Revista de Biología Marina y Oceanografía
Vol. 51, Nº2: 347-357, agosto 2016

ARTICLE

Length-weight relationships and condition factor of two Sciaenid species *Micropogonias furnieri* and *Cynoscion guatucupa* from the Rio de la Plata and Uruguayan ocean coast, Southwestern Atlantic

Relaciones longitud-peso y factor de condición estacional y anual de dos especies de Sciaenidos *Micropogonias furnieri* y *Cynoscion guatucupa* del Río de la Plata y costa oceánica uruguaya (Atlántico Suroeste)

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Resumen.- En este trabajo se analizaron las relaciones longitud-peso y el factor de condición de *Micropogonias furnieri* y *Cynoscion guatucupa* en diferentes épocas [verano; otoño; invierno, primavera y años (2006, 2007 y 2011)] a partir de muestreos mensuales de desembarques de la flota costera uruguaya que operó en el Río de la Plata y costa oceánica uruguaya. Fueron analizados 9.146 individuos de *M. furnieri* (entre 15-69 cm de longitud total) y 5.285 individuos de *C. guatucupa*, (entre 21-54 cm de longitud total). Para ambas especies, el coeficiente de alometría fue negativo ($b < 3$), excepto para *M. furnieri* en primavera de 2006 (isométrico, $b = 3$) y durante verano de 2011 (positivo, $b > 3$). Para *M. furnieri*, las pendientes no mostraron diferencias significativas entre el 2006 y 2007, mientras que el 2011 presentó diferencias significativas con ambos años. Para *C. guatucupa* no se encontraron diferencias significativas entre el 2007 y 2011, pero si cuando ambos años fueron comparados con el 2006. Los mayores valores del factor de condición fueron obtenidos en verano de 2006 y durante el verano y otoño del 2007 para *M. furnieri*, mientras que para *C. guatucupa* fueron en invierno 2006 y otoño 2007. Para ambas especies el factor de condición mostró diferencias significativas estacionales y anuales. Este trabajo presenta la primera referencia del factor de condición para estas especies de Sciaenidos en el área de estudio.

Palabras clave: Peces costeros, Corvina blanca, pescadilla de calada, Atlántico Sudoccidental, crecimiento alométrico

Abstract.- The present study analyses the seasonal (summer: January, February, March; autumn: April, May, June; winter: July, August, September and spring: October, November, December) and annual (2006, 2007 and 2011) length-weight relationships and condition factors of *Micropogonias furnieri* and *Cynoscion guatucupa* from Río de la Plata and the Uruguayan ocean coast from data collected throught monthly landings by the Uruguayan coastal fleet in the Montevideo port (Uruguay). A total of 9,146 individuals of *M. furnieri* ranging from 15 to 69 cm total length (L_T); and 5,285 individuals of *C. guatucupa*, ranging from 21 to 54 cm L_T were analyzed. For both species, the allometry coefficients showed that growth in the majority of seasons were negative ($b < 3$), except for *M. furnieri* in spring 2006 (isometric, $b = 3$) and during summer 2011 (positive, $b > 3$). For *M. furnieri*, no significant differences among slopes were found between 2006 and 2007 whereas 2011 showed significant differences compared to 2006 and 2007. For *C. guatucupa* no significant differences among slopes were found between 2007 and 2011, whereas 2006 showed significant differences with other years. The highest values for the condition factor in *M. furnieri* were recorded in summer 2006, and during the summer and autumn 2007 and for *C. guatucupa* in winter 2006 and autumn 2007. Significant seasonal and annual differences for condition factors were found for both species. This work provides the first reference regarding condition factor for both *sciaenid species* in the study area.

Key words: Coastal fishes, whitemouth croaker, striped weakfish, length-weight

INTRODUCTION

Studies on length-weight relationship are noteworthy in fishery because it shows relevance regarding fish population dynamics and growth patterns on fish stocks (Froese 2006). Length-weight relationship parameters (a and b) are useful in fisheries in many different ways: to estimate weight of individual fish from its length, to calculate condition factors (Le Cren 1951, Froese 2006), to compare life history and populations morphology belonging to different regions, and to evaluate changes in growth associated with environmental disturbances such as increased temperatures, acidification, exploitation, among others (Petrakis & Stergiou 1995, Moutopoulos & Stergiou 2002, Froese 2006). The total fisheries production in the South Brazilian, Uruguayan and Argentinean coastal regions (< 50 m depth) are supported by sciaenid species (Vasconcellos & Haimovici 2006, Norbis *et al*. 2006, Villwock de Miranda & Haimovici 2007), mainly by the whitemouth croaker *Micropogonias furnieri* (Desmarest, 1823) and the striped weakfish *Cynoscion guatucupa* (Cuvier 1830) (Carozza *et al*. 2004, Ruarte *et al*. 2004, Norbis *et al*. 2006, Norbis & Galli 2013). The whitemouth croaker is a demersal benthic marine species widely distributed along the western Atlantic coast from Mexico (20ºN) to Argentina (41ºS) (Isaac 1988). It is a multiple spawner that spawn in the inner part of the Rio de la Plata estuary and Uruguayan Atlantic coast from October to March (Austral spring-summer) (Macchi *et al*. 1996, 2003; Vizziano 2002). A juvenile occurs within the Río de la Plata (Jaureguizar *et al*. 2003) and at rivers entrance and streams and coastal lagoons of Uruguay (Borthagaray *et al*. 2011, Gurdek & Acuña 2014). The whitemouth croaker has 100% persistence in shallow internal estuarine waters (ranging 3 to 19 m deep), ranging in temperature from 16 to 20ºC and with salinity fluctuations between 13.5 and 22.5 (Lorenzo *et al*. 2011). The striped weakfish is a demersal bentho-pelagic fish found in South American Atlantic waters with a distribution ranging from Rio de Janeiro (22º54'S), Brazil, to northern Patagonia, Argentina (43ºS) (Cousseau & Perrotta 2004, Menezes *et al*. 2003). This species is a partial spawner (Cassia 1986, Macchi 1998) reproducing from October to March (austral spring-summer) in the ocean (Cassia 1986, Militelli & Macchi 2006) off the coast of Punta del Este (35º15'S - 54º50'W), Uruguay (Macchi 1998, Militelli & Macchi 2006). A juvenile occurs in high densities in the coastal zone of the Uruguayan shelf (Ruarte *et al*. 2005). The striped weakfish typically displayed high density and persistence in the Uruguayan coastal assemblage, located on the inner continental shelf in the Uruguayan Atlantic coast at depths of 17 to 40 m, with a temperature between 12 and 18ºC and salinity ranging from 28.9 and 33.1 (Lorenzo *et al*. 2011).

The aim of this study was to determine the seasonal and annual length-weight relationships and the condition factor of *M. furnieri* and *C. guatucupa*, respectively.

MATERIALS AND METHODS

The two species under study are target species of the Uruguayan bottom trawls coastal fleet that operated in the Río de la Plata and Uruguayan coastal area (Norbis & Galli 2013). On board of fishing vessel and after catch, fishermen puts the fishes inside boxes. Each box of 23 kg total fish weight was defined as a sampling unit and the sampling consisted in taking all fish from 2 boxes. Sampling involves taking 2 boxes of the first landing, leaving 3 landings and get 2 boxes from next landing. These boxes had not been previously selected and the technicians who performed the sampling did not know which boxes were going to be sampled. This sampling procedure takes place from the beginning to the end of the landing. Fish landing was carried out up to 16 boxes at a time. Both species samples were obtained from monthly landings by Uruguayan coastal fleet at the Montevideo port (Uruguay) from 2006, 2007 and 2011 (Fig. 1). The data were grouped and analyzed by season (summer: January, February, March; autumn: April, May, June; winter: July, August, September and spring: October, November, December), and year (aggregate of data corresponding to each season of the year = pooled data). Fishes were measured from the tip of the mouth to the caudal fin (to the nearest 0.1 cm total length, L_T) and weighed using an electronic balance Sartorius (to the nearest 0.1 g total weight, W_T). The parameters for the equation $W_T = a\ L_T^{\,b}$ (Ricker 1973) were estimated by linear regression, after a logarithmic transformation of the variables. Model validation was analyzed by checking the errors trend, the statistical significance of the slope (*b*), the intercept (*a*) and the correlation coefficient (r) using the Student's t test (Sokal & Rohlf 1995). A total of 9,146 individuals of *M. furnieri* belonging to 3 summers, 2 autumns, 2 winters and 2 springs and a total of 5285 individuals of *C.guatucupa* belonging to 1 summer, 2 autumns, 2 winters and 3 springs, were analyzed for calculating the $L_T – W_T$ relationships. In order to check whether fish growth was statistically different from isometric growth (H_0: b= 3), a t-test was performed. The length-weight regression models among seasons of the same year, among years and from the same season from different years were compared with analysis of covariance (ANCOVA) using the length as covariate (Sokal & Rohlf 1995). Relative condition factor (Krel) (Le Cren 1951) according to Froese (2006), was calculated by the following expression: Krel= $W_T/aL_T^{\,b}$, using *a* and *b* obtained of the regression models. The median Krel values with 25 and 75 percentiles were estimated using Past (version 3.10) (Hammer *et al*. 2001). The estimated Krel was compared among seasons per year and for each year using Kruskal-Wallis (KW) non-parametric analysis of variance (Sokal & Rohlf 1995). When significant differences were detected, we used the Mann-Whitney test, adjusted by Bonferroni criterion, in order to evaluate specific differences among seasons. In all cases we used a $P = 0.05$.

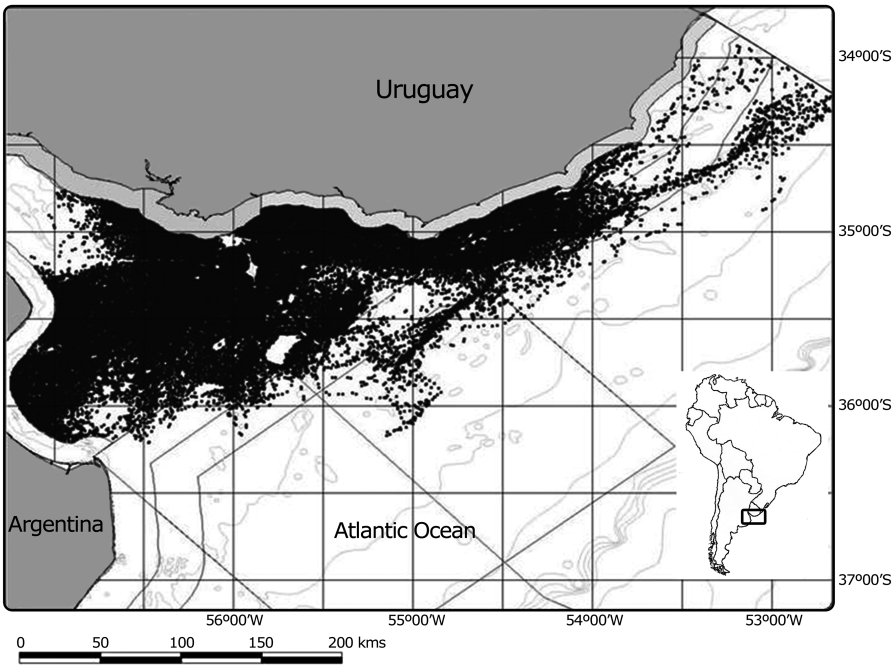

Figure 1. Spatial distribution of the uruguayan coastal fleet activity along of the year / Distribución espacial de la actividad de la flota costera uruguaya a lo largo de un año

Results

Micropogonias furnieri

Minimum and maximum T_L for all sampled individuals was 15 cm and 69 cm, respectively (Table 1). All estimated regressions coefficient were highly significant ($P < 0.0001$), and ranged from 2.65 for summer 2006 to 3.08 for summer 2011. More than 90% of W_T variability was explained for the models, except for autumn 2006 (r^2= 88%) (Table 1). The allometry coefficients showed in most seasons a negative growth ($b < 3$), except for spring 2006 (isometric, b= 3) and for summer 2011 (positive, $b > 3$). Only for 2011 (pooled data) the growth was isometric. For slopes, significant differences between seasons within a year and between summer and winter for different years were found. Non-significant differences were found for spring (Table 1). For pooled data, non-significant differences were found between 2006 and 2007, whereas 2011 showed significant differences compared to 2006 and 2007. The highest values of Krel in descendent order were recorded in winter 2007, spring 2011, and autumn 2006. The lowest value was recorded during the summer 2007 (Table 1). Significant differences were found between seasons for 2006 (KW= 72.75, P= $1.099e^{-15} < 0.05$; between autumn in relation with summer, winter and spring), for 2007 (KW= 955.7, P= $2.2e^{-16} < 0.05$; between winter with respect to summer and autumn), and between summer and spring for 2011 (KW= 25.7, P= $3.964e^{-07} < 0.05$). Also, significant differences were found between years (KW= 955.7, P= $2{,}946e^{-208} < 0.05$; between 2011 with respect to 2006 and 2007).

Cynoscion guatucupa

Minimum and maximum T_L among all individuals sampled were 21 cm and 54 cm, respectively (Table 2). All estimated regressions coefficient were highly significant ($P < 0.0001$), and ranged from 2.61 in autumn 2007 to 2.92 in spring 2011. More than the 90% of total W_T variability was explained for the models, except for spring 2006 and 2007 (r^2= 86 and 88%, respectively) (Table 2). The allometry coefficients showed that growth for all season and pooled data were negative ($b < 3$). For slopes, significant differences between seasons by year and between summer and winter for different years were found (Table 2). For pooled data, non significant differences were found between 2007 and 2011, whereas 2006 showed significant differences with other years. The highest values of

Table 1. Estimated parameters of length-weight relationships and relative condition factor by season and year for *M. furnieri*. Max= maximum length (cm); Min= minimum length (cm); n= number of individuals included in the analysis; a= intercept; b= slope; CI 95%= confidence interval; r= correlation coefficient; r^2= coefficient of determination; Krel= Relative condition factor; 25 prcntil= percentile 25; 75 prcntil= percentile 75; (0)= Isometric growth; (+)= Significant positive allometry; (-)= Significant negative allometry; * = Significant differences ($P < 0.05$) / Parámetros estimados de la relación longitud-peso y factor de condición relativo por época y año para *M. furnieri*. Max= longitud máxima (cm); Min= longitud mínima (cm); n= número de individuos incluidos en el análisis; a= intercepto b= pendiente; CI 95%= intervalo de confianza; r= coeficiente de correlación; r^2= coeficiente de determinación; Krel= Factor de condición relativo; 25 prcntil= Percentil 25; 75 prcntil= Percentil 75; (0)= Crecimiento isométrico; (+)= Alometría positiva significativa; (-)= Alometría negativa significativa; * = Diferencias significativas ($P < 0,05$)

Year	Season	Length		Parameters of the relationships					Relative Condition Factor		
		Min.	Max.	n	a	b ± CI 95%	r	r^2	Krel	25 prcntil	75 prcntil
2006	Summer	18	61	1035	0.0413	2.65 ± 0.03* (-)	0.98	0.96	0.99	0.94	1.05
	Autumn	28	61	1144	0.0253	2.78 ± 0.06* (-)	0.94	0.88	1.02	0.98	1.08
	Winter	24	64	2169	0.0183	2.87 ± 0.02* (-)	0.99	0.97	0.99	0.94	1.04
	Spring	32	56	200	0.0150	2.92 ± 0.08 (0)	0.98	0.96	1.00	0.96	1.04
	Pooled	18	64	4548	0.0254	2.78 ± 0.02* (-)	0.98	0.96	1.00	0.95	1.06
2007	Summer	24	63	1512	0.0351	2.69 ± 0.03* (-)	0.97	0.95	0.98	0.93	1.04
	Autumn	25	55	349	0.0331	2.70 ± 0.08* (-)	0.96	0.93	1.00	0.94	1.05
	Winter	22	62	1089	0.0140	2.92 ± 0.03* (-)	0.99	0.97	1.12	1.05	1.19
	Pooled	22	63	2950	0.0242	2.78 ± 0.02* (-)	0.96	0.95	1.00	0.95	1.07
2011	Summer	15	64	873	0.0071	3.08 ± 0.04* (+)	0.98	0.95	1.00	0.93	1.08
	Spring	21	69	775	0.0136	2.93 ± 0.03* (-)	0.99	0.98	1.03	0.98	1.08
	Pooled	15	69	1648	0.0101	2.99 ± 0.03* (0)	0.98	0.96	1.05	0.95	1.13

Table 2. Estimated parameters of length-weight relationships and relative condition factor by season and year for *C. guatucupa*. Max= maximum length (cm); Min= minimum length (cm); n= number of individuals included in the analysis; a= intercept; b= slope; CI 95%= confidence interval; r= correlation coefficient; r^2= coefficient of determination; Krel= Relative condition factor; 25 prcntil= percentile 25; 75 prcntil= percentile 75; (0)= Isometric growth; (+)= Significant positive allometry; (-)= Significant negative allometry; *= Significant diferences ($P < 0.05$) / Parámetros estimados de la relación longitud-peso y factor de condición relativo por época y año para *C .guatucupa*. Max= longitud máxima (cm); Min= longitud mínima (cm); n= número de individuos incluidos en el análisis; a= intercepto b= pendiente; CI 95%= intervalo de confianza; r= coeficiente de correlación; r^2= coeficiente de determinación; Krel= Factor de condición relativo; 25 prcntil= Percentil 25; 75 prcntil= Percentil 75; (0)= Crecimiento isométrico; (+)= Alometría positiva significativa; (-)= Alometría negativa significativa; *****= Diferencias significativas ($P < 0,05$)

Year	Season	Length		Parameters of the relationships					Relative Condition Factor		
		Min.	Max.	n	a	b ± CI 95%	r	r^2	Krel	25 prcntil	75 prcntil
2006	Winter	24	53	1218	0.0359	2.63 ± 0.04 (-)	0.97	0.94	1.01	0.96	1.06
	Spring	32	52	214	0.0135	2.82 ± 0.10 (-)	0.93	0.86	1.30	1.24	1.37
	Pooled	24	53	1432	0.0251	2.73 ± 0.05 (-)	0.96	0.92	1.00	0.95	1.05
2007	Summer	22	53	886	0.0154	2.84 ± 0.03 (-)	0.98	0.96	1.02	0.96	1.08
	Autumn	21	50	721	0.0342	2.61 ± 0.05 (-)	0.97	0.94	1.01	0.95	1.06
	Winter	29	54	800	0.0136	2.88 ± 0.06 (-)	0.95	0.91	0.99	0.94	1.03
	Spring	31	51	356	0.0297	2.68 ± 0,10 (-)	0.93	0.87	1.01	0.96	1.05
	Pooled	21	54	2763	0.0147	2.86 ± 0.02 (-)	0.98	0.96	0.99	0.94	1.04
2011	Autumn	24	50	292	0.0280	2.68 ± 0.05 (-)	0.99	0.97	1.01	0.97	1.07
	Spring	32	54	798	0.0125	2.92 ± 0.06 (-)	0.96	0.92	0.98	0.94	1.04
	Pooled	24	54	1090	0.0146	2.87 ± 0.03 (-)	0.98	0.97	1.01	0.96	1.07

Krel were recorded in spring 2006, and the lowest values were recorded in spring 2011 and winter 2007 (Table 2). Significant differences were found between winter and spring for 2006 (KW= 524.9, $P= 2.2e^{-16} < 0.05$); among seasons (KW= 66.3, $P= 2.135e^{-14} < 0.05$) for 2007, except between autumn with respect to spring. Significant differences between autumn and spring (KW= 33.2, $P= 8.397e^{-09} < 0.05$) were found in 2011. All year showed significant differences (KW= 60.12, $P= 8.82e^{-14} < 0.05$).

DISCUSSION

Data from different years and seasons showed that both species grew more in length than weight ($b < 3$). Not all literature reviewed showed data by season, sexes, or size range used for estimated length-weight relationships. Only 3 published papers have shown values of $b > 3$ for *Micropogonias furnieri* (Ehrhardt & Arena 1977, Ehrhardt *et al*. 1979; for females in both cases) and *Cynoscion guatucupa* (Madureira & Rossi-Wongtschowski 2005) (Table 3). The size-at-maturity for *M. furnieri* and *C. guatucupa* from the study area has been estimated between 32-36 cm T_L and 30-34.5 cm T_L, respectively (Pin *et al*. 2002, Norbis & Galli 2013). According to the minimum and maximum T_L recorded in this work, our data includes juvenile and adult individuals, and therefore should be considered as an average annual value, with the relationships being limited to the size range used to estimate the parameters. In 17 out of 49 published works (38%) of *M. furnieri* and in 2 out of 28 (7%) published works of *C. guatucupa*, were documented b values greater than 3, although it is not possible to know whether the differences are equal or significantly different of 3 (isometric or positive-negative allometric growth). This aspect should be taken into account given their importance for comparing conspecific individuals that inhabit different environments or species with wide distribution ranges sampled in different times.

For *M. furnieri* values of $b > 3$ (grew more in weight than in length) corresponded to individuals collected in shallow and protected coastal areas (coastal lagoons, bays, river mouths) or juveniles stages (Castello 1986, Muto *et al*. 2000, Joyeux *et al*. 2009, Borthagaray *et al*. 2011, Passos *et al*. 2012, Segura *et al*. 2012, Gurdek & Acuña 2014), except the b estimated by Franco *et al*. (2014) (Table 3). Individuals that inhabit shallow coastal waters (Castello 1986, Borthagaray *et al*. 2011) grow differently from those that inhabit greater depths (Haimovici & Umpierre 1996, Norbis & Verocai 2005), and use shallow coastal waters as nursery and feeding grounds (Mandali & Paes 1998, 2005; Olsson *et al*. 2013). Length-weight relationships are useful for comparisons regarding regional life histories of certain species of fish populations from different environments (Petrakis & Stergiou 1995, Froese 2006). For *M. furnieri* and approximately for the same sampling period, estimated value of b= 2.84+/-0.05 (negative allometric growth) in the Rio de la Plata (Norbis & Verocai 2002) was lower than b= 3.18+/-0.04 (positive allometric growth) estimated for Rocha coastal lagoon (Borthagaray *et al*. 2011) (Table 3), suggesting differences in length-weight relationships and growth. In the Rocha Lagoon the whitemouth croaker can be considered as resident, with a high degree of habitat fidelity (Saona *et al*. 2003, Olsson *et al*. 2013) and a complete life cycle within the lagoon (Vizziano *et al*. 2002). The size at first maturity in the Rocha Lagoon (19-20 cm) (Vizziano *et al*. 2002), was smaller than the estimated for the Río de la Plata (32-35 cm) (Pin *et al*. 2002, Norbis & Galli 2013), and in both cases corresponded to the third year of life (Verocai 2004, Norbis & Verocai 2005, Borthagaray *et al*. 2011). The increased in length-at-age in the Rocha lagoon (Borthagaray *et al*. 2011) was smaller than at inner continental shelf and in the Rio de la Plata (Haimovici & Umpierre 1996, Norbis & Verocai 2005). Morphometric and growth differences (Norbis & Verocai 2005, Borthagaray *et al*. 2011, Galli & Norbis 2013) in addition to genetic evidence (Pereira *et al*. 2009, D'Anatro *et al*. 2011) predicted the 2-stock hypothesis for *M. furnieri* in the study area, including coastal lagoons. Although the different stocks or groups have an important geographical proximity, environmental factors such as temperature and salinity may play an important role in the habitat differentiation and it is possible to identify different environmental systems between Río de la Plata (Guerrero *et al*. 1997) and Uruguayan coastal lagoons (Conde & Sommaruga 1999), that could affect the differences in length-weight relationships. The Río de la Plata is an extensive coastal plain estuary which receive fresh water inputs from Paraná and Uruguay rivers, with strong tidal influence, and a quasi-permanent salt wedge regime, which generates bottom and surface salinity fronts (Guerrero *et al*. 1997). Coastal lagoons are microtidal shallow brackish lagoons with strong influence of winds which continuously mix the water column (Conde & Sommaruga 1999, Conde *et al*. 1999, 2000).

For *C. guatucupa* no published works have provided differential growing for length-weight relationships, while a spatial segregation by sizes, with nursery grounds located on the inner continental shelves along the Uruguayan Atlantic coast is know (Ehrhardt *et al*. 1977, 1979; Cousseau *et al*. 1986, Ruarte *et al*. 2005). Similarly, studies on morphometric and genetic differentiation for *C. guatucupa* suggest that only one group is present in the study area (Sabadin *et al*. 2010) therefore, the length-weight relationships were representative for the entire population.

Table 3. Estimated parameters of length-weight relationships by year, season and sex for *M. furnieri* y *C. guatucupa* obtained from published literature. Max= maximum length (cm); Min= minimum length (cm); a= intercept; b= slope; IC 95%= confidence limit; Su= summer; A= autumn; W= winter; Sp= spring; f= females; m= males / Parámetros estimados de la relación longitud-peso por año, época y sexo para *M. furnieri* y *C. guatucupa* obtenidas de trabajos publicados. Max= longitud máxima (cm); Min= longitud mínima (cm); a= intercepto b= pendiente; IC 95%= intervalo de confianza; Su= verano; A= otoño; W= invierno; Sp= primavera; f= hembras; m= machos

Species	Length (cm)		Parameters of the relationships		Season	References
	Min.	Max.	A	b ± CL 95%		
M. furnieri			0.01031	2.99		Vazzoler & Iwai (1971)
			0.00896	3.05		Yamaguti *et al.* (1973)
	27.0	53.0	0.04438	2.63	Su_m	Ehrhardt *et al.* (1977)
	28.0	57.0	0.01664	2.90	A_m	Ehrhardt *et al.* (1977)
	26.0	58.0	0.01566	2.91	W_m	Ehrhardt *et al.* (1977)
	25.0	60.0	0.02628	2.76	Sp_m	Ehrhardt *et al.* (1977)
	29.0	56.0	0.04410	2.64	Su_f	Ehrhardt *et al.* (1977)
	28.0	57.0	0.01290	2.97	A_f	Ehrhardt *et al.* (1977)
	26.0	60.0	0.01276	2.96	W_f	Ehrhardt et al. (1977)
	25.0	60.0	0.02158	2.82	Sp_f	Ehrhardt *et al.*(1977)
			0.01089	3.11	f	Ehrhardt & Arena (1977)
			0.01566	2.91	m	Ehrhardt & Arena (1977)
			0.01248	2.96		Haimovici (1977)
	30.0	59.0	0.02654	2.76	Su_m	Ehrhardt *et al.* (1979)
	29.0	55.0	0.01757	2.88	A_m	Ehrhardt *et al.* (1979)
	30.0	60.0	0.01642	2.89	W_m	Ehrhardt et al. (1979)
	33.0	50.0	0.04310	2.65	Sp_m	Ehrhardt *et al.* (1979)
	29.0	59.0	0.02160	2.81	Su_f	Ehrhardt *et al.* (1979)
	30.0	55.0	0.01725	2.88	A_f	Ehrhardt *et al.* (1979)
	30.0	63.0	0.01320	2.96	W_f	Ehrhardt *et al.* (1979)
	30.0	55.0	0.00936	3.05	Sp_f	Ehrhardt *et al.* (1979)
			0.00551	3.12		Castello (1986)
			0.01570	2.91		Isaac (1988)
			0.01250	2.96		Isaac (1988)
			0.01030	3.00		Isaac (1988)
			0.00897	3.06		Isaac (1988)
			0.01090	3.11		Isaac (1988)
			0.00551	3.12		Isaac (1988)
	6.4	62.2	$3.8*10^{-6}$	3.18 ± 0.04		Muto *et al.* (2000)
	13.5	73.6	$9.74*10^{-6}$	3.02		Haimovici & Velasco (2000)
			0.00879	3.06		Magro *et al.* (2000)
			0.00770	3.09		Magro *et al.* (2000)
	22.0	65.0	0.02038	2.84		Norbis & Verocai (2002)
	22.0	61.0	0.02315	2.79	m	Norbis & Verocai (2002)
	25.0	65.0	0.02393	2.79	f	Norbis & Verocai (2002)
			0.09045	2.99		Rodriguez da Costa & Araújo (2003)
	36.0	63.0	0.0215	2.83		Carozza *et al.* (2004)

Table 3. Continued / Continuación

	4.1	53.0	0.00830	3.05		Vianna *et al.* (2004)
	16.2	67.8	$1.6*10^{-5}$	2.93		Carneiro *et al.* (2005)
	18.1	60.8	0.01210	2.97		Carneiro *et al.* (2005)
	13.6	73.6	$1.14*10^{-5}$	2.92		Haimovici & Ignácio (2005)
	11.0	20.4	0.13890	2.25		Silva-Júnior *et al.* (2007)
	4.8	13.6	0.00673	3.17 ± 0,06		Joyeux *et al.* (2009)
	14.1	38.4	0.00538	3.18 ± 0.04		Borthagaray *et al.* (2011)
	3.4	17.9	0.00457	3.18 ± 0.06		Passos *et al.* (2012)
	4.5	25.5	0.00600	3.15 ± 0.06		Segura *et al.* (2012)
	2.7	26.5	0.00741	3.07 ± 0.02		Gurdek & Acuña (2014)
	2.1	13.0	0.00800	2.90 ± 0.09		Franco *et al.* (2014)
C. guatucupa	22.0	53.0	0.01952	2.80	Su_m	Ehrhardt *et al.* (1977)
	24.0	50.0	0.05040	2.55	A_m	Ehrhardt *et al.* (1977)
	27.0	51.0	0.02755	2.73	W_m	Ehrhardt *et al*. (1977)
	27.0	54.0	0.01645	2.86	Sp_m	Ehrhardt *et al*. (1977)
	20.0	54.0	0.01727	2.83	Su_f	Ehrhardt *et al.* (1977)
	20.0	50.0	0.04399	2.58	A_f	Ehrhardt *et al.* (1977)
	25.0	51.0	0.02499	2.75	W_f	Ehrhardt *et al.* (1977)
	25.0	49.0	0.02287	2.77	Sp_f	Ehrhardt *et al.(*1977)
	23.0	52.0	0.02660	2.71	Su_m	Ehrhardt *et al*. (1979)
	22.0	51.0	0.04491	2.56	A_m	Ehrhardt *et al.* (1979)
	21.0	48.0	0.03789	2.63	W_m	Ehrhardt *et al*. (1979)
	20.0	52.0	0.04936	2.56	Sp_m	Ehrhardt *et al.* (1979)
	21.0	54.0	0.02731	2.70	Su_f	Ehrhardt *et al.*(1979)
	21.0	54.0	0.02888	2.69	A_f	Ehrhardt *et al.* (1979)
	21.0	53.0	0.08499	2.40	W_f	Ehrhardt *et al.* (1979)
	17.0	54.0	0.05587	2.53	Sp_f	Ehrhardt *et al.* (1979)
			0.333	2.79	Su	Viera & Haimovici (1993)
			0.667	2.66	A	Viera & Haimovici (1993)
			0.963	2.55	W	Viera & Haimovici (1993)
			1.621	2.52	Sp	Viera & Haimovici (1993)
	4.7	38.9	$1.47*10^{-5}$	2.92 ± 0.01		Muto *et al.* (2000)
	5.8	57.5	$1.94*10^{-5}$	2.87		Haimovici & Velasco (2000)
	21	60	0.0515	2.55		Portela *et al.* (2002)
	49	60	0.00800	3.02		Portela *et al.* (2002)
			0.0186	2.81		Ruarte *et al.* (2004)
			0.0212	2.74		Ruarte *et al.* (2004)
	5.8	57.5	$1.73*10^{-5}$	2.88		Haimovici & Villwock de Miranda (2005)
			0.00962	3.01		Madureira & Rossi-Wongtschowski (2005)
	3.6	45.0	0.0120	2.93 ± 0.04		Segura *et al.* (2012)

This is the first study estimating the relative condition factor for both sciaenid species in the study area. *M. furnieri* and *C. guatucupa*, spawn in the same season (spring-summer) selecting habitats with contrasting salinity conditions (Macchi 1998, Macchi *et al*. 1996, 2003; Vizziano 2002, Militelli & Macchi 2006, Jaureguizar & Guerrero 2009), and have different trophic behaviour: *M. furnieri* is a benthic species (Puig 1986, Masello *et al*. 2002, Olsson et al. 2013) while *C. guatucupa* is nectopelagic species (Lopez-Cazorla 1996). Changes in the relative condition factor among seasons along the year for both species could be related to reproduction, feeding habits and/or water temperature; nonetheless, more studies considering monthly samples of temperature and indicator of the gonadosomatic index and condition factor are still needed in order to confirm this hypothesis.

The use of condition factor is extensively common in fisheries research as a morphometric condition index, and provides a useful tool to examine overall growth or habitat quality (Froese 2006). For *M. furnieri*, the pooled Krel in 2011 was highest than the values estimated for 2006 and 2007 and the opposite occurred with *C. guatucupa*: the pooled Krel in 2006 was higher than the values estimated for 2007 and 2011. The occurrence of two consecutive episodes of El Niño - La Niña may cause significant changes in environmental characteristics related to run-off of the Parana and Uruguay rivers with changes in the coastal salinity and turbidity conditions (Mechoso & Perez-Iribarren 1992, Pisciottano *et al.* 1994, García & Vargas 1998, Genta *et al.* 1998, Nagy *et al.* 2002), as occurred during 2010 (El Niño year) and 2011 (La Niña year) (NOAA 2011). This could have altered the habitat quality (*i.e.*, food availability) for benthic (*M. furnieri*) and nectopelagic (*C. guatucupa*) species, and the condition factor increased, or decreased, but no data about feeding exist for confirm this hypothesis.

ACKNOWLEDGMENTS

We thank Diego Pagano, Juana Fernández, Elisa Martinez, Enrique Isnardi, Marcelo Lozano, Miguel Gómez (team of landing sampling of DINARA) who collected the data used in this work, and team of the Fishing Vessel Monitoring System (DINARA): Julio Choca, Yamandú Marín, Bernando González and Gastón Beathyate for provide us Figura 1 and two anonymous reviewers by the comments realized.

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Received 20 July 2015 and accepted 4 April 2016

Editor: Claudia Bustos D.