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Technical contribution

Length-weight relationships of 14 fish species from a lowland tropical reservoir in southeastern Brazil

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Summary

The present work reports the length-weight relationships of 14 abundant fish species from a tropical reservoir (Juturnaiba Reservoir), which is the water supply for several municipalities in the northern Rio de Janeiro State, southeastern Brazil. Fishes were collected quarterly in 2006 and 2007 using gillnets of different mesh sizes (15–120 mm stretched mesh) that were set up at sunset and retrieved the following morning, remaining for ca. 15 h. Of the 14 species, eight had no records in the FishBase LWR database; new maximum lengths are given for eight species.

Introduction

Length-weight relations (LWRs) are important components of fisheries biology. They can be used for converting lengths into biomass, determining fish condition, comparing fish growth among areas, and as a complement to species-specific reproduction and feeding studies (Le Cren, 1951; Martin-Smith, 1996; Koutrakis and Tsikliras, 2003; Froese, 2006). In spite of the abundance of ichthyofauna in the tropics, LWR data of many fish species are still unavailable in FishBase (Froese and Pauly, 2015). The present study describes the length-weight relationships of 14 fish species from the Juturnaíba Reservoir, southeastern Brazil.

Materials and methods

The Juturnaíba Reservoir (22°35′–22°41′S; 41°15′–42°19′W) has an area of ca. 43 km^2 with a maximum depth of 8 m. The reservoir is located in lowland areas (water level of ca. 8 m above the sea level) and the dam is about a 70 km distance from the coastline. The surrounding vegetation is degraded, a result of previous agricultural and pasture use. This reservoir supplies most of the water for several municipalities in the North of Rio de Janeiro State, southeastern Brazil.

Fish collections were carried out quarterly between January 2006 and December 2007 at ten sampling sites evenly distributed along the reservoir. A standardized fishing effort was applied at each sampling occasion. Three gill nets (30 × 3 m) with mesh sizes ranging from 15 to 120 mm stretched mesh, covering an area of ca. 270 m^2 were used at each sampling site. The nets were set up at sunset and retrieved the next morning, remaining in operation for approximately 15 h. The collected fishes were fixed in 10% formalin and transferred to 70% ethanol after 24 h for further identification.

Fish species were identified in the laboratory, measured for total length (TL, 0.1 cm) and total weight (W, 0.1 g). The length-weight ($W = a \times TL^b$) relationships of 14 species were estimated by linear regression in the transformed equation: $\log(W) = \log(a) + b \times \log(TL)$ (Le Cren, 1951), where W is the body weight (g), TL is the total length (cm), a is the y-intercept and b is the slope. Prior to regression analysis, log-log plots of W and TL were used to detect and exclude outliers (Froese et al., 2011). Additionally, 95% confidence limits of a and b and the coefficient of determination r^2 were estimated. Comparisons of maximum sizes recorded in previous studies were performed considering the FishBase website (Froese and Pauly, 2015).

Results

A total of 2024 individuals distributed among 14 species and nine families were used to calculate the length–weight relationships. Values of a and b and their related statistics are provided in Table 1. All LWRs were significant ($P < 0.05$) and presented high coefficient of determination (r^2), which ranged from 0.96 to 0.99, revealing a high percentage of explanation of the response variable by the predicted variable. For eight of the species no length-weight relationships were available in FishBase (Froese and Pauly, 2015); the LWR parameters obtained are the first records in the scientific literature. In addition, we report new maximum lengths for eight species (Table 1).

Discussion

The values of b ranged from 2.87 in *Leporinus copelandii* to 3.51 in *Loricariichthys castaneus*. The b values for *Eigemnania virescens* (3.08) and *Centropomus undecimalis* (3.11) were higher than those previously recorded: 2.45 for the former species in Itaipu Reservoir, Southern Brazil (Benedito-Cecilio

Table 1
Length-weight data of 14 species collected in Juturnaiba Reservoir, Rio de Janeiro State, southeastern Brazil

Order/Family	Species	N	Total length range (cm)	Weight range (g)	*a*	95% CL *a*	*b*	95% CL *b*	r^2
Characiformes									
Anostomidae	*Leporinus copelandii* Steindachner, 1875*	16	11.4–**36.7**	16.3–313.8	0.0149	0.0055–0.0400	2.87	2.55–3.19	0.96
Curimatidae	*Cyphocharax gilbert* (Quoy & Gaimard, 1824)*	102	8.8–**24.2**	6.0–241.7	0.0051	0.0038–0.0068	3.37	3.27–3.47	0.98
Erythrinidae	*Hoplias malabaricus* Bloch, 1794	180	11.7–42.9	21.8–979.6	0.0056	0.0041–0.0077	3.22	3.13–3.31	0.97
Characidae	*Oligosarcus hepsetus* (Cuvier, 1829)*	141	10.1–**32.0**	7.5–384.4	0.0045	0.0035–0.0058	3.24	3.15–3.32	0.98
Siluriformes									
Heptapeteridae	*Pimelodella lateristriga* Lichtenstein, 1823*	14	9.0–**15.7**	4.1–29.4	0.0032	0.0014–0.0074	3.26	2.93–3.58	0.98
Loricariidae	*Hypostomus affinis* (Steindachner, 1877)*	22	9.3–38.8	5.7–345.7	0.0069	0.0032–0.0147	3.03	2.60–3.27	0.97
	Loricariichthys castaneus (Castelnau, 1855)*	175	16.2–**39.6**	8.6–266.7	0.0006	0.0004–0.0008	3.51	3.42–3.60	0.97
Gymnotiformes									
Sternopygidae	*Eigenmannia virescens* (Valenciennes, 1836)	10	18.5–**38.5**	10.9–113.6	0.0013	0.0003–0.0057	3.08	2.64–3.53	0.97
Mugiliformes									
Mugilidae	*Mugil curema* (Valenciennes, 1836)	32	21.7–46.0	95.0–944.1	0.0091	0.0051–0.0163	3.00	2.83–3.17	0.98
Percifomes									
Centropomidae	*Centropomus undecimalis* (Bloch, 1792)	17	11.0–38.5	14.8–606.0	0.0069	0.0041–0.0111	3.11	2.94–3.28	0.99
Cichlidae	*Australoheros facetus* (Jenyns, 1842)	10	12.6–19.3	51.4–196.6	0.0227	0.0060–0.0855	3.04	2.54–3.52	0.96
	Cichla kelberi Kullander & Ferreira, 2006[a]	292	4.6–**39.4**	6.5–731.8	0.0072	0.0059–0.0088	3.20	3.13–3.26	0.97
	Crenicichla lacustris (Castelnau, 1855)*	44	10.3–**35.2**	11.3–427.8	0.0043	0.0022–0.0081	3.30	3.09–3.50	0.96
	Geophagus brasiliensis (Quoy & Gaimard, 1824)*	104	6.3–25.5	4.4–352.5	0.0194	0.0145–0.0258	3.02	2.92–3.13	0.97

N, number of individuals; *a,* y-intercept; *b*, allometric coefficient; CL, confidence limit; r^2, coefficient of determination.
Maximum total length greater than reported in FishBase in bold.
[a]Non-native species.
*Data represent first reported length-weight relationship for the species.

et al., 1997), and 2.69–3.04 for the latter species in Laguna de Terminos, Mexico (Carvajal, 1975), Cuba (Alvarez-Lajonchere et al., 1982), Curuçá Estuary in Para State, northern Brazil (Giarrizzo et al., 2006), and coastal lagoons of the Rio de Janeiro State, southeastern Brazil (Franco et al., 2014). Likewise, *Hoplias malabaricus* (b = 3.22) had higher b value than those recorded in Itaipu Reservoir (3.12), Southern Brazil (Benedito-Cecilio et al., 1997), in the Santa Lucia River basin (2.97) in Uruguay (Teixeira-de Mello et al., 2009), and in the Laguna San Miguel del Monte (3.19) in Argentina (Domanico, 1998). On the other hand, *Australoheros facetus* (b = 3.04) and the non-native *Cichla kelberi* (b = 3.20) had similar b values to those recorded in the Santa Lucia River basin (b = 3.09), in Uruguay (Teixeira-de Mello et al., 2009), and in the Lobo Reservoir (b = 3.18), southeastern Brazil (Souza et al., 2008), respectively.

In the current literature (Froese and Pauly, 2015) there are several b values recorded for *Mugil curema* (2.63–3.09), with most records being comparatively lower than in our findings (b = 3.00), possibly due to a high percentage of large specimens in our samples. In our study, all species had b values within the range of 2.50–3.50, as suggested by Pauly and Gayanilo (1997). The only exception was *L. castaneus* with b = 3.51. Moreover, all species showed a values within the range of 0.001–0.05 as reported by Froese (2006), except *L. castaneus* where th intercept value (lower than 0.001) clearly reflected the flat and elongated body shape of this species. It is hoped that this work will be helpful in future ecological studies in the region.

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