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Technical contribution

Length–weight relationships for 25 fish species from three coastal lagoons in Southeastern Brazil

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Summary

This work analyzes the relationship between length and weight for 25 fish species belonging to 15 families in three mixohaline/hypersaline coastal lagoons in Southeastern Brazil. The study presents the first estimation of L–WRs for six species (*Anchoa tricolor*, *Brevoortia aurea*, *Jenynsia multidentata*, *Ctenogobius boleosoma*, *Microgobius meeki* and *Bathygobius soporator*) and maximum lengths for four species (*Atherinella brasiliensis*, *Jenynsia multidentata*, *Poecilia vivipara* and *Microgobius meeki*) that are greater than previously recorded.

Introduction

Weight–length relationships are commonly used in fisheries biology to convert length measures into weight. Although such information is scarce for Brazilian coastal lagoons, this information is necessary for fisheries management in the area as well as for estimation of the biomass of the fish species. The objective of the present study was to establish the weight–length relationships for 25 fish species from three coastal lagoons in Southeastern Brazil. Several fish species use coastal lagoons as part of their life cycle (Yáñez-Arancibia et al., 1994; Blaber, 2002; Keefer et al., 2008). The three lagoons have a well-defined salinity gradient and a narrow sea connection in common. Maricá lagoon has an area of 34.7 km^2 and salinity range between 7 and 35, Saquarema has an area of 21.0 km^2 and a salinity of 16 to 36, and Araruama has an area of 210 km^2 and salinity between 36 and 51.

Materials and methods

Sampling of specimens was conducted in three coastal lagoons (S22°49′~22°57′; W42°03′~42°54′), between February and August 2011. Fishes were caught with a beach seine (10 m long, 2.5 m high, 7.5 mm mesh) at sites randomly chosen and covering the entire lagoons areas. Collected fishes were fixed in 10% formalin for 48 h and preserved in 70% ethanol. All fishes were identified to species, measured for total length (±1 mm precision), and weighed with an electronic scale (±0.01 g precision).

Prior to regression analysis, log-log plots of the length-weight pairs were performed to identify outliers (Froese et al., 2011). Extremes outliers attributed to data error were excluded from the analyses. Length-weight relationships were estimated by linear regression analysis based on logarithms: Log (W) = Log (a) + b × Log (L) where *W* is the weight of the fish (g), *L* is the total length (cm), *a* is a scaling constant, and *b* is a growth parameter (Ricker, 1973). Additionally, 95% confidence limits of *b* and the coefficient of determination r^2 were estimated. The plot of log *a* vs *b* was used to detect and exclude outliers. Comparisons of maximum sizes recorded in previous studies were performed considering the FishBase website (Froese and Pauly, 2012). A Student's *t*-test was used to compare if the calculated *b* values differed significantly ($P < 0.05$) from the value of 3.00.

Results and discussion

A total of 22802 specimens belonging to 25 species and 15 families were used to calculate the length–weight relationships (Table 1). For four species, a maximum length greater than reported by Froese and Pauly (2012) was recorded. For six species no length–weight relationships were available in FishBase (Froese and Pauly, 2012), and the LWR parameters obtained are the first records in the scientific literature (Table 1).

Linear regressions were highly significant for all species ($P < 0.001$). The values of parameter *b* ranged from 2.693 in *Centropomus undecimalis* to 3.547 in *Sardinella brasiliensis*. The mean value for this parameter was calculated as 3.110 (SD: 0.021) and within the range of 2.50–3.50 as suggested by Pauly and Gayanilo (1997). Coefficient of determination values (r^2) was >0.95 in 100% of the species, and ranged from 0.95 to 0.99.

In the current literature (Froese and Pauly, 2012) the *b* values for *Genidens genidens* (range = 3.041–3.280), *Atherinella brasiliensis* (3.183–3.277), *D. rhombeus* (2.983–3.345), and *Centropomus undecimalis* (2.851–3.009) were significantly higher than in our findings, possibly due to a large percentage of small specimens in our samples. On the other hand, *Elops saurus* (2.733–3.187), *Jenynsia multidentata* (3.014–3.106) and *Pogonias chromis* (2.870–3.030) had comparatively lower values (Froese and Pauly, 2012) than our findings. The present study is a preliminary reference on six species and three size records, which is useful information on weight-

Table 1
Descriptive statistics and length-weight relationships (LWR) for 25 fish species in three coastal lagoons, Southeastern Brazil. Parameters of LWR specified (*a* and *b*) by standard error (SE) and Confidence Interval (CI) of *b*. N = sample size, total length (cm) and weight (g), r^2 = coefficient of determination, *Lmax* = reported maximum total length * (cm)

Families/Species	N	Length	Weight	*Lmax*	*a*	*b*	SE (*b*)	CI 95% (*b*)	r^2	Life stage
Elopidae										
Elops saurus	117	3.6–16.0	0.06–14.26	100	0.002	3.206	0.049	3.109–3.303	0.97	J/A[2]
Engraulidae										
Anchoa januaria	5436	1.1–10.2	0.01–7.1	7.5	0.010	3.418	0.010	3.397–3.493	0.95	J/A[8]
Anchoa tricolor[b]	13	4.6– 9.8	0.63–6.19	11.8	0.007	3.016	0.121	2.750–3.281	0.98	J/A[1]
Clupeidae										
Harengula clupeola	213	2.1– 11.1	0.05–12.01	18	0.004	3.267	0.053	3.163–3.372	0.95	J/A[1]
Sardinella brasiliensis	118	2.6–5.4	0.06–1.29	25*	0.003	3.547	0.075	3.396–3.697	0.95	J[1]
Opisthonema oglinum	660	2.6–12.6	0.1–14.72	38	0.002	3.371	0.031	2.678–3.062	0.95	J/A[9]
Brevoortia aurea[b]	1467	1.9–12.0	0.03–13.56	26*	0.006	3.111	0.022	3.068–3.153	0.98	
Ariidae										
Genidens genidens	579	3.7–24.5	0.47–77.54	35	0.008	2.871	0.026	2.819–2.922	0.95	J/A[6]
Mugilidae										
Mugil curema	1005	2.1–37.8	0.07–309.2	90	0.012	2.919	0.019	2.882–2.957	0.96	J/A[4]
Atherinopsidae										
Atherinella brasiliensis[a]	7164	1.0–**17.7**	0.01–33.52	16	0.005	3.013	0.008	2.997–3.028	0.95	J/A[1]
Hemiramphidae										
Hyporhamphus unifasciatus	94	6.2– 20.2	0.45–20.2	30	0.001	3.230	0.056	3.119–3.342	0.97	J/A[9]
Anablepidae										
Jenynsia multidentata[a.b]	1271	1.1– **8.8**	0.01– 8.19	6.5*	0.008	3.217	0.018	3.216–3.290	0.96	J/A[10]
Poeciliidae										
Poecilia vivipara[a]	318	1.1– **6.0**	0.01–3.27	4	0.008	3.368	0.038	3.294–3.443	0.96	J/A[7]
Centropomidae										
Centropomus undecimalis	29	3.2–17.2	0.27–32.6	140	0.014	2.693	0.115	2.456–2.930	0.95	J[13]
Gerreidae										
Diapterus rhombeus	747	2.0–10.0	0.09–11.3	40	0.012	2.902	0.025	2.852–2.952	0.95	J/A[5]
Eucinostomus argenteus	597	1.6–14.5	0.04–36.3	20	0.009	3.031	0.021	2.989–3.073	0.97	J/A[5]
Eucinostomus gula	29	4.0–11.2	0.61–20.59	23	0.008	3.178	0.091	2.992–3.364	0.98	J/A[5]
Sciaenidae										
Micropogonias furnieri	158	2.1–13.0	0.06–16.85	60	0.008	2.934	0.051	2.834–3.034	0.96	J[11]
Pogonias cromis	15	2.1–18.1	0.06–90.78	170	0.005	3.330	0.037	3.250–3.410	0.99	J[3]
Cichlidae										
Oreochromis niloticus	25	1–7.9	0.02–8.57	60*	0.017	2.870	0.092	2.678–3.062	0.98	J/A[12]
Gobiidae										
Ctenogobius boleosoma[b]	97	1.6–5.5	0.03–1.2	7.5	0.005	3.136	0.069	2.998–3.273	0.96	
Gobionellus oceanicus	27	2.3–17.5	0.06–20.82	30	0.005	2.870	0.110	2.640–3.098	0.96	J/A
Microgobius meeki[a.b]	291	1.4–**6.9**	0.02–1.45	5.4	0.005	2.937	0.039	2.859–3.015	0.95	
Bathygobius soporator[b]	25	3.3–11.9	0.38–20.84	15	0.010	3.117	0.088	2.935–3.298	0.98	J/A[1]
Achiridae										
Achirus lineatus	322	1.8–10.4	0.08–19.06	23	0.010	3.204	0.035	3.135–3.273	0.96	J[1]

[1]Felix et al. (2006); [2]McBride (2004); [3]Murphy and Taylor (1989); [4]Oliveira (2010); [5]Araújo et al. (1999); [6]Rocha and Freire (2009); [7]Mendonça and Andreata (2001); [8]Santos et al. (2007); [9]Powell et al. (2007); [10]Goyenola et al. (2011); [11]Gomez and Guzman (2005); [12]Duponchelle and Panfili (1998); [13]Perera-García et al. (2010).
[a]Species with a maximum length greater than previously recorded (Froese and Pauly, 2012).
[b]LWRs published for first time in scientific literature or databases up to August 2012 (Froese and Pauly, 2012).
Bold indicates maximum size data.

length relationships of species from coastal lagoons in the Southeastern Brazil.

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References

Araújo, F. G.; Gomes, I. D.; Bertoldo, I. C., 1999: Sexual ratio and reproductive period of three *Mojarras* species (Osteichthyes, Perciformes) in the Sepetiba Bay, RJ. Rev. Bras. Med. Vet. **21**, 207–210.

Blaber, S. J. M., 2002: 'Fish in hot water': the challenges facing fish and fisheries research in tropical estuaries. J. Fish Biol. **61**, 1–20.

Duponchelle, F.; Panfili, J., 1998: Variations in age and size at maturity of female Nile tilapia, *Oreochromis niloticus*, populations from man-made lakes of Côte d'Ivoire. Environ. Biol. Fishes **52**, 453–465.

Felix, F. C.; Spach, H. L.; Hackradt, C. W.; Moro, P. S.; Rocha, D. C., 2006: Seasonal abundance and composition of fish assemblage in two estuarine beaches in Paranaguá's Bay. Paraná. Rev. Bras. Zoociências **8**, 35–48.

Froese, R.; Pauly, D., 2012: FishBase, 2011. World Wide Web electronic publication. http://www.fishbase.org (accessed on 21 August 2012).

Froese, R.; Tsikliras, A. C.; Stergiou, K. I., 2011: Editorial note on weightlength relations of fishes. Acta Ichthyol. Piscat. **41**, 261–263.

Gomez, G.; Guzman, R., 2005: Reproductive aspects and population dynamics of whitemouth croaker, *Micropogonias furnieri*, in the Gulf of Paria, Sucre state. Venezuela. Zootecnia Trop. **23**, 69–90.

Goyenola, G.; Iglesias, C.; Mazzeo, N.; Jeppesen, E., 2011: Analysis of the reproductive strategy of *Jenynsia multidentata* (Cyprinodontiformes, Anablepidae) with focus on sexual differences in growth, size, and abundance. Hydrobiologia **673**, 245–257.

Keefer, M. L.; Peery, C. A.; Wright, N., 2008: Evaluating the NOAA Coastal and Marine Ecological Classification Standard in estuarine systems: A Columbia River Estuary case study. Estuar. Coast. Shelf Sci. **78**, 89–106.

McBride, R. S., 2004: Mechanisms maintaining sympatric distributions of two ladyfish (Elopidae: *Elops*) morphs in the Gulf of Mexico and western North Atlantic Ocean. Limnol. Oceanogr. **49**, 1173–1181.

Mendonça, J. P.; Andreata, J. V., 2001: Reproductive aspects of *Poecilia vivipara* (Bloch & Schneider) Poeciliidae of Rodrigo de Freitas Lagoon, Rio de Janeiro. Brazil. Rev. Bras. Zoo. **18**, 1041–1047.

Murphy, M. D.; Taylor, R. G., 1989: Reproduction and growth of black drum, *Pogonias cromis*, in Northeast Florida. Northeast Gulf Sci. **10**, 127–137.

Oliveira, M. R., 2010: Reproductive biology of Mullet, Mugil curema Valenciennes, 1836 (Osteichthyes: Mugilidae) in the coastal waters of the Rio Grande do Norte. UFRN, Natal, RN, pp. 71.

Pauly, D.; Gayanilo, F. C. Jr, 1997: A Bee: an alternative approach to estimating the parameters of a length-weight relationship from length-frequency samples and their bulk weights. NAGA ICLARM, Manila, Philippines.

Perera-García, M. A.; Mendonza-Carranza, M.; Contreras-Sánchez, W. M.; Huerta-Ortíz, M.; Pérez-Sánchez, E., 2010: Reproductive biology of common snook *Centropomus undecimalis* (Perciformes: Centropomidae) in two tropical habitats. Rev. Biol. Trop. **59**, 669–681.

Powell, A. B.; Thayer, G.; Lacroix, M.; Cheshire, R., 2007: Juvenile and small resident fishes of Florida Bay, a critical habitat in the Everglades National Park, Florida. NOAA Professional Paper NMFS 6, pp. 210.

Ricker, W. E., 1973: Linear regressions in fisheries research. J. Fish. Res. Board Can. **30**, 409–434.

Rocha, G. R. A.; Freire, K. M. F., 2009: Biology and dominance relationships of the main fish species in the Lake Encantada, Ilhéus. Brazil. Acta Limnol. Bras. **21**, 309–316.

Santos, J. N. S.; Araújo, F. G.; Silva, M. A.; Vasconcellos, R. M., 2007: Sex ratio and sexual dimorphism of the anchovy *Anchoa januaria* (Actinopterygii, Engraulidae) in a tropical bay in southeastern Brazil. J. Fish Biol. **71**, 877–888.

Yáñez-Arancibia, A.; Dominguez, A. L. L.; Pauly, D., 1994: Coastal lagoons as fish habitats. In: Coastal Lagoon Processes. B. Kjerfve (Ed) Elsevier Sciences Publishers, Amsterdam, pp. 363–376.

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