



## Intra-annual length-weight relationships for juveniles of *Micropogonias furnieri* (Desmarest, 1823) in a sub-estuarine system from Uruguay

RODRIGO GURDEK\* & ALICIA ACUÑA-PLAVAN

Sección Oceanografía y Ecología Marina, Instituto de Ecología y Ciencias Ambientales (IECA), Facultad de Ciencias, Universidad de la República (Udelar). Iguá 4225, CP 11400, Montevideo, Uruguay.

\*Corresponding author: [rgurdek@gmail.com](mailto:rgurdek@gmail.com)

**Abstract.** Temporal length-weight relationships are presented for the juveniles of the sciaenid *Micropogonias furnieri*, in a temperate sub-estuary from Uruguay. Parameter  $b$  varied from 2.75 to 3.23 and mean condition factor between 0.73 and 0.94. Smallest juveniles presented lower  $b$  values for every period.

**Keywords:** Sciaenidae, whitemouth croaker, length-weight parameters, condition factor, Pando sub-estuary

**Resumen. Relaciones largo-peso intra-anales de juveniles de *Micropogonias furnieri* (Desmarest, 1823) en un sistema subestuarial de Uruguay.**

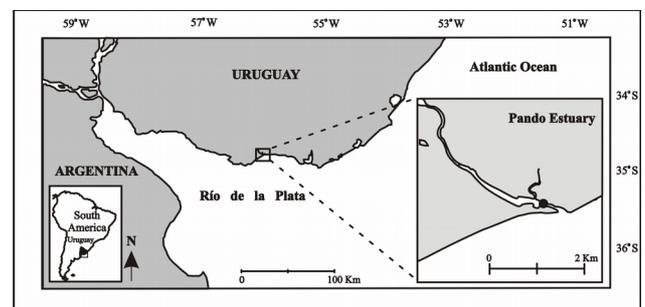
Se presentan las relaciones temporales de largo/ peso de juveniles del sciénido *Micropogonias furnieri*, en un subestuario templado de Uruguay. El parámetro  $b$  varió entre 2,75 y 3,23 y la media del factor de condición entre 0,73 y 0,94. Los juveniles de menor talla presentaron los menores valores de  $b$  en todos los períodos.

**Palabras clave:** Sciaenidae, corvina rubia, parámetros de largo-peso, factor de condición, subestuario Pando

Length-weight relationships are used in fisheries and ecological research with many purposes, for example, to predict weight corresponding to a given length of individual fishes or to provide information about the type of growth and condition factor of populations (Olim & Borges 2006). The whitemouth croaker *Micropogonias furnieri* is a widely distributed species along the western Atlantic coast from the Yucatan Peninsula (Mexico) to the Gulf of San Matias, Argentina, at 41° S (Isaac 1988). *Micropogonias furnieri* is one of the most important resources of coastal fisheries in the southwest Atlantic Ocean and particularly in the Río de la Plata estuary (RdIP) (Norbis & Galli 2013). This study presents the length-weight relationships for juveniles of *M. furnieri* in the Pando sub-estuary, according to seasons and size groups.

The Pando tidal creek system (34°47' S, 55°52' W) (Figure 1) is a small temperate sub-estuary influenced by tidal waters of the RdIP (southern

Uruguay) (Acha *et al.* 2008). No data exist on astronomical tides for the Pando estuary, but the adjacent area of the RdIP presents small tidal amplitude (0.3 m) (MTO-PNUD 1979).



**Figure 1.** Study area in the lower Pando sub-estuarine system. Fish sampling station is indicated by a black circle.

The Pando stream covers a drainage basin of 973 km<sup>2</sup> and presents an average flow of 10.9 m<sup>3</sup>/ s (Cayssials *et al.* 2000). The study was carried out

from May 2002 to June 2003 in the lower portion of the Pando sub-estuary (Fig. 1). Fish were collected monthly (except in May 2003), during the evening, at three replicate sites in nearshore waters by seine net (12 m long, 2 m high, 12 mm knot-to-knot). The net (with two ropes of 25 m each, attached to each extreme) was laid parallel to the coast by using a boat and then pulled out onto the shore, covering a swept area of 300 m<sup>2</sup>. Specimens of *M. furnieri* were counted, measured to the nearest 0.1 cm (total length, *L*) and weighed to the nearest 0.01 g (total weight, *W*). The parameters *a* and *b* of the length-weight relationship (*L/W*) were estimated by analysis of linear regression, after the logarithmic transformation ( $\log W = \log a + b \log L$ ). The condition factor (*K*) was calculated using the following equation:  $K = (W/L^3) \times 100$ . Regarding ontogenetic changes in the diet of *M. furnieri*, as described by Giberto *et al.* (2007), *L/W* were analyzed between size groups. Giberto *et al.* (2007) proposed a change in the feeding preferences of the whitemouth croaker in the RdIP, from individuals feeding mainly on planktonic organisms (*Lt* < 10 cm) to individuals feeding mainly on benthic organisms (*Lt* > 10 cm). Analysis of variance (ANOVA) and covariance (ANCOVA) were used, after Log transformation of the data, to test whether months differed significantly in terms of *L/W* and *K*. Statistical significance of the coefficient of determination (*r*<sup>2</sup>) was also estimated. A significance level of  $\alpha = 0.05$  was established (Sokal & Rohlf 1969).

Results obtained are summarized in Table I. A total of 855 juvenile specimens of whitemouth

croaker *M. furnieri* (Perciformes, Sciaenidae) ranging from 3.9 to 18.7 cm were caught by seine netting over the study period (Table I). The dominance by juvenile individuals in estuarine populations is a common pattern found in other estuaries around the world due to nursery functions they provide (i.e. feeding, refuge), particularly for postlarvae and juveniles (Potter & Hyndes 1999, Cardoso *et al.* 2011, Martinho *et al.* 2012).

All regressions were significant ( $p < 0.05$ ) and coefficients of determination were always close to one, suggesting good adjustment of data. Parameter *b* varied from 2.82 to 3.23 and mean condition factor ranged between 0.73 and 0.94. Values of the parameter *b* remained within the expected range of 2.5 and 3.5 (Carlander 1969). The annual *L/W* for juveniles of *Micropogonias furnieri* was determined according to the following equation:  $W = 0.00815 \times L^{3.03}$ . Previous studies by Gurdek & Acuña (2014) in the Pando sub-estuary, determined the annual parameters of *a* and *b* as 0.00741 and 3.07, respectively. Results were similar to those from the present study, and variations can be attributed to differences on sampling size. In this sense, Gurdek & Acuña (2014) increased the sampling effort to monthly and exceptional daily sampling periods, and therefore, included a wider size range of the species. Temporal differences were found in the Pando sub-estuary throughout the year in *L/W* (ANCOVA;  $p < 0.05$ ) and *K* (ANOVA;  $p < 0.05$ ). In general terms, parameter *b* showed greater values from October to January (spring and early summer), and in April and June 2003 (Table I).

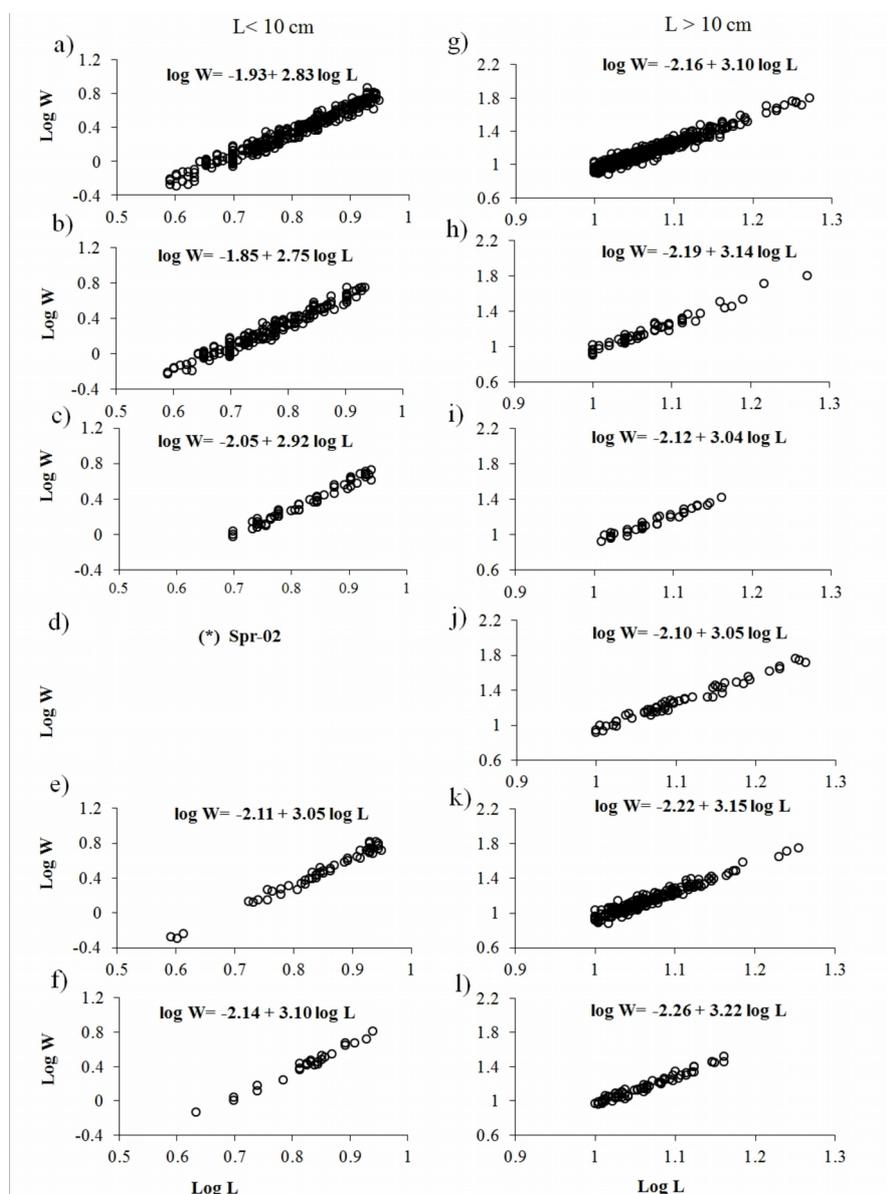
**Table I.** Length-weight relationships for juveniles of whitemouth croaker *Micropogonias furnieri* collected monthly from May 2002 to June 2003, in the Pando sub-estuarine system (southern Uruguayan coast). N, number of specimens collected; Min, minimum total length; Max, maximum total length; *a*, *b*, *r*<sup>2</sup>, intercept, slope and coefficient of determination of the length-weight relationship, respectively; 95% CL, 95% confidence limit level (SE x *t*-value at 5% significance level); *K*, condition factor; \*,  $p < 0.05$ ; \*\*\*,  $p < 0.001$ .

Period	N	Total length (cm)			Parameters of the relationship			
		Min	Max	Mean	<i>a</i> ( $\pm$ 95% CL)	<i>b</i> ( $\pm$ 95% CL)	<i>r</i> <sup>2</sup>	Mean <i>K</i>
May	225	3.9	18.7	7.4	0.00978 (0.00896-0.01068)	2.96 (2.92-3.00)	0.99***	0.91
Jun	31	5.1	15.5	9.4	0.00662 (0.00391-0.01121)	3.04 (2.80-3.28)	0.96***	0.74
Jul	80	5	14.5	8.2	0.00673 (0.00584-0.00774)	3.09 (3.02-3.16)	0.99***	0.81
Aug	19	5.4	12.8	7.9	0.00611 (0.00323-0.01156)	3.08 (2.77-3.39)	0.96***	0.73
Sep	11	9.4	14	12	0.01277 (0.00597-0.02734)	2.83 (2.52-3.13)	0.98***	0.83
Oct	3	12.2	16.5	14.3	0.00681 (0.00003-1.72103)	3.12 (1.03-5.20)	0.99*	0.93
Nov	30	5.5	18	12.1	0.00628 (0.00385-0.01025)	3.14 (2.94-3.34)	0.97***	0.89
Dec	45	5.7	18.3	10.7	0.00647 (0.00470-0.00889)	3.14 (3.00-3.28)	0.98***	0.91
Jan	53	8.5	18	11.9	0.00553 (0.00400-0.00763)	3.18 (3.05-3.31)	0.98***	0.87
Feb	72	7	15	10.9	0.01419 (0.00935-0.02153)	2.82 (2.65-3.00)	0.94***	0.94
Mar	178	3.9	14	10.2	0.00735 (0.00670-0.00806)	3.06 (3.02-3.10)	0.99***	0.85
Apr	45	5.5	14.5	11.1	0.00543 (0.00403-0.00732)	3.23 (3.10-3.35)	0.98***	0.94
Jun	63	4.3	14.1	9.4	0.00649 (0.00527-0.00800)	3.15 (3.05-3.24)	0.99***	0.91
Annual	855	3.9	18.7	9.5	0.00815 (0.00771-0.00861)	3.03 (3.01-3.06)	0.99***	0.88

$K$  values were higher from October, showing lower values during winter months (Table I). Type of growth and variations in condition of *M. furnieri* in the Pando sub-estuary varied along the year, as described by Costa & Araújo (2003) for juveniles of the same species in Sepetiba bay (Brazil). These authors found intra-annual and spatial variability of condition factor of *M. furnieri* juveniles, suggesting the ontogenetic changes and feeding availability as possible determining factors. According to Canavese (2007), the whitemouth croaker shows an opportunistic behaviour depending on monthly prey availability according to seasons. Similar results were supported by Olsson *et al.* (2013) in an adjacent estuarine system. Canavese

(2007) showed that the species presented higher feeding intensities, as well as stomach fullness, during the warmer months (i.e. spring and summer months) and lower during winter and autumn months, which can be related to  $L/W$  and  $K$  values.

Results also show that ontogenetic changes, regarding feeding preferences, could determine changes on the type of growth of juvenile fish. When compared the annual growth rate between different size groups (and different feeding preferences), analysis determined that individuals  $< 10$  cm presented a lower  $b$  value ( $b = 2.83$ ), compared to those  $> 10$  cm ( $b = 3.10$ ) (Figures 2a and 2g).



**Figure 2.** Intra-annual length-weight relationships for juveniles of *Micropogonias furnieri*, according to seasons and ontogenetic changes in diet in the Pando sub-estuary from Uruguay. a, g: Annual period (2002/ 03); b, h: autumn-02, c, i: winter-02; d, j: spring-02 (\*: no data according to minimum sample size of 20 individuals); e, k: summer-03; f, l: autumn-03.

The same pattern was found when analyzing the seasonal  $L/W$  changes over the study period, with smaller whitemouth croakers presenting lower values than larger ones, for every season (Figures 2b-2f and 2h-2l). Results were similar to those of Costa & Araújo (2003), who described a trend for smaller individuals to show lower allometric coefficients, while bigger individuals showed higher allometric coefficients. This pattern could be mainly explained in terms of energy allocation, where smaller individuals would present higher growth rates than larger ones, even within juvenile sized ranges.

Also, inter-annual differences in  $L/W$  were detected (autumn 2002/ 2003). The Pando sub-estuary is connected to the larger RdIP, suggesting the population connectivity of the species in previous studies (Acuña *et al.* 2010). Differences across years in  $L/W$  could be related to the introduction of new cohorts into the system, as well as to environmental dynamics or varied size distribution. Further analysis, considering the length and abundance distributions of *M. furnieri* populations over temporal scales, should be carried out to determine the dynamics of the species between both systems.

#### Acknowledgements

We would like to thank the people who participated in field data collection and laboratory procedures during the Project IctioPando: F. Viana, R. Canavese, C. Passadore, A. Carnikián, Julio Richly, B. Musso, M. Zarucki, F. Vásquez, N. Borba and H. Ferrando.

#### References

- Acuña, A. P., Passadore, C. & Gimenez, L. 2010. Fish assemblage in a temperate estuary on the Uruguay coast: seasonal variation and environmental influence. **Brazilian Journal of Oceanography**, 58(4): 299-314.
- Acha, E. M., Mianzan, H., Guerrero, R., Carreto, J., Giberto, D., Montoya, N. & Carignan, M. 2008. An overview of physical and ecological processes in the Rio de la Plata Estuary. **Continental Shelf Research**, 28: 1579-1588.
- Canavese, R. S. 2007. Hábitos tróficos de la ictiofauna de la región estuarial del Arroyo Pando (Canelones, Uruguay). **Tesis de Grado**. Universidad de la República, Montevideo, Uruguay, 50 p.
- Cardoso, I., França, S., Pais, M. P., Henriques, S., Fonseca, L. C. & Cabral, H. N. 2011. Fish assemblages of small estuaries of the Portuguese coast: A functional approach. **Estuarine, Coastal and Shelf Science**, 93: 40-46.
- Carlander, K. D. 1969. **Handbook of freshwater fishery biology**, Vol. 1. The Iowa State University Press, Ames, IA, 752 p.
- Cayssials, R., Hernández, J., Cantón, V., Fernández, V., Laborde, J. L. & Collazo, D. 2000. Caracterización del medio físico. Pp. 14-73. *In*: Laborde, J. L., Perdomo, A. & Gómez-Erache, M. (Eds.) **Diagnóstico ambiental y sociodemográfico de la zona costera uruguaya del Río de la Plata**. Ecoplata, Montevideo, Uruguay, 991 p.
- Costa, M. R. & Araújo, F. G. 2003. Length weight relationship and condition factor of *Micropogonias furnieri* (Desmarest) (Perciformes, Sciaenidae) in the Sepetiba Bay, Rio de Janeiro State, Brazil. **Revista Brasileira de Zoologia**, 20: 685-690.
- Giberto, D. A., Bremec, C. S., Acha, E. M. & Mianzan, H. W. 2007. Feeding of the whitemouth croaker *Micropogonias furnieri* (Sciaenidae; Pisces) in the estuary of the Río de la Plata and adjacent Uruguayan coastal waters. **Atlantica, Rio Grande**, 29(2): 75-84.
- Gurdek, R. & Acuña, A. P. 2014. Weight-length relationships of 12 fish species from the Pando tidal creek estuary (subsystem of the Río de la Plata, Uruguay). **Journal of Applied Ichthyology**, 30(2): 426-427.
- Isaac, V. J. 1988. **Synopsis of biological data on the whitemouth croaker *Micropogonias furnieri* (Desmarest, 1823)**. FAO Fisheries Synopsis, no. 150, 35 p.
- Martinho, F., Cabral, H. N., Azeiteiro, U. M. & Pardal, M. A. 2012. Estuarine nurseries for marine fish: Connecting recruitment variability with sustainable fisheries management. **Management of Environmental Quality: An International Journal**, 23: 414-433.
- MTOP-PNUD. 1979. **Proyecto sobre conservación y mejora de playas** (URU. 73007). Ministerio de Transporte y Obras Públicas, UNESCO, Montevideo, Uruguay, 593 p.
- Norbis, W. & Galli, O. 2013. Spatial co-occurrence of two sciaenid species (*Micropogonias furnieri* and *Cynoscion guatucupa*) subject to fishing in the Río de la Plata and oceanic coast of Uruguay: ecological or technological interdependence? **Boletim do Instituto de**

- Pesca**, 39: 137-148.
- Olim, S. & Borges, T. C. 2006. Weight-length relationships for eight species of the family Triglidae discarded on the south coast of Portugal. **Journal of Applied Ichthyology**, 22: 257-259.
- Olsson, D., Forni, F., Saona, G., Verocai, J. & Norbis, W. 2013. Temporal feeding habits of the whitemouth croaker *Micropogonias furnieri* in a shallow coastal lagoon (southwestern Atlantic Ocean, Uruguay). **Ciencias Marinas**, 39: 265-276.
- Potter, I. C. & Hyndes, G. A. 1999. Characteristics of the ichthyofaunas of southwestern Australian estuaries, including comparisons with holarctic estuaries and estuaries elsewhere in temperate Australia: A review. **Australian Journal of Ecology**, 24: 395-421.
- Sokal, R. R. & Rohlf, J. F. 1969. **Biometria**. Freeman W.H. and Company, New York, 832 p.

Received: September 2015

Accepted: June 2016

Published: August 2016