

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

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Cite this article as: Reis, I., Cerim, H., & Ates, C. (2019). Length-weight relationship of 13 fish species from the Lower Sakarya River, Turkey. *Aquatic Sciences and Engineering*, 34(3), 86-89.

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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Submitted:
16.05.2019

Revision Requested
03.07.2019

Last Revision Received
17.07.2019

Accepted:
28.07.2019

Online published:
00.00.2019

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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), Adapazari (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 ($\pm 0,01$ 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*



Figure 1. Study area.

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-

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

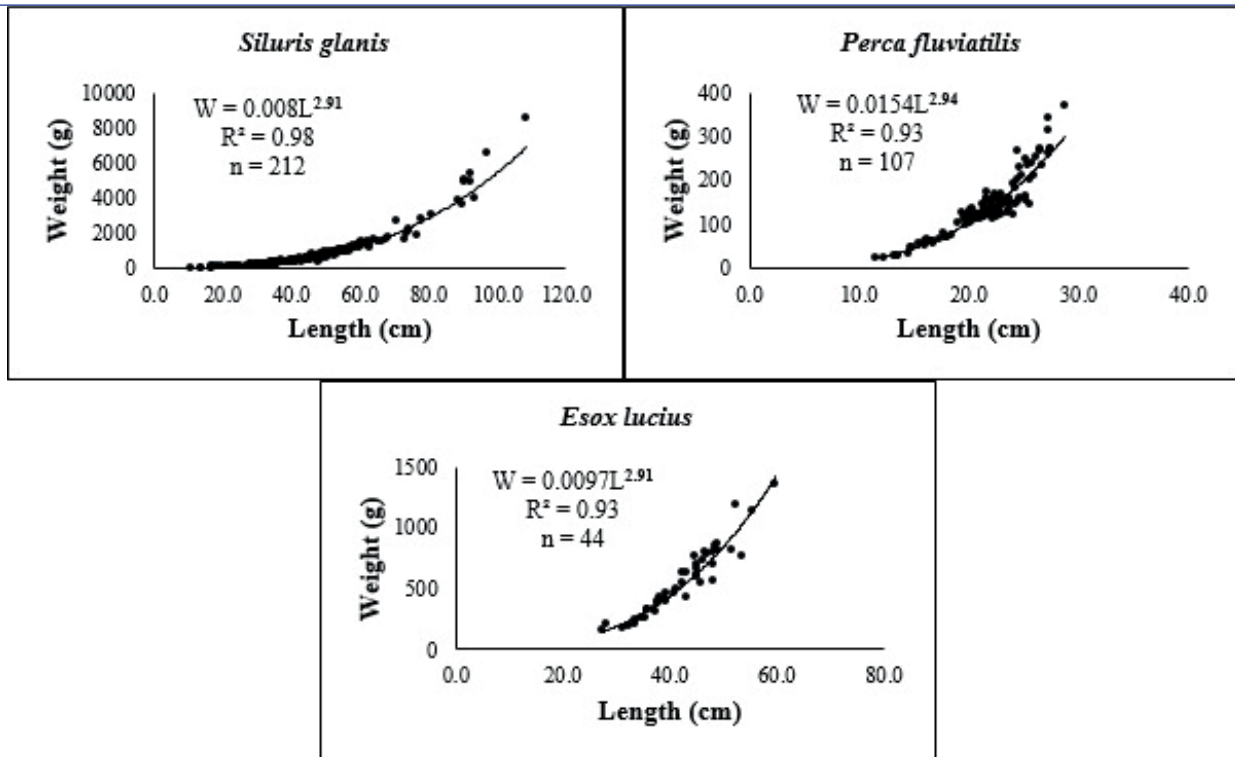


Figure 2. Length-weight relationships ($W=aL^b$) of three commercial fish species from the Sakarya River.

tween total length (TL) and total weight (W) were given for the most commercial fish species *S. glanis*, *P. fluviatilis*, *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, Galagou, & 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, Acipinar, 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, Fabr e, & 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

Acknowledgements: We would like to thank Dr. İrem KÖSE REİS, Alper ALP, Erdinç AYDIN and all the fishermen for their help.

Financial Disclosure: This study was funded by Muğla Sıtkı Koçman University, Scientific Research Project Office with project number 17/073.

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

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