

Short communication

Length–weight relationships of six freshwater fishes from small streams flowing into Lake Sapanca, NW Turkey

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Summary

Length–weight relationships are given on six freshwater fish species (*Phoxinus phoxinus*, *Cobitis vardarensis*, *Neogobius gymnotrachelus*, *Proterorhinus marmoratus*, *Petroleuciscus borysthenicus* and *Gambusia holbrooki*) from four streams flowing into Lake Sapanca, north-western Turkey.

Introduction

In fisheries biology, length–weight relationships are useful for the conversion of growth-in-length equations to growth-in-weight for use in stock assessment models and to estimate stock biomass from limited sample sizes (e.g. Binohlan and Pauly, 1998; Filiz and Bilge, 2004).

To the best knowledge of the authors, no information is available on the length–weight relationship of *Phoxinus phoxinus* and there is only one study on the lake populations of *Cobitis vardarensis*, *Neogobius gymnotrachelus*, *Gambusia holbrooki*, *Petroleuciscus borysthenicus* and *Proterorhinus marmoratus* from Turkey (Tarkan et al., 2006). The aim of the present paper was to present the length–weight relationships for these species from several small streams in Turkey.

Materials and methods

Study site

Lake Sapanca is located in the Marmara region of north-west Turkey (40°41' to 40°30'N, 30°09' to 30°20'E). Thirteen small streams flow into the lake and there is one outlet. These streams show typical Mediterranean climate characteristics with considerable seasonal variation in flow regime and predominantly stony substrates. They are largely unpolluted, although there are several trout farms (Albay et al., 2003).

Sampling and analysis

Between July 2006 and October 2007, specimens of *P. phoxinus*, *G. holbrooki*, *C. vardarensis*, *N. gymnotrachelus*, *P. borysthenicus* and *P. marmoratus* were collected during fish surveys from four streams of Lake Sapanca, namely: the Maşukiye, Mahmudiye, Kurtköy, and Yanık. The fish were captured by electrofishing (Samus 725-G), then preserved in a 5% formaldehyde solution and transported to the laboratory for later examination. In the laboratory, the fish were measured for standard length (SL, from the anterior tip of the upper jaw to

the tip of the hypural bone) to the nearest 1 mm and wet body weight (W_T) to the nearest 0.0001 g.

Data analysis

All LWRs were calculated using linear regression of the log-transformed equation $W = aL^b$, where W is the total weight (g), L is the standard length (cm) and a and b are the parameters of the equation. The 95% confidence limits of b was calculated to indicate deviation from $b = 3.0$. All scientific names were checked in FishBase (Froese and Pauly, 2008).

Results and discussion

Length–weight relationships of 281 specimens of six fish species belonging to four families were calculated. Sample size, size range (cm, SL), length–weight parameters a and b , the 95% confidence limits of b and the correlation coefficient (r^2) are given in Table 1. The three species for which no LWR were found in FishBase (Froese and Pauly, 2008) are highlighted in bold. Cases of allometric growth of exponent b are also indicated with confidence limits in bold.

According to Carlender (1977), values of $b < 2.5$ or > 3.5 are often the consequence of small sample sizes. This was the case for *N. gymnotrachelus* in the present study with $b = 2.44$. Also, variation from isometry with $b \sim 3$ and low correlation coefficient (r^2) may be due to narrow length range, as was the case for *C. vardarensis*.

Tarkan et al. (2006) presented LWRs for 32 freshwater species from several lakes and reservoirs of the Marmara region of Turkey, five of which included herein (*G. holbrooki*, *P. marmoratus*, *N. gymnotrachelus*, *C. vardarensis*, *P. borysthenicus*). The scaling exponent values (b) in the present study are quite similar to those of Tarkan et al. (2006) for *P. borysthenicus* and *C. vardarensis* but considerably lower for two gobiid species (*P. marmoratus* and *N. gymnotrachelus*).

The growth type of *G. holbrooki* was negatively allometric in the present study in contrast to other studies conducted in Mediterranean lakes or large rivers, which report positive allometry for this species (Andreu-Soler et al., 2006; Esmaili and Ebrahimi, 2006; Tarkan et al., 2006). This fish species prefers slow-flowing waters and high vegetation (Rupp, 1997), which do not fit the stream conditions in the present study. *Gambusia holbrooki* is an opportunistic species and feeds on

Table 1

Descriptive statistics and estimated parameters of length–weight relationships ($W = aSL^b$, in g and cm) for 6 fish species caught in streams of Lake Sapanca

Family	Species	n	SL range (cm)	a	b	95% CI of b	r ²
Cyprinidae	<i>Phoxinus phoxinus</i>	132	1.9–5.9	0.0150	3.23	3.23–3.32	0.98
	<i>Petroleuciscus borysthenicus</i>	13	5.1–9.1	0.0136	3.35	3.21–3.49	0.98
Cobitidae	<i>Cobitis vardarensis</i>	11	5.3–7.3	0.0083	3.19	2.61–3.77	0.93
Gobiidae	<i>Neogobius gymnotrachelus</i>	15	5.3–6.1	0.0549	2.44	2.06–2.82	0.98
	<i>Proterorhinus marmoratus</i>	52	1.8–4.9	0.0305	2.85	2.71–2.99	0.97
Poeciliidae	<i>Gambusia holbrooki</i>	58	1.4–3.5	0.0252	2.68	2.54–2.82	0.98

n, sample size; min and max, minimum and maximum standard lengths in cm; a and b, parameters of the relationship; CI of b, confidence interval for parameter b; r², correlation coefficient.

Bold type indicates that LWR not found in FishBase. Allometric growth of exponent b also indicated with confidence limits in bold.

zooplankton, aquatic and surface insects, snails, other fish species and algae (Cabral et al., 1998; Garcia-Berthou, 1999). However, there is no published material on its feeding habits and growth in small temperate streams, thus further research is necessary to explain the factors underlying observed growth variations between different ecosystems. Further, in Turkey *G. holbrooki* has sometimes been misidentified due to its strong physical similarity to *G. affinis* (e.g. Özuluğ et al., 2007).

Phoxinus phoxinus has attracted more research interest as it is a widespread fish species in Europe (Banareescu, 1990). Our results are in accord with other published length–weight relationships showing positive allometric growth for this species (i.e. better growth in terms of weight gain) (Oscoz et al., 2005; Leunda et al., 2006; Prpa et al., 2007).

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