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Research Article

Length-Weight relationship of 13 fish species from the Lower Sakarya River, Turkey

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ABSTRACT

In this study, a total of 1935 fish samples were collected monthly between June 2017 and May 2018 belonging to 5 families; Cyprinidae, Siluridae, Percidae, Centrarchidae and Esocidae from the lower Sakarya River, Turkish shores of the western Black Sea. Estimation for *b* value of the length-weight relationship ranged between 2.87 (*Carassius gibelio*) and 3.41 (*Alburnus escherichii*). Length–weight estimates and TL_{max} value (18.2 cm) for *A. escherichii* are not available in Fishbase and are first given in this research. Eleven of the evaluated 13 species are commercial for the Sakarya River fishery. The results of this research could be useful for further fishery studies in the lower Sakarya River.

Keywords: Length–weight relationship, Sakarya River, allometric growth, cyprinidae

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INTRODUCTION

Rivers and natural lakes are important ecosystems of our world and cover approximately 2.5% of the earth's surface (Shiklomanov, 1999). Turkey's inland water resources potential can be considered as important because of its position in the world. Turkey has an important inland water fishery potential with 33 rivers (177714 km), 200 natural lakes (900118 ha), 159 dam lakes (342377 ha) and 750 ponds (15500 ha) (FAO, 2015). Despite this potential, the production of inland waters is quite low. Fishery production can be increased by converting un-utilized water resources into production areas or by allowing use. Therefore, there is a need for comprehensive and stock assessment researches on fish populations which have economic importance in our inland waters and other populations to which they are related and their ecological environments. Thus, maximum sustainable yield can be provided without destroying the ecological balance and damaging existing stocks.

As indicated in the many other studies, Length-Weight Relationships (LWRs) have an important role in fish stock management (Kalaycı, Samsun, Bilgin, & Samsun, 2007) and also they are useful for comparing life history and morphological aspects of different populations from other regions (Goncalves et al., 1997). LWRs explain the mathematical correlation between fish length and weight. These relationships are used for conversion of length observations to weight values to provide some measure of biomass (Froese, 1998). In fishery studies, length is easier to record than mass, therefore, if we have a length value, body weight could be determined (Harrison, 2001).

In this study, the Lower Sakarya River region, which is chosen as the study area, has economically benefited as well as being a significant protein source for the local people with its ecology and the fish species it hosts. In this respect, the sustainable management of fishing in the region has great importance. The aim of this study is to contribute to sustainable fisheries

management and literature by revealing the growth characteristics of fish species which have economic importance in the region.

MATERIALS AND METHODS

This study was conducted between June 2017 and May 2018 on the lower Sakarya River, in Turkey. Three sampling locations were chosen in the Sakarya river, Pamukova (1), Adapazarı (2) and Karasu (3) (Figure 1). Data were collected monthly with trammel nets (inner panel: 52-72-88 mm, outer panel: 300 mm; stretched mesh sized), fyke net (140 mm stretched mesh sized, 5 m leader net) and electro shocker (SAMUS 1000; 500W). The sampling areas were sandy-muddy substrates and depths were between 3-10 meters.

The samples were taxonomically identified in the laboratory according to Kuru, (2004); Kottelat & Freyhof, (2007); Geldiay & Balik, (2009). Total lengths were measured with measurement boards (±0.1 cm) and weights were taken with a precision balance (±0,01 g).

The parameters *a* and *b* of relationships of the equation $W = aL^b$ (Ricker 1975) which is estimated through logarithmic transformation; $\log W = \log a + b \log L$

where W is weight (g), L is total length (cm), *a* is the intercept and *b* is the slope of the linear regression. Parameters *a* and *b* were calculated by least-squares regression, as was the coefficient of determination (R^2). 95% confidence limits (CI) of *b* was also estimated (Pauly, 1993). Growth was determined separately for each fish species based on length-weight relationship equations.

RESULTS AND DISCUSSION

A total of 1935 fish samples were collected in this study. 13 fish species belonging to five families, Cyprinidae (78.86%), Siluridae (10.96%), Percidae (5.53%), Centrarchidae (2.38%) and Esocidae (2.27%), were examined. Estimation for *b* value of the length-weight relationship ranged between 2.87 (*C. gibelio*) and 3.41 (*A. escherichii*). The growth type of *A. brama, A. escherichii, Barbus sp., C. carassius, L. gibbosus, R. rutilus, S. erythrophthalmus, V. vimba* was determined as positive allometry (*b*>3) and *C. gibelio, E. Lucius, S. glanis* was determined as negative allometry (*b*<3) whereas *B. bjoerkna* and *P. fluviatilis* showed isometry (*b*=3). Mean condition factor values ranged from 0.59 (*S. glanis*) to 2.27 (*L. gibbosus*). Sample size (N), minimum and maximum lengths, minimum and maximum weights, length-weight relationship parameters (*a* and *b*), standard error of *b* (S_b), the coefficient of determination (R^2), confidence interval (CI) of *b*, growth type of species are presented in Table 1. Additionally, the relationship be-

Figure 1. Study area.

Table 1. Estimated LWR parameters of 13 fish species from the Sakarya River, Turkey

Species	N	TL_{min}-TL_{max}	W_{min}-W_{max}	*a*	*b*	R^2	S_b	%95CI of *b*	Growth type
Abramis brama	143	14.3-53.7	33.35-1977.48	0.0074	3.12	0.97	0.05	3.04-3.21	+A
*Alburnus escherichii**	122	6.5-18.2	1.01-46.84	0.0026	3.41	0.98	0.06	3.34-3.50	+A
Barbus sp.	38	25.3-55.7	163.05-1911.43	0.0042	3.26	0.97	0.05	3.09-3.43	+A
Blicca bjoerkna	547	6.2-30.4	3.15-311.15	0.0101	3.07	0.94	0.07	3.01-3.14	I
Carassius carassius	38	16.1-25.3	83.83-295.94	0.0148	3.12	0.96	0.04	2.91-3.35	+A
Carassius gibelio	179	9.3-32.4	13.76-592.75	0.0264	2.87	0.97	0.06	2.80-2.94	-A
Esox lucius	44	27.2-59.8	153.16-1353.12	0.0097	2.91	0.93	0.06	2.66-3.14	-A
*Lepomis gibbosus**	46	3.9-14.7	0.83-75.74	0.0091	3.37	0.98	0.04	3.25-3.49	+A
Perca fluviatilis	107	11.4-28.7	20.45-370.51	0.0154	2.94	0.93	0.06	2.79-3.09	I
Rutilus rutilus	152	11.2-32.2	14.46-364.67	0.0053	3.27	0.97	0.06	3.20-3.36	+A
Scardinius erythrophthalmus	43	10.2-30.2	13.46-432.41	0.0088	3.15	0.99	0.03	3.05-3.25	+A
Silurus glanis	212	10.7-108.4	8.59-8536.4	0.008	2.91	0.98	0.05	2.87-2.96	-A
Vimba vimba	264	12.3-29.1	20.86-322.61	0.0083	3.09	0.96	0.05	3.02-3.17	+A

*: Non commercial; +A: Positive Allometric; -A: Negative Allometric; I: Isometric

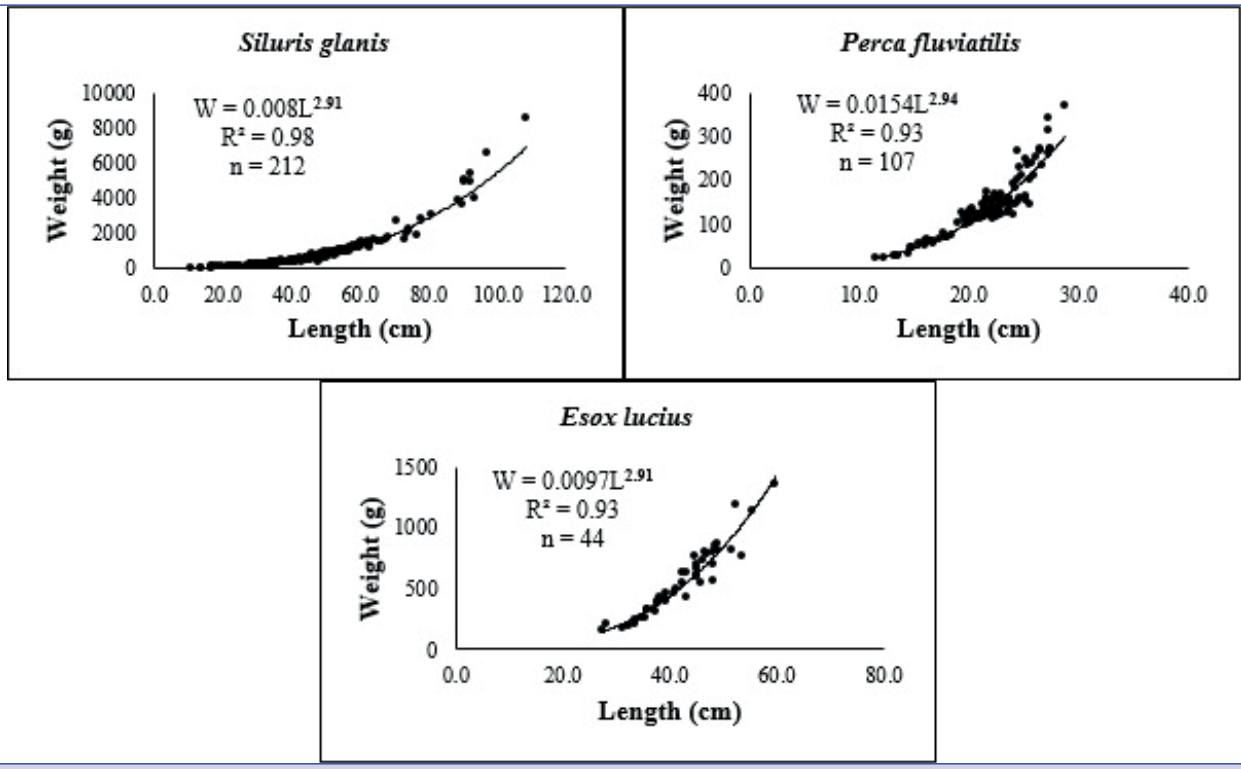

Figure 2. Length–weight relationships ($W=aL^b$) of three commercial fish species from the Sakarya River.

tween total length (TL) and total weight (W) were given for the most commercial fish species *S. glanis, P. fluvitilis,, E. lucius* (Figure 2).

The population parameters such as length-weight relationship (LWR) are one of the most useful parameters of fishery management and have importance in fisheries science. LWR is also important in fisheries management for comparative growth studies (Moutopoulos & Stergiou 2002; Tsoumani, Liasko, Moutsaki,, Kagalou, & Leonardos, 2006).

Length–weight estimates for *A. escherichii* are not available in the Fishbase database and it is first given in this research. Furthermore, the TL_{max} value (18.2 cm) of this study for *A. escherichii* was found to be the highest compared to the Fishbase database.

According to Froese (2006), *b* is expected to range from 2.5 to 3.5, all species analyzed being within this range. In this study, *A. brama*, *A. escherichii, Barbus sp., C. carassius*, *L. gibbosus*, *R. rutilus, S. erythrophthalmus* and *V. vimba* showed positive allometric ($b>3$), *C. gibelio, E. lucius* and *S. glanis* showed negative allometric ($b<3$) and *B. bjoerkna* and *P. fluviatilis* ($b=3$) showed isometric growth. For the 13 species presented in this paper the *b* values were in general agreement with results obtained in other geographical areas (Saç & Okgerman 2016; Tarkan, Gaygusuz, Acıpınar, Gürsoy, & Özuluğ, 2006; Erguden & Goksu, 2009; Bobori, Moutopoulos, Bekri, Salvarina, & Munoz, 2010; Torcu Koç, Aka, & Treer, 2006). In contrast, Kahraman, Göktürk, & Aydın, (2014), studied in the same region, found positive allometric growth for *S. glanis*. These differences may be due to the fish condition, seasonality, sex, gonadal maturity, stomach fullness, length range, amount of sample and sampling method (Haimovici & Velasco, 2000; Teixeira, Silva, Fabré, & Batista, 2017). Thus, there is a need for all researchers worldwide to agree on a standardized fishing method to sample fish for LWR studies.

CONCLUSION

Consequently, the lower Sakarya River is important for the local fishery. Almost no recent information is available for the study area. According to our results, eleven of the evaluated the thirteen fish are commercially important for small-scale fishery. So, these parameters could be useful to maintain a more effective future stock management of the studied species in the lower Sakarya River.

Ethics Committee Approval: Legal research ethics committee approval permissions for the survey were obtained from the Adnan Menderes University, Animal Experiments Local Ethics Committee

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Conflict of Interest: The authors have no conflicts of interest to declare

REFERENCES

Bobori, D. C., Moutopoulos, D. K., Bekri, M., Salvarina, I. & Munoz, A. I. P. (2010). Length-weight relationships of freshwater fish species caught in three Greek lakes. *Journal of Biological Research-Thessaloniki, 14*, 219-224.

Ergüden, S. A. & Göksu, M. Z. L. (2009). Length-weight relationships for 12 fish species caught in Seyhan Dam Lake in southern Anatolia, Adana, Turkey. *Journal of Applied Ichthyology, 25*, 501-502. [CrossRef]

Erkoyuncu, I. (1995). Balıkçılık Biyolojisi ve Populasyon Dinamiği. [Fish Biology and Population Dynamics.] Ondokuz Mayıs University, Faculty of Fisheries Textbook, Sinop, pp. 265.

FAO. (2015). Studies and Reviews. Mediterranean Coastal Lagoons: Sustainable Management and Interactions Among Aquaculture, Capture Fisheries and the Environment. Rome, No:95. ISBN 978-92-5-108792-3

Froese, R. (2006). Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. *Journal of Applied Ichthyology, 22*(4), 241-253. [CrossRef]

Froese, R. (1998). Length-weight relationships for 18 less-studied fish species. *Journal of Applied Ichthyology, 14*, 117-118. [CrossRef]

Geldiay, R. & Balık, S. (2009). Türkiye Tatlısu Balıkları. [Freshwater fish in Turkey.] Ege University, Faculty of Fisheries Textbook, Series:46, VI. Press, Izmir, pp 648.

Goncalves, J. M. S., Bentes, L., Lino, P. G., Ribeiro, J., Canario, A. V. M. & Erzini, K. (1997). Weight-length relationships for selected fish species of the small-scale demersal fisheries of the south and south-west coast of Portugal. *Fisheries Research 30*(3), 253-256. [CrossRef]

Haimovici, M. & Velasco, G. (2000). Length weight relationship of marine fishes from southern Brazil. *Naga, The ICLARM Quarterly, 23*(1), 1–5.

Harrison, T. D. (2001). Length-weight relationships of fishes from South African estuaries. *Journal of Applied Ichthyology*, *17*(1), 46-48. [CrossRef]

Kahraman, A. E., Göktürk, D. & Aydın, E. (2014). Length-Weight Relationships of Five Fish Species from the Sakarya River, Turkey. *Annual Research & Review in Biology, 4* (15), 2476-2483.

Kalaycı, F., Samsun, N., Bilgin, S. & Samsun, O. (2007). Length Weight Relationship of 10 Fish Species Caught by Bottom Trawl and Midwater Trawl from the Middle Black Sea, Turkey. *Turkish Journal of Fisheries and Aquatic Science, 7*(1), 33-36.

Kottelat, M. & Freyhof, J. (2007). Handbook of European Freshwater Fishes. Switzerland: Steven Simpson Books.

Kuru, M. (2004). Türkiye İçsu Balıklarının Son Sistematik Durumu. [Recent systematic status of inland water fishes of Turkey.] *Gazi University Journal of Gazi Educational Faculty, 24*(3), 1-21.

Moutopoulos, D. K. & Stergiou, K. I. (2002). Length-weight and length-length relationships of fish species from Aegean Sea (Greece). *Journal of Applied Ichthyology, 18*(3), 200-203. [CrossRef]

Pauly, D. (1993). Fishbyte section editorial. *Naga, the ICLARM Quarterly, 16*, 26.

Ricker, W. E. (1975). Computation and interpretation of biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada, Bulletin 191, 400p.

Saç, G. & Okgerman, H. (2016). Length-Weight Relationship, Length-Length Relationship and Condition Factor of Some Fish Populations in Büyükçekmece Reservoir (İstanbul, Turkey). *Journal of Limnology and Freshwater Fisheries Research, 2*(1), 43-48. [CrossRef]

Shiklomanov, I. A. (1999). World water resources and their use. St. Petersburg, Russia: State Hydrological Institute/UNESCO.

Tarkan, A. S., Gaygusuz, Ö., Acıpınar, H., Gürsoy, Ç. & Özuluğ, M. (2006). Length-weight relationship of fishes from the Marmara region (NW-Turkey). *Journal of Applied Ichthyology, 22*(4), 271-273. [CrossRef]

Teixeira, E. C., Silva, V. E. L., Fabré, N. N. & Batista, V. S. (2017). Length–weight relationships for four stingray species from the tropical Atlantic Ocean. *Journal of Applied Ichthyology, 33*(3), 594-596. [CrossRef]

Torcu Koç, H., Aka, Z. & Treer, T. (2006). A review of length-weight relationships of fishes from freshwaters of Turkey. *Journal of Applied Ichthyology, 22*(4), 264-270. [CrossRef]

Tsoumani, M., Liasko, R., Moutsaki,, P., Kagalou, I. & Leonardos, I. (2006). Length-weight relationships of an invasivecyprinid fish (*Carassius gibelio*) from 12 Greek lakesin relation to their trophic states. *Journal of Applied Ichthyology, 22*(4), 281-284. [CrossRef]