



Biometric relationships and sex ratio of the crab *Callinectes ornatus* (Ordway, 1863) (Decapoda, Portunidae) captured as bycatch in the northeast coast of Brazil

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Abstract: This study aimed to determine biometric relationships and sex ratio of the *Callinectes ornatus* Ordway, 1863 captured in the northeast coast from Brazil. Male demonstrated allometric positive growth, and female negative allometric growth. The sex rate was higher values for male (1.65:1).

Key words: Brachyura, length-weight relationship, Sergipe state, fishery management.

Relações biométricas e proporção sexual do caranguejo *Callinectes ornatus* (Ordway, 1863) (Decapoda, Portunidae) capturado como fauna acompanhante na costa nordeste do Brasil. Resumo: Este estudo estimou as relações biométricas e proporção sexual do *Callinectes ornatus* capturados na costa nordeste do Brasil. Os machos obtiveram um crescimento alométrico positivo e as fêmeas um crescimento alométrico negativo. A razão sexual diferiu, sendo machos mais frequentes (1.65: 1).

Palavras-Chave: Brachyura, relação peso-comprimento, estado de Sergipe, manejo pesqueiro.

The trawl is one of the most used fishing gears to capture shrimp, however it has low species selectivity and accidentally catches crabs and other groups labeled as bycatch (Rezende *et al.*, 2019; Santos *et al.*, 2020; Lira *et al.*, 2021). In Brazil, at Sergipe state, Santos *et al.* (2018) warned about the population decrease of Portunid crabs due the bycatch fisheries and the need for natural stocks monitoring.

The families Portunidae (Rafinesque, 1815) are important fishery resources for riversides, including 16 species around the world and six species along to Brazilian coast (Ng *et al.*, 2008). Among the species, the crab *Callinectes ornatus* (Ordway, 1863) is usually found near the mouths of rivers and bays, most commonly in intermediate salinity waters (Keunecke *et al.*, 2012; Watanabe *et*

al., 2014). This species inhabits sand, mud or shell substrates and occurs from the intertidal zone to a depth of 75 m in the western Atlantic (Melo, 1996). They are opportunistic and omnivorous and plays an important role in regulating the number and distribution of prey species (Mantelatto & Cristofolletti, 2001) as well as have a secondary economic importance (Costa & Negreiros-Fransozo, 1998) being consumed mainly by small fishing communities (Sforza *et al.*, 2010). These crabs *C. ornatus* stand out as the most abundant Portunids discarded as bycatch (Carvalho *et al.*, 2011). Due to their economic importance in Brazil, several studies determined reproduction (Mantelatto & Fransozo 1999, Carvalho *et al.* 2011, Keunecke *et al.*, 2012), feeding behavior (Mantelatto *et al.*, 2001), growth (Keunecke *et al.*, 2008) and population structure

(Branco & Lunardon-Branco 1993, Negreiros-Fransozo *et al.*, 1999; Sforza *et al.*, 2010). However, there are still few studies on the population biology on the coast of northeastern Brazil, and information of growth, age, reproduction and stock planning are needed.

Length-weight relationship is an important parameter of wild fishery stocks. The different applications range to determine the weight of one individual (based on length) or indicate fish conditions including body fatty and gonadal development (Le Cren, 1951; Santos *et al.*, 2022). The sex ratio can also signify migratory events in reproductive periods, as well as migration of juvenile fish for growth. Thus, the present study evaluated biometric relationships and the sex ratio of *C. ornatus* captured as bycatch in trawler fisheries in Sergipe state, northeast of Brazil. Samples derived from the bycatch of the seven-bearded shrimp (*Xiphopenaeus kroyeri* (Heller, 1862) trawling fishery, in Pirambu, Sergipe state, Brazil (Fig. 1). Crabs were collected monthly between March 2020 and March 2021 by local semi-industrial fishing fleets, in 5 to 9 m depth, using a 20 mm net. There was no continuous sampling during the shrimp closed season in January, April and December (Instrução Normativa MMA nº14, 14 de Outubro de 2004).

The whole specimens were preserved in 70% ethanol and deposited in the collection of museum/lab of Gestão e Extensão Pesqueira from Federal University of Sergipe. All specimens were sexed and measurement. The carapace length (CL), carapace width (CW; do not including side thorns) and weight (W) were measured for each individual with the aid of a digital pachymeter (0.01 mm) and digital scale (0.1 g). The crabs were identified according to Williams (1974), the color of carapace ranged from blue to olive-green, with the dorsal surface of the legs having a specific color (olive-green). Additionally, the sex was classified as male or female based on the morphology of abdomen (Melo, 1996).

The samples were classified by length (mm) determining 10 level of length according to Sturges rule (Zar, 2010). A chi-square test (χ^2) with the Yates correction for continuity was applied to test if the overall sex ratio differed from 1:1 (Zar, 2010)

Based on the morphometrics values was estimated out the potential ($W = \beta_0 \cdot CL^{\beta_1}$, $W = \beta_0 \cdot CW^{\beta_1}$) and linear ($CW = \beta_0 + \beta_1 \cdot CL$) regression for both male and female, being β_0 the intercept and β_1 the allometric coefficient (allometric

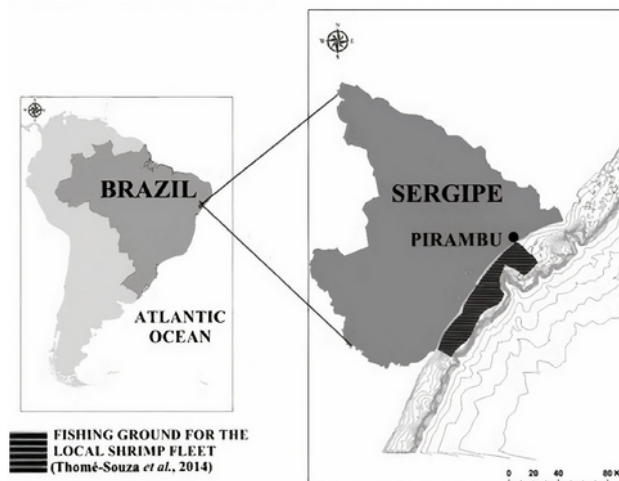


Figure 1. Trawler fishing area for the local shrimp fleet off the state of Sergipe (Brazil), indicating the municipality of Pirambu (10° 40' 42" S, 36° 52' 25" W), where the crab *Callinectes ornatus* (Ordway, 1863) were collected as bycatch, monthly between March 2020 and March 2021.

positive relationship if $\beta_1 > 3$, allometric negative relationship if $\beta_1 < 3$, and isometric if $\beta_1 = 3$ (Froese, 2006). The adjustment of the model to the data was measured by the r-squared coefficient of determination (r^2). Residue of the data were subjected to a normality test (Shapiro-Wilk), nevertheless, all variables showed significant difference. The Mann-Whitney test was used to compare CW and CL between male and female, and a non-parametric test applied to two independent samples (Zar, 2010). Significance were consider with $p < 0.05$, performed in the software R version 4.0.3. (Development Core Team R, 2020).

Overall, 318 crabs were captured with 198 males and 120 females (Fig. 2), including 17 ovigerous females ready to breed. Males and females showed no significant difference in CL ($W=10512$, $p=0.6612$) and CW ($W=10694$, $p=0.4883$) (Fig. 3), however there was a significant difference for weight ($W=11310$, $p=0.0182$) (Tab. I). The sex ratio was 1.65:1 and it was statistically different from 1:1 ($\chi^2 = 18.645$, $p < 0.0001$). The angular coefficient of the weight-length (Table I) and carapace width relationships for males was >3 and for females was <3 , positive and negative allometric growth, respectively. The relationship between carapace width- carapace length was $r^2 = 0.99$ for males and $r^2 = 0.96$ for females (Table II).

In the present study, males had a positive allometric growth with higher growth by weight than in length, corroborating with several studies at the genus and species of *C. ornatus* (Branco *et al.*, 1993;

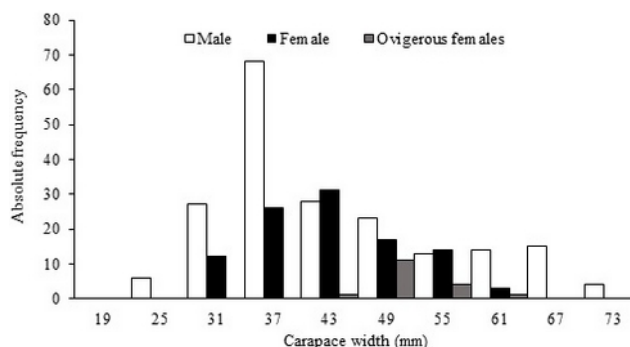


Figure 2. Frequency distribution of carapace width for male, female and ovigerous females of *Callinectes ornatus* (Ordway, 1863) captured in the Sergipe, Northeast from Brazil.

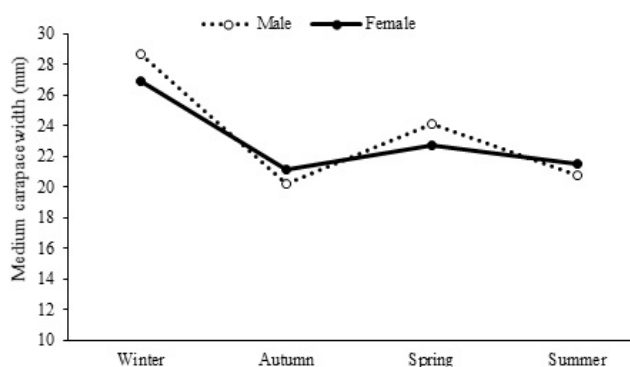


Figure 3. Seasonal variation of Medium Carapace width for male and female *Callinectes ornatus* (Ordway, 1863) captured in the Sergipe, Northeast from Brazil.

Araújo & Lira, 2012; Moslen & Miebaka, 2018; Kampouris *et al.*, 2020). However, the females had a negative allometric growth in the two potential relationships ($W \sim CL$ and $W \sim CW$). This pattern is characteristic for females, as reported by Tudesco *et al.* (2012) which revealed a negative allometric relationship for females in the north of Rio de Janeiro state.

These observations in the growth of both sexes can be explained by some biological and

behavioral factors. Male crabs were heavier than females (Olmi & Bishop, 1983; Baptista *et al.*, 2003; Baptista-Metri *et al.*, 2005; Pinheiro & Fiscarelli, 2009) during to reproductive cycle of crabs. For females, the growth decreases after puberty, because they expend more energy during gametogenesis (Mantelatto & Corrêa, 1996). Males have a longer growth period, spending more energy, as a larger size represents a competitive advantage over other males, in addition to facilitating the mating process (Tudesco *et al.*, 2012). Another phenomenon associated with growth in males is the "guard-partner" behavior during and after copulation, providing protection for the recent post-exchange of carapace of the female (Pinheiro & Fransozo, 1999).

According to Herrera (2017), the male become maturity at 58.5 mm and female at 54.5 mm. Females reserve a large part of their energy to egg production, which could explain the lower weight than males. The ovigerous females of some species of *Callinectes* prefer waters with high salinity, which could help the larvae to float and maintain osmotic pressure (Pita *et al.*, 1985; Mantelatto, 2000). This could explain the low number of females in the study area and their absence in a few months of sampling (November, December and March), since the collections were made near the coast, which receives a large flow of fresh water from the estuary.

The sampling area was comprised of marine coastal waters, where adult crab specimens are more numerous than juveniles (0.04 juveniles: 1 adult). It is understood that crab groups of smaller sizes can be spatially segregated according to environmental characteristics. Studies on the *Callinectes* spp. revealed that young prefer calm and flat waters, with more organic matter and low salinity (Mantelatto, 2000; Fernandes *et al.*, 2006). It is likely that the juveniles are distributed into the estuary where there is no fishing (Watanabe *et al.*, 2014).

Table I. Data of weight and length for female (F) and male (M) of *Callinectes ornatus* (Ordway, 1863) captured in the Sergipe, northeast from Brazil. LC =Length carapace, CW= carapace width, W= weighth, min= Minimum, max= maximum and sd= Standard deviation.

Sex	LC min-max (mean $\pm$ sd)	CW min-max (mean $\pm$ sd)	W min-max (mean $\pm$ sd)
F	14.08-33.63 (21.67 $\pm$ 4.71)	24.58 -55.27 (37.11 $\pm$ 7.45)	1.5 - 21.9 (7.23 $\pm$ 4.56)
M	10.15-39.96 (22.08 $\pm$ 6.74)	16.70- 67.79 (37.85 $\pm$ 11.62)	0.5-50.1 (14.21 $\pm$ 13.92)

Table II. Intercept (β_0) and inclination (β_1) to weight~carapace length relationship, weight~carapace width relationship and carapace width~carapace length relationship for female (F) and male (M) of *Callinectes ornatus* captured in the Sergipe, northeast from Brazil. CL= Carapace length, CW =Carapace width, W= weigth, CI= Confidence interval and r^2 = Coefficient of determination.

Relationships	Sex	Regression coefficient		
		β_0 (CI; $\alpha=0.05$)	β_1 (CI; $\alpha=0.05$)	r^2
W~CL	F	0.00160 (0.00070-0.00400)	2.67340 (2.38970-2.95710)	0.7758
	M	0.00030 (0.00020-0.00050)	3.18240 (3.03810-3.32660)	0.9061
W~CW	F	0.00010 (0.00006-0.00040)	2.89991 (2.61510-3.18460)	0.8016
	M	0.00006 (0.00004-0.00010)	3.17450 (3.04260-3.30641)	0.9199
CW~CL	F	0.77780 (0.67750-0.87811)	0.92230 (0.8896-0.95510)	0.9686
	M	0.52600 (0.47840-0.57360)	1.00400 (0.98851-1.01951)	0.9880

In several population biology studies, Portunidae males are more abundant than females, as observed by Santos *et al.* (2016) at proportions of 57.9% for males. In the present study males also occurred at higher proportions of male (65.8%), likely by the influence of fishing applied to crab stocks, driving the migration of adult females to covered areas (Branco & Fracasso, 2004). With the sex ratio obtained (1.65:1), there are some possible explanations such as reversion or sex differences in longevity, mortality, and growth rate (Hsueh *et al.*, 1993; Kampouris *et al.*, 2020). Another justification is that a female can mate with several males during the same reproductive period and adult females can move away from the coast where temperature and/or salinity conditions (24 to 31°C and 30 to 38 ppm) are adequate for spawning (Negreiros-Fransozo & Fransozo, 1995; Watanabe *et al.*, 2014; Garçon *et al.*, 2021).

In conclusion, males have a positive allometric growth, while females have negative allometric growth, indicating sexual difference of species, probably caused by anthropic or environmental factors. However, more studies in the northeast Brazilian coast must be carried out to evaluate the population dynamic of *C. ornatus*, highlighting its reproductive biology as well as exploring the economic contribution for riversides.

References

- Araújo, M. S. L. C. & Lira, J. J. P. R. 2012. Condition factor and carapace width versus wet weight relationship in the swimming crab *Callinectes danae* Smith 1869 (Decapoda: Portunidae) at the Santa Cruz Channel, Pernambuco State, Brazil. **Nauplius**, 20(1): 41-50.
- Baptista, C., Pinheiro, M. A. A., Blankensteyn, A. & Borzone, C. A. 2003. Estrutura populacional de *Callinectes ornatus* Ordway (Crustacea, Portunidae) no Balneário de Shangri-Lá, Pontal do Paraná, Paraná, Brasil. **Revista Brasileira de Zoologia**, 20(4): 661-666.
- Baptista-Metri, C., Pinheiro, M. A. A., Blankensteyn, A. & Borzone, C. A. 2005. Biologia populacional e reprodutiva de *Callinectes danae* Smith (Crustacea, Portunidae) no Balneário de Shangri-lá, Pontal do Paraná, Paraná, Brasil. **Revista Brasileira de Zoologia**, 22(2): 446-453.
- Branco, J. O. & Fracasso, H. A. A. 2004. Biologia populacional de *Callinectes ornatus* (Ordway) na Armação do Itapocoroy, Penha, Santa Catarina, Brasil. **Revista Brasileira de Zoologia**, 21(1): 91-96.
- Branco, J. O. & Lunardon-Branco, M. J. 1993. Aspectos da biologia de *Callinectes ornatus* Ordway, 1863 (Decapoda, Portunidae) da região de Matinhos, Paraná, Brasil. **Arquivos de Biologia e Tecnologia**, 36(3): 489-496.
- Brasil. 2004. Instrução normativa nº 14, de 14 de outubro de 2004. Regulamentação da pesca de camarões nos Estados de Alagoas, Sergipe e Bahia, Nordeste, Brasil. **Diário Oficial da República Federativa do Brasil**, 14 de outubro de 2004, Seção 1, p. 103-104.
- Carvalho, E. A. S. D., Carvalho, F. L. D. & Couto, E. D. C. G. 2011. Maturidade sexual em *Callinectes ornatus* Ordway, 1863 (crustacea: decapoda: portunidae) no litoral de Ilhéus,

- BA, Brasil. **Papéis Avulsos de Zoologia**, 51(1): 367-372.
- Costa, T. M. & Negreiros-Fransozo, M. L. 1998. The reproductive cycle of *Callinectes danae* Smith, 1869 (Decapoda, Portunidae) in the Ubatuba Region, Brazil. **Crustaceana**, 71(1): 615-627.
- Development Core Team R. 2020. R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna <https://www.r-project.org/>
- Fernandes, J. M., Rosa, D. M., Araujo, C. C., Ripoli, L. & Santos, H. S. 2006. Biologia e distribuição temporal de *Callinectes ornatus* Ordway, 1863 (Crustacea, Portunidae) em uma praia arenosa da Ilha do Frade, Vitória-ES. **Boletim do Museu de Biologia Mello Leitão**, 20(1): 59-71
- Froese, R. 2006. Cube law, condition factor and weight-length relationships: history, metaanalysis and recommendations. **Journal of applied ichthyology**, 22(4): 241-253.
- Garçon, D. P., Leone, F. A., Faleiros, R. O., Pinto, M. R., Moraes, C. M., Fabri, L. M. & McNamara, J. C. 2021. Osmotic and ionic regulation, and kinetic characteristics of a posterior gill (Na⁺, K⁺)-ATPase from the blue crab *Callinectes danae* on acclimation to salinity challenge. **Marine Biology**, 168(6): 1-19.
- Herrera, D. R. 2017. Distribuição, estrutura populacional, reprodução e crescimento de *Callinectes danae* Smith, 1869 e *Callinectes ornatus* Ordway, 1863 (Decapoda, Brachyura, Portunidae) na região de Cananéia, litoral sul paulista. **PhD Tese**, Universidade Estadual Paulista, São Paulo, Brasil, 153p.
- Hsueh, P. W., McClintock, J. B. & Hopkins, T. S. 1993. Population dynamics and life history characteristics of the blue crabs *Callinectes similis* and *C. sapidus* in bay environments of the northern Gulf of Mexico. **Marine Ecology**, 14(3): 239-257.
- Kampouris, T. E., Kouroupakis, E. & Batjakas, I. E. 2020. Morphometric Relationships of the Global Invader *Callinectes sapidus* Rathbun, 1896 (Decapoda, Brachyura, Portunidae) from Papapouli Lagoon, NW Aegean Sea, Greece. with Notes on Its Ecological Preferences. **Fishes**, 5(1): 1-9.
- Keunecke, K. A., D'Incao, F., Verani, J. R. & Vianna, M. 2012. Reproductive strategies of two sympatric swimming crabs *Callinectes danae* and *Callinectes ornatus* (Crustacea: Portunidae) in an estuarine system, south-eastern Brazil. **Journal of the Marine Biological Association of the United Kingdom**, 92(2): 343-347.
- Keunecke, K. A., D'Incao, F., Moreira, F. N., Silva, D. R. & J. R. Verani. 2008. Age and growth of *Callinectes danae* and *C. ornatus* (Crustacea, Decapoda) in Guanabara bay, Rio de Janeiro, Brazil. **Iheringia**, 98(2): 231-235.
- Le Cren, E. D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). **The Journal of Animal Ecology**, 1(1): 201-219.
- Lira, A. S., Lucena-Frédou, F., Ménard, F., Frédou, T., Gonzalez, J. G., Ferreira, V. & Le Loc'h, F. 2021. Trophic structure of a nekto-benthic community exploited by a multispecific bottom trawling fishery in Northeastern Brazil. **PloS one**, 16(2): 0246491.
- Mantelatto, F. L. M. & Corrêa, E. K. 1996. Composition and seasonal variations of the brachyuran crabs (Crustacea, Decapoda) living on Sargassum cymosum in the Ubatuba region, São Paulo, Brazil. **Revista Bioikos**, 10(1/2): 22-31.
- Mantelatto, F. L. M. & Fransozo, A. 1997. Fecundity of the crab *Callinectes ornatus* (Ordway, 1863) (Decapoda, Brachyura, Portunidae) from the Ubatuba region, São Paulo, Brazil. **Crustaceana**, 1(1): 214-226.
- Mantelatto, F. L. M., Fransozo, A. & Negreiros-Fransozo, M. L. 1995. Distribuição do caranguejo *Hepatus pudibundus* (Herbst, 1785) (Crustacea, Decapoda, Brachyura) na Enseada da Fortaleza, Ubatuba (SP), Brasil. **Boletim do Instituto Oceanográfico**, 43(1): 59-69.
- Mantelatto, F. L. M. & Christofoletti, R. A. 2001. Natural feeding activity of the crab *Callinectes ornatus* (Portunidae) in Ubatuba Bay (São Paulo, Brazil): influence of season, sex, size and molt stage. **Marine Biology** 138 (1): 585-594.
- Mantelatto, F. L. M. 2000. Allocation of the portunid crab *Callinectes ornatus* (Decapoda: Brachyura) in the Ubatuba Bay, northern coast of São Paulo State, Brazil. **Crustacean Issues** 12(1): 431-443.
- Melo-Filho, G. A. S. 1996. **Manual de identificação dos brachyura (caranguejos e**

- siris) do litoral brasileiro**, Editora Plêiade, 603 p.
- Moslen, M. & Miebaka, C. A. 2018. Condition factor and length-weight relationship of two estuarine shell fish (*Callinectes* sp. and *Penaeus* sp.) from the Niger Delta, Nigeria. **International Journal of Fisheries and Aquatic Sciences**, 6(1): 188-194.
- Negreiros-Fransozo, M. L. & Fransozo, A. 1995. On the distribution of *Callinectes ornatus* (Ordway, 1863) and *Callinectes danae* Smith, 1869 (Brachyura, Portunidae) in the Fortaleza Bay, Ubatuba, Brazil. **Iheringia, Série Zoologia**, 79(1): 13-25.
- Negreiros-Fransozo, M. L., Mantelatto, F. L. & Fransozo, A. 1999. Population biology of *Callinectes ornatus* (Ordway, 1863) (Decapoda, Portunidae) from Ubatuba (SP), Brazil. **Scientia Marina**, 63(2): 157-163.
- Ng, P. K., Guinot, D. & Davie, P. J. 2008. Systema Brachyurorum: Part I. An annotated checklist of extant brachyuran crabs of the world. **The raffles bulletin of zoology**, 17(1): 1-286.
- Olmi, E. J. & Bishop, J. M. 1983. Variations in total width-weight relationships of blue crabs, *Callinectes sapidus*, in relation to sex, maturity, molt stage, and carapace form. **Journal of Crustacean Biology**, 3(4): 575-581.
- Pinheiro, M. A. A. & Fiscarelli, A. G. 2009. Length-weight relationship and condition factor of the mangrove crab *Ucides cordatus* (Linnaeus, 1763) (Crustacea, Brachyura, Ucididae). **Brazilian Archives of Biology and technology**, 52(1): 397-406.
- Pinheiro, M. A. A. & Fransozo, A. 1999. Reproduction of the speckled swimming *Arenaeus cribrarius* (Brachyura: Portunidae) on the Brazilian coast near 23°30'S. **Journal of Crustacean Biology**, 22 (2): 416-428.
- Pita, J. B., Rodrigues, E. S., Graça-Lopes, R. & Coelho, J. A. P. 1985. Levantamento da família Portunidae (Crustacea, Decapoda, Brachyura) no complexo baía-estúário de Santos, São Paulo, Brasil. **Boletim do Instituto de Pesca** 12(3): 153-162.
- Rezende, G. A., Ortega, I. & Dumont, L. F. C. 2019. Interannual variation of bycatch assemblages of artisanal bottom shrimp-trawling on the Patos Lagoon estuary, Brazil. **Regional Studies in Marine Science**, 32(1): 100878.
- Santos, H. L. Santana, F. S., Gonçalves, F. D. S. & Araújo, A. R. R. 2020. Estrutura populacional do camarão pedra *Sicyonia typica* (Boeck, 1864) no estado de Sergipe-Brasil. **Acta of Fisheries and Aquatic Resources**, 8(1): 37-41.
- Santos, H. L., Santana, F. S., Gonçalves, F. D. S., Deda, M. S., Carvalho, A. S., Paixão, P. E.G. & Abe, H. A. 2022. Length-weight relationship and condition factor of the nine fish species of bycatch from Northeast Brazilian Coast. **ACEH Journal of Animal Science**, 7(1): 12-15.
- Santos, M. D. C. F., Port, D., Fisch, F., Barbieri, E. & Branco, J. O. 2018. Biologia populacional de *Callinectes ornatus* associada à pesca do camarão-sete-barbas, rio São Francisco (Alagoas e Sergipe, Brasil). **Boletim do Instituto de Pesca**, 42(2): 449-456.
- Sforza, R., Nalesso, R. C. & Joyeux, J. C. 2010. Distribuição e estrutura populacional de *Callinectes danae* (Decapoda: Portunidae) em um estuário tropical brasileiro. **Journal of Crustacean Biology**, 30 (4): 597-606.
- Tudesco, C. C., Fernandes, L. P. & Di Benedetto, A. P. M. 2012. Population structure of the crab *Callinectes ornatus* Ordway, 1863 (Brachyura: Portunidae) bycatch in shrimp fishery in northern Rio de Janeiro State, Brazil. **Biota Neotropica**, 12(1): 93-98.
- Watanabe, T. T., Sant'Anna, B. S., Hattori, G. Y. & Zara, F. J. 2014. Population biology and distribution of the portunid crab *Callinectes ornatus* (Decapoda: Brachyura) in an estuary-bay complex of southern Brazil. **Zoologia (Curitiba)**, 31(4): 329-336.
- Williams, A. B. 1974. The swimming crabs of the genus *Callinectes* (Decapoda: Portunidae). **Fishery Bulletin**, 72(3): 685-798.
- Zar J. H. 2010. **Biostatistical analysis**. Englewood Cliffs, NJ: Pearson Prentice Hall, 662 p.

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