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Short Communication: Length-weight relationship and condition factor of the nine fish species of bycatch from Northeast Brazilian Coast

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ABSTRACT

The length-weight relationship (LWR) and relative condition factor (Kn) are essential biometric tools in fishery studies. They provide information about the fish's growth, condition, and suitability in its habitat. LWR values were estimated for nine fish (Chloroscombrus chrysurus, Larimus breviceps, Nebris microps, Odontognathus mucronatus, Paralonchurus brasiliensis, Pellona harroweri, Ointmentsys corvinaeformis, Selene setapinnis, Stellifer rastrifer) captured as bycatch in shrimp trawling from commercial trawls, were collected monthly, between March and November 2019. The coefficient b ranged from 2.7547 to 3.4100 and the Fulton and relative condition factor ranged from 0.39 to 1.38 and 1.00 to 1.02, respectively. The current study would provide baseline data about LWR and the relative condition factor for these species captured in northeast Brazilian coast. These data are valuable for establishing a monitoring and management system for this fish species

Introduction

Trawling of shrimp has been commonly associated to the bycatch of other aquatic organisms because the mesh size (Medeiros et al., 2018). This accidental capture and subsequent discard of unwanted species can cause environmental problems for fisheries stocks (Abdulgader *et al.*, 2020). For this reason, studies about populational structure of bycatch could play an important role for mitigate environmental impacts and provide an adequate fish management (Glass, 2000; Kennelly and Broadhurst, 2021).

Determine growth features leading weight and length play an important role to studies on dynamic of population (Morato *et al.*, 2001), as well as to determine welfare conditions which can be influenced by biotic and abiotic factors (Ramses *et al.*, 2020). The importance to determine length-weight relationship (LWRs) in fish has been cited by fisheries biology studies aiming to environmental conditions and the ecology of species (habitat conditions, health conditions and morphological characteristics) (Schneider *et al.*, 2000; Froese, 2006). It must be noted, however, that LWRs differ among fish species depending on the inherited body shape and the physiological factors such as maturity and spawning (Schneider *et al.*, 2000; Santos *et al.*, 2020)

An important point is the condition factor (K) from LWRs (Le Cren, 1951). The "K" can indicate healthiness degree of a single fish species, current

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nutritional conditions or spent energetic sources with cyclical activities, allowing the relation between environmental conditions and behavioral features of species (Yilmaz *et al.*, 2012; Mensah, 2015; Bulanin *et al.*, 2017). Its maximum welfare for fish species in Kn is equal to or close to 1. (Moutopoulos and Stergiou, 2002; Gubiani *et al.*, 2020). Thus, the present study aimed to evaluate weight-length relationship for nine fish species from bycatch.

Materials and Methods

Study site and collection of data

Samples of the shrimp trawling bycatch (*Xiphopenaeus kroyeri*) from Pirambu-SE (Brazil) (figure. 1), were monthly collected between march and november (2019) in the semi-industrial fishing, mesh 20 mm, ranging from 5 to 20 meters in depth.

Later, the fishes fresh were taken to the Fisheries Management and Extension Laboratory at the Federal University of Sergipe, where weight and total length determined with the aid of ictiometer (0.1cm) and digital scale (0.01g), respectively.

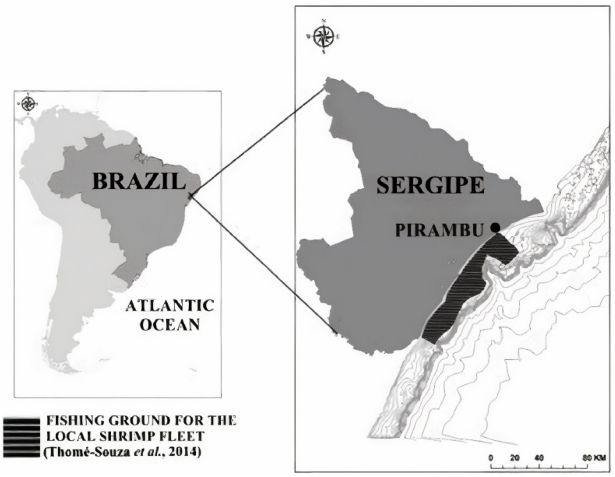

Figure 1. Localization area off the state of Sergipe (Brazil), indicating the location of the municipality of Pirambu and the fishing ground for the local shrimp fleet.

Length-weight relationship (LWR)

To calculate the length-weight relationship was used the equation:

$$W = a.L^b$$

W = weight (g)
a = intersection point of straight in the axis W
L = total length (cm)
b = angular coefficient of regression

The constants were estimated by linear regression from transformed equation

$$\text{Log } W = \text{Log } a + b \text{ Log } L$$

Log W = logarithm of weight (g)
Log a = intersection point of straight in the axis W
b = angular coefficient of regression
Log L = logarithm of total length (cm).

For remove extreme outliers, data were conducted to logarithmic transformation (Froese, 2006) and adjustments of the model were measured by square-r (r^2). The growth undergone the followed classification: (b=3) isometric growth, (3<) negative allometric growth and (3>) positive allometric growth.

Fulton condition factor (Kf) and Relative condition factor (Kn)

Falton condition factor and relative condition factor (Kn) was calculated using an expression by Fulton (1904) and Le Cren (1951), respectivaly, in the equations below:

$K_f = 100\frac{Wr}{TL^3}$ and $Kn = \frac{Wr}{We}$, respectively (Fulton, 1904; Le Cren, 1951)

Legend: Wr – observed weight; We – estimated weight; Kf – fulton condition factor; Kr – relative condition factor; confidence limit (95%) for *a* and *b* (Zar, 2010).

Statistical analysis

To evaluate if b was statistically different from an isometric growth (β1: 3), all data were conducted to t-test (α= 0.05) (Zar, 2010). All statistical analysis were carried out in the R software (Version 4.0.5, R Development Core Team, 2021).

Results

A total of nine fish species (*Chloroscombrus chrysurus*, *Larimus breviceps*, *Nebris microps*, *Odontognathus mucronatus*, *Paralonchurus brasiliensis*, *Pellona harroweri, Pomadasys corvinaeformis, Selene setapinnis* and *Stellifer rastrifer*) were identified during the collects. Among these fish species, only five obtained positive allometric growth b>3(Table 1).

For fulton condition factor (Kn), the fish species *Chloroscombus chrysur*, *Odontognathus mucronatus* and *Paralonchurus brasiliensis* demonstrated high values (k>1) while *Pomadasys corvinaeformis* and *Selene setapinnis* obtained low values (k<1) (Table 1).

Discussion

Length-weight relationship can provide details about morphological and physiological characteristics of the fish, life story, age and patters of growth (Froese, 2006; Ogle, 2016). For example, based in the equation, the angular coefficient (*b*) has been commonly used for explain nutritional

condition through the biotic and abiotic factors

Table 1. The total length, growth patterns and co

Species	n	TL (cm)		W (g)		Parameter LWR			Allometric	Condition factor	
		Min	Max	Min	Max	a (95% Cl a)	b (95% Cl b)	r^2		Kf(M±Sd)	Kn(M±Sd)
Chloroscombus chrysurus	22	9.4	13.7	7.00	16.77	0.0125 (0.0051-0.0301)	2.8638 (2.5039-3.2236)	.932	-	(0.89±0.06)	(1.00±0.07)
Larimus breviceps	82	5.2	16.4	1.40	60.80	0.0081 (0.0062-0.0105)	3.1508 (3.0342-3.2675)	.973	+	(1.14±0.13)	(1.00±0.11)
Nebris microps	26	7.9	18.4	5.01	64.60	0.0090 (0.0052-0.0154)	3.0474 (2.8182-3.2766)	.969	+	(1.01±0.11)	(1.00±0.11)
Odontognathus mucronatus	79	5.8	17.7	0.80	13.10	0.0074 (0.0049-0.0110)	2.7547 (2.6024-2.9067)	.944	-	(0.39±0.06)	(1.00±0.15)
Paralonchurus brasiliensis	109	5.8	20.6	1.40	100.52	0.0026 (0.0020-0.0032)	3.4100 (3.3212-3.4989)	.981	+	(0.74±0.10)	(1.00±0.10)
Pellona harroweri	88	4.4	12.3	0.90	18.60	0.0111 (0.0088-0.0139)	2.9521 (2.8424-3.0617)	.970	-	(1.00±0.09)	(1.00±0.09)
Pamodasys corvinaeformis	48	9.1	17.1	9.90	77.30	0.0091 (0.0066-0.0125)	3.1715 (3.0397-3.3033)	.980	+	(1.38±0.07)	(1.00±0.05)
Selene setapinnis	25	3.6	10.0	0.80	12.90	0.0177 (0.0132-0.0237)	2.8400 (2.6801-2.9999)	.983	-	(1.34±0.19)	(1.00±0.12)
Stellifer rastrifer	134	5.6	15.3	2.50	45.90	0.0081 (0.0063-0.0103)	3.1692 (3.0644-3.2739)	.964	+	(1.20±0.15)	(1.02±0.12)

(Zaher *et al.*, 2015).

According to Froese (2006) b-values of the length- weight relationship mostly range from 2.50 to 3.50, as observed in the present study. The positive allometric growth observed in this study also occurred for *Paralonchurus brasiliensis* (3.47), *Pomadasys corvinaeformis* (3.15), *Stellifer rastrifer* (3.36) and Larimus breviceps (3.16) captured in the coast region of brazilian northeast. For species that have allometric negative growth, it corrobororates with Viana et al. (2016) who found similar results in *Chloroscombus chrysurus* (2.93), *Nebris microps* (3.00). For allometric positive growth, it corroborates with freire et al which estimated the value 2.97 in Brazilian south.

Values of fulton and relative condition factor can indicate nutritional and physiological status of the fish (Adeogun *et al.*, 2016; Panicker and Katchi, 2021; Muchlisin *et al.*, 2010). Through this calculate, values above one (>1 according to Fulton, 1904) could indicate nice conditions for growth. Nonetheless, many factors affect the growth condition of fish including reproductive cycles, availability of food, as well as habitat, activities, and environmental factors (Edah *et al.*, 2010; Muchlisin *et al.*, 2017; Jisr *et al.*, 2018). In the present study, *Pomadasys corvinaeformis* and *Selene setapinnis* obtained high values for fulton condition factor probably indicating adequate conditions for development. Nonetheless, *Odontognathus mucronatus* obtained lower values of condition factor probably because the different environment, method of capture or available food (Melo *et al.*, 2004; Matos *et al.*, 2019; Pouladi *et al.*, 2020).

Conclusions

This is the first report about LWRs and Kn for some fish species collected from northeast Brazilian coast. About 55% of analyzed fish species demonstrated positive allometric growth related to environmental conditions or morphological characteristics. Kn was ranged close to 1 showing an overall state of welfare of the fish species. Specifically, Pomadasys corvinaeformis and Selene setapinnis showed the best fitness condition. Thus, would be needed to organize the fishing mainly for studied fish species incorporating biological specifications from cycle of life, age and growth, for support future studies.

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