AGE, GROWTH, AND LENGTH-WEIGHT RELATIONSHIP OF COMMON NASE (*CHONDROSTOMA NASUS*) IN THE DANUBE RIVER NEAR BELGRADE (SERBIA)

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Growth parameters, length-weight relationship, and condition of the common nase (*Chondrostoma nasus*) in the Danube River near Belgrade were analyzed on a sample (n=30) from the commercial catch, caught between March and May 2017. The total body length of the sampled individuals ranged from 268 to 401 mm, and body weight from 195 to 875 g. Age was determined from scales and individuals aged 5+, 6+ and 7+ were present in the sample, in approximately the same percentage. The regression coefficient of the length-weight relationship was b = 3.28. The value of $b > 3$ indicates a positive allometry, which denotes that the weight growth rate is greater than the length growth rate. The Fulton's condition factor ranged from 0.90 and 1.36, with the mean value of 1.07. The parameters of the von Bertalanffy growth function were L_∞ = 697.84, k = 0.08, and t_0 = -1.72. The estimated phi-prime growth performance index (j') was 4.60. The lengths were back-calculated using the method of Monastyrsky, and the greatest relative growth increment was observed in the first and second year of life.

Keywords: length-weight relationship, condition factor, length-at-age, back-calculation, allometric growth, large river

INTRODUCTION

Body size can determine predator–prey activity patterns, energy requirements, fecundity, mating success, longevity, as well as mortality (JENNINGS et al. 2001, DMITRIEW 2011). Growth rates are linked with resource availability and the trade-off between predation risk and foraging effort, and can change rapidly due to environmental variations (DMITRIEW 2011).

The common nase (*Chondrostoma nasus*) is characteristic for hyporithral and epipotamal river zones (SCHIEMER et al. 2002), and it can also be found in large rivers with moderately flowing water (KOTTELAT and FREYHOF 2007). It feeds predominantly on benthic algae (RECKENDORFER et al. 2001), but can also consume insect larvae, snails, fish eggs, and detritus (SYSA et al. 2006). Many local populations are endangered due to environmental degradation and habitat loss (TARGOŃSKA et al. 2008), mainly through construction of dams and modification of river banks (OVIDIO and PHILIPPART 2008). It is a commercially exploited species in Serbia (SMEDEREVAC-LALIĆ 2013).

Due to the local endangerment, its commercial value, and lack of data, the aim of this study was to determine growth parameters, length-weight relationship, and condition factor of the common nase in this part of the Danube River.

MATERIALS AND METHODS

Thirty nase specimens were obtained from a commercial catch in the Danube River near Zemun, between 1170th and 1173th river kilometer. Sampling was conducted from March until May 2017. The total length *TL* (to the nearest mm) and weight *W* (to the nearest g) were measured for each sampled individual. Scales used for age determination were taken from the region between the lateral line and the dorsal fin. After the removal, scales were cleaned with a fine brush, rinsed in water, and dried on filter paper. Fish age was estimated

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twice by two readers, to avoid bias. Cleaned scales were mounted on microscopic slide and viewed on a stereo microscope. Scale images were photographed with a microscope camera and used for further analyses. Scale and annuli radius measurements were done using a Digimizer image analysis software (MedCalc Software bvba). Total length back-calculation was performed according to the Monastyrsky's equation (FRANCIS 1990):

$$Ln = (\frac{Sn}{S})^{b} TL \quad (1).$$

The Beverton's model was used for fitting of the von Bertalanffy growth curve (RICKER 1971, RICKER 1975). The von Bertalanffy growth equation was estimated using the finite difference diagram of Walford. Growth curves were gene-rated with the Simply Growth program (©PISCES Conservation Ltd, 2002), which estimates parameters by non-linear regression using the Levenberg–Marquardt method:

$$Lt = L_{\infty}(1 - e^{-k(t-t_0)}) \quad (2).$$

To test the overall growth performance and to overcome the problem of correlation between growth parameters k and L_{∞}, the phi-prime index (j') was calculated (MUNRO and PAULY 1983, PAULY and MUNRO 1984):

$$j' = \log10\, k + 2 \log10\, L_{\infty} \quad (3),$$

where k is Brody's growth coefficient and L_{∞} is asymptotic length.

The length-weight relationship was calculated using the Simply Growth program. Fulton's condition factor was calculated using the following equation (RICKER 1975):

$$K = \frac{W}{L^3} 100 \quad (4).$$

RESULTS

The minimum total body length of the sampled nase individuals was 268 mm and the maximum was 401 mm (mean 327 ± 6 mm S.E.). The minimum weight was 195 g and the maximum was 875 g (mean 389 ± 25 g S.E.). Sampled fish belonged to 5+, 6+, and 7+ age groups, and each group was present in approximately the same percentage in the sample.

Annual length growth (length-at-age) was back-calculated using the growth models of Monastyrsky and von Bertalanffy (**Tab. 1**). The greatest relative growth increment was observed in the first and second year of life.

The total body length of the sampled common nase in the Danube River, defined according to the parameters of the von Bertalanffy growth curve (**Fig. 1**), can be calculated in any given time as:

$$Lt = 698.84\ x\ (1 - e^{-0.08(t+1.72)}) \quad (5).$$

The estimated phi-prime growth performance index (j') was 4.60.

The regression coefficient b of the length-weight relationship was $b > 3$ (**Fig. 2**). The Fulton's condition factor ranged from 0.90 to 1.36, with the mean value of 1.07 (**Fig. 3**). The highest average value of the Fulton's condition factor was observed for individuals in 7+ age group (1.11), and the lowest in 6+ age group (1.03).

DISCUSSION

Growth rate and length-weight relationship of a fish are the result of both abiotic and biotic factors, and they vary between waterbodies, size ranges, growth stanzas, sexes, reproductive phases, and seasons (SAFRAN 1992, FROESE 2006, EPLER et al. 2009). To avoid bias in comparisons, the results that we presented should only be considered accurate for the similar range of sizes that we report on.

Nase individuals from three rivers in the upper Vistula River drainage (Poland) have smaller body lengths than nase individuals of the

		Total body length (mm)						
Age	*n* = 30	L1	L2	L3	L4	L5	L6	L7
5+	8	137	194	235	271	298		
6+	11	135	183	223	266	296	318	
7+	11	140	182	220	262	303	336	358
TL von Bertalanffy		136	180	219	256	290	322	350
TL Monastyrsky		137	186	226	266	299	327	358
increment (mm)			49	40	40	33	28	31
increment (%)			36	21	18	12	9	9

Tab. 1 Back-calculated total length-at-age of the common nase from the Danube River near Belgrade.

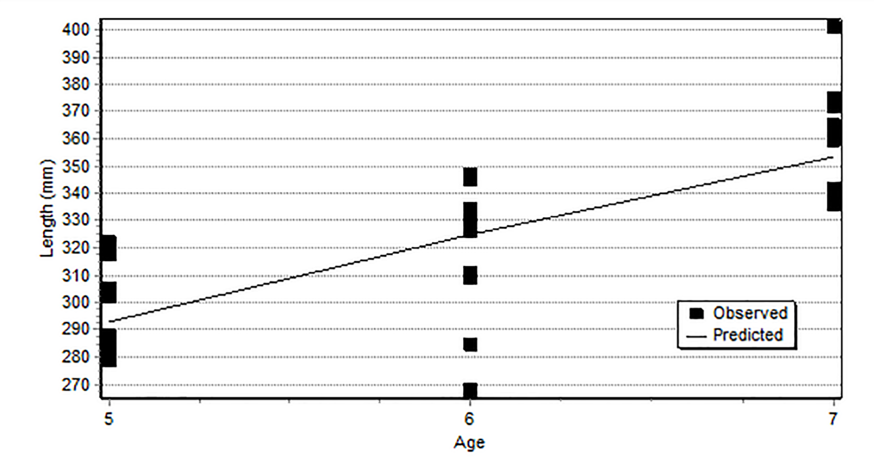

Fig. 1 The von Bertalanffy growth curve of the common nase from the Danube River near Belgrade.

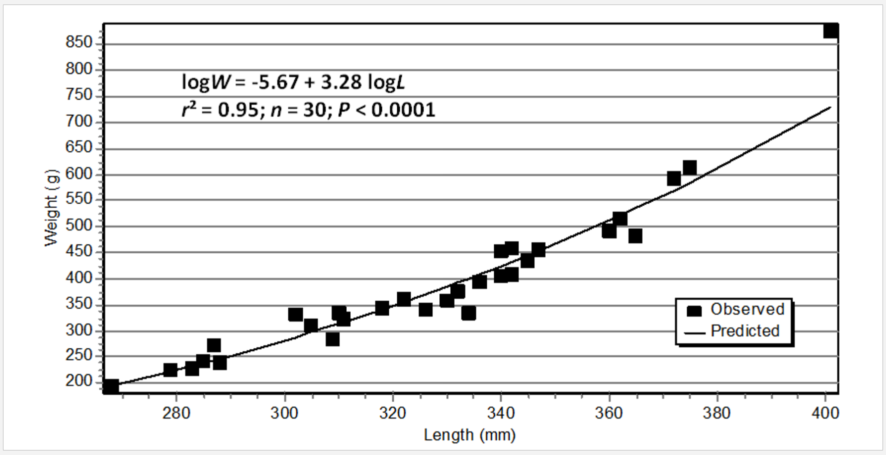

Fig. 2 Length-weight relationship of the common nase from the Danube River near Belgrade.

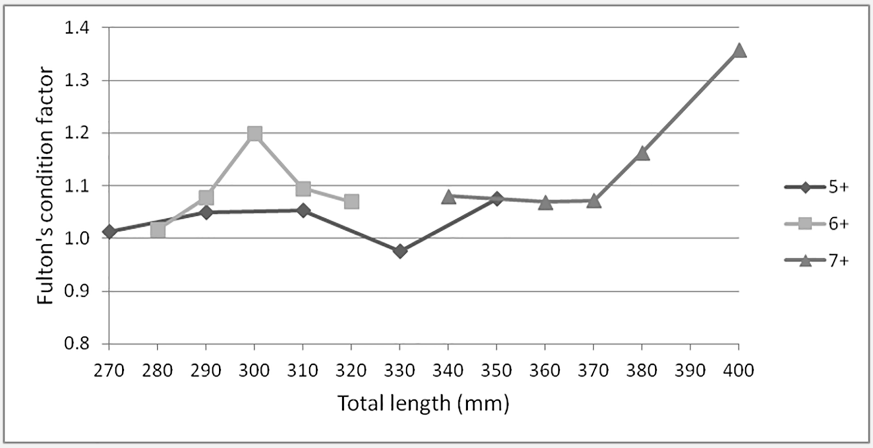

Fig. 3 Fulton's condition factor of the common nase from the Danube River near Belgrade.

same age caught in the Danube River (EPLER et al. 2009). The difference is especially pronounced in the first and second year of age – the back calculated lengths of the fish from the Danube River in these two age classes are twice the length of the fish caught in three Polish rivers, and fish from 7+ age class are of similar length to fish from 10+ and 11+ age classes. However, the annual growth increments are similar and no significant differences (Students' t test, $P > 0.05$) were found between the annual increments for the nase from the Danube and the average values for the nase from three Polish rivers.

The estimated asymptotic length (L_∞ = 698 mm TL) was lower than the value obtained by VATER (1997) for the nase from the Slovak stretch of the Danube (L_∞ = 763 mm SL). The values of asymptotic standard length for several other rivers in Slovakia and eastern Czech Republic ranged from as small as 244 mm to 737 mm (VATER 1997). Brody's growth coefficient k is related to longevity and is considered a good predictor of natural mortality (PAULY 1980) and average fecundity (CHARNOV 2008). Nase specimens caught in the Danube near Belgrade have a similar k value (0.08) as nase specimens caught in the Slovak stretch of the Danube (0.07), however, these values are lower than in other rivers in Slovakia and eastern Czech Republic (mean 0.13) (VATER 1997). A preliminary growth estimate of k for the nase obtained from literature data by FROESE and BINOHLAN (2003) is higher (0.23) then the value estimated for the nase in the Danube.

The value of $b > 3$ indicates a positive allometry, i.e. that large individuals increase in height or width more than in length, which can be the result of an ontogenetic change in body shape with size (rare) or increase in weight (common) (FROESE 2006). The nase from the Danube has a higher b value (3.28) than the nase from rivers in Croatia (3.15) (TREER et al. 2008).

Nase individuals from the Danube have a lower value of the Fulton's condition factor K (1.07) than nase individuals from the upper Vistula River drainage (1.26–1.54) (EPLER et al. 2009). Nase individuals sampled in Camligoze Dam Lake (Turkey) have a similar range of K values (0.77–1.29) as nase individuals from the Danube (0.90–1.36), however, the mean value of the Fulton's condition factor is somewhat lower in nase specimens from Turkey (0.99) (DIRICAN and CILEK 2012).

The results of this study can be employed as baseline data in fisheries management and conservation of the species, considering that data on the common nase growth and length-weight relationship are very limited, not only in Serbia but throughout its range.

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