

**MORPHOMETRICS AND LENGTH STRUCTURE OF *Micropogonias furnieri*
(DESMAREST, 1823) (PERCIFORMES, SCIAENIDAE) IN GUANABARA BAY, STATE
OF RIO DE JANEIRO, BRAZIL**

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ABSTRACT

The whitemouth croaker *Micropogonias furnieri* is the most common species of Sciaenidae in Guanabara Bay, southeastern coast of Brazil. Data from monthly trawls taken from a shrimp boat between May 2003 and June 2005 showed that whitemouth croakers are regularly present year-round; the catch was entirely composed of juveniles. The length-weight relationship for pooled sexes was represented by the equation $W_t = 0.0053 * L_t^{3.183}$. Significant seasonal differences in the condition factor were not observed ($p > 0.05$). Regarding the morphometric characterization of this population stratum, most of the characters examined showed isometric growth, except for Pre-anal Distance, which showed positive allometry and Eye Diameter, which showed negative allometry. Morphometric aspects of the population in Guanabara Bay seem to be similar to those from coastal populations of southeastern Brazil (population I), which differ from populations on the south coast.

Key words: demersal fish; bottom trawl; bycatch; *Micropogonias furnieri*; length-weight relationship; morphometrics

**MORFOMETRIA E ESTRUTURA POPULACIONAL DE *Micropogonias furnieri*
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JANEIRO, BRASIL**

RESUMO

A corvina, *Micropogonias furnieri*, é a espécie de Sciaenidae mais comum na baía de Guanabara, sudeste do Brasil. Baseados em arrastos mensais, efetuados por um barco camaroneiro que opera com rede simples de arrasto-de-fundo, entre maio de 2003 e junho de 2005, observamos que sua presença é regular ao longo de todo o ano, sendo capturados apenas juvenis. A relação comprimento-peso para os sexos grupados, é representada pela equação $P_t = 0,0053 * C_t^{3,183}$. Não foram constatadas diferenças sazonais significativas ($p > 0,05$) para o fator de condição, indicando que este não sofre amplas variações ao longo do ano. Com relação à caracterização morfométrica do estrato populacional que utiliza a baía e é capturado pelos arrasteiros, observamos que a maioria dos caracteres examinados apresenta crescimento isométrico, exceto para a Distância pré-anal, que apresentou alometria positiva e o Diâmetro do olho, com alometria negativa. A população da baía de Guanabara parece ser similar em seus aspectos morfométricos às outras populações costeiras da região sudeste do Brasil (população I), que diferem das populações da costa Sul.

Palavras-chave: peixes demersais, arrasto-de-fundo, fauna acompanhante, *Micropogonias furnieri*, relação comprimento-peso, morfometria

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INTRODUCTION

Fishes of the family Sciaenidae are among the most important resources of coastal fisheries in the Atlantic Ocean, Gulf of Mexico, and the United States (CHAO and MUSICK, 1977). Sciaenids commonly use estuaries as spawning and nursery grounds (VAZZOLER *et al.*, 1999). The whitemouth croaker *Micropogonias furnieri* (Desmarest, 1823) is prominent among the sciaenids caught along the southern and southeastern coast of Brazil. It is the main demersal species landed by the fishing fleet in these areas, occupying the second place among coastal fishes of commercial value (CARNEIRO *et al.*, 2005). The whitemouth croaker has a wide geographical distribution in the Western Atlantic, from the Gulf of Mexico and Antilles (20°N) to the Gulf of San Matias in Argentina (41°S). It occurs on sandy and muddy bottoms, and is an obligatory demersal species, without vertical displacements. The whitemouth croaker is euryhaline and eurythermal: on the Brazilian coast, it occurs in salinities from 0.1 to 35 and temperatures from 11 to 31.6°C (CARNEIRO *et al.*, 2005).

VAZZOLER (1971; 1991) reported the occurrence of two populations along the southeastern and southern coasts of Brazil (population I: 23° - 29°S; population II: 29° - 33°S). These populations differ in reproduction periods and in recruitment, spawning areas, values of L_{50} and L_{100} , growth parameters, longevity, and meristic and morphometric characteristics. Based on these geographical data, the whitemouth croakers of Guanabara Bay, in the state of Rio de Janeiro, should be included in population I.

Characteristics of the population segment are basic information for the success of measures proposed for fishery management. VAZZOLER (1996) emphasized the importance of obtaining basic information, such as population size structure, to estimate the size of stocks available for fishing.

In the estuary of Guanabara Bay, the fishery of pink shrimps (*Farfantepenaeus paulensis* and *F. brasiliensis*) and white shrimp (*Litopenaeus schmitti*) catch large numbers of small-sized whitemouth croakers, which are discarded because they lack commercial value (VIANNA *et al.*, 2004a). The aim

of the present study was to determine the length-weight relationship and the variations in the condition factor among seasons and to characterize morphometrically the population segment of *M. furnieri* caught by bottom trawl fishery in Guanabara Bay.

MATERIAL AND METHODS

Samples of fish were collected twice a month on commercial shrimp bottom otter trawler used to catch pink shrimps (*Farfantepenaeus paulensis* and *F. brasiliensis*) and white shrimp (*Litopenaeus schmitti*) in Guanabara Bay. Data were provided by a haul made from a 9.5 m boat operating at an average depth of 10 m. The towing speed was maintained around 2.0 knots and each haul lasted 30 minutes and was nocturnal, because the aim was the capture of the shrimp-alive used as bait. The dimensions of the net used were 18 mm mesh size from opposite knots on codend; length of 7 m on the upper side of the net; each door weights 23 kg.

From May 2003 to June 2005, 2,667 individual whitemouth croakers were collected and identified according to MENEZES and FIGUEIREDO (1980), measured, counted and weighted at 0.1g. The structure of the population of *M. furnieri* was recorded monthly, based on the number of individuals per class of total length (L_t). The relationship to total weight (W_t - g) was calculated based on total length (L_t - cm) obtained by the adjusted potential function for each three-monthly period (season), expressed as: $W_t = a * L_t^b$. The coefficients a and b were obtained after logarithmic transformations of W_t and L_t . For each b , Student's t test was applied to test the hypothesis that the calculated value was equal to 3.0 (ZAR, 1984).

For the morphometric characterization, the following measurements were obtained for 2,063 individuals: standard length (SL), head length (HL), eye diameter (ED), pre-dorsal distance (PDD), pre-pectoral distance (PPD), pre-ventral distance (PVD), pre-anal distance (PAD), and pectoral fin length (PFL), using a caliper, to the nearest 0.1 cm.

The body proportions were calculated, relating the values of HL, PDD, PPD, PVD, PAD,

and PFL to SL, and the ED to HL. The data were log-transformed and the linear regressions were calculated. For the analysis of isometry, the regression coefficients were compared to the constant 1 by Student's *t* test (ZAR, 1984). This isometric analysis indicates whether the morphometric characters grow in the same proportion as the standard length and the head length, as the fish grows.

For seasonal comparisons, the monthly samples were grouped as follows: Summer (January 2004 and 2005, February 2004 and 2005, and March 2004 and 2005), Autumn (April 2004 and 2005, May 2003 and 2004, and June 2003 and 2004), Winter (July 2003 and 2004, August 2003 and 2004, and September 2003 and 2004), and Spring (October 2003 and 2004, November 2003 and 2004, and December 2003 and 2004).

RESULTS

Micropogonias furnieri comprised 17.5% of the total number of individuals (15,235) and 12.1% of the total weight (249.9 kg) sampled, and was present in all samples. The 2,667 individuals measured had total biomass of 30,207 g. The total weight varied between 0.2 and 144.9 g (12.7 ± 14.4 g), and the total length between 2.6 and 25.4 cm (10.2 ± 3.6 cm).

The length-class frequency distribution, showed one prominent mode at 9.5 cm (Figure 1). The recruitment estimated from the catch in the trawls showed individuals beginning at 2.5 cm, and the highest intensity between April and June at 4.5 cm. The largest individuals, mostly between 10.5 and 18.5 cm, were caught in summer (Figure 2).

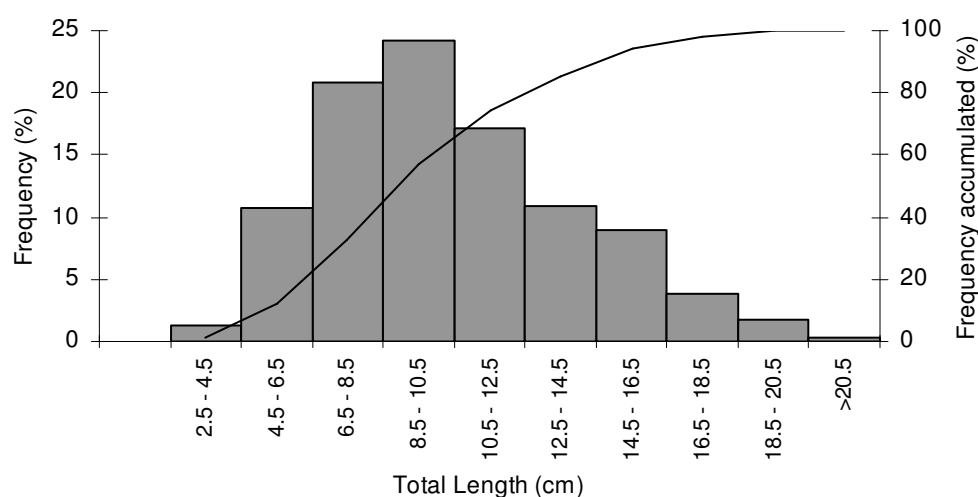


Figure 1. Total-length class frequencies (cm) of *Micropogonias furnieri*, caught with an otter trawl, in Guanabara Bay between May 2003 and June 2005

The length/weight relationship (Figure 3) was obtained for 2,667 individuals smaller than L_{i50} (= 22.4 cm - VAZZOLER, 1991), expressed by $W_i = 0.0053 \cdot L_i^{3.183}$, ($r_{\text{Pearson}} = 0.99$). This relationship indicated positive allometric growth, with a calculated value of 9.2727 ($p < 0.05$).

Table 1 presents the parameters of the length/weight relationships calculated for each three-monthly period, and the *t*-values from the significance tests of the differences between each coefficient of regression obtained (*b*) and 3.0. No significant seasonal differences were observed ($p > 0.05$).

The morphometric measurements and the body proportions related to Head Length (HD) and to Standard Length (SL) are shown in Table 2. SL ranged from 27 to 188 mm. The results of the *t*-test of the regression coefficient for each body proportion, at $p < 0.05$ are shown in Table 2. Most characters examined showed isometric growth, except for PAD which showed positive allometry, and ED which showed negative allometry (Figure 4). That is, PAD enlarges regarding to SL, and ED proportionally decreases in relation to HL, along the fish growth.

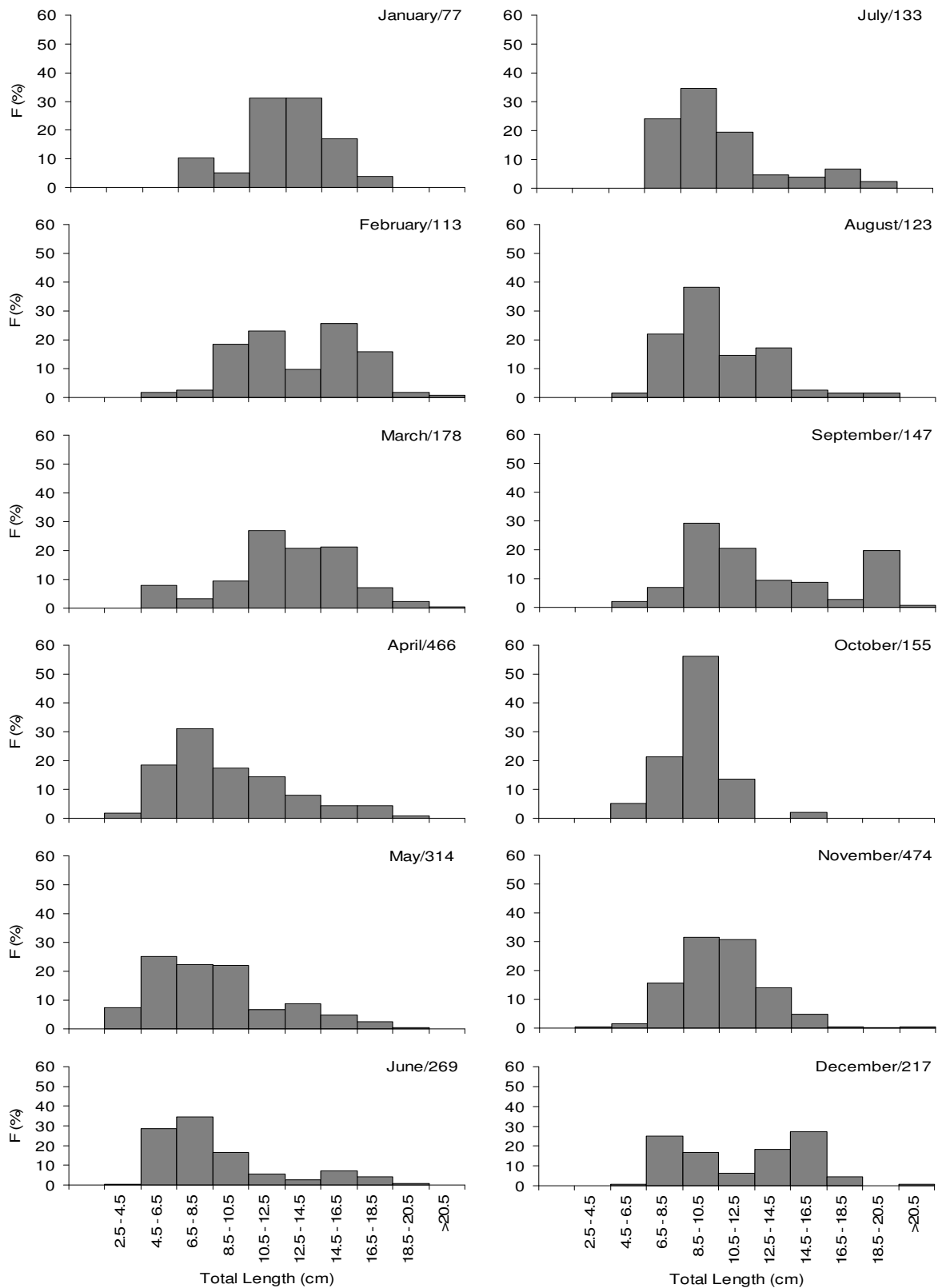


Figure 2. Monthly distribution of the total length (cm) of individuals of *Micropogonias furnieri*, caught with an otter trawl in Guanabara Bay between May 2003 and June 2005. The month and number of specimens analyzed are indicated at lower right of each graph

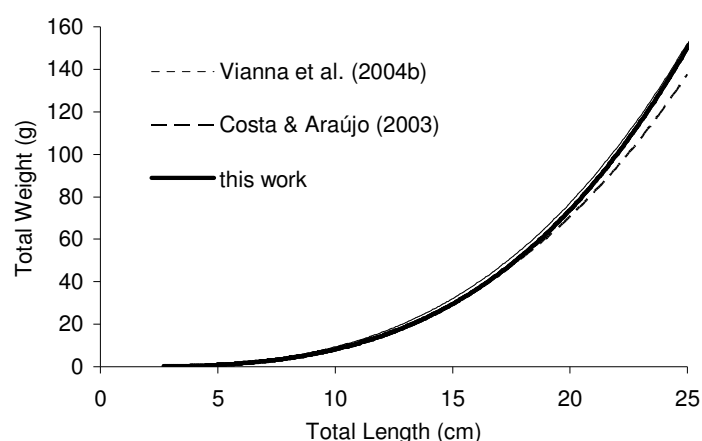


Figure 3. Relation between total weight (g) and total length (cm) of *Micropogonias furnieri*, caught with an otter trawl in Guanabara Bay between May 2003 and June 2005, compared with previous studies

Table 1. Regression analysis and Student's *t* test, at 95% level of confidence, for the length/weight relationship of *Micropogonias furnieri* in Guanabara Bay between May 2003 and June 2005. (n) number of individuals; (r) correlation coefficient; (a and b) parameters of the length/weight equation; (A) regression constant

Season	n	r	$a = e^A$	$b = B$	A	Student's <i>t</i>	<i>t</i> -critical
Autumn 2003	182	0.98	0.008	3.0053	-4.8871	0.0168	1.96
Winter 2003	169	0.99	0.006	3.0895	-5.0456	0.1563	1.96
Spring 2003	352	0.99	0.008	3.0545	-4.8715	0.1006	1.96
Summer 2004	205	0.99	0.004	3.2774	-5.4481	0.6309	1.96
Autumn 2004	586	0.98	0.002	3.5342	-6.0901	1.8740	1.96
Winter 2004	234	0.98	0.009	2.9579	-4.6569	-1.5744	1.96
Spring 2004	494	0.98	0.004	3.2786	-5.4898	-1.6744	1.96
Summer 2005	164	0.98	0.007	3.0965	-5.0302	0.0844	1.96
Autumn 2005	281	0.99	0.006	3.1654	-5.1765	0.4007	1.96

Table 2. Certain morphometrics of *Micropogonias furnieri*, caught with an otter trawl in Guanabara Bay between September 2003 and February 2005, and *t* test applied to the regression coefficient, at significance level $p < 0.05$

Character	No. individuals	Minimum	Maximum	Mean	Standard Error	<i>t</i> test
Standard length (SL) (mm)		27.0	188.0	81.6	27.9	
Percentage of standard length						
Head length (HL)	2,063	15.4	66.2	30.5	3.2	1.0701
Pre-dorsal distance (PDD)	2,062	4.0	77.5	36.2	3.2	1.2968
Pre-pectoral distance (PPD)	2,059	3.9	89.9	32.2	2.8	-1.3264
Pre-ventral distance (PVD)	2,052	3.9	73.3	33.7	2.9	2.3839
Pre-anal distance (PAD)	2,063	16.6	94.6	65.3	5.8	3.4697 *
Pectoral fin length (PFL)	2,056	6.3	44.1	20.4	3.1	2.3481
Percentage of head length						
Eye diameter (ED)	2,062	12.7	43.0	29.3	4.8	-32.6551 *

(*) Significantly different at 95% confidence interval ($t_{critical} = 2.58$).

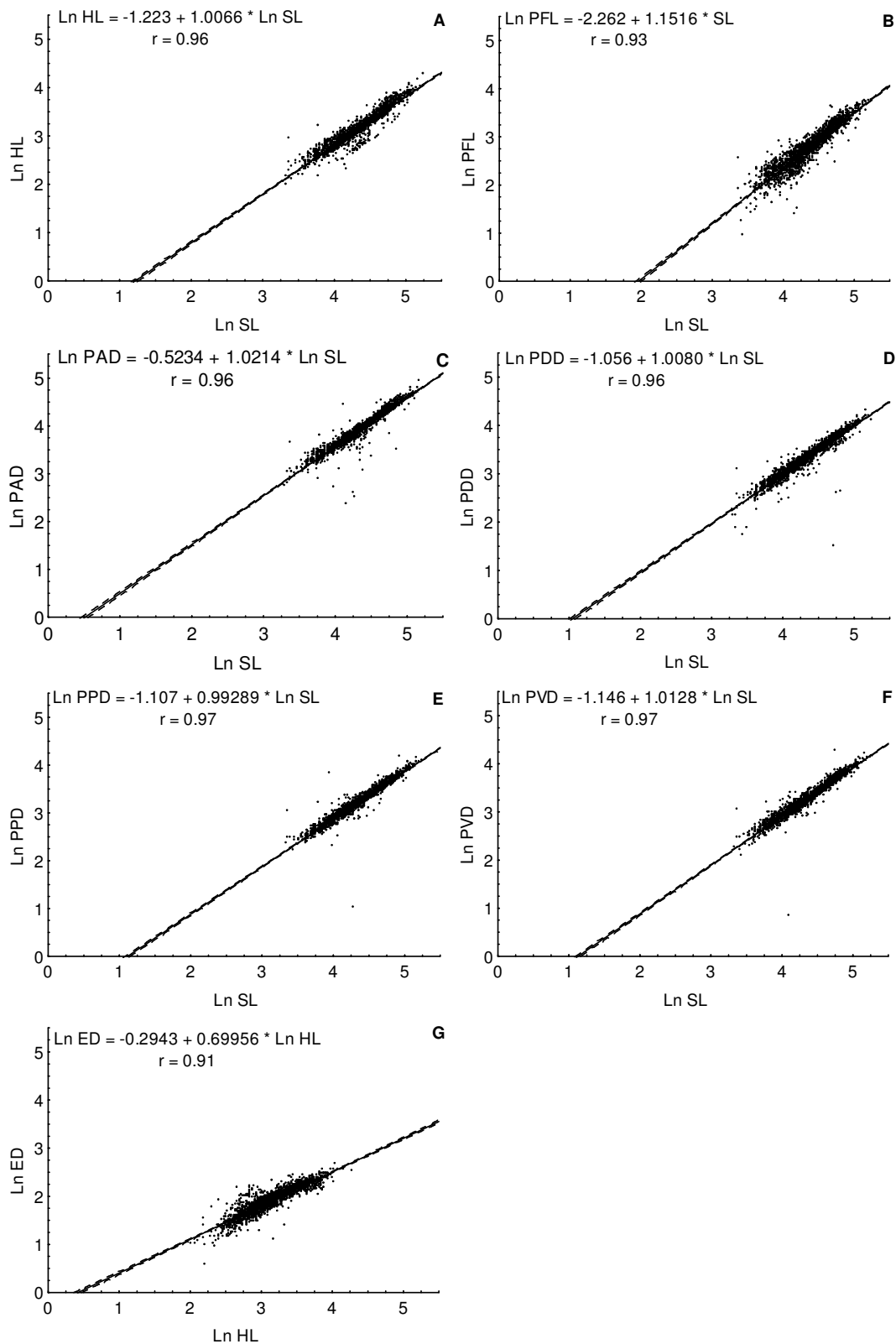


Figure 4. Linear regressions among the log-transformed values for standard length of *Micropogonias furnieri* in Guanabara Bay: (A) head length; (B) pectoral fin length; (C) pre-anal distance; (D) pre-dorsal distance; (E) pre-pectoral distance; (F) pre-ventral distance; (G) eye diameter

DISCUSSION

The population consisted entirely of juveniles. This confirms the predatory action of the otter trawl on whitemouth croakers in Guanabara Bay, as previously observed by VIANNA *et al.* (2004a).

The recorded recruitment reflects the low fishing gear selectivity. Individuals as small as 2.5 cm were caught, mostly between April and June, in agreement with the results of VAZZOLER (1991) and CARNEIRO *et al.* (2005).

The whitemouth croaker is a partial spawner which reproduces year-round in the open sea, however, juveniles of the species remain in lagoons and estuaries favorable for feeding and growth (VAZZOLER, 1991). This explains the year-round presence of juveniles observed in the present study in Guanabara Bay, which confirmed that juveniles of *M. furnieri* seek out protected areas in bays and estuaries. Also, they are apparently adapted to the alterations in Guanabara Bay, which are caused as much by natural environmental variations as by human influence, common in semi-enclosed environments near urban areas, such as the bay.

No significant differences were observed between each of the three-monthly regression coefficients (*b*) and the constant 3.0, indicating that small specimens kept the same body form and condition as large specimens along the whole studied period. Young fish tend to allocate a large amount of energy to growth, whereas adults put a considerable part of their energy into reproduction or increasing weight (VAZZOLER, 1996; FROESE, 2006).

This suggests that the constant input of organic matter into the bay from continental drainage results in high levels of food enrichment of the local stratum, close to the bottom, independently of seasonal natural phenomena. The local juvenile whitemouth croakers, which are bottom-feeders and dependent on estuaries, find these conditions very favorable. According to CARNEIRO *et al.* (2005), the whitemouth croaker population in southeastern Brazil is presently in a better condition of fat and general well-being, if compared to length/weight relationships estimated in late 1970s, which are much lower than those found in the most recent studies (*e.g.*, population I: $a=0.0000103$, $b=2.9996$ -

VAZZOLER, 1971; population II: $a=0.0000073$, $b=3.0677$ - VAZZOLER, 1971).

As in the previous comparisons (VAZZOLER, 1991), differences are evident between Population I and Population II on the southeastern coast. In coastal areas, the weight increase (*b*) in population II is greater than in population I, although this parameter increases considerably in estuaries due to food availability. COSTA and ARAÚJO (2003) and VIANNA *et al.* (2004b) observed in Sepetiba Bay (state of Rio de Janeiro) and in the coastal system of Ubatuba (state of São Paulo), respectively, that parameter *b* of the length-weight relationship is similar to the related parameter for estuarine areas (VAZZOLER, 1991), as in the present study. Figure 3 makes evident that the analyzed population stratum belongs to Population I, as defined in the literature.

Regarding the morphometric characterization of the population that uses the Bay and was caught by the otter trawl, most of the characters examined showed isometric growth, except for Pre-anal Distance, with positive allometry, and Eye Diameter, with negative allometry. That is, PAD increases proportionally to SL meanwhile ED decreases in relation to HL, along the ontogenetic process.

The morphometric aspects of *M. furnieri* in Guanabara Bay seem to be similar to the population off the southeastern Brazil (population I), which differ from the southern coast population. The analyzed specimens showed values for body proportions very close to those defined by VAZZOLER (1971) and were therefore assignable to population I, of warmer waters.

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