ISSN 0374-5686
s-ISSN 2526-7639
http://dx.doi.org/10.32360/acmar.v51i1.19835

NOTAS CIENTÍFICAS

Arquivos de Ciências do Mar

ICHTHYOFAUNA OF THE ESTUARIES OF THE CRICARÉ RIVER: LENGTH-WEIGHT RELATIONSHIP

Ictiofauna dos estuários do Rio Cricaré: relação peso-comprimento

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ABSTRACT

This work presents the length-weight relationship of 25 fish species. The collections were carried out monthly from 2010 to 2011 using bottom trawls in the estuaries of the Cricaré River, Espirito Santo state, Brazil.

Keywords: fishes, coastal zone, Espírito Santo, Brazil

RESUMO

Este trabalho apresenta a relação peso-comprimento de 25 espécies de peixes. As coletas foram realizadas mensalmente de 2010 a 2011, utilizando redes de arrasto em estuários do rio Cricaré, Espírito Santo, Brasil.

Recebido em: 08/09/2017
Aprovado em: 15/03/2018
Publicado online em: 05/09/2018

Palavras-chave: *peixes, zona costeira, Espírito Santo, Brasil.*

INTRODUCTION

Length-weight relationship studies are used in fishery biology and in fish management because they permit weight estimates from length data and vice versa (Froese, 2006), comparison of spatial and temporal differences between populations or species, and determination of the condition factor (Viana *et al*., 2004). The parameters of this relationship (*a* and *b*) vary according to sex, body size, time and space, and variations in the population structure, food availability and fishery pressure may result in different length-weight relationships for the same species (Giacalone *et al*., 2010).

Considering the differences between the two estuaries, the objective of the present study was to identify possible changes in the relationship between length and weight of analyzed fish.

MATERIALS AND METHODS

Study area

The Cricaré River basin (northern Espírito Santo state) covers an area of about 13,500 km^2 and is formed by the Cotaxé and Cricaré rivers, whose headwaters are found in Minas Gerais state, and meet in the municipality of São Mateus (Espírito Santo state). The Cricaré River flows north and drains into the Atlantic Ocean in the municipality of Conceição da Barra (Espírito Santo state) (Silva *et al*., 2005), while the Mariricu River (tributary of the Cricaré River) flows south and drains into the community of Barra Nova in the municipality of São Mateus, and forms the Barra Nova estuary. From this point, the two estuaries are clearly different: while the estuary to the north (39º43'56.3"W / 18º35'59.8"S) is characterized by, mainly, red mangrove (*Rhizophora mangle*) and white mangrove (*Laguncularia racemosa*) forests (Silva *et al*., 2005), the estuary to the south (39º44'47.5"W / 18º57"05.3"S) is formed by black mangrove (*Avicennia schaueriana* and *A. germinans*) forests in the upper course, mixed (*R. mangle, L. racemosa* and *A. schaueriana*) in the middle course and red (*R. mangle*) in the lower course (Petrobras, 2007).

The estuaries of the Cricaré River present semidiurnal tides. The tidal mean was 0.78 m (mean interval between -0.04 and 1.51 m in the study period, Marinha, 2011). The climate is tropical wet, typical of intertropical regions, and a rainy period in the summer and dry period between April and September.

Data collection

The present work was developed in the estuaries of the Cricaré River (Conceição da Barra to the north and São Mateus/Barra Nova to the south) between September 2010 and October 2011. Three five-minute bottom trawls (with 2.8 m mouth opening by 3.90 m length) (mesh – body: 3.9 cm and bag: 2.2 cm) (mean velocity: 2.9 km/h) were carried out monthly in each of the four areas chosen in each estuary.

All of the collected material was separated into plastic bags by site and sample, refrigerated and sent to the zoology laboratory of the Centro Universitário Norte do Espírito Santo (UFES) for identification and biometry. The identification of the fish was done to the lowest taxonomic level possible, based on Figueiredo & Menezes (1978, 1980,

2000), Menezes & Figueiredo (1980, 1985), Barletta & Corrêa (1992) and the consultation of specialists. The biometry was carried out using a digital scale (± 0.01g) and a portable ichthyometer (± 1.0 mm).

Data analyses

The total length (TL) (mm) and weight (W) (g) data of each fish with a capture number ≥5 per species and estuary (Conceição da Barra and Barra Nova) were log-transformed in order to identify possible outliers. The constant of the linear equation (*a*) and the allometric coefficient (*b*) were obtained using linear regression analyses (log W= log *a* +*b* log TL), with the TL and W data log-transformed. The coefficient of determination (r^2) was used as an indicator of the quality of the linear regression (Joyeux et al., 2009). Student's *t*-test ($p<0.05$) was applied to verify if *b* differed significantly from 3.0 (thus defining the type of growth: isometric or allometric), as well as detect significant differences between the coefficients of the 13 species common to the two estuaries (Le Cren, 1951, Zar, 1984).

RESULTS

A total of 25 species (13 occurring in both estuaries, nine exclusively in Conceição da Barra and three only in Barra Nova) was analyzed. As regards the species that occurred in both estuaries, the coefficient of determination (r^2) varied from 0.8183 (*Cetengraulis edentulus*) to 0.9930 (*Bairdiella ronchus*). In respect of the species exclusive to Barra Nova and Conceição da Barra, r^2 varied from 0.8011 (*Gobioides broussonnetii*) to 0.9860 (*Archosargus protabocephalus*), and 0.6618 (*Cyclichthys spinosus*) to 0.9948 (*Lutjanus jocu*), respectively. The values of *b* varied from 2.5742 in *Centropomus parallelus* to 3.5174 in *Rypticus randalli* for species common to both estuaries, from 2.4716 (*C. spinosus*) to 3.2429 (*Stellifer rastrifer*) for species present only in Conceição da Barra and from 2.0810 (*Gobioides broussonnetii*) to 3.2185 (*Centropomus undecimalis*) for species occurring only in Barra Nova (Tables 1 and 2).

Of the 13 species present in both estuaries, isometric growth was observed in seven species and positive allometric growth in one. On the other hand, *Centropomus parallelus*, *Cetengraulis edentulus*, *Micropogonias furnieri*, *Rypticus randalli* and *Symphurus tessellatus* presented different type of growth in each estuary (Tables 1 and 2). Of the three species caught only in the estuary of Barra Nova, one presented isometric growth, one positive allometric growth and one negative allometric growth (Table 2), while between nine species caught only in the estuary of Conceição da Barra, four present isometric growth, four negative allometric growth and one positive allometric growth (Table 1). The length-weight relationship data of *Polydactylus oligodon* are available only for Colombia.

Table 1 - Species and parameters of the length- weight relationships of fishes in the estuary of Conceição da Barra (Espírito Santo state). Data in bold refer to the species that occurred only in the estuary of Conceição da Barra (I: isometric; A+: positive allometric; A- : negative allometric).

Species	N	TL (mm) min-max	a	TL 95% inf.	TL 95% sup.	b	TL 95% inf.	TL 95% sup.	r^2	Grow
Achirus declivis	207	39-180	-4.9338	-5.0384	-4.8291	3.1170	3.0639	3.1702	0.9849	I
Achirus lineatus	89	42-114	-4.8830	-5.0909	-4.6751	3.0870	2.9794	3.1946	0.9739	I
Bairdiella ronchus	35	77-208	-5.2466	-5.4470	-5.0463	3.1660	3.0716	3.2604	0.9930	I
Caranx latus	**21**	**36-115**	**-4.2123**	**-4.4973**	**-3.9274**	**2.6796**	**2.5259**	**2.8333**	**0.9851**	**A-**

(continuation Table 1)

Cathorops spixii	65	112-250	-4.9498	-5.2586	-4.6410	2.9847	2.8465	3.1229	0.9673	I
Centropomus parallelus	15	135-269	-4.0838	-5.0035	-3.1641	2.5742	2.1691	2.9794	0.9355	A-
Cetengraulis edentulus	57	112-162	-5.8015	-6.7204	-4.8826	3.3441	2.9183	3.7700	0.8183	I
Citharichthys spilopterus	113	72-165	-5.3909	-5.6556	-5.1261	3.1453	3.0125	3.2781	0.9520	I
Cyclichthys spinosus	**47**	**60-86**	**-3.1284**	**-4.1073**	**-2.1494**	**2.4716**	**1.9472**	**2.9959**	**0.6618**	**A-**
Cynoscion acoupa	59	51-287	-5.2511	-5.4184	-5.0839	3.0744	2.9946	3.1542	0.9905	I
Diapterus rhombeus	1151	40-195	-5.1954	-5.2759	-5.1149	3.1717	3.1298	3.2136	0.9505	A+
Lagocephalus laevigatus	**24**	**38-175**	**-4.9403**	**-5.4008**	**-4.4798**	**3.1641**	**2.9173**	**3.4109**	**0.9698**	**I**
Lutjanus jocu	**15**	**76-210**	**-4.6757**	**-4.9554**	**-4.3960**	**2.9612**	**2.8334**	**3.0889**	**0.9948**	**I**
Micropogonias furnieri	41	89-165	-5.1225	-5.3066	-4.9383	3.0552	2.9680	3.1424	0.9923	I
Mugil curema	**15**	**153-312**	**-4.2524**	**-4.7333**	**-3.7715**	**2.6709**	**2.4627**	**2.8790**	**0.9834**	**A-**
Polydactylus oligodon	**21**	**112-192**	**-5.2904**	**-5.9335**	**-4.6474**	**3.1228**	**2.8268**	**3.4188**	**0.9625**	**I**
Pseudauchenipterus nodosus	**48**	**82-131**	**-4.8585**	**-5.5232**	**-4.1938**	**2.9579**	**2.6279**	**3.2880**	**0.876**	**I**
Rypticus randalli	25	105-164	-4.7132	-5.4629	-3.9636	2.9347	2.5841	3.2854	0.9287	I
Selene vomer	**23**	**42-163**	**-4.1467**	**-4.4379**	**-3.8554**	**2.6453**	**2.4946**	**2.7960**	**0.9845**	**A-**
Sphoeroides testudineus	237	54-238	-4.6457	-4.8292	-4.4622	3.0000	2.9158	3.0841	0.9545	I
Stellifer rastrifer	**79**	**53-163**	**-5.4199**	**-5.5760**	**-5.2638**	**3.2429**	**3.1635**	**3.3222**	**0.9885**	**A+**
Symphurus tessellatus	45	99-195	-5.8434	-6.0924	-5.5943	3.3399	3.2263	3.4535	0.9879	A+

Table 2 - Species and parameters of the length- weight relationships of fishes in the estuary of Barra Nova. Data in bold refer to the species that occurred only in the estuary of Barra Nova (I: isometric; A+: positive allometric).

Species	N	TL (mm) min-max	a	TL 95%		b	TL 95%		r^2	Grow.
				inf.	sup.		inf.	sup.		
Achirus declivis	120	43-110	-4.6898	-4.9830	-4.3967	2.9742	2.8156	3.1328	0.9212	I
Achirus lineatus	32	40-75	-4.6491	-5.1850	-4.1131	2.9504	2.6473	3.2534	0.9295	I
Archosargus probatocephalus	**36**	**82-186**	**-4.8138**	**-5.0784**	**-4.5491**	**3.0572**	**2.9300**	**3.1843**	**0.9860**	**I**
Bairdiella ronchus	156	96-210	-5.2519	-5.4338	-5.0701	3.1543	3.0714	3.2373	0.9734	A+
Cathorops spixii	14	174-224	-5.3505	-6.2760	-4.4249	3.1357	2.7352	3.5363	0.9604	I
Centropomus parallelus	94	99-419	-5.0998	-5.2891	-4.9106	3.0256	2.9419	3.1093	0.9825	I
Centropomus undecimalis	**31**	**167-417**	**-5.6747**	**-5.1287**	**-6.2207**	**3.2185**	**2.9920**	**3.4450**	**0.9668**	**A+**
Cetengraulis edentulus	34	79-194	-6.0034	-6.7315	-5.2752	3.4353	3.0929	3.7776	0.9288	A+
Citharichthys spilopterus	24	65-180	-5.1418	-5.5832	-4.7005	3.0156	2.7997	3.2316	0.9744	I
Cynoscion acoupa	32	36-414	-5.3044	-5.5535	-5.0552	3.0915	2.9676	3.2154	0.9886	I
Diapterus rhombeus	407	50-192	-5.5794	-5.6660	-5.4929	3.3518	3.3100	3.3935	0.9840	A+
Gobioides broussonnetii	**75**	**244-488**	**-3.4728**	**-4.0880**	**-2.8577**	**2.0810**	**1.8391**	**2.3229**	**0.8011**	**A-**
Micropogonias furnieri	114	71-202	-5.4465	-5.6588	-5.2343	3.1933	3.0930	3.2935	0.9726	A+
Rypticus randalli	44	65-172	-5.9586	-6.5171	-5.4000	3.5174	3.2555	3.7794	0.9446	A+
Sphoeroides testudineus	182	50-231	-4.7864	-4.9289	-4.6439	3.0485	2.9807	3.1163	0.9775	I
Symphurus tessellatus	19	117-150	-5.1831	-6.1247	-4.2415	3.0070	2.5586	3.4553	0.9217	I

DISCUSSION

The results demonstrated high coefficients of determination for the fish in the estuaries of the Cricaré River, which indicated the effective relationship between growth (length) and weight gain in these fish. However, it should be emphasized that the type of growth determined by the length-weight relationships referred to the site and time of the study, as a series of factors influenced the ontogenetic development of the ichthyofauna (Froese, 2006). Perhaps this was the reason *C. parallelus*, *C. edentulus*, *M. furnieri*, *R. randalli* and *S. tessellatus* presented a different type of growth in each estuary. This shows that although this study has covered, in every season, different oceanographic conditions and the composition of the vegetation of the estuaries of Barra Nova and Conceição da Barra, these factors were insufficient to demonstrate differences in the type of growth of seven

species. Therefore, future analyses should consider other factors such as sex, gonodal maturity and diet (among others).

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