of the same kind.

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Post-hatching growth in the Black-Bellied Sandgrouse in western Morocco

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Growth rate was determined in hatchling Black-bellied Sandgrouse (*Pterocles orientalis*) from date of hatching to 100 days, at which time they weighed approximatively 416.6±70.5 g. Mean body mass at hatching was 18.8±1.0 g. A Gompertz equation was used to describe the sigmoidal growth curve; asymptotic body mass (ABM) was 405 g. Highest average daily gain was 7.4g/day which occurred between days 26 and 30, corresponding to age at the inflection point of the growth curve and appreciatively with age of fledging; mean mass gain was 5g/day. Average growth rate was 0.0432/day which is higher than that of a phasianid of similar body size. Time to reach ABM and to grow from 0.10 to 0.90 ABM were 97 days and 78.8 days, respectively. The metabolic age of sandgrouse at hatching was 12.5 days and much lower than the mean of 23.6 days for some other precocial birds. Furthermore, the metabolic age of the sandgrouse was lower than the mean of such birds at 0.5 ABM (41.5 vs. mean of 67.8 days), even though the time required to grow from 0.25 to 0.75 ABM was very similar (34 vs. mean of 34.8 days). Appendicular dimensions, namely tarsus, bill and folded wing lengths were also recorded, and the related growth parameters obtained using Gompertz equations.

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Reproductive characteristics of the Black-bellied Sandgrouse on the arid Haouz plain, western Morocco

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Aspects of breeding in the Black-bellied Sandgrouse (*Pterocles orientalis*) were investigated on the arid Haouz plain near Marrakech, western Morocco, over spring and summer 2003. Nineteen eggs were collected in the field, individually marked, weighed, measured, and incubated in a ventilated incubator. Back-dating broods indicated that successful nesting occurred over 15 weeks from April through July. Nest sites, and chicks accompanied by both parents, were observed on different occasions. Thirteen nests were found with 1, 2 or 3 eggs per nest in 4(31%), 1(8%) and 8(62%) nests respectively; average clutch size was 2.31±0.95. The cylindrical-elliptical eggs averaged 25.2±2.2 g when fresh and measured 47.8±1.8 mm x 31.8±0.7 mm; mean calculated egg volume was 24.7±1.5 mm^3. A maximal incubation period of 25-26 days was recorded in the incubator, which was comparable to that observed in the field. Among the nineteen eggs incubated, 12 were fertile and 10 (83.3%) hatched successfully. Average body weight at hatching was 18.8±1.0 g, at 74.2±2.7% of mean egg weight at the beginning of incubation. The data obtained on breeding patterns in the natural environment combined with those from successful artificial egg incubation contributes to knowledge of the reproductive biology of this species and should be helpful for its conservation.

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Feeding ecology of the Northern Bald Ibis in its European winter and summer habitat: an experimental field study with hand-raised individuals

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The Northern Bald Ibis (NBI; *Geronticus eremita*) is a highly endangered bird species with the majority of remaining birds living in a single colony at the Moroccan coast. Historically, this species was widely distributed in the circum-Mediterranean area and Central Europe. A thriving zoo population allowed us to experimentally study the ecological demands of this species in the field. Using hand-raised individuals, feeding habits were evaluated in different agricultural areas, representing a potential summer habitat north of the Alps and a winter habitat in southern Tuscany, Italy. The birds fed on a wide range of invertebrates, preferably on slowly moving species, probing the soil down to 10 cm, and also on the epigean fauna. Feeding rates of birds were higher in the summer than in the winter habitat, which corresponds to the higher energetic needs during the reproductive period. Feeding efficiency was closely related to the cultivation technique in the feeding area. Birds were most successful on ecologically cultivated land and on pastures grazed by cattle. Dry weight of the birds' food was estimated and compared with the birds' energetic demands (field metabolic rate, FMR). Our study suggests that in the summer habitat, birds can cover their energetic needs easily, whereas in the winter habitat, variation in food availability may explain the movement patterns of independent juvenile birds. We discuss our results in view of the conservation and potential reintroduction of this species in Europe.

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Health and Healthcare of falcons in United Arab Emirates

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A variety of viral, bacterial and fungal diseases are seen in falcons. However, most of the diseases are not fatal if precautions and treatment are given in time. Bacterial infections are not as dangerous as viral diseases. Most bacterial and viral diseases are transmitted to falcons through preys. The common viral diseases, which are seen in falcons, are Newcastle disease, raptor pox, falcon herpesvirus and influenza A virus. The common bacterial diseases seen are Chlamydiosis, Salmonellosis, Mycoplasma and Avian tuberculosis. Bacterial infections are not as dangerous as viral diseases. The common fungal diseases are Aspergillosis and Candidiasis. The protozoan diseases occurring in falcons are Trichomoniasis, Coccidiosis and Babesiosis. Ticks, mites, lice, louse flies, blowflies and feather flies are common ectoparasites.The main prophylactic actions involve optimizing the conditions in captivity to meet all the animal's natural requirements. Proper management, better hygiene, balanced diet and routine check up will prevent almost all diseases to a certain extent. Notable infrastructure is required for better healthcare and management of diseases of these birds. The present study was conducted at falcon hospitals, clinics and breeding centers, in Abu Dhabi, Dubai, Sharjah and Al Ain in the United Arab Emirates during 1999-2003. The management strategy adopted by the clinics or hospitals in each case was studied and documented. A critical examination of the current health care practices was conducted and attempts were made to develop a strategy to take care of the shortcomings. In captive falcons nutrition deficiencies and metabolic disorders are directly related to the quality of the food and environment provided. Proper management, better hygiene, balanced diet and routine check up will prevent almost all diseases to a certain extent.

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Morpho-functional features of the jaw apparatus in the suboscinine broadbills, family Eurylaimidae

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This study of the morpho-functional features of the jaw in the Old World suboscinine family of broadbills has been carried out on species of all but three of the nine genera: *Eurylaimus javanicus, Cymbirhynchus macrorhynchos, Serilophus lunatus, Psarisomus dalhousiae, Calyptomena viridis*, and *Smithornis capensis*. Heads and jaw muscles were first dissected, with detailed sketches made of the skull and recording of the shape and interrelations of aponeuroses in the jaw, followed by functional analysis of the jaw apparatus as a whole. As has been shown, the members of the Eurylaimidae form a natural group, with a common plan to the structure of the jaw apparatus specially adapted for consuming large items of food. All species have a wide bill and pharynx, and differ from other passerines in the simple pinnate structure of their jaw muscles, which consist of relatively long muscle fibres capable of extensive contraction and a small number of aponeuroses. Such structural features enable the jaws to open widely at the gape, and give broadbills the unusual capacity to process food at the back of the mouth. Correlated with these specializations is the structure of the tongue, which is wide, fleshy and highly mobile. Such characteristics separate the insectivorous Asian broadbills into two groups, one comprising *Psarisomus* and the other *Eurylaimus, Cymbirhynchus* and *Serilophus*. The green, frugivorous *Calyptomena* broadbills form a discrete group, while *Smithornis* combines a mosaic of the features of all three groups.

Round Table Discussions

R01

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Avian microbiology: A new perspective in ornithology?

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The microflora in and on birds is an emerging topic of study that offers an exciting new perspective on central questions in ornithology. How might plumage micro-organisms affect the evolution of the structure and diversity of feathers? What role has plumage microflora played in the evolution of molt and maintenance behavior? What is the contribution of micro-organisms that cause STDs to the evolution of avian reproductive behavior, such as mate-guarding, extra-pair copulations, polygyny, and polyandry? What role do micro-organisms play in hatching and fledging success? What role do birds play in the dispersal of disease organisms, both those that cause avian disease and those that cause human disease? What techniques are best for the study of the avian microflora and how do different techniques complement one another? These questions will provide the starting point for an informal, open, and wide-ranging consideration of how micro-organisms interact with birds and how we can study the interactions.

R02

Craig A

Iris coloration in birds: why highlight the eyes?

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While many bird species have dark irides which do not contrast with surrounding head plumage, others have highly conspicuous white, yellow, red, or even blue or green irides. In a preliminary published survey of passerine birds, I found that a colored iris occurs most often in particular taxonomic groups; yet there is little evidence of common life-history traits which might explain the evolution of this characteristic. Age-related changes in iris color have been reported for many bird groups. How does this affect vision? What role does iris color play in behavior? Are there common biochemical pathways in pigment production?

Phylogeny, physiology, foraging, and social signaling may all be part of this puzzle. Clearly, a full explanation requires input from ornithologists in many different fields.

R03

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Impact of brominated flame retardants on birds

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Brominated flame retardants (BFRs) are commonly used in polymer resins as the cheapest means of confering fire resistance. The most popularly used BFRs, i.e. polybrominated diphenyl ethers (PBDEs), are found in electronic home appliances, automotive parts, switches, fuses, cables, construction materials, carpets and textiles, and many other common household items; they have become an inextricable part of modern technology and society, occurring also in human breast milk, fat and blood. The high bioavailability of these compounds results in bioaccumulation in organisms and biomagnification through the food chain. Because (1) the effects of high levels of PBDEs in birds are not well known, (2) PBDEs appear to be of global distribution, and (3) a number of ornithologists are investigating their impacts, this Round Table Discussion provides an excellent opportunity to bring this potentially widespread contaminant of birds before a world-wide audience. The overall aims of the RTD are to provide an overview of current exposure of birds to BFRs in both the aquatic and terrestrial ecosystems, and to stimulate further research on these chemical contaminants in both wild and captive birds. Specifically, we will discuss the latest information on (1) the levels of BFRs in birds, (2) measurement of the levels, (3) temporal and spatial trends in the spread of BFRs, and (4) bioaccumulative impact on avian species.

R04

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Invasions in birds: causes, mechanisms and adaptive significance

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Invasions or irruptions (the appearance of a species at unusually high densities within and often outside its normal range) are well known in various Holarctic bird species. There are various views on the causes of invasions, but we still lack knowledge about the mechanisms, internal physiology and adaptive significance of the phenomenon, and to what extent it differs from other forms of migration. Most research on invasions has been based mainly on visual observations, and few papers address the physiological condition of irruptive birds. The purpose of the round table is to discuss our current understanding of bird invasions and outline future research needs. Co-operative, standardized and large-scale network research on some model species could provide much of the information necessary to gain a greater understanding of the phenomenon. List of issues to be discussed:Terminology. Ecological traits and forms of migratory activity in different irruptive species. Ultimate and proximate causal factors. Age and sex composition as a cue for understanding the causes and mechanisms of invasions. Physiological condition of birds during invasions. Possibilities for experimental studies of the internal mechanisms. Hypotheses concerning the adaptive significance of invasions. Aspects and methods for international co-operation in invasion research.

R05

Pechacek P[1], Jackson JA[2]

Current global conservation status of woodpeckers

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Woodpeckers are a group of birds of special importance in ecosystems: they are primary cavity excavators, and the cavities that they make provide nesting, sleeping and sheltering sites for a wide range of secondary cavity-users from other birds to mammals and other animals. Woodpeckers, therefore, are keystone species in most forest ecosystems. Unfortunately, populations of many woodpecker species are declining, some of them put at risk only recently. Woodpeckers need large, weakened, and often rotting trees (i.e. snags) for their excavations, and these are not often plentiful. Their dearth is commonly caused by forestry silvicultural practice, bringing them into conflict with modern forestry and a diversity of other human activities that alter forest habitats. Snag management has been acknowledged as an important tool in woodpecker conservation, but many foresters see timber production endangered by the presence of snags, harboring as they can insect pests prone to infest surrounding forest. Thus, habitats suitable for woodpeckers are often limited and constrained, which underlies the decline of many woodpeckers in many areas. The purpose of this round table discussion is to bring together researchers working on woodpecker species to share their knowledge on the current status of woodpeckers under various ecosystems and ecosystem use and management. Issues for discussion: - Conservation status of woodpeckers on different continents - Generic regional problems - Development of a global conservation strategy - Establishment of a woodpecker species survival group at the IUCN - Recent findings on woodpecker biology and ecology - Woodpecker dispersal and gene flow - New methods and technologies in woodpecker research

R07

von Philipsborn V

The different influences of magnetic fields on avian behavior

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The earth emanates local magnetic vectors. Each vector and its horizontal plane enclose a local angle of inclination. The horizontal magnetic components delineate meridians which always point to magnetic north. Birds can cross meridians to east or west, while the angles change between south and north - but how do birds recognize these components and the difference between inclinations? Observations in undisturbed nature reveal that some birds home between clouds during the night, others migrate for 8115 km non-stop along Alaskan meridians, the House Swift (*Apus apus*) compensates for wind drifts in darkness, pigeons react to local field heterogeneities, and migrants surpass equatorial zero vertical intensities while others avoid polar low horizontal intensities. Experimental set-ups have different effects on birds. In cages the birds cannot move across meridians, reacting to additional magnetic vectors instead. Inclination is heterogeneous between coils, and birds cannot perceive them; and directed alternating fields can diffuse inclination. Displaced swinging magnets do not affect (a) the inclination angles for homing and (b) the crossing of meridians. Magnets near birds can disturb inclination. Moving magnets *en route* always disturb inclination but not latitudinal homing. Rotating horizontal fields have never been applied to simulate additional crossing to birds and deviate them from individual homes. An analysis of the above observations and effects may help us to understand magneto-reception and the theory underlying physical calculations needed by two senses for four functions to: (1) sense the crossing of magnetic lines, (2) account for the horizontal flux crossed, (3) perceive the angle of inclination, and (4) fix on the nearest magnetic pole. Using these functions, birds adjust their directions to find their homes.

R08

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ORNIS: Extending the data network globally for biodiversity research on birds

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Museum collections house millions of bird specimens worldwide, yet it has been impossible to access, retrieve, and integrate data efficiently across these collections for biodiversity research. ORNIS (ORNithological information system, http://ornisnet.org) is a 5-yr project that addresses this problem by developing an online, distributed network of avian data. The network currently includes 33 data providers from North America (Canada, United States, and Mexico), with records for over 5 million specimens as well as 21 million observations of birds. ORNIS couples support for database networking with georeferencing of specimen-based locality data, development and testing of web-based tools for error-checking and data improvement, and improved applications for Geographic Information System analysis. We hope to extend the network globally by engaging the international ornithological community in a roundtable discussion at the 2006 IOC. The enriched data served via ORNIS will enable many exciting research studies on birds, including phylogeography and systematics, biogeography, migration, ecological niche modeling, and tracking emerging diseases such as Avian Influenza.

R09

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Photoperiodicity in tropical birds

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In tropics, because of the availability of diverse tropic resources and equable thermal conditions reproduction occurs throughout the year. However, breeding in individual species is essentially periodic. The role of day length as an environmental cue was long excluded in view of the small amplitude of the annual photo-cycle despite the observation that all tropical species of birds examined were found to be photosensitive. Arguments have emerged concerning explanation of the photoperiodic capability ranging from “ancestral response” to “experimental artefact”. In the last two decades considerable interest has been generated in the control of reproduction in tropical birds. In two earlier IOCs the first author (ACS) already organized a round table discussion “Reproduction in Tropical Birds” followed by a full fledged symposium (with Ebo Gwinner). Studies on populations from the Indian subcontinent, Latin America and Africa have indicated that tropical birds may use day-length as information for timing seasonal cycles. With the help of simulated natural and near natural day lengths Baya weavers and Spotted ant birds were shown to be able to measure day-length. The endogenous circannual rhythm of reproduction and molt in Spotted Munias was shown to be synchronized by minor increases in day light hours during vernal equinox and the role of varying light intensity was suspected in Stone chats. These emerging ideas that have challenged earlier concepts call for a RTD on photoperiodicity in tropical birds. The RTD will: provide a platform to compare photoperiodic responses of diverse birds, identify patterns and provide insights into possible mechanisms involved.

R10

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Birds in cities

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During the last century the world’s urban population multiplied tenfold and in 2010 50 % of the human population will live in cities. So the impact of urbanization to wildlife will increase continuously. There is a global tendency for certain types of bird (animal) species to settle in the new environment. Thus science and management of urban wildlife programs will become of increasing importance in the future. Complex ‘ of questions: 1. Synurbanisation and climate; are there any hints for a west – east – gradient in Europe? 2. S. and biotope; are there more urbanized woodlandspecies’ in western Europe cities? Diversity in cities – determinated by what? What is the contribution of public green spaces and private gardens to urban biodiversity and how can we improve their value to birds? 3. S. and habitat; which species’ breed in and on buildings and in which cities? 4. S. and population; which species has higher densities in cities and why?

Of what kind are the relationships between urban and suburban populations? 5. S. and fitness; are there really better reproduction rates in city populations than in rural ones? What happens to the surplus? 6. S. and genetic; are there any genetic differences between city- and rural populations? 7. S. and alien species; are there any hints for a SW – NE – gradient in Europe? 8. S. and seasons of the year; are there more birds coming into the city in winter because of better conditions (climate, foraging)? Where do they come from? 9. S. and conservation of biodiversity (regional and global). 10. Methods: Special problems of of bird census in urban areas. - Are there any possibilities of installing permanent monitoring areas in several cities? What are the results of experimental studies on the differences between urban and rural populations (e.g. Kaspar-Hauser-studies, imprinting, b#reeding biology, foraging behavior) ? Are there any?

R11

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Capturing indigenous ornithology

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Often in mainstream studies of ornithology, indigenous components are missing, no matter what the continent. Whatever the field, indigenous knowledge is rarely incorporated into the design of the study. Yet indigenous people who have preserved their knowledge can contribute a dimension that is usually overlooked. This information can contribute to conservation biology, and its inclusion can assist in the preservation of knowledge that may otherwise be lost. Overcoming attitudes to incorporating such knowledge is a challenge. This round table addresses these issues and how indigenous information and input can be melded into a more holistic consideration of ornithology. It considers how to include people with knowledge that do not necessarily have the language skills of the 'dominant' cultures or skills in the western scientific tradition, how to shape studies around an indigenous framework if it differs from 'western' science, how to give status to knowledge that is different from the mainstream while still protecting it from exploitation. Ornithological studies will be much richer for the inclusion of indigenous knowledge where it still exists. Specific questions are: 1. How can indigenous ornithology be incorporated in a study? 2. How can indigenous people, often with low levels of literacy in English, be built into a study? 3. How does indigenous knowledge enhance the richness of any ornithological study? 4. How do can early anthropological studies be melded with current cultural frameworks? 5. In a western scientific world, how can cultural safety and sensitivity be provided for indigenous traditions?

R12

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Strategies for successful bird conservation in arable and grassland ecosystems

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Even though man-modified landscapes are rarely primary areas for biodiversity conservation, they are still essential as alternative habitats for many species. This is especially true of agricultural landscapes because they are often the only non-forested habitat available and also cover significant portions of many countries. The way in which agricultural landscapes are managed can therefore have a major impact on a significant component of biodiversity. In agricultural areas, birds are good indicators of the health of the environment, and changes in their abundance are linked to the state of their breeding or foraging habitats, both at summer and winter quarters. At present, many species of birds inhabiting agricultural grasslands and arable farmland are undergoing steep population declines in diverse parts of the world. The main reason for the declines is likely to be much the same globally: intensification of human activity. So too are the approaches needed to slow and halt the declines. The purpose of this RTD is to bring together scientists studying farmland bird conservation worldwide in order to identify research that has led to ‘science-based’ solutions that may be applied from one region to another globally. Our specific goals are to: (1) review research that has addressed the causes of bird population declines in different regions, and identify commonalities among regions; (2) canvass how research has informed management strategies in different regions; (3) identify effective regional strategies that may be applied successfully in different parts of the world; and (4) determine the spatial scale most appropriate for integrating bird conservation with production in agricultural systems - e.g. the relative merits of low intensity farming over a wide area versus high intensity on smaller areas to leave more pristine habitat. This RTD compliments symposium 11 by setting the wider scene in which agri-environment schemes may operate effectively.

R13

Harebottle D, Oschadleus HD

AFRING and the future of waterbird ringing in Africa

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We invite all stakeholders and interested and affected parties to discuss (1) the way forward to extend waterbird ringing in Africa and (2) the development of AFRING, a homologous body that would coordinate waterbird ringing schemes in Africa and provide an infrastructure for storing and curating ringing data. Potential species-specific projects and future waterbird ringing courses will be discussed, the latter a primary focus of AFRING that aims to build adequate ringing capacity in Africa.

R14

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Validity and pitfalls of stress hormone analyses: a user’s perspective

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Stress can have profound effects on the fitness of an individual. Therefore, it is of importance to know when and why an individual is stressed. This can be of particular interest in such disciplines as conservation biology, physiology, animal behavior, and veterinary medicine, as well as in reproductive and zoo biology. The concentration of glucocorticoid corticosterone in plasma and glucocorticoid metabolites in droppings is generally used as a measure of stress in birds. However, these measurements need to be used carefully and interpreted with circumspection. There are misconceptions about the ease of their use, especially concerning the relatively new method of hormone analysis in droppings. In this RTD, we shall evaluate, from a user's perspective, (1)what information can be obtained by the two glucocorticoid techniques in relation to the species studied and the particular question asked, (2)what their advantages and disadvantages are, and (3)what pitfalls need to be avoided. Moreover, we will discuss which validations of the technique are required for safe use.

R15

Coppack T[1], Partecke J[2]

The urbanization of birds: from behavioral plasticity to adaptive evolution

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Environments which have been modified by humans in order to make them inhabitable for themselves occasionally provide favourable conditions for wild birds. One extreme example is the rapid expansion of towns that has created a new type of ecosystem. Some bird species have become "urban endemites" whereas other more generalistic species are distributed along the entire rural-urban gradient. Different "ecotypes" of the same species may arise in response to environmental variation along this habitat gradient. However, in most cases, it is still unclear whether phenotypic plasticity or genetic adaptation are the causes of observed differences in life-history and behavior. The aim of this round table is to provide a forum for ornithologists interested in the causes and consequences of phenotypic responses to the urban environment. A special emphasis will be made on the role of phenotypic plasticity in mediating genetic adaptation. The following questions will be addressed: (1) Is there a common interspecific suite of phenotypic changes following urbanization? (2) How can we distinguish between phenotypic plastic adjustment, genetic adaptation and adaptation of reaction norms in urbanized populations? (3) Are we to expect differences between short- and long-lived species in their potential to adapt to novel environments? And (4) are there differences in the adaptive potential between populations of different migratory status?

R16

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The importance of the Great Rift Valley for Palearctic bird migration

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The Great Rift Valley (GRV) - which stretches over 7,000 km from the Taurus Mountains in Turkey to the Zambezi River in Mozambique and includes 22 countries - is currently being proposed as a UNESCO World Heritage Transnational Serial Nomination. This region is one of the most important bird migration routes in the world, and, if declared, will constitute the largest transnational World Heritage Site. The concept is to bring together the States Parties situated along the Great Rift Valley to form a network of protected important habitats critical to birds migrating along this corridor. Several countries are in the process of nominating sites on the basis of their importance to bird migration. The suggested critical areas include Lake Nakuru, Kenya, and the Hula Valley, Israel, and also provisionally suggested sites in Tanzania and Egypt. Each site within The Great Rift Valley Migration Flyway will operate independently, but specific administrative and management principles that will be summarized at the Roundtable will apply to all parts of the Flyway. It is proposed that BirdLife International, Africa, will oversee management coherence for the entire site. The Round Table will form the basis of scientific discussion and the formation of a scientific working group to guide the nomination process with emphasis on African countries. The aim is to create a multidisciplinary scientific programme to deal with key issues such as identifying and protecting habitats for stopover, staging and wintering; understanding migration strategies and routes; and developing a standardized monitoring scheme based on surveys, constant effort ringing, radars and satellite transmitters.

R17

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Towards a global catalogue of bird-types, or how to link information on museum specimens

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Taxonomy is a tool of fundamental importance for all kinds of studies on organisms. In this context, types play an important role as name-bearing specimens. The importance of type specimens requires global availability of the information about types. Therefore, as parts of different projects, type catalogues of individual museum collections are in preparation. Some are already available via the relevant museums' home pages. However, in general the ornithologist is mostly interested in the type specimens of a particular systematic bird group, rather than those from a particular collection. Therefore a common address for searching for type specimens in collections worldwide would be very helpful for the user. The round table aims to discuss how a practical linking could be achieved, which digital type catalogues are available, what standards we will need and which potential problems we have to solve. Recently, information about primary types of birds (and other vertebrates) in German collections were made available through the internet (http://www.gbif.de). So far, 5000 specimens from nearly 3000 of the expected 4000 primary type taxa of birds from the 10 largest ornithological collection of Germany have been investigated, digitised and linked within the GBIF network. Experience derived from this project will be discussed.

R18

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Future directions in European Montagu's harrier research and conservation

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In Europe, research on the threatened Montagu's Harrier (*Circus pygargus*) (listed in the European Birds Directive, Annex I) is carried out in many countries. In agricultural habitat, nest protection is necessary and at the same time, data on the ecology of this raptor are collected, and strategies for species conservation are thought of. As Montagu's Harrier is a long-distance migrant and European sub-populations are not isolated from each other, only an international approach can lead to a successful conservation of the European harrier population. We would like to discuss the following subjects with fellow researchers and other interested participants: (1) How can we co-operate in research on migratory routes and wintering behavior (satellite telemetry studies in different countries, field work in winter quarters fromout different countries)? (2) How can we co-operate in analyses of ring-data (survival analysis)? (3) How can we co-operate in genetic analyses (feather samples to investigate population structure and connectivity)? (4) How can we co-operate within the French wingtag-initiative? (5) How can we come to European ideas on population structure and conservation strategies for this species? (6) In what way can we improve the exchange of ideas and information between European harrier researchers/conservationists? (7) What do we see as priorities for future research?

R19

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Conservation medicine: Towards an understanding of the role of infectious diseases and parasites in wild birds

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Wild birds carry infectious agents and macroparasites. Except for a few epidemic outbreaks with high mortality, for example avian malaria on Hawaii or the rapid spread of mycoplasmal eye disease in American house finches, little is known about the role of infection and parasites on either individuals or populations of wild birds. This is partly because the effects may be subtle: for example, they might affect sexual selection, lower reproductive success, influence population dynamics or demographics, migratory fattening or flight performance. Infectious disease ecology is a emerging subject, and should attract more emphasis as natural infections may have considerable consequences in conservation. However, the field of infection disease ecology is complex, and requires a multidisciplinary approach as it sits at the interface of the environment, human and non-human hosts and pathogens. Habitat destruction and fragmentation, chemical pollution, climate change and even the overuse of antibiotics in human health care are some of the factors which may have considerable effects on wildlife health and their host-parasite interactions. Infectious disease ecology is the integration of techniques and partners from diverse disciplines. The proposed RTD aims to introduce this subject to a broader audience by discussing objectives and means for a better understanding of the principles of wildlife infection disease ecology, and its application to avian conservation medicine.

R20

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Why a Free Data Policy is needed for birds and habitats: The good, the bad and the ugly

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Free data represent major progress when it comes to research, management and conservation of the globe and human society. The free data concept applies to virtually all bird and wildlife information, including habitats. This enlightening but relatively simple concept has widely been accepted since the Biodiversity Convention in Rio de Janeiro in 1992, although it still lacks global implementation. Beyond bird distribution and abundances, it also applies to all measurements for birds and the landscapes in which they live. Disciplines such as behavioral ecology, stable isotope analysis and physiology have major potential for making data available through free databases. Species biology needs to be included as well, as comprehensive and compatible data are required for consistent management of species along international flyways and across borders. It is also crucial to address the issue of data quality, geo-referencing and GIS mapping in these databases. Apart from actual bird and habitat data as such, these concepts emphasize the coordinating power of the internet, digitization, software and quantitative analytical approaches such as modeling with GIS. Despite progress on many of these issues, other arguments have been brought forward in recent years that would withold aspects of bird-related data from public dissemination. Moreover, the idea of giving out raw information as well as interpreted and modeled data is still not widely accepted by many data collectors and agencies. This RTD will present data projects, case studies, and the pros and cons of arguments over the public dissemination of biological data in order to explain the Free Data Policy.

RT21

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Teaching the Next Generation of Avian Biologists

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The teaching of ornithology has a long tradition in introducing students to the biology, diversity, classification and evolution of birds. Practically all textbooks in ornithology, however, have been written by North American or European authors using case studies and research approaches developed mostly in North America and Europe. Only a few textbooks focus on native birds of other continents [for example, (1) Gordon L. Maclean. 1990. Ornithology for Africa. University of Natal Press, Pietermaritzburg, South Africa, and (2) Ian Rowley. 1982. Bird Life. Collins, Sydney, London.]. Fewer still may have been written in non-European languages. This apparent dearth of non-European, non-North-American and non-English textbooks in ornithology may have unanticipated, little-discussed consequences for the future of basic and applied avian biology, including conservation issues. Some of the questions to be explored are: (1) Does the dearth of non-European, non-North-American and non-English textbooks (a) influence the number of people aspiring to careers in ornithology in developing countries, where the greatest number of bird species occur; and (b) limit the choice of research, methodologies, and conservation priorities outside Europe and North America? (2) How can we increase the number of (a) ornithology textbooks that use non-European and non-North American examples, and (b) professional avian biologists outside Europe and North America? The discussions may consider the development of an annotated bibliography of textbooks in ornithology and avian biology, which could be made available through the IOC webpage.

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