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ORNITHOLOGICAL IMPOTRANCE OF GRUŽA ACCUMULATION

DALIBORKA BARJAKTAROV

Natural History Museum, Njegoševa 51, 11000 Beograd, Serbia and Montenegro,
e-mail: daliborka@beotel.yu

SUMMARY

The damming of the middle course of the Gruža River, done in order to supply drinking and technical water for the Kragujevac District, resulted in the forming of the Gruža reservoir. This lake fills the depression of the Kničko Field between Gledičke Mts and the Kotlenik. As the bird fauna of reservoirs is insufficiently studied, both in this country and abroad, this paper on the state of bird fauna of the Gružansko Lake is an attempt to improve this situation. Situated on an assumed Morava River - Vardar River migration route, the lake has an important role in the migration of both resident and transitory bird species, but also as a wintering site for certain species of ducks and geese. During this research, 78 bird species were recorded of which 25 species were proven to breed in this area. Most species were recorded in the zone of strong anthropogenic influence, which is understandable since before the building of the dam and the forming of the artificial lake the Kničko Field had been dominated by agricultural land, mowed meadows and orchards.

Key words: bird migration, the Gruža reservoir, bird fauna

INTRODUCTION

The Gružansko Lake is an artificial lake, formed after the damming of the River Gruža in order to provide water supply for industry in the Kragujevac District (Marković, 1980). Besides the developmental and economic significance, the Gruža reservoir represents a new and suitable stopover habitat for wetland and other birds that use Eastern European migratory pathways. This modified area, situated on the Morava River - Vardar River migratory route, enables the migrating birds to rest, regain their strength and recharge the energy supplies before continuing the migration.

The bird fauna of reservoirs in Serbia (Vasić and Šoti, 1979), but also in the former Yugoslavia (Vasić, 1979; Lukač, 1983; Mužinić, 1976), was studied rarely, primarily due to a lack of interest of ornithologists in such ecosystems, which as a rule are poor in bird diversity. Consequently, the bird fauna of the basin of the River Gruža and the surroundings of the town of Kragujevac was studied rarely and sparsely (Matvejev, 1938; 1950, Marinković, 1995, 1997). This paper presents the results of two years of research efforts on the collecting of data on the status of bird fauna at the Gružansko Lake and its surroundings.

CHARACTERISTICS OF THE GRUŽANSKO LAKE

The Gružansko Lake (also known as the Knićko Lake) was formed by damming the middle course of the Gruža River, which was done in order to supply the nearby Kragujevac District with water for residential, industrial and other uses (Pantović and Madžarević, 1999). The lake fills the depression of the Knićko Field and it is situated between Gledičke Mts in the east and the Kotlenik in the west (Veljović, 1967). The building of the dam started in 1979 and it was completed in 1985. The lake covers the area of 934 ha, and it is one of the largest water surfaces in the region of Šumadija. The total length of the lake is about 10 km, the width varying between 300 and 2800 m. The greatest depth is immediately below the dam, 31 m, while the lake is only 1.3 m deep in some places. Oscillation of water level in the reservoir is 3–5 m, depending on the season (Milojević, 1994). Besides the atmospheric water and the water from the Gruža River, the lake also receives water from the Boračka River, the previous right tributary of the Gruža River. Most of the lake has the character of lowland reservoirs, with small depth and banks surrounded with agricultural fields and meadows. Only a small section of the banks near the dam has some characteristics of steep-shore cliffs, overgrown with forest vegetation. The lake is rich in fish.

The lake itself differentiates into four main zones: the zone of permanent open water, which covers the largest area, the flooded zone, the zone of forested and steep cliffs and the zone of strong anthropogenic influence. The zone of emergent vegetation covers a small area, a belt 5-10 m wide that stretches along the shore. It is dominated by reed (*Phragmites communis*) and sedge (*Scirpus lacuster*). At the north side of the lake, at the confluences of the Gruža and Boračka rivers, formations of flooded wetland meadows make a belt up to 100 m in width (Figure 1). The dominant species in the association of wetland meadows, which are submerged for a greater part of the year, is *Trifolium resupinaum* (Veljović, 1967). Somewhat further away, in the shallower coastal belt, there is also a development of submerged macrophytic vegetation composed of floating-leaved pondweed (*Potamogeton natans*), meadow bistort (*Polygonum bistorta*), common hornwort (*Ceratophyllum demersum*) and Eurasian water milfoil (*Myriophyllum spicatum*).

The eastern and southern shores of the lake are stony and steep, and only in certain spots are they less steeply inclined. The shores are overgrown with xero-mesophytic oak forest from the association *Quercion frainetto* and the sparse shrubby vegetation (Stevanović & Stevanović, 1995). The western shore of the lake is slightly undulating, covered with orchards, cultivated fields under vegetables (cabbage and potatoes) and mowed meadows. The main problem of the Gružansko Lake is the relatively increased eutrophication and aging, caused by negative anthropogenic factors, due to the intensive use of cultural practices in the surrounding cultivated land, influx of sewage waters from neighboring households, etc. (Pantović and Madžarević, 1999).



Fig. 1. Flooded meadows along the Gružansko Lake, near the mouth of the River Gruža

MATERIAL AND METHODS

The main method of data collecting was the minimal transect as defined by Matvejev (1976). Besides faunistic data, this method also provided data on the structure of the bird community in the studied location. Presence of certain bird species, whose entire life cycle is associated with water, was established by counting (Campbell and Lack, 1985). Additionally, birds were caught in ornithological nets for ringing. The results of these activities were identification of the species inhabiting the area of the Gružansko Lake and facilitated monitoring of bird migration.

The data on bird fauna cover only the Gružansko Lake, its shores and the immediate vicinity (wetland meadows, cultivated land, open grassland and forest communities). This paper includes only the spring-summer aspect, while the fall-winter aspect was not studied.

RESULTS AND DISCUSSION

The valley type of bird fauna predominates in the greatest part of Serbia, including the region of Šumadija. This type of bird fauna includes lowlands and river valleys, modified and artificial water habitats, orchards and vineyards, gradually climbing into hills (Matvejev, 1950). In the area of the Gružansko Lake and its immediate vicinity, elements of all biomes mentioned may be found. For easier study of the bird fauna, we determined several zones and biotopes:

I Zone – Permanent open water

- a) **Biotope of open water** (limnal) represents the lake surface free of aquatic vegetation. During the year, considering the presence or absence of vegetation, this biotope is

least susceptible to change, but at the same time it is under the heaviest influence of strong winds.

- b) **Biotope of macrophytic vegetation** includes a combination of floating and submerged plants: floating-leaved pondweed and meadow bistort (*Potamogeton natans* and *Polygonum bistorta*), common hornwort (*Ceratophium demersum*) and Eurasian water milfoil (*Myriophyllum spicatum*).

II Zone – Flooded zone

- a) **Biotope of emergent vegetation** occupies the narrow belt around the lakeshores where the dominant species are reed (*Phragmites communis*) and sedge (*Scirpus lacuster*).
- b) **Biotope of wetland meadows** is present around the mouths of the Gruža and Boračka rivers. It is composed of hygrophilous vegetation dominated by the association *Trifolium resupinati*, dotted with scattered willow (*Salix* sp.) trees. This biotope is very suitable for feeding and breeding of birds, so it has the greatest diversity of species.

III Zone – Forested and steep shores

This zone includes associations of oak forest that cover the eastern and southern shores of the lake. In certain places, the shores become steep and inaccessible, overgrown with sparse woody vegetation.

IV Zone – Zone of strong anthropogenic influence

- a) **Biotope of orchards** includes cultivated areas around the lake, represented by forest remnants, planted orchard trees and sparse shrubby vegetation.
- b) **Biotope of cultivated farmland** is under the strongest anthropogenic influence. It is characterized by cultivated areas, mostly under vegetables.
- c) **Biotope of open grassland communities** is characterized by grass vegetation, which is periodically mowed (mown meadows). Also present are occasional hedgerows, solitary fruit trees and solitary forest trees that remained after the forest had been cleared.

Based on the field studies, Table 1 lists the bird species by zone, their abundance and status at the lake, as well as their protection status in Europe.

Explanation of abbreviations in the table:

- I a – biotope of open water;
- I b – biotope of macrophytic vegetation;
- II a – biotope of emergent vegetation;
- II b – biotope of wetland meadows;
- III – zone of forested and steep shores;
- IV a – biotope of orchards;
- IV b – biotope of cultivated farmland;
- IV c – biotope of open grassland communities.

Status:

B – *breeding* – species that breed in the area;

P – *passage* – species that pass through the area during migration or wandering;

W – *wintering* – species that spend winter in the area

V – *visitor* – species that are occasionally recorded in the area during the reproductive period, but do NOT breed there (breeding species of other habitats nearby);

Rg – *regular* – regularly recorded (during breeding, migration or during winter);

S – *secure* – species with stable population numbers (neither increasing nor decreasing);

D – *decline* – species with decreasing population numbers;

R – *rare* – species threatened with extinction;

V – *vulnerable* – species with decreasing population numbers and threatened with extinction;

(P) – Temporary status.

Table 1. List of bird species in the area of the Gružansko Lake and its surroundings

No.	Species	Presence in the zone	Max. no. of recorded or estimated individuals	Status of threat/protection	
				At the lake	In Europe
1.	<i>Tachybaptus ruficollis</i>	I a	15	P	S
2.	<i>Podiceps cristatus</i>	I a; I b	100	RgB	S
3.	<i>Phalacrocorax carbo</i>	I a; III	70	RgB	S
4.	<i>Nycticorax nycticorax</i>	II b	3	V	D
5.	<i>Ardeola ralloides</i>	II a, II b	5	V	V
6.	<i>Egretta garzetta</i>	II a	3	Rg	S
7.	<i>Egretta alba</i>	II a	20	Rg B	S
8.	<i>Ardea cinerea</i>	II a, II b, III	60	RgB	S
9.	<i>Ciconia ciconia</i>	II b	6	RgV	V
10.	<i>Anas platyrhynchos</i>	I a, I b	1000	RgB W	S
11.	<i>Aythya ferina</i>	I a, I b	30	Rg B	S
12.	<i>Haliaeetus albicilla</i>	I a	1	RgV	R
13.	<i>Circus aeruginosus</i>	II a, II b	3	Rg	S
14.	<i>Accipiter gentilis</i>	III	2	Rg	S
15.	<i>Accipiter nisus</i>	III	2	Rg	S
16.	<i>Buteo buteo</i>	IV b, IV c	6	Rg	S
17.	<i>Falco tinnunculus</i>	IV a, IV b	2	RgB	D
18.	<i>Coturnix coturnix</i>	IV c	15	Rg B	V
19.	<i>Phasianus colchicus</i>	IV c	10	RgB	S
20.	<i>Fulica atra</i>	I b, II a	50	RgB	S
21.	<i>Vanellus vanellus</i>	II b	12	RgB	S (P)
22.	<i>Calidris alpina</i>	II a	30	P	S (P)
23.	<i>Philomachus pugnax</i>	II b (II a)	25	P	S (P)
24.	<i>Tringa totanus</i>	II b (II a)	15	P	D
25.	<i>Tringa ochropus</i>	II b (II a)	50	P	S
26.	<i>Tringa glareola</i>	II b (II a)	15	P	D
27.	<i>Larus ridibundus</i>	I a	20	Rg	S
28.	<i>Chlidonias niger</i>	Ia, I b	20	Rg	D

29.	<i>Columba palumbus</i>	III	8	Rg	S
30.	<i>Sreptopelia decaocto</i>	IV a, IV b	20	Rg	S (P)
31.	<i>Streptopelia turtur</i>	IV a, IV b	8	Rg	D
32.	<i>Cuculus canorus</i>	II a, II b	10	Rg	S
33.	<i>Alcedo atthis</i>	II a	4	Rg	D
34.	<i>Upupa epos</i>	IV a, IV b	6	Rg	S
35.	<i>Picus viridis</i>	III	3	Rg	D
36.	<i>Dendrocopos major</i>	III	4	Rg	S
37.	<i>Dendrocopos syriacus</i>	III	3	Rg	S (P)
38.	<i>Galerida cristata</i>	IV c	7	Rg	D (P)
39.	<i>Lullula arborea</i>	IV c	4	Rg	V
40.	<i>Hirundo rustica</i>	I, II, IV	30	RgV	D
41.	<i>Delichon urbica</i>	I, II, IV	25	RgV	S
42.	<i>Anthus trivialis</i>	IV b, IV c	4	Rg	S
43.	<i>Motacilla flava</i>	II a, II b	10	RgB	S
44.	<i>Motacilla alba</i>	II a, II b	8	RgB	S
45.	<i>Erithacus rubecula</i>	III	8	RgB	S
46.	<i>Luscinia megarhynchos</i>	II b	20	RgB	S
47.	<i>Saxicola torquata</i>	IV b	10	P	S
48.	<i>Turdus merula</i>	II b, IV a	30	RgB	S
49.	<i>Acrocephalus palustris</i>	II a	4	Rg	S
50.	<i>Acrocephalus arundinaceus</i>	II a	10	Rg	S (P)
51.	<i>Hippolais palida</i>	IV a, IV b	4	P	V (P)
52.	<i>Sylvia communis</i>	IV a, IV b	20	RgB	S
53.	<i>Sylvia borin</i>	IV a, IV b	16	Rg B	S
54.	<i>Sylvia atricapilla</i>	IV a, IV b	18	RgB	S
55.	<i>Philooscopus sibilatrix</i>	III	4	P	S (P)
56.	<i>Philloscopus collybita</i>	III	8	Rg	S (P)
57.	<i>Muscicapa striata</i>	III	5	P	D
58.	<i>Aegithalos caudatus</i>	IV a, IV b	15	Rg	S
59.	<i>Parus palustris</i>	III	5	Rg	S
60.	<i>Parus caeruleus</i>	III	15	Rg	S
61.	<i>Parus major</i>	III	25	Rg	S
62.	<i>Sitta europea</i>	III	5	Rg	S
63.	<i>Oriolus oriolus</i>	II b, III	7	Rg	S
64.	<i>Lanius collurio</i>	IV a, IV b	15	RgB	D (P)
65.	<i>Garrulus glandarius</i>	II b, III	10	Rg	S (P)
66.	<i>Pica pica</i>	IV a, IV b	20	RgB	S
67.	<i>Corvus monedula</i>	IV b, IV c	20	Rg	S (P)
68.	<i>Corvus frugilegus</i>	IV b, IV c	35	Rg	S
69.	<i>Corvus corone cornix</i>	IV b, IV c	20	Rg	S
70.	<i>Corvus corax</i>	III	5	V	S (P)
71.	<i>Sturnus vulgaris</i>	IV a, IV b	40	RgB	S
72.	<i>Passer montanus</i>	IV b, IV c	20	Rg	S
73.	<i>Fringilla coelebs</i>	III	20	RgB	S
74.	<i>Carduelis chloris</i>	IV a, IV b	5	Rg	S
75.	<i>Carduelis carduelis</i>	IV a, IV b	13	Rg	S(P)
76.	<i>Coccothraustes</i>	IV a, IV b	8	Rg	S

	<i>coccothraustes</i>				
77.	<i>Emberiza citrinella</i>	IV a, IV b	20	RgB	S (P)
78.	<i>Emberiza hortulana</i>	IV b, IV c	11	RgB	V (P)
79.	<i>Emberiza cirlus</i>	IV a, IV b	7	Rg B	S (P)
80.	<i>Miliaria calandra</i>	IV b, IV c	15	RgB	S (P)

The presence of several different habitats in the area of the Gružansko Lake enables greater bird diversity, both of breeders and migratory species. According to Matvejev (1950), the fauna of the Gružansko Lake and its surroundings can be considered a valley type of bird fauna, a subtype of cultivated fields at foothills. Remembering the presence of species connected with water, this type of bird fauna is modified in certain sense, and the method of counting provided data on their abundance and status.

During the study of the spring-summer aspect of the Gružansko Lake, a total of 80 bird species were recorded. Twenty-seven of these were determined to be regular breeding species at the lake and in its immediate surroundings. Considering the species distribution through the zones, most species (32) were recorded in the zone of strong anthropogenic influence, i.e., in the zone of modified habitats (cultivated fields, orchards, mown meadows, etc.) A somewhat smaller number (26 species) was recorded in the flooded zone. Twenty species were recorded in the zone of forested and steep shore cliffs. Only 11 bird species were recorded in the zone of permanent open water. The reason for such a distribution of species is the fact that the flooding of the Gruža River valley and the building of the reservoir led to significant changes in the ecosystems of this area. In that way, the species that used to breed in meadows and cultivated land next to the Gruža River moved to surrounding areas, while various species of wetland birds occupied the newly formed lake. The bird fauna of this area was thus enriched with new species that are not characteristic for the valley type of bird fauna.

Birds are mobile organisms which do not dwell exclusively in one biotope but move from one biotope to another in order to satisfy their basic needs (Table 1). Especially during breeding season, they tend to feed in one biotope and often breed in another. Therefore, the distribution of the bird fauna of the Gružansko Lake by zones should not be considered as a strictly closed but as a dynamic and variable system, influenced by ecological requirements of species and environmental conditions.

The listing and abundance of the species presented in Table 1 are not final because the research did not include the fall-winter aspect. However, this list might be extended to include the woodcock (*Scolopax rusticola*) and the snipe (*Gallinago gallinago*), which were observed on spring migration in the vicinity of Kragujevac by Matvejev (1938). As the small water surfaces in the vicinity of Kragujevac are places where species from the order *Anseriformes*, especially ducks (*Anas penelope*, *Anas crecca*, *Anas querquedula*, *Anas platyrhynchos*, *Anas acuta*, *Aythya ferina* and *Aythya nyroca*) may be observed in winter (Marinković, 1997), it is quite possible that during migration they also visit the Gružansko Lake. This assumption is supported by the fact that on October 27th, 2001, about 1000 individuals of *Anas platyrhynchos* were recorded on the lake, as well as by the fact that this species also breeds in this location.

The ornithological value of artificial water ecosystems is due to the fact that they are often situated on the migration routes of many bird species, and that as such they represent the only

water surfaces where these birds may rest and renew their strength and fatty deposits. As some very rare bird species are recorded in such locations during the spring and winter migrations, the importance of artificial lakes for the diversity of bird species may be considered as extraordinary (Vasić and Šoti 1979; Mužinić 1986). Besides, artificial lakes are new and certainly interesting habitats not only during migration but also during breeding season, since most of them are stocked with fish and they provide suitable conditions for feeding of many birds, primarily the ichthyophagous ones (Vasić 1979; Grubač & Grubač 2002).

Diversity of bird species inhabiting an artificial lake may be great, enhancing the richness of bird fauna in a region. The value of the studied wetland location may decrease for many bird species, first of all due to large anthropogenic activity (presence of numerous angler fishermen and picnickers) and then due to the proximity of cultivated surfaces that adjoin the very lake, allowing the runoff of pesticide-contaminated water directly into the lake. This problem is present in almost all artificial reservoirs that are not under a strict protection regimen or are insufficiently studied (Lukač 1983; Mužinić 1986; Grubač & Grubač 2002).

If properly managed, artificial water ecosystems can be easily turned into centers of biological diversity, which, despite their size, can become important for the preservation of many rare species, not only birds but also amphibians (Paunović et al., 2003). Therefore, it is necessary to better protect the existing artificial reservoirs, especially as they are valuable and often the only resting places for migratory birds.

CONCLUSION

As the bird fauna of the Gružansko Lake and its surroundings has not been studied previously, a two-year study was undertaken to collect data on the state of bird fauna at this reservoir.

During the research in the spring-summer aspect, 78 bird species were recorded, and 25 species were determined to breed in that area. The list of species is not complete, as it should also include the birds appearing on the location during the fall migration and winter months.

Most species were recorded in the zone of strong anthropogenic influence because, before the building of the dam and artificial lake, the Knićko Field had been dominated by cultivated land, mowed meadows and orchards, so the species from these biotopes probably only moved to nearby localities. A novelty for this area are the species of water habitats, occupying the very surface of the lake.

Direct runoff of pesticides from the surrounding agricultural land and the increased anthropogenic influence at the lake itself and around it are negative influences for the species richness, in terms of destroying or degradation breeding habitats of birds.

As the Gružansko Lake is located on the assumed Morava-Vardar migratory route, it plays an important role in the migration of both resident and transitory bird populations, as well as a wintering area for certain species of ducks and geese.

The study of the Gružansko Lake is by no means complete and it must be continued to include not only the breeding and migration seasons but also the winter aspect.

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ORNITOLOŠKI ZNAČAJ GRUŽANSKE AKUMULACIJE

DALIBORKA BARJAKTAROV

Prirodnjački muzej, Njegoševa 51, 11000 Beograd, Srbija i Crna Gora

e-mail: daliborka@beotel.yu

SAŽETAK

Pregrađivanjem srednjeg toka reke Gruže, radi snabdevanja opštine Kragujevac pijaćom i tehničkom vodom, nastala je Gružanska akumulacija. Jezero ispunjava depresiju Kničkog polja i između Gledićkih planina i Kotlenika. Kako je ornitofauna akumulacionih jezera kod nas, ali i u svetu slabo proučavana, u radu su prikazani podaci o stanju ornitofaune Gružanskog jezera. Jezero ima važnu ulogu tokom seobe stranih i zavičajnih populacija ptica, ali i kao zimovalište za neke vrste pataka i gusaka, jer se nalazi na pretpostavljenom moravsko – vardarskom migratornom putu. Tokom istraživanja, zabeleženo je 78 vrsta ptica, od čega je za 25 vrsta utvrđeno da se gnezde na ovom području. Najveći broj vrsta zabeležen je u zoni jakog antropogenog uticaja, što je i razumljivo jer je pre izgradnje brane i akumulacionog jezera u Kničkom polju preovladavalo obradivo zemljište, livade košenice i voćnjaci.

Ključne reči: Gružanska akumulacija, migracija ptica, ornitofauna.