



Length–weight relationships of eleven mesopelagic fishes from oceanic islands of the Southwestern Tropical Atlantic

Leandro Nolé, Michael Maia Mincarone, Bárbara Teixeira Villarins, Thierry Frédou, Alex Souza Lira, Arnaud Bertrand, Flávia Lucena Frédou, Leandro Nolé Eduardo, Bárbara Villarins, Flávia Frédou

► To cite this version:

Leandro Nolé, Michael Maia Mincarone, Bárbara Teixeira Villarins, Thierry Frédou, Alex Souza Lira, et al.. Length–weight relationships of eleven mesopelagic fishes from oceanic islands of the Southwestern Tropical Atlantic. *Journal of Applied Ichthyology*, 2019, 35 (2), pp.605-607. 10.1111/jai.13840 . ird-02197003

HAL Id: ird-02197003

<https://ird.hal.science/ird-02197003>

Submitted on 29 Jul 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Length–weight relationships of eleven mesopelagic fishes from oceanic islands of the Southwestern Tropical Atlantic

DOI: 10.1111/jai.13840

Leandro Nolé Eduardo^{1*}, Michael Maia Mincarone², Bárbara Teixeira Villarins², Thierry Frédou¹, Alex Souza Lira¹, Arnaud Bertrand^{1,3,4}, Flávia Lucena Frédou¹

¹ Universidade Federal Rural de Pernambuco, Departamento de Pesca e Aquicultura, Recife, PE, Brazil.

² Universidade Federal do Rio de Janeiro, Núcleo em Ecologia e Desenvolvimento Socioambiental de Macaé, Macaé, RJ, Brazil.

³ Universidade Federal de Pernambuco, Departamento de Oceanografia, Recife, PE, Brazil.

⁴ Institut de Recherche pour le Développement, Sète, France.

*Corresponding author: leandronole@hotmail.com; Tel: +55 81 3320 6015.

ABSTRACT

This study provides the length-weight relationship for eleven deep-sea fishes from oceanic islands of the Southwestern Tropical Atlantic: *Bonapartia pedaliota*, *Sigmops elongatus* (Gonostomatidae), *Argyropelecus aculeatus*, *Argyropelecus affinis*, *Argyropelecus sladeni*, *Sternoptyx diaphana*, *Sternoptyx pseudobscura* (Sternoptychidae), *Malacosteus niger*, *Thysanactis dentex* (Stomiidae), *Melanonus zugmayeri* (Melanonidae), and *Ectreposebastes imus* (Setarchidae). Data were collected during a scientific survey (2017) around Rocas Atoll, Fernando de Noronha Archipelago and adjacent seamounts, using a micronekton trawl (side length of body mesh: 40 mm, side length of cod-end mesh: 10 mm) at 35 stations from 0 to 1113 m depth. A new maximum standard length for *Bonapartia pedaliota* and *Ectreposebastes imus* are also provided.

INTRODUCTION

In the western Tropical Atlantic, the Fernando de Noronha Archipelago, Rocas Atoll and adjacent seamounts host a remarkable biodiversity (Fiedler et al., 2016; Hazin et al., 1998). For this reason, the marine ichthyofauna of this large biogeographic unit categorized as Ecologically or Biologically Significant Marine Areas - EBSA (CBD, 2014) has been studied by many authors (Dominguez et al., 2016; Kikuchi & Schobbenhaus, 2002; Oliveira et al., 2011). However, most efforts focused on fishes living near to the surface (0-200 m) and few studies described the mesopelagic zone (200-1000 m depth) of this region, which is considered as one of the most understudied of the world ocean (St. John et al., 2016).

The mesopelagic community is a key resource for higher trophic levels, maintaining part of the marine biodiversity and playing an important role in carbon sequestration and thus on the biological carbon pump (Proud et al., 2017; St. John et al., 2016). To better account for the role of this community in the ecosystem structure and function, a prerequisite is to have the necessary biological information. One of such key basic knowledge concerns the length-weight relationships (LWR) that are one of the requisites for fisheries management and conservation (Froese, 2006; Froese et al., 2011). Indeed, LWRs are used to estimate body weight by length measurements, assess the condition factor or well-being of species of interest, as well as for the calculation of production and biomass of a fish stock (Froese, 2006). Despite this, information on LWRs are still lacking for many deep-sea fishes. Here, we provide new LWRs for eleven mesopelagic fish species collected along the northeast Brazilian oceanic islands, in order to increase the biological data and general knowledge of these species.

MATERIAL AND METHODS

The study area comprises the northeast Brazilian oceanic islands, including Rocas Atoll (3°52'S, 33°49'W), Fernando de Noronha Archipelago (3°50'S, 32°25'W) and adjacent seamounts. Data were collected during the scientific survey ABRACOS (Acoustics along the BRAzilian COaSt) conducted on board the RV *Antea*, from 9th April to 6th May 2017. Mesopelagic sampling was conducted using a micronekton trawl (side length of body mesh: 40 mm, side length of cod-end mesh: 10 mm) at 35 stations from 0 to 1113 m depth. After capture, the material was fixed in a 4% formalin solution for one month and then preserved in a 70% alcohol solution for proximally six months before processing for length and weight. At the laboratory, species were identified,

measured (nearest 0.1 cm of standard length, SL) and weighed (nearest 0.01 g of total weight, TW). All specimens were deposited in the Fish Collection of the Núcleo em Ecologia e Desenvolvimento Socioambiental de Macaé (NPM), Universidade Federal do Rio de Janeiro (NUPEM/UFRJ).

The parameters of the LWR were estimated through the equation: $TW = a \times SL^b$, where TW is the total weight (g), SL is the standard length (cm), a is a constant being the initial growth index and b is the slope of the regression. Prior to the calculation of LWRs, the relationship plots were executed for visual inspection and removal of outliers (Froese & Binohlan, 2000). The significance of the regression was tested by ANOVA and the degree of association between TW and SL was calculated by the determination coefficient (r^2). We only included LWRs for species with $n > 30$, except for three species for which a wide fish-length range was available.

RESULTS

A total of 11 species belonging to five families and three orders were analysed (Table 1). All regressions were highly significant ($P < 0.01$), with the coefficient of determination (r^2) ranging from 0.9511 to 0.9862. The value of b varied between 2.66 for *Sternoptyx pseudobscura* and 3.22 for *Sigmops elongatus*, while the parameter a ranged between 0.0012 for *Thysanactis dentex* and 0.0250 for *Ectreposebastes imus*.

DISCUSSION

This work provides the first LWR for six species: *S. pseudobscura*, *B. pedaliota*, *S. elongatus*, *T. dentex*, *M. zugmayeri*, and *E. imus*. LWR information has been previously available for *A. aculeatus*, *A. affinis*, *A. sladeni*, *S. diaphana*, and *M. niger*, but it was based on a small length range, small sample size (<5) and/or without the descriptive statistics of the relationships (Alpoim et al., 2002; Davison et al., 2015). All species presented here but *A. aculeatus* and *M. niger*, have no LWRs available in FishBase. In addition, the highest standard-length values for *Bonapartia pedaliota* and *Ectreposebastes imus* are reported herein.

As established by Froese (2006), the allometric coefficients for all LWRs were within the expected range of 2.5–3.5. These values are reflection of intrinsic characteristics and process of adaptations of each species, as ontogenetic reproductive or environmental variations, mainly between sexes (Froese, 2006). In addition, fixation

in alcohol and formaldehyde can affect length and weight measurements through the shrinking and dehydration of specimens. For that reason, we recommend consider the LWRs presented here as being tentative.

Overall, this study increases the knowledge on mesopelagic fishes, providing basic biological information useful for further studies in ecology, conservation, and fisheries assessment.

ACKNOWLEDGEMENTS

We acknowledge the French oceanographic fleet for funding the at-sea survey ABRACOS (<http://dx.doi.org/10.17600/17004100>) and the officers and crew of the RV *Antea* for their contribution to the success of the operations. The present study could not have been done without the work of all participants from the BIOIMPACT (UFRPE) and LIZ (UFRJ) laboratories. We thank the CNPq (Brazilian National Council for Scientific and Technological Development) for providing student scholarship to LNE and ASL, and research grant for TF and FLF. This work is a contribution to the LMI TAPIOCA, CAPES/COFECUB program (88881.142689/2017-01), and PADDLE project (funding by the European Union's Horizon 2020 research and innovation programme - grant agreement No. 73427).

REFERENCES

- Alpoim, R., Ávila de Melo, A., Banon, R., Casas, M., Cervino, S., Junquera, S., Martín, I., Murua, H., Paz, X., Pérez-Gándaras, G., del Río, J. L., Rodríguez-Marín, E., Saborido-Rey, F., dos Santos, E. J., & Vásquez, A. (2002). Distribution and main characteristic of fish species on Flemish Cap based on the 1988-2002 EU-surveys in July. *NAFO SCR* 02/72(N4685), 1–73.
- CBD. (2014). *Ecologically or Biologically Significant Marine Areas (EBSAs). Special places in the world's oceans*. (2nd ed.). Recife: Secretariat of the Convention on Biological Diversity.
- Davison, P., Lara-Lopez, A., & Anthony Koslow, J. (2015). Mesopelagic fish biomass in the southern California current ecosystem. *Deep-Sea Research Part II: Topical Studies in Oceanography*, 112, 129–142. <https://doi.org/10.1016/j.dsr2.2014.10.007>
- Dominguez, P. S., Zeineddine, G. C., Rotundo, M. M., Barrella, W., & Ramires, M. (2016). A pesca artesanal no arquipélago de fernando de noronha (PE). *Boletim do Instituto de Pesca*, 42(1), 241–251. <https://doi.org/10.5007/1678-2305.2016v42n1p241>
- Fiedler, F. N., Sales, G., Giffoni, B. B., Port, D., Ana, R. S., Barreto, A. S., & Schwingel, P. R. (2016). Hyperiid amphipods around the seamounts and islands off

132 northeastern Brazil. *Brazilian Journal of Oceanography*, 64(4), 339–351.

133 Froese, R. (2006). Cube law, condition factor and weight-length relationships: history,
134 meta-analysis and recommendations. *Journal of Applied Ichthyology*, 22(4), 241–
135 253. <https://doi.org/10.1111/j.1439-0426.2006.00805.x>

136 Froese, R., & Binohlan, C. (2000). Empirical relationships to estimate asymptotic
137 length, length at first maturity and length at maximum yield per recruit in fishes,
138 with a simple method to evaluate length frequency data. *Journal of Fish Biology*,
139 56(4), 758–773. <https://doi.org/10.1006/jfbi.1999.1194>

140 Froese, R., Tsikliras, A. C., & Stergiou, K. I. (2011). Editorial note on weight-length
141 relations of fishes. *Acta Ichthyologica et Piscatoria*, 41(4), 261–263.
142 <https://doi.org/10.3750/AIP2011.41.4.01>

143 Hazin, F. H. V., Zagaglia, J. R., Broadhurst, M. K., Travassos, P. E. P., & Bezerra, T. R.
144 Q. (1998). Review of a small-scale pelagic longline fishery off northeastern Brazil.
145 *Marine Fisheries Review*, 60, 1–8.

146 Kikuchi, R. K. P., & Schobbenhaus, C. (2002). Atol das Rocas, litoral do Nordeste do
147 Brasil - Único atol do Atlântico Sul Equatorial Ocidental. In C. Schobbenhaus, D.
148 A. Campos, E. T. Queiroz, M. Winge & M. L. C. Berbert-Born (eds.). *Sítios*
149 *Geológicos e Paleontológicos do Brasil*. Brasília: DNPM/CPRM (SIGEP), pp.
150 379–393. <https://doi.org/10.1590/S1676-06032008000300013>

151 Oliveira, P. G. V., Oliveira, D. S., Pinheiro, P. B., Hazin, F. H. V., Carvalho, F. C.,
152 Veras, D. P., & Silva, M. B. (2011). Population structure and growth of young
153 lemon shark, *Negaprion brevirostris* (Poey, 1868), at the Atol das Rocas
154 Biological Reserve, Brazil. *Revista de Gestão Costeira Integrada*, 11(4), 389–395.
155 <https://doi.org/10.5894/rgci236>

156 Proud, R., Cox, M. J., & Brierley, A. S. (2017). Biogeography of the global ocean's
157 mesopelagic zone. *Current Biology*, 27(1), 113–119.
158 <https://doi.org/10.1016/j.cub.2016.11.003>

159 St. John, M. A., Borja, A., Chust, G., Heath, M., Grigorov, I., Mariani, P., Martin, A. P.,
160 & Santos, R. S. (2016). A dark hole in our understanding of marine ecosystems
161 and their services: Perspectives from the mesopelagic community. *Frontiers in*
162 *Marine Science*, 3, 1–6. <https://doi.org/10.3389/fmars.2016.00031>

163 Tchamabi, C. C., Araujo, M., Silva, M., & Bourlès, B. (2017). A study of the Brazilian
164 Fernando de Noronha Island and Rocas Atoll wakes in the tropical Atlantic. *Ocean*
165 *Modelling*, 111, 9–18. <https://doi.org/10.1016/j.ocemod.2016.12.>

167 Table 1. Descriptive statistics and parameters of LWRs for 12 deep-sea fishes caught using a micronekton trawl at the northeast Brazilian oceanic
 168 islands and seamounts, from 9th April to 6th May 2017. **SL** = Standard Length, **TW** = Total Weight, **a** = initial growth index, **b** =slope of the
 169 regression and **r²** = determination coefficient.

170

Taxa	n	SL (cm)		TW (g)		Regression parameters		r ²	
		Min	Max	Min	Max	a	b (95% CL)		
Stomiiformes									
Gonostomatidae									
<i>Bonapartia pedaliota</i> Goode & Bean, 1896	85	3.7	7.5	0.4	2.7	0.0074 (0.0058-0.0094)	2.94 (2.80-3.08)	0.9571	
<i>Sigmops elongatus</i> (Günther, 1878)	35	4.9	25	0.2	28	0.0015 (0.0009-0.0023)	3.229 (3.07-3.39)	0.9814	
Sternoptychidae									
<i>Argyropelecus aculeatus</i> Valenciennes, 1850	49	3	8.2	0.8	20.9	0.0350 (0.0245-0.0496)	2.996 (2.77-3.21)	0.9529	
<i>Argyropelecus affinis</i> Garman, 1899	260	2.8	7.8	0.31	6.09	0.0218 (0.0183-0.0258)	2.807 (2.70-3.91)	0.9511	
<i>Argyropelecus sladeni</i> Regan, 1908	26	2	6.6	1.15	7.2	0.0425 (0.0257-0.0705)	2.703 (2.39- 3.01)	0.9618	
<i>Sternoptyx diaphana</i> Hermann, 1781	600	1.2	4.3	0.1	4.3	0.0570 (0.0370-0.0770)	2.89 (2.79-2.99)	0.9275	
<i>Sternoptyx pseudobscura</i> Baird, 1971	51	1.3	5.6	0.24	6.6	0.0754 (0.0582-0.0970)	2.663 (2.45-2.88)	0.9655	
Stomiidae									
<i>Malacosteus niger</i> Ayres, 1848	33	6.3	18.1	1.5	34.4	0.0057 (0.0009-0.0030)	2.956 (2.74-3.17)	0.9635	
<i>Thysanactis dentex</i> Regan & Trewavas, 1930	35	4.3	14.5	0.1	10.6	0.0012 (0.0009-0.0012)	3.197 (3.07-3.33)	0.9868	
Gadiformes									
Melanonidae									
<i>Melanonus zugmayeri</i> Norman, 1930	20	6.4	19.1	1.06	32.31	0.0036 (0.0018-0.0071)	2.973 (2.68-3.26)	0.9623	
Scorpaeniformes									
Setarchidae									
<i>Ectreposebastes imus</i> Garman, 1899	25	5.2	23.4	3.43	290.3	0.0250 (0.0138-0.0482)	3.025 (2.81-3.24)	0.9728	