LENGTH-WEIGHT RELATIONSHIP OF NINE FISH SPECIES FROM GRUŽA RESERVOIR (CENTRAL SERBIA)

Nataša Kojadinović[1], Milena Radenković[1], Simona Đuretanović[1], Aleksandra Milošković[2], Marija Jakovljević[1], Tijana Veličković[1], Vladica Simić[1]

Abstract: Length–weight relationship give information on the condition and growth patterns of fish. This study reports length– weight relationships for *Abramis brama* (Linnaeus, 1758), *Alburnus alburnus* (Linnaeus, 1758), *Carassius auratus* (Linnaeus, 1758), *Cyprinus carpio* (Linnaeus, 1758), *Rutilus rutilus* (Linnaeus, 1758), *Silurus glanis* (Linnaeus, 1758), *Ameiurus nebulosus* (Le Sueur, 1819), *Perca fluviatlis* (Linnaeus, 1758) and *Sander lucioperca* (Linnaeus, 1758). Specimens were collected from 2007 to 2013 in Gruza Reservoir (Central Serbia). The b values in the LWRs of analyzyed fish varied between 2.274 and 3.213.

Keywords: freshwater fish, Central Serbia, length-weight, fishing ecology

Introduction

Length–weight relationships (LWRs) were originally used to provide information on the fish condition and to determine whether somatic growth was isometric or allometric (Le Cren, 1951; Ricker, 1975). LWRs are fundamental in fisheries research (Tsionki et al., 2021). In particular, thew can be used for the determination of weight and biomass from length data, as indications of the body condition and for comparisons of species–specific growth between regions and among seasons provided that the same sampling methodology is used (Bobori et al., 2010, Froese 2006., Petrakis & Stergiou, 1995).

Materials and methods

The Gruža Reservoir is situated in Central Serbia, near the city of Kragujevac, at an altitude of 269 m, with a surface area of 9.34 km² and a maximum depth of

---

[1]Department of Biology and Ecology, Faculty of Science, University of Kragujevac, Kragujevac, Serbia

(natasa.kojadinovic@pmf.kg.ac.rs)

[2]Institute for Information Technologies Kragujevac, University of Kragujevac, Kragujevac, Serbia

31 m (Fig. 1). It was formed in 1985 to supply drinking water to the population of the region, and also for recreational purposes (Milošković, 2013).

The Gruža reservoir biotope is extremely favourable for the development of different hydrobiont communities and high fish fauna production (Marković, 2011).
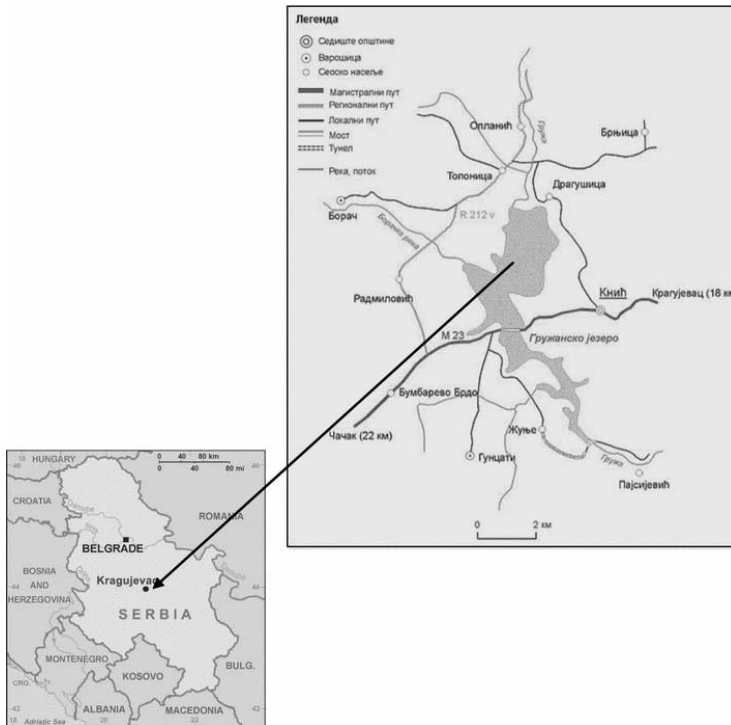

Figure 1. Location of the Gruža Reservoir near the city of Kragujevac, Central Serbia

Fishes were sampled from 2007 to 2013, using gillnets with different mesh sizes (from 10 to 120 mm) and electrofishing (Aquatech IG 1300). In the laboratory sampled specimens were identified to species according to Kottelat and Freyhof (2007) and Simonović (2001), then measured to the nearest 1 mm (total length, L) with a sliding caliper and weighed to the nearest 0.1 g (weight, W).

Length–to–weight relationship for total body weight was calculated using the equation W ¼ aLb, where W is the total weight (expressed in grams), L is the total length (expressed in centimetres), a is a coefficient related to body form and b is an exponent indicating isometric growth when equal to 3.

The parameters a and b were estimated by linear regression on the transformed equation: log(W) ¼ log(a) + b log(L) (Koutrakis and Tsikliras, 2002)

Results and discussion

In this study, 1752 specimens of fish belonging to nine species from five families were sampled: *Abramis brama* (Linnaeus, 1758), *Alburnus alburnus* (Linnaeus, 1758), *Carassius auratus* (Linnaeus, 1758), *Cyprinus carpio* (Linnaeus, 1758), *Rutilus rutilus* (Linnaeus, 1758), *Silurus glanis* (Linnaeus, 1758), *Ameiurus nebulosus* (Le Sueur, 1819), *Perca fluviatilis* (Linnaeus, 1758) and *Sander lucioperca* (Linnaeus, 1758). Table 1 shows the sample size, minimum and maximum length, parameters a and b values and the coefficient of determination (r^2).

Table 1. Descriptive statistics and estimated parameters of length-weight relationships for nine species caught in Gruža Reservoir

Family	Species	n	Min TL	Max TL	a	b	SE (b)	r^2
Cyprinidae	*Abramis brama*	845	14.2	44.5	0.034	2.617	0.046	0.892
	Carassius auratus	542	10.5	43.0	0.016	2.992	0.720	0.872
	Cyprinus carpio	49	26.0	82.1	0.018	2.933	0.073	0.999
Leuciscidae	*Alburnus alburnus*	73	13.1	17.2	0.059	2.274	0.408	0.840
	Rutilus rutilus	74	12.5	28.5	0.007	3.213	0.084	0.976
Siluridae	*Silurus glanis*	10	49.6	188.4	0.005	3.044	0.073	0.998
Ichtaluridae	*Ameiurus nebulosus*	21	11.5	26.8	0.006	3.200	0.104	0.990
Percidae	*Perca fluviatilis*	32	10.5	30.0	0.015	2.903	0.275	0.888
	Sander lucioperca	106	22.0	66.2	0.004	3.182	0.109	0.944

N, sample size; Min TL, minimum values of total length; Max TL, maximum values of total length; a and b, parameters of the equation; SE(b), standard error of b; r^2, coefficient of determination.

The slope b value of length–weight relationships provides useful information on fish growth. It shows isometric growth when b=3, while it indicates positive allometry when b>3, and negative allometry when b<3 (Tarkan et al., 2006). Positive or negative allometry indicates a rounder or slimmer body, respectively, whereas isometric growth shows that the body grows in the same proportion in all dimensions (Jobling, 2008).

The b values varied from 2.274 for *A. alburnus* to 3.213 for *R. rutilus*. Similar results for *R. rutilus* (b 3.270) were found by Tsoumani et al. (2013). In Gruža Reservoir five of the nine analysed species showed negative allometric growth (*A. brama*, *A. alburnus*, *C. auratus*, *C. carpio* and *P. fluviatilis*), and in this case ones become more elongated as it increases in length. Earlier researches reported that negative allometric growth pattern with b value less than 3 exist in *A. brama* (Guettaf et al., 2019) and *A. alburnus* (Lujić et al., 2013). Amdreu-Soler (2006) corroborate the positive allometric growth for *S. lucioperca* reported in our study.

On the other hand, Marinovic et al. (2016), reported that *C. auratus* from the Gruža Reservoir displayed isometric growth which is not in conformity with the current study. This may be possibly due to several factors such as the number of specimens examined, food availability, season and sex

Conclusion

The present study is the first attempt to provide information about lenght-weight relationships of fish species in Serbia, and could give useful insight for management and conservation of these species

Acknowledgement

References

Andreu-Soler A., Olivia-Paterna F.J., Torralva M. (2006). Areview of length-weight relationships of fish from the Segura Siver basin (SE Iberian Penincula). Journal of Applied Ichthyology 22, 295–296.

Bobori D.C., Moutopoulos D.K., Bekri M., Salvarina I., Muñoz A.I.P. (2010). Length–weight relationships of freshwater fish spe-cies caught in three Greek lakes. Journal of Biological Research 14, 219–224.

Carlender K. (1969). Handbook of Freshwater Fishery Biology. Iowa Uniwersity Press, USA, pp. 557.

Froese R. (2006). Cube law, condition factor and weight–length relationships: History, meta-analysis and recommendations. Journal of Applied Ichthyology 22, 241–253.

Guettaf M., Rachedi M., Gueroui Y., Bousbia A., Chelaghmia M., Maoui A. (2019). Age and growth of common bream, *Abramis brma* (L.), caught at Hammam Debagh Reservoir (Guelma, northeast Algeria). Fisheries & Aquatic life 27, 149–158.

Jobling M. (2008). Environmental factors and rates of development and growth. In: Handbook of fish biology and fisheries, Vol. 1: fish biology. P.J. Hart and J. D. Reynolds (Eds). Blackwell Publishing Ltd, Oxford, 97–122.

Kottelat M., Freyhof J. (2007). Handbook of European freshwater fishes. Kottelat, Cornol, Switzerland and Freyhof, Berlin, Germany, pp.646.

Koutrakis E.T. Tsikliras A.C. (2002). Length–weight relationships of fishes from three northern Aegean estuarine systems (Greece). Journal of Applied Ichthyology 19, 258–260.

Le Cren E.D. (1951). The length–weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). Journal of Animal Ecology 20, 201–219.

Lujić J., Kostić D., Bjelić-Čabrilo O., Popović E., Miljanović B., Marinović Z., Marković G. (2013). Ichtyofauna composition and population parameters of fish species from the special nature reserve „Koviljansko–Petrovaradinski rit" (Vojvodina, Srbija). Turkish Journal of Fisheries and Aquatic Sciences 13, 665–673.

Marinović Z., Lujić J., Bolić-Trifunović V., Marković G. (2016). Comparative study of growth in *Carassius gibelio* (Bloch, 1782) and *Rutilus rutilus* (L., 1758) from two Serbian reservoirs: Multi–model analysis and inferences. Fisheries research 173, 11-19.

Marković G. (2011. Introduced (non-native) fish species in Central Serbian Reservoirs. V International Conference „Aquaculture & Fishery", Faculty of Agriculture, Belgrade-Zemun, Serbia, 285-293.

Milošković A., Branković S., Simić V., Kovačević S., Ćirković M., Manojlović D. (2013). The Accumulation and Distribution of Metals in Water, Sediment,

Aquatic Microphytes and Fishes of the Gruža Reservoir, Serbia. Bulletin of Environmental Contamination and Toxicology 90, 563-569

Petrakis G., Stergiou K.I. (1995). Weight–length relationships for 33 fish species in Greek waters Fisheries Research 21(3–4), 465–469.

Ricker W.E. (1975). Computation and interpretation of biological statistics of fish populations. Bulletin fisheries research board of Canada 191, pp. 382.

Simonović P. (2001). Ribe Srbije. NNK International, Beograd. Zavod za zaštitu prirode Srbije i Biološki fakultet Univerziteta u Beogradu, Beograd, pp. 247.

Tarkan A.S., Gaygusuz O., Acıpınar H., Gursoy C., Ozulug M. (2006). Length–weight relationship of fishes from the Marmara region (NW-Turkey). Journal of Applied Ichtyology 22, 271–273.

Tsionki I., Petriki O., Leonardos I.D., Karachle P.K., Stoumboudi M.T. (2021). Length–weight relationships of 6 fish species caught in a Mediterranean lake (Trichonis-NW Greece). Journal of Applied Ichthyology 37, 631–634.

Tsoumani M., Apostolidis A., Leonardos I. (2013). Length-weght relationship of Rutilus species from fifteen Greek lakes. Journal of Applied Ichtyology 29, 297–298.