ISSN 0374 - 5686

Arquivos de Ciências do Mar

# WEIGHT-LENGTH RELATIONSHIP OF DEMERSAL FISH OF BAIA SUL, FLORIANÓPOLIS, SANTA CATARINA STATE, BRAZIL

## Relação peso-comprimento dos peixes da Baía Sul, Florianópolis, Santa Catarina, Brasil

**Ana Carolina dos Passos[1], Beatriz Fernanda Chinchilla Cartagena[2], Mauricio Hostim-Silva[3], Matheus Oliveira Freitas[4], Henry Louis Spach[5]**

[1] Universidade Federal do Espírito Santo, Programa de Pós-Graduação em Oceanografia Ambiental, Departamento de Oceanografia. CEP 29075910, Vitória, ES, Brasil. Email: anapassosoc@gmail.com

[2] Universidade Federal do Pará, Pós Graduação em Biologia Ambiental, Instituto de Estudos Costeiros. CEP 68600000, Bragança, PA, Brasil. E-mail: bfccartagena@gmail.com

[3] Universidade Federal do Espírito Santo - CEUNES – DCBA - Rodovia BR 101 Norte, Km. 60 - CEP 29932-540 - São Mateus/ES – Brasil. E-mail: mhostim@gmail.com

[4] Programa de Pós Graduação em Ecologia e Conservação. Setor de Ciências Biológicas, Universidade Federal do Paraná. Caixa Postal 19031, CEP 81531-980, Curitiba, PR. E-mail: serranidae@gmail.com

[5] Universidade Federal do Paraná - Setor de Ciências da Terra - Centro de Estudos do Mar. Av. Beira Mar, s/n - Pontal do Sul – CEP 83255-000 - Pontal do Paraná/PR – Brasil. E-mail: henry@ufpr.br

## *ABSTRACT*

*This work presents the weight-length relationship of 35 species of fish belonging to 27 families. The samples were carried out bimonthly from 2001 to 2003 using seines in Saco dos Limões, Baia Sul, Florianópolis, Santa Catarina state, Brazil. The total weight (TW) and total length (TL) data of the species with n ≥ 30 were log-transformed and plotted graphically to identify and remove outliers. The regression analysis was performed to define parameters a and b, from which the weight-length relationship of each species was verified. Growth type determination were classified according to three types: isometric (19 species), positive allometric (12) and negative allometric (4). The weight-length relationship estimate of two species is presented for the first time in Brazil, bringing new information on the life history of species, as well as important results for the evaluation of regional fishery.*

***Key-words:*** *demersal fish, LWR, South Brazil.*

## RESUMO

Este trabalho apresenta a relação peso-comprimento de 35 espécies pertencentes a 27 famílias. As coletas foram realizadas mensalmente entre 2001 e 2003 com redes de arrasto no Saco dos Limões, Baía Sul, Florianópolis (SC), Brasil. O peso total e o comprimento total das espécies com n ≥ 30 sofreram transformação logarítmica e foram plotados graficamente

Recebido: 5 set 2016
Aceito: 16 abr 2017
Publicado online: 31 mai 2017

para identificação e remoção de outliers. Uma análise de regressão foi realizada para definir os parâmetros *a* e *b*, a partir dos quais a relação peso-comprimento de cada espécie foi estimada. A determinação do crescimento foi classificada em: isométrica (19 espécies), alométrica-positiva (12 espécies) e alométrica-negativa (4 espécies). A relação peso-comprimento para duas espécies encontradas neste estudo é inédita no Brasil, trazendo novas informações sobre a história de vida das espécies, além de resultados importantes para a avaliação da pesca regional.

**Palavras-chave:** ictiofauna, relação peso-comprimento, sul do Brasil.

## INTRODUCTION

Weight-length relationships are important in ecological studies (Vallisneri *et al.*, 2010) because they furnish information about the life history of species, contribute to regional fishery evaluation (Nieto-Navarro *et al.*, 2009) and permit the calculation of the production and biomass of fish populations (Giacalone *et al.*, 2010). Parameters *a* and *b* were obtained through linear regression, and in biological terms, represent the condition factor (Mortuzza *et al.*, 2006) and the growth type of the fish, respectively. When near 3, the allometric coefficient (*b*) indicates isometric growth (Froese, 2006).

As regards fish caught off the coast of Brazil using bottom trawling, weight-length relationships are described in the north-northeastern coast (Cordovil & Camargo, 2007; Romero *et al.*, 2008; Freire *et al.*, 2009; Joyeux *et al.*, 2009) and in the south-southeastern coast (Giannini & PaivaFilho, 1990; Bernardes & Rossi, 2000; Haimovici & Velasco, 2000; Muto *et al.*, 2000; Araújo & Vicentini, 2001; Almeida & Branco, 2002; Santos, 2004; Vianna *et al.*, 2004; Souza-Conceição *et al.*, 2005; Frehse, 2009; Joyeux *et al.*, 2009; Freitas *et al.*, 2010; Haluch *et al.*, 2011). This study furnishes the weight-length relationships of 44 fish species collected in Baia Sul, Florianópolis, Santa Catarina state, with weight-length relationship estimate of two species for the first time in Brazil.

## MATERIAL AND METHODS

This study was carried out in Saco dos Limões, Baia Sul, Florianópolis, on the central coast of Santa Catarina state (27º37'31.07"S; 48º32'12.80"W). Bimonthly samples were carried out from February 2001 to December 2003 during the day and at night at six sampling sites, for a total of 216 samples distributed equally between day and night (bottom trawling – meshes: 12 and 14 mm; length: 4.5 m; mouth width: 7.5 and 9 m in the upper and lower parts, respectively).

The specimens were preserved in ice and transported to the laboratory of Environmental Science of Vale do Itajaí (UNIVALI), where they were identified using the dichotomic keys of Figueiredo & Menezes (1978; 1980; 1985; 2000) and Fischer (1978). Weighing was carried out using a digital scale (precision 0.01 g) and total length (TL) measured (in cm) using an ichthyometer. The adopted growth model was log-transformed ($\log W = \log a + b^* \log TL$), where W is the weight in grams and TL the total length in centimeters; *a* is the constant and *b* the allometric coefficient (King, 1995; Froese, 2006). These last two were estimated using a linear regression analysis of the log-transformed data (Giacalone, 2010) (Excel 2007). In order to verify if *b* was different

from the isometric value ($b$ = 3), a t-test was applied with a confidence interval of ±95% ($\alpha$ = 0.05) (Sokal & Rohlf, 1987).

## RESULTS

A total of 35.303 fish, belonging to 35 species and 27 families, was evaluated. The number of individuals varied from 37 (*Mycteroperca microlepis*) to 10.970 (*Genidens genidens*). As regards two species (*Catathyridium garmani* and *Oligoplites saliens*), as far as could be determined, this is the first work to publish length-weigth relationship data and for two species (*Archosargus rhomboidalis and Mycteroperca microlepis*) this relationship is presented for the first time in Brazil (Table 1).

The smallest lengths found for *Diplectrum radiale* (7.5 cm) in Viana *et al.* (2004), *Genidens genidens* (8.3 cm) in Joyeux *et al.* (2009), *Orthopristes ruber* (5.5 cm) in Santos *et al.* (2004) were larger than the ones found for these species in Baia Sul (6.3 cm, 4.2 cm and 6.0 cm, respectively). Whereas larger lengths recorded in the literature for *Cetengraulis edentulus* (17.1 cm) in Joyeux *et al.* (2009), *Citharichthys spilopterus* (19.0 cm) in Muto *et al.* (2000), *Isopisthus parvipinnis* (22.8 cm) in Romero *et al.* (2008), *Sphoeroides testudineus* (26.4 cm) in Joyeux *et al.* (2009), *Sphoeroides greeleyi* (16.1 cm) in Joyeux *et al.* (2009) and *Symphurus tessellatus* (16.7 cm) in Joyeux *et al.* (2009) were smaller than the ones recorded in this study (17.2 cm, 19.9 cm, 25.2 cm, 26.0 cm, 28.0 cm, 26.6 cm and 26.1 cm, respectively). It is important to consider that in both cases, works carried out on the Brazilian coast with the same method of capture, but with different mesh sizes. The species *Gobionellus oceanicus*, *Sphoeroides spengleri* and *Stephanolepis hispidus* were compared to a single reference Joyeux *et al.*, (2009) for the two formers ones and Muto *et al.* (2000), for the other, with minimum and maximum lengths always smaller in Baia Sul for *G. oceanicus* and larger for *S. spengleri* and *S. hispidus* (Table 1).

The coefficient of determination ($r^2$) showed a strong relationship between weight and length for the fish from Baia Sul – more than 0.950 for 28 species, between 0.950 and 0.900 for six species and less than 0.900 for one species (*Gobionellus oceanicus*) (Table 1). The allometric coefficient (b) presented a mean value of 2.059 in *Gobionellus oceanicus* to 3.333 in *Diapterus rhombeus* (Table 1) and the t-test showed isometric (19 species), positive allometric (12) and negative allometric (4) growth (Table 1).

Table 1 - Length-weight relationship of the species collected in Saco dos Limões, Florianópolis, Santa Catarina state, Brazil) listed in phylogenetic order according to Nelson (2006)

| Family<br>Species | N | TL (mm)<br>mín | <br>max | a (95% CL) | b (95% CL) | $r^2$ | t | grow |
|---|---|---|---|---|---|---|---|---|
| Engraulidae | | | | | | | | |
| *Cetengraulis edentulus* (Cuvier, 1829) | 1082 | 91 | 172 | -5.743 (-5.819/-5.666) | 3.321 (3.285/3.357) | 0.968 | 7.991 | A+ |
| Ariidae | | | | | | | | |
| *Genidens barbus* (Lacepède, 1803) | 1884 | 48 | 256 | -5.382 (-5.475/-5.290) | 3.120 (3.075/3.166) | 0.939 | 1.432 | Iso |
| *Genidens genidens* (Cuvier, 1829) | 9090 | 11 | 1043 | -5.249 (-5.275/-5.222) | 3.060 (3.047/3.073) | 0.952 | 0.695 | Iso |
| Synodontidae | | | | | | | | |
| *Synodus foetens* (Linnaeus, 1766) | 165 | 100 | 279 | -5.523 (-5.737/-5.309) | 3.111 (3.018/3.205) | 0.964 | 2.103 | A+ |

*(continuation table 1)*

| Family / Species | N | TL (mm) mín | TL (mm) max | a (95% CL) | b (95% CL) | $r^2$ | t | grow |
|---|---|---|---|---|---|---|---|---|
| Mugilidae | | | | | | | | |
| *Mugil curema* Valenciennes, 1836 | 183 | 116 | 340 | -4.852 (-4.987/-4.716) | 2.934 (2.875/2.993) | 0.981 | -1.556 | Iso |
| Triglidae | | | | | | | | |
| *Prionotus punctatus* (Bloch, 1793) | 664 | 33 | 222 | -5.243 (-5.370/-5.116) | 3.145 (3.081/3.208) | 0.934 | 1.174 | Iso |
| Centropomidae | | | | | | | | |
| Serranidae | | | | | | | | |
| *Diplectrum radiale* (Quoy & Gaimard, 1824) | 183 | 63 | 206 | -5.58 (-5.734/-5.427) | 3.320 (3.248/3.391) | 0.979 | 6.160 | A+ |
| *Mycteroperca microlepis* (Goode & Bean, 1879)* | 37 | 70 | 261 | -4.961 (-5.190/-4.732) | 3.032 (2.925/3.139) | 0.989 | 0.624 | Iso |
| Pomatomidae | | | | | | | | |
| *Pomatomus saltatrix* (Linnaeus, 1766) | 60 | 86 | 253 | -5.700 (-6.082/-5.318) | 3.308 (3.129/3.488) | 0.958 | 4.930 | A+ |
| Carangidae | | | | | | | | |
| *Chloroscombrus chrysurus* (Linnaeus, 1766) | 1587 | 30 | 200 | 2.794 (-4.609/-4.502) | 2.765 (2.736/2.794) | 0.957 | -3.140 | A- |
| *Oligoplites saurus* (Bloch & Schneider, 1801) | 194 | 78 | 204 | -4.763 (-4.945/-4.58) | 2.797 (2.709/2.885) | 0.953 | -4.271 | A- |
| *Oligoplites saliens* (Bloch, 1793)* | 305 | 61 | 182 | -5.028 (-5.198/-4859) | 2.938 (2.849/3.027) | 0.933 | -1.261 | Iso |
| *Selene setapinnis* (Mitchill, 1815) | 113 | 50 | 162 | -4.721 (-4.874/-4.568) | 2.909 (2.833/2.985) | 0.981 | -1.915 | A- |
| *Selene vomer* (Linnaeus, 1758) | 265 | 32 | 218 | -4.661 (-4.773/-4.548) | 2.911 (2.854/2.967) | 0.975 | -0.914 | Iso |
| Sparidae | | | | | | | | |
| *Archosargus rhomboidalis* (Linnaeus, 1758)* | 992 | 68 | 279 | -4.807 (-4.867/-4.748) | 3.022 (2.994/3.051) | 0.978 | 0.457 | Iso |
| Gerreidae | | | | | | | | |
| *Diapterus rhombeus* (Cuvier, 1829) | 2316 | 35 | 191 | -5.555 (-5.609/-5.502) | 3.333 (3.306/3.360) | 0.962 | 4.440 | A+ |
| *Eucinostomus argenteus* Baird & Girard, 1855 | 2739 | 34 | 166 | -4.915 (-4.968/-4.863) | 2.988 (2.961/3.016) | 0.944 | -0.191 | Iso |
| *Eucinostomus gula* (Quoy & Gaimard, 1824) | 4618 | 45 | 252 | -4.997 (-5.050/-4.945) | 3.049 (3.023/3.076) | 0.918 | 0.815 | Iso |
| *Eucinostomus melanopterus* (Bleeker, 1863) | 73 | 108 | 207 | -5.072 (-5.399/-4.744) | 3.047 (2.898/3.197) | 0.958 | 1.127 | Iso |
| Haemulidae | | | | | | | | |
| *Orthopristis ruber* (Cuvier, 1830) | 75 | 55 | 269 | -4.912 (-5.049/-4.775) | 3.031 (2.967/3.096) | 0.992 | 0.667 | Iso |
| Sciaenidae | | | | | | | | |
| *Micropogonias furnieri* (Demarest, 1823) | 1650 | 36 | 284 | -5.362 (-5.494/-5.299) | 3.159 (3.129/3.189) | 0.963 | 2.007 | A+ |
| *Cynoscion leiarchus* (Cuvier, 1830) | 161 | 53 | 237 | -5.206 (-5.307/-5.105) | 3.096 (3.047/3.154) | 0.99 | 1.857 | A+ |
| *Isopisthus parvipinnis* (Cuvier, 1830) | 93 | 40 | 260 | -5.228 (-5.332/-5.124) | 3.112 (3.061/3.163) | 0.994 | 2.366 | A+ |
| Gobiidae | | | | | | | | |
| *Gobionellus oceanicus* (Pallas, 1770) | 43 | 153 | 253 | -3.215 (-4.162/-2.269) | 2.059 (1.644/2.473) | 0.703 | -12.357 | A- |
| Ephippidae | | | | | | | | |
| *Chaetodipterus faber* (Broussonet, 1782) | 184 | 49 | 150 | -4.48 (-4.605/-4.355) | 3.025 (2.961/3.088) | 0.98 | 0.691 | Iso |

*(continuation table 1)*

| Family<br>Species | N | TL (mm)<br>mín | <br>max | a (95% CL) | b (95% CL) | $r^2$ | t | grow |
|---|---|---|---|---|---|---|---|---|
| Trichiuridae | | | | | | | | |
| *Trichiurus lepturus* Linnaeus, 1758 | 73 | 261 | 637 | -6.96 (-7.348/-6.571) | 3.248 (3.098/3.397) | 0.963 | 3.649 | A+ |
| Paralichthyidae | | | | | | | | |
| *Citharichthys spilopterus* Gunther, 1862 | 2674 | 35 | 199 | -5.628 (-5.674/-5.582) | 3.265 (3.241/3.288) | 0.965 | 3.165 | A+ |
| *Etropus crossotus* Jordan & Gilbert, 1882 | 242 | 41 | 142 | -5.392 (-5.525/-5.258) | 3.184 (3.113/3.254) | 0.971 | 3.123 | A+ |
| Achiridae | | | | | | | | |
| *Catathyridium garmani* (Jordan, 1889)* | 86 | 44 | 125 | -5.306 (-5.678/-4.934) | 3.305 (3.115/3.496) | 0.933 | 3.398 | A+ |
| Cynoglossidae | | | | | | | | |
| *Symphurus tessellatus* (Quoy & Gaimard, 1824) | 281 | 43 | 261 | -5.177 (-5.340/-5.014) | 3.000 (2.924 / 3.077) | 0.955 | 0.000 | Iso |
| Monacanthidae | | | | | | | | |
| *Stephanolepis hispidus* (Linnaeus, 1766) | 47 | 50 | 192 | -4.588 (-4.821/-4.355) | 2.935 (2.187/3.052) | 0.982 | -1.218 | Iso |
| Tetraodontidae | | | | | | | | |
| *Lagocephalus laevigatus* (Linnaeus, 1766) | 246 | 47 | 317 | -4.765 (-4.871/-4.660) | 3.005 (2.951/3.058) | 0.98 | 0.069 | Iso |
| *Sphoeroides spengleri* (Bloch, 1785) | 83 | 50 | 196 | -4.571 (-4.871/-4.391) | 2.936 (2.842/3.029) | 0.979 | -1.088 | Iso |
| *Sphoeroides testudineus* (Linnaeus, 1758) | 691 | 33 | 280 | -4.664 (-4.734/4.593) | 2.995 (2.961/3.028) | 0.978 | -0.059 | Iso |
| *Sphoeroides greeleyi* (Gilbert, 1900) | 224 | 33 | 266 | -4.556 (-4.659/-4.454) | 2.931 (2.876/2.986) | 0.98 | -1.084 | Iso |

N: number of individuals; TL: total length; min.: minimum total length; max.: maximum total length; a: constant (95% confidence limit); b: allometric coefficient (95% confidence limit); r2: coefficient of determination; t: t-test; grow: type of growth (Iso=isometric, A+: positive allometric, A-: negative allometric); (*): species with the length-weigth relationship recorded for the first time.

## DISCUSSION

In the determination of the length-weight relationships, factors related to sampling (fishing gear used, number of samples, sampling site, etc.) and development phase of the fish can interfere in the results (Froese, 2006). In this way, larger samples, obtained over a long period and which comprise a larger number of size classes, make more consistent estimates of the parameters of this relationship possible. Thus, the results obtained for the Baia Sul species can be considered representative and reliable, as they were estimated based on an adequate number of individuals ($n \geq 30$), which presented sizes within the ranges of variation cited for most of the species. In addition, the collections were carried out in both periods (day and night) for three years, which probably incorporated the seasonal variations of the study area.

The comparison of the coefficients of determination ($r^2$) of this and other studies that used the same method of capture (with different mesh sizes) and were carried out, mainly, on the north-northeastern coasts of Brazil (Cordovil & Camargo, 2007; Romero *et al.*, 2008; Freire *et al.*, 2009; Joyeux *et al.*, 2009) and south-southeastern (Giannini & Paiva-Filho, 1990; Bernardes & Rossi, 2000; Haimovici & Velasco, 2000; Muto *et al.*, 2000; Araújo & Vicentini, 2001; Almeida & Branco, 2002; Santos *et al.*, 2004; Viana *et al.*, 2004; Souza-Conceição *et al.*,

2005; Frehse, 2009; Joyeux *et al.*, 2009; Freitas *et al.*, 2010; Haluch *et al.*, 2011) verified the lowest values of this coefficient for eleven species (although the lowest value was 0.955), which may reflect local conditions, since there was no clear differentiation of the coefficients of determination ($r^2$) between the north-northeast (maximum of 0.993 in Joyeux *et al.*, 2009) and south-southeast coasts (0.996 in Muto *et al.*, 2000) and probably these differences were not significant.

Among the families, some species presented higher coefficients of determination, while others presented lower coefficients in relation to the references previously cited, so that the length-weight relationship in a certain family cannot be considered more consistent than in another. Similarly, the larger or smaller lengths recorded for the species that occurred in Baia Sul were not related to the families, and may have occurred as a response of each species to the local conditions or sample effort.

Giarrizzo *et al.* (2006) found similarity in the type of growth of the species of the families Carangidae, Mugilidae and Tetraodontidae, which, in the present study, was verified for Tetraodontidae, Sciaenidae, Ariidae, Paralichthyidae and Achiridae.

Although isometric growth has predominated in sampling (followed by positive and negative allometric growth), Froese (2006) warns that the discussion of the coefficient (*b*) of a single length-weigth relationship, reflects the difference of the condition of the fish from only the area and moment of collection. This same author states that consistent patterns of allometric growth are rare, and should be supplemented by an analysis of the phases of growth and discussions of the potential evolutionary benefits associated with the ontogenetic changes in the body proportions.

## FINAL CONSIDERATIONS

This work presents the weight-length relationship of 35 species of fish belonging to 27 families. Growth type determination were classified according to three types: isometric (19 species), positive allometric (12) and negative allometric (4). As regards two species (*Catathyridium garmani* and *Oligoplites saliens*), as far as could be determined, this is the first work to publish length-weight relationship data and for two species (*Archosargus rhomboidalis and Mycteroperca microlepis*) this relationship is presented for the first time in Brazil, bringing new information on the life history of species, as well as important results for the evaluation of regional fishery.

**Acknowledgments** - The authors thank Universidade do Vale do Itajaí, specifically the members of Projeto Baia Sul, for providing the data used in this work.

## REFERENCES

Almeida, L.R. & Branco, J.O. Aspectos biológicos de *Stellifer stellifer* na pesca artesanal do camarão sete-barbas, Armação do Itapocoroy, Penha, Santa Catarina, Brasil, *Rev. Bras. Zool.* v. 19, p. 601-610, 2002.

Araújo, F.G. & Vicentini, R.N. Relação peso-comprimento da corvina *Micropogonias furnieri* (Desmarest) (Pisces, Sciaenidae) na Baia de Sepetiba, Rio de Janeiro, *Rev. Bras. Zool.*, v. 18, p. 133-138, 2001.

Bernardes, R.A. & Rossi-Wongtschowski, C.L.D.B. Length-Weight Relationship of Small Pelagic Fish Species of the Southeast and South Brazilian Exclusive Economic Zone. Naga, *The ICLARM Quarterly*, v. 23, p. 30-32, 2000.

Cordovil, G. & Camargo, M. Análise populacional do peixe–espada, *Trichirus lepturus* (Perciformes; Trichiuridae), no estuário do Rio Caeté, costa norte do Brasil, *Uakari*, v. 3, p. 104-108, 2007.

Figueiredo, J.L. & Menezes, N. *Manual de peixes marinhos do sudeste do Brasil. II. Teleostei (1).* Museu de Zoologia, USP, São Paulo, 1978.

Figueiredo, J.L. & Menezes, N. *Manual de peixes marinhos do sudeste do Brasil. III. Teleostei (2).* Museu de Zoologia, USP, São Paulo, 1980.

Figueiredo, J.L. & Menezes, N. *Manual de peixes marinhos do sudeste do Brasil. IV. Teleostei (3).* Museu de Zoologia, USP, São Paulo, 1985.

Figueiredo, J.L. & Menezes, N. *Manual de peixes marinhos do sudeste do Brasil. VI. Teleostei (5).* Museu de Zoologia, USP, São Paulo, 2000.

Fischer, W. *FAO species identification sheets for fishery purpose: Western Central Atlantic (fishing area 31).* Vol.I, II, III, IV, V. FAO, Rome, 1978.

Freire, K.M., Rocha, G.R.A. & Souza, I.L. Length–weight relationships for fishes caught by shrimp trawl in southern Bahia, Brazil, *J. Appl. Ichthyol*., v. 25, p. 356–357, 2009.

Frehse, F.A. (2009) *Estrutura populacional e dieta de Stellifer rastrifer e Stellifer brasiliensis (Schultz, 1945) (Sciaenidae, Perciformes), nos períodos diurno e noturno, em quatro áreas da plataforma sul do Estado do Paraná e norte do Estado de Santa Catarina*. Dissertação de mestrado, Universidade Federal do Paraná, Curitiba, Brasil.

Freitas, M.O., Vasconcelos, L,M,, Hostim-Silva, M, & Spach, H.L. Length–weight relationships for fishes caught by shrimp trawl in Santa Catarina coast, south Atlantic, Brazil, *J. Appl. Ichthyol*., v. 27, p. 1–2, 2010.

Froese, R. Cube law, condition factor and weight–length relationships: history, meta-analysis and recommendations, *J. Appl. Ichthyol*., v. 22, p. 241–253, 2006.

Frota, L. O., Costa, P.A.S. & Braga, A.C. Length-weight relationships of marine fishes from the central Brazilian coast, NAGA, *World Fish Center Quarterly*, v. 27, p. 20-26, 2004.

Giacalone, V.M., D'Anna, G., Badalamenti, F. & Pipitone, C. Weight-length relationships and condition factor trends for thirty-eight fish species in trawled and untrawled areas off the coast of northern Sicily (central Mediterranean Sea), *J. Appl. Ichthyol*., v. 26, p. 954–957, 2010.

Giannini, R. & Paiva-Filho, A.M. Aspectos bioecológicos de *Stellifer rastrifer* (Perciformes: Sciaenidae) na Baia de Santos, SP, *Bol. Inst. Oceanog*., v. 38, p. 57-67, 1990.

Giarrizzo, T., Jesus, A. J. S., Limeira, E.C., Almeida, J.B.A., Isaac, V. & Saint-Paul, U. Weight-length relationships for intertidal fish fauna in a mangrove estuary in Northern Brazil, *J. Appl. Ichthyol*., v. 22, p. 325–327, 2005.

Haimovici, M. & Velasco, G. Length-weight relationship of marine fishes from southern Brazil, NAGA, *The ICLARM Quarterly*, v. 23, p. 19-23, 2000.

Haluch, C.F., Abilhoa, V., Freitas, M.O., Corrêa, M.F.M. & Hostim-Silva, M. Estrutura

populacional e biologia reprodutiva de *Menticirrhus americanos* (Linnaeus, 1758) (Teleostei, Sciaenidae) na Baia de Ubatuba-Enseada, Santa Catarina, Brasil, *Biotemas*, v. 24, p. 47-59, 2011.

Joyeux, J.C., Giarrizzo, T., Macieira, R.M., Spach, H.L. & Vaske Jr., T. Length–weight relationships for Brazilian estuarine fishes along a latitudinal gradient. *J. Appl Ichthyol*., v. 25, p. 350-355, 2009.

King, M. *Fisheries biology: assessment and management*. Fishing News Books, Oxford, UK, 1995.

Mortuza, M.G. & Rahman, T. Length-weight relationship, condition factor and sex-ratio of freshwater fish, *Rhinomugil corsula* (Hamilton) (Mugiliformes: Mugilidae) from Rajshahi, Bangladesh. *J. Biol. Scienc*., v. 14, p. 139-141, 2006.

Muto, E.Y., Soares, L.S.H. & Rossi-Wongtschowski, C.L.D.B. Length-weight relationships of marine fish species off São Sebastião system, São Paulo, southeastern Brazil, NAGA, *The ICLARM Quarterly*, v. 23, p. 27–29, 2000.

Nelson, J.S. *Fishes of the world*, 4th eds. John Wiley & Sons, Inc., Hoboken, New Jersey, USA, 2006.

Nieto-Navarro, J.T., Zetina-Rejón, M., Arreguín-Sánchez, F., Arcos-Huitrón, N.E. & Pena-Messina, E. Length-Weight Relation of Demersal Fish from the Eastern Coast of the Mouth of the Gulf of California, *J. Fish. Aquat. Scienc*., v. 5, p. 494-502, 2010.

Romero, R.M., Moraes, L.E., Santos, M.N., Rocha, G.R.A. & Cetra, M. Biology of *Isopisthus parvipinnis*: an abundant sciaenid species captured bycatch during sea-bob shrimp fishery in Brazil, *Neotrop. Ichthyol*., v. 6, p. 67-74, 2008.

Santos, A.L.B., Pessanha, A.L.M., Costa, M.R. & Araújo, F.G. Relação peso-comprimento de *Orthropistis ruber* (Cuvier) (Teleostei, Haemulidae) na Baia de Sepetiba, Rio de Janeiro, Brasil, *Rev. Bras. Zool*., v. 21, p. 185-187, 2004.

Severino, R.B.A. *Contributo para o estudo da espécie* Centrophorus squamosus *e sua importância na pescaria de* Aphanopus carbo *na Madeira,* Relatório de Estágio do Curso de Licenciatura em Biologia Marinha e Pescas realizado na Direcção Regional de Pescas – Madeira, 2004.

Sokal, R.R.& Rohlf, F.J. *Introduction to biostatistics*, 2nd ed. Freeman Publication, New York, 1987.

Souza-Conceição, J.M., Rodrigues-Ribeiro, M. & Castro-Silva, M.A. Dinâmica populacional, biologia reprodutiva e o ictioplâncton de *Cetengraulis edentulus* Cuvier (Pisces, Clupeiformes, Engraulidae) na enseada do Saco dos Limões, Florianópolis, Santa Catarina, Brasil, *Rev. Bras. Zool*., v. 22, p. 953-961, 2005.

Vallisneri, M., Montanini, S. & Stagioni, S. Length–weight relationships for the family Triglidae in the Adriatic Sea, northeastern Mediterranean, *J. Appl. Ichthyol*., v. 26, p. 460-462, 2010.

Vianna, M., Costa, F.E.S. & Ferreira, C.N. Length-weight relationship of fish caught as by-catch by shrimp fishery in the southeastern coast of Brazil, *Bol. Inst. Pesca*, v. 30, p. 81-85, 2004.