PANAMJAS
Pan-American Journal of Aquatic Sciences

# 'Miunça' and 'pescadinha' landed as bycatch from shrimp fisheries in northeastern Brazil

KÁTIA MEIRELLES FELIZOLA FREIRE*, IZABELA DE FÁTIMA LESSA CANUTO, JÉSSICA VERAS DINIZ & TATIANA MENEZES DA SILVA

*Laboratório de Ecologia Pesqueira (LEP), Departamento de Engenharia de Pesca e Aquicultura (DEPAQ), Universidade Federal de Sergipe (UFS). Av. Marechal Rondon, s/n, Jardim Rosa Elze, São Cristóvão – Sergipe - Brasil. CEP: 49100-000.*

** Corresponding author: kmffreire2018@gmail.com*

**Abstract:** The present study aimed at identifying fish species from the bycatch constituting the categories 'miunça' and 'pescadinha' landed by the shrimp fleet in the state of Sergipe, comparing with information from statistical bulletins, and assessing the occurrence of seasonal changes in this species composition. Samples were obtained each month directly from the shrimp boats fishing along the coast of Sergipe, when their catch was landed between August 2018 and July 2019. All fishes were identified, measured (total length; cm), and weighed (total weight; g). A total of 60 kg of fishes was analyzed, encompassing 1412 individuals of 35 species, belonging to 16 families. Sciaenidae, Polynemidae, and Haemulidae were the most representative families. The most abundant species in 'miunça' were *Polydactylus virginicus*, *Larimus breviceps*, *Paralonchurus brasiliensis*, and *Stellifer brasiliensis*. In 'pescadinha', the species with the highest number were *P. virginicus*, *L. breviceps*, and *Conodon nobilis*. About 70% of all species were observed in both categories, with individuals from 'pescadinha' being larger than 'miunça', but the magnitude of this difference changed in different months. Only eight species analyzed here were individually reported in bulletins of fishery statistics for Sergipe, representing 56.7% of the total sampled biomass, and other 15 were reported in groups including two or more species.

**Key words:** capture, shrimp fleet, by-catch, fishery statistics, Sergipe.

**'Miunça' e 'pescadinha' desembarcadas como fauna acompanhante das pescarias de camarão no nordeste do Brasil. Resumo**: O presente estudo teve como objetivo identificar as espécies de peixes da ictiofauna acompanhante que constituem as categorias 'miunça' e 'pescadinha' desembarcadas pela frota camaroneira do estado de Sergipe, comparando com a informação disponível nos boletins estatísticos e avaliar a existência de variações sazonais. A obtenção das amostras de cada categoria foi realizada por mês diretamente dos barcos camaroneiros que pescam ao longo da costa de Sergipe, durante o desembarque, entre agosto de 2018 e julho de 2019. Todos os peixes amostrados foram identificados, medidos (comprimento total; cm) e pesados (peso total; g). Um total de 60 kg de peixes foi analisado, totalizando 1412 indivíduos de 35 espécies, pertencentes a 16 famílias. Sciaenidae, Polynemidae e Haemulidae foram as famílias mais representativas. As espécies mais abundantes na 'miunça' foram *Polydactylus virginicus*, *Larimus breviceps*, *Paralonchurus brasiliensis* e *Stellifer brasiliensis*. Já na 'pescadinha', as espécies com maior número foram *P. virginicus*, *L. breviceps* e *Conodon nobilis*. Cerca de 70% de todas as espécies foram observadas em ambas as categorias, sendo que os exemplares da 'pescadinha' tiveram tamanho superior ao da 'miunça', mas a magnitude dessa diferença variou entre meses. Apenas oito espécies analisadas aqui foram registradas individualmente nos boletins da estatística pesqueira de Sergipe, representando 56,7% da biomassa total amostrada, e outras 15 foram registradas em grupos incluindo duas ou mais espécies.

**Palavras-chave:** captura, frota camaroneira, ictiofauna acompanhante, estatística pesqueira, Sergipe.

## Introduction

Marine fisheries contributed with 50.4% of the total production of fishery resources in Brazilian waters in 2007, the last year with detailed catch statistics by species and by state in Brazil (IBAMA 2007). According to this bulletin, the northeastern region was responsible for the second highest total catches. This region is composed by nine states, with Sergipe being the smallest state of the region (and of the entire country) and with a coast stretching along approximately 163 km (Fonseca *et al.* 2010). The main resource caught in waters off Sergipe, both in total weight and value, is the group of penaeids. In 2014, about 1,233 tonnes of penaeids were caught in Sergipe, representing 35% of its total marine catch (Araújo *et al.* 2016). The main penaeids captured are the Atlantic seabob, *Xiphopenaeus kroyeri* (Heller, 1862), the Southern brown shrimp, *Farfantepenaeus subtilis* (Pérez Farfante, 1967), the Red spotted shrimp *Farfantepenaeus brasiliensis* (Latreille, 1817), and the Southern white shrimp, *Litopenaeus schmitti* (Burkenroad, 1936) (Freire *et al.* 2020a).

The coast of Sergipe is mainly influenced by the drainage of the São Francisco River, even though its drainage volume has decreased after the construction of a series of dams along its extension (Brito & Magalhães 2017). An additional volume of fresh water is drained to the coast of Sergipe by the Piauí, Sergipe, Vaza-Barris, and Real rivers, which may influence the abundance of local stocks, particularly those of shrimps (Carneiro & Arguelho 2018, Santos *et al.* 2007). Motorized shrimp fisheries of Sergipe started in 1979 by a fleet based in the municipality of Pirambu using boats originating from Pontal do Peba in the state of Alagoas (Santos *et al*. 2007). However, shrimp catches were reported in national bulletins since 1962 (Freire *et al.* 2015). These fisheries are considered artisanal and reported as such in national bulletins (see, e.g., IBAMA 2007), despite the semi-industrial features of the boats employed (Araújo *et al.* 2016, Santos 2010).

Even though the shrimp boats based in Sergipe target the shrimp species previously cited, other shrimp species are also caught (Freire *et al.* 2020a), as well as a large number of juvenile fishes, including those of commercial species (Barreto *et al.* 2018). Bycatch can represent up to ten times the shrimp catch in northeastern Brazil (Santos 2010). Globally, bycatch includes diverse taxonomic groups, many of which with no commercial interest and discarded back into the sea (Clucas 1997, Fonseca *et al.* 2005, Keledjian *et al.* 2014). Thus, the ecosystem is impacted (Silva Júnior *et al.* 2019), despite the impossibility of measuring the extension of this impact in many cases. According to Alverson *et al.* (1994), global annual discards amounted to 17.9 - 39.5 million tonnes and shrimp trawling targeting tropical species was responsible for about one third of the total discards. However, discard rates decreased in posterior years (Kelleher 2005), even though a direct comparison of figures is not possible due to the difference in methodologies used in these two studies. The use of more selective fishing gears, introduction of regulations for the capture and discard of bycatch, better enforcement of these regulations, decreasing effort of some of the main trawling fisheries, increasing use of bycatch employing diverse technologies (which led to a change in the definition of target species) were some of the main causes of decreasing discards (Kelleher 2005).

Shrimps are caught along the coast of the state of Sergipe with double-rig twin otter trawl and boats 8-13 m long at a depth of 15-20 m (Santos *et al.* 2007). Part of the bycatch of this fishery is discarded into the sea, part is consumed by fishers (for subsistence), and another part is sold in the local market adding value to the shrimp fishery (Araújo *et al.* 2016). Shrimp fishers separate smaller fish specimens into a category called ‘miunça’ and/or ‘mistura’ to be sold in the local market (Thomé-Souza *et al*. 2012). During the study conducted on the population dynamics of the Atlantic seabob, *Xiphopenaeus kroyeri*, when samples were collected in the Fishing Porto of Aracaju (Reis Jr. *et al.* 2019), it was noticed that another category is landed in the local market, called ‘pescadinha’, which included not only sciaenids, as expected, but also fish species of other families (Mr. Diógenis Lopes, data collector for the *Projeto de Monitoramento Participativo do Desembarque Pesqueiro* – PMPDP, personal communication). According to Lopes, this category included larger specimens in relation to ‘miunça’.

The bulletins of marine catch statistics for the state of Sergipe indicated different composition of ‘pescadinha’ throughout the years. In 2010 and 2012, ‘pescadinha’ included *Isopisthus parvipinnis* and all weakfishes of small size. In 2011, ‘pescadinha’ was associated only with *I. parvipinnis* (Thomé-Souza *et al.* 2013). For 2013 and 2014, *Macrodon ancylodon* and *Nebris microps* were included together with *I. parvipinnis* in this category. There is also one category named ‘outros’ (others), which is comprised of species landed together due to their small quantity. Finally, there is a category named ‘pescada’, which included larger specimens of sciaenids of two to five species, depending on the year: *Cynoscion virescens*, *Cynoscion microlepidotus*, *Cynoscion leiarchus*, *M. ancylodon* and *N. microps* (Thomé-Souza *et al.* 2014b, Thomé-Souza *et al.* 2012, Thomé-Souza *et al.* 2013), *C. virescens*, *C. microlepidotus*, and *C. leiarchus* (Thomé-Souza *et al.* 2014a), and *C. microlepidotus* and *C. leiarchus* (Araújo *et al.* 2016).

There are fish species in Brazil presenting various common names, as well as common names that are associated with the same fish species (Freire & Pauly 2005). This richness of common names is directly related to the commercial interest, the larger size, and easily accessible habitats, such as reefs. Due to the high richness of names, some inconsistences may occur when translating the original common names reported in catch bulletins into species names (Clauzet 2009, Freire *et al.* 2021). This study was conducted to test the hypothesis of similarity in the species composition of the categories ‘miunça’ and ‘pescadinha’ landed together with shrimps in the Fishing Port of Aracaju, in the state of Sergipe, northeastern Brazil. Additionally, we evaluated the hypothesis of larger fish size and weight in the category ‘pescadinha’ in relation to ‘miunça’. Finally, we assessed the occurrence of seasonal changes in both composition and size of these two categories.

## Materials and Methods

Samples were obtained monthly between August 2018 and July 2019 at the Fishing Port of Aracaju, in the state of Sergipe. No sample was obtained during the closed seasons between December 1$^{st}$ and January 15$^{th}$, and between April 1$^{st}$ and May 15$^{th}$ (MMA 2004). Each month, two samples of 3 kg each were obtained directly from shrimp boats before they landed their catch at the port, one for ‘miunça’ and another for ‘pescadinha’, as defined by commercial fishers and landed separately to be sold in the local market. Artisanal shrimp boats operate along the entire coast of Sergipe (Fig. 1), but the samples were not georeferenced, as they were obtained at the landing port. All samples were fresh and transported fresh in polystyrene boxes to the *Laboratório de Ecologia Pesqueira* (LEP), located at the *Departamento de Engenharia de Pesca e Aquicultura* (DEPAQ) at the *Universidade Federal de Sergipe* (UFS). The samples were then frozen for posterior analysis.

The species found in each category (‘miunça’ and ‘pescadinha’) were identified using the following references: Carpenter (2002a, 2002b), Figueiredo & Menezes (1978, 1980, 2000), Marceniuk (2005), Marceniuk *et al.* (2020), Menezes & Figueiredo (1980, 1985). After the identification, each specimen was measured using an ichthyometer (total length; TL; precision: 0.1 cm) and weighed using a digital scale (total weight; TW; precision: 0.1 g). The length structure was then compared to the size at first maturity mostly obtained from FishBase (Froese & Pauly 2022) and complemented with other references (see Table I). Additionally, the reporting system of catches for each of these species in bulletins of fishery statistics for Sergipe was assessed: individual record, grouped with other species, or not at all (Araújo *et al.* 2016, Thomé-Souza *et al.* 2014a, Thomé-Souza *et al.* 2014b, Thomé-Souza *et al.* 2012, Thomé-Souza *et al.* 2013).

A Wilcoxon test for paired samples (*wilcox.test* function) was used to test for a general difference in the species composition of the categories ‘miunça’ and ‘pescadinha’. A cluster analysis was used to check for the similarity of species composition for each category during different months of the year using the *kmeans* function, and the packages *factoextra* and *NbClust*. The same procedure was used to indicate which species co-occurred in the same samples. For the cluster analysis, the numerical abundance of each species in each sample after standardization and the Bray-Curtis similarity coefficient were used (Legendre & Legendre 1998).

The hypotheses that the total length and total weight of ‘pescadinha’ were higher than ‘miunça’ were tested using a two-way comparison of medians (*med2way* function; *WRS2* package) after the assumptions for a two-way ANOVA were checked: normality using the Shapiro-Wilk test and homoscedasticity using the Levene test (Mair & Wilcox 2020, Zar 2010). Post hoc comparisons were

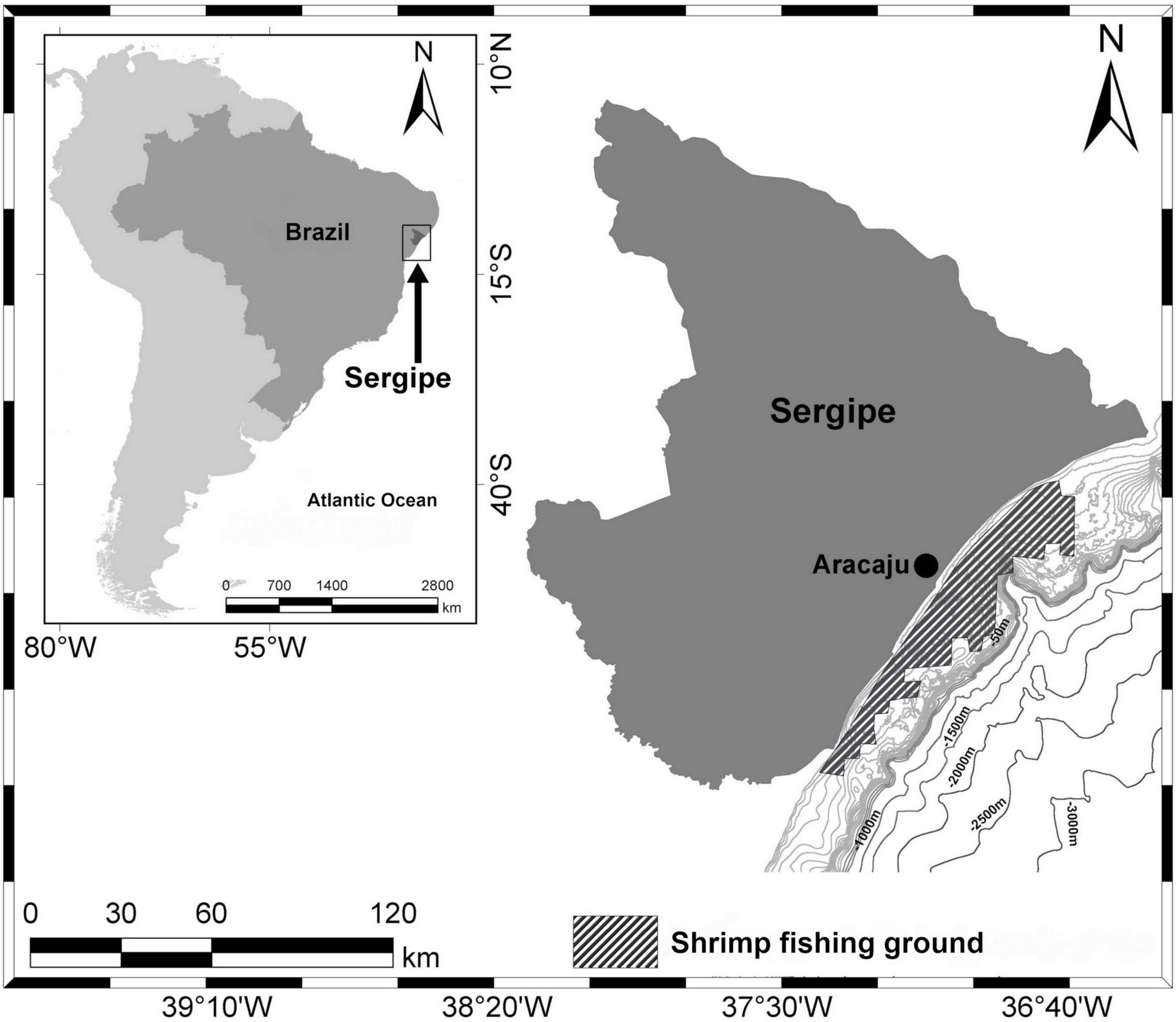


**Figure 1.** Map indicating the localization of the state of Sergipe and the fishing ground for the shrimp fleet in Sergipe.

computed using the *mcp2a* function (*WRS2* package) (Mair & Wilcox 2020). All statistical analyses were performed using the R statistical software, version 4.1.0, using a significance level of 5% (R Core Team 2021).

## Results

A total of 60 kg of bycatch was sampled, which included 1,412 fish specimens (856 in 'miunça' and 556 in 'pescadinha') and 35 species within 16 families (Table I). The families including the highest number of specimens in the categories 'miunça' and 'pescadinha' were: Sciaenidae (61.6% and 46.4%, respectively), Polynemidae (23.6% and 40.8%) and Haemulidae (9.7% and 10.4%) (Table I). The species with the highest number of specimens within the category 'miunça' were: *Polydactylus virginicus*, *Larimus breviceps*, *Paralonchurus brasiliensis*, and *Stellifer brasiliensis*, representing together 57.9% of the specimens (54.4% of the total biomass for 'miunça'). The following species were found exclusively in this category: *Achirus achirus*, *Aluterus monoceros*, *Aspistor quadriscutis*, *Bagre marinus*, *Chaetodipterus faber*, *Diplectrum radiale*, *Harengula jaguana*, *Menticirrhus cuiaranensis*, *Peprilus crenulatus*, and *Stellifer stellifer* (3.5% of the numerical abundance and 4.6% of the biomass).

'Pescadinha' included mainly *P. virginicus*, *L. breviceps*, and *Conodon nobilis*, representing 50.7% of the numerical abundance (57.8% of the total biomass for 'pescadinha'). Only one species was unique to this category, *Sphyraena barracuda*, representing 0.2% of the numerical abundance and 0.4% of the biomass. Moreover, about 70% of the 35 species found in this study were common to both

**Table I**. Fish species caught as bycatch in the shrimp trawling fishery along the coast of the state of Sergipe (2018-2019), together with their minimum and maximum total length (TL) and total weight (TW), as well as the number of individuals included in each sample (N) (M = 'miunça'; P = 'pescadinha'). The maximum length ($L_{max}$) and size at first maturity ($L_m$) reported in FishBase are also presented (Froese & Pauly 2022); F indicates the size at first maturity for females and M for males (single values indicated that $L_m$ were not attributed to neither). G represents species reported in groups (e.g., 'pescadas' = weakfishes) and I corresponds to species that were individually reported at least in one of bulletins containing catch statistics for fisheries taking place in Sergipe (Araújo *et al.* 2016, Thomé-Souza *et al.* 2014a, Thomé-Souza *et al.* 2014b, Thomé-Souza *et al.* 2012, Thomé-Souza *et al.* 2013): 0 and 1 indicate not reported and reported, respectively. The table is organized by the total numerical abundance within each fish family.

| Families/Species | TL (cm) Min.-Max. | TW (g) Min.-Max. | N | $L_{max}$ (cm) | $L_m$ (F/M) | G/I |
|---|---|---|---|---|---|---|
| SCIAENIDAE | | | | | | |
| *Larimus breviceps* Cuvier, 1830 | 7.0 – 19.0 M<br>13.7 – 25.0 P | 3.3 – 87.2 M<br>35.7 – 209.7 P | 140 M<br>55 P | 31.0 | 14.4[1] | 0/1 |
| *Paralonchurus brasiliensis* (Steindachner, 1875) | 14.4 – 20.0 M<br>15.9 – 22.9 P | 22.5 – 69.2 M<br>30.4 – 114.8 P | 86 M<br>47 P | 30 | 14.3/13.0[5] | 0/0 |
| *Stellifer brasiliensis* (Schultz, 1945) | 12.1 – 18.4 M<br>15.5 – 16.8 P | 15.9 – 73.4 M<br>45.1 – 60.3 P | 68 M<br>2 P | 17.0 | 7.3 | 1/0 |
| *Ctenosciaena gracilicirrhus* (Metzelaar, 1919) | 11.7 – 17.2 M<br>10.0 P | 24.3 – 78.9 M<br>13.0 P | 40 M<br>1 P | 21.0 | 13.4/12.3[6] | 0/0 |
| *Stellifer rastrifer* (Jordan, 1889) | 12.5 – 17.3 M<br>11.7 – 16.3 P | 24.1– 70.9 M<br>22.5 – 61.3 P | 30 M<br>2 P | 32.1 | 9.8 | 1/0 |
| *Micropogonias furnieri* (Desmarest, 1823) | 14.6 – 19.9 M<br>15.8 – 22.2 P | 33.5 – 81.4 M<br>36.1 – 114.6 P | 22 M<br>23 P | 60.0 | 30.6 | 0/1 |
| *Isopisthus parvipinnis* (Cuvier, 1830) | 14.1 – 21.5 M<br>15.5 – 24.0 P | 21.5 – 88.6 M<br>31.5 – 105.1 P | 21 M<br>38 P | 25.0 | 14.4[1] | 1/0 |
| *Menticirrhus martinicensis* (Cuvier, 1830) | 13.8 – 18.5 M<br>17.2 – 24.4 P | 23.6 – 58.5 M<br>52.0 – 152.7 P | 21 M<br>34 P | 50.0 | 17.7 | 1/0 |
| *Macrodon ancylodon* (Bloch & Schneider, 1801) | 15.9 – 20.6 M<br>18.2 – 24.5 P | 29.8 – 66.3 M<br>41.4 – 117.1 P | 18 M<br>9 P | 45.0 | 23.7 | 1/0 |
| *Cynoscion jamaicensis* (Vaillant & Bocourt, 1883) | 13.1 – 18.2 M<br>15.4 – 26.7 P | 26.4 – 62.7 M<br>39.3 – 149.5 P | 10 M<br>14 P | 50.0 | 19.0[2] | 0/0 |
| *Cynoscion leiarchus* (Cuvier, 1830) | 16.8 – 20.2 M<br>17.5 – 24.1 P | 44.5 – 74.4 M<br>56.1 – 141.4 P | 13 M<br>13 P | 90.8 | 32.4/27.0[7] | 1/0 |
| *Menticirrhus cuiaranensis* Marceniuk *et al.*, 2020 | 15.5 – 18.5 M<br>– P | 28.8 – 51.9 M<br>– P | 7 M<br>0 P | 48.3 | 23.0 | 1/0 |
| *Nebris microps* Cuvier, 1830 | 14.0 – 18.1 M<br>16.7 – 25.4 P | 22.1 – 58.3 M<br>38.7 – 159.0 P | 7 M<br>12 P | 40.0 | 23.3[8] | 1/0 |
| *Cynoscion virescens* (Cuvier, 1830) | 17.4 – 21.6 M<br>20.4 – 25.2 P | 32.9 – 56.9 M<br>43.6 – 137.1 P | 6 M<br>6 P | 115.0 | – | 1/0 |
| *Ophioscion punctatissimus* Meek & Hildebrand, 1925 | 11.8 – 19.0 M<br>19.4 – 20.3 P | 18.7 – 89.7 M<br>93.3 – 100.0 P | 5 M<br>2 P | 25.0 | – | 0/0 |
| *Stellifer stellifer* (Bloch, 1790) | 13.4 – 14.8 M<br>– P | 28.7 – 36.3 M<br>– P | 2 M<br>0 P | 21.0 | 7.5 | 0/0 |
| *Stellifer* spp. | 12.2 – 18.5 M<br>– P | 19.8 – 87.8 M<br>– P | 37 M<br>0 P | – | – | 0/0 |
| POLYNEMIDAE | | | | | | |
| *Polydactylus virginicus* (Linnaeus, 1758) | 12.2 – 22.5 M<br>14.4 – 24.2 P | 16.3 – 97.4 M<br>33.3 – 136.6 P | 202 M<br>22 P | 33.0 | 22.1[3] | 0/1 |
| HAEMULIDAE | | | | | | |
| *Conodon nobilis* (Linnaeus, 1758) | 13.0 – 19.0 M<br>14.0 – 22.7 P | 31.8 – 106.9 M<br>37.3 – 161.9 P | 49 M<br>50 P | 33.6 | 14.3[4] | 1/1 |
| *Haemulopsis corvinaeformis* (Steindachner, 1868) | 13.0 – 19.5 M<br>17.0 – 20.1 P | 20.0 – 102.2 M<br>68.4 – 121.3 P | 32 M<br>7 P | 25.0 | 10.3/10.4[9] | 1/0 |
| *Genyatremus cavifrons* (Cuvier, 1830) | 13.3 – 15.0 M<br>21.1 P | 43.2 – 54.5 M<br>158.6 P | 2 M<br>1 P | 12.6 | – | 0/0 |

| Families/Species | TL (cm) Min.-Max. | TW (g) Min.-Max. | N | $L_{max}$ (cm) | $L_m$ (F/M) | G/I |
|---|---|---|---|---|---|---|
| MULLIDAE | | | | | | |
| *Upeneus parvus* Poey, 1852 | 14.0 – 16.1 M<br>15.6 P | 30.5 – 43.0 M<br>38.7 P | 9 M<br>1 P | 30 | – | 0/0 |
| STROMATEIDAE | | | | | | |
| *Peprilus crenulatus* Cuvier, 1829 | 12.0 – 15.4 M<br>– P | 31.5 – 69.0 M<br>– P | 8 M<br>0 P | 15.0 | 10.8[8] | 0/0 |
| OPHIDIIDAE | | | | | | |
| *Lepophidium brevibarbe* (Cuvier, 1829) | 14.8 – 22.0 M<br>19.8 P | 11.5 – 45.0 M<br>29.9 P | 7 M<br>1 P | 27.3 | – | 0/1 |
| SERRANIDAE | | | | | | |
| *Diplectrum radiale* (Quoy & Gaimard, 1824) | 15.2 – 18.4 M<br>– P | 55.3 – 79.5 M<br>– P | 5 M<br>0 P | 26.0 | 13.0[11] | 0/0 |
| GERREIDAE | | | | | | |
| *Diapterus rhombeus* (Cuvier, 1829) | 13.5 M<br>16.9 – 19.3 P | 36.7 M<br>74.9 – 110.5 P | 1 M<br>7 P | 40 | 15.2[10] | 1/1 |
| SHYRAENIDAE | | | | | | |
| *Sphyraena barracuda* (Edwards, 1771) | – M<br>31.2 P | – M<br>171.8 P | 0 M<br>1 P | 200.0 | 66.0 | 1/0 |
| *Sphyraena guachancho* Cuvier, 1829 | 21.9 – 22.6 M<br>25.2 P | 43.3 – 55.7 M<br>76.6 P | 2 M<br>1 P | 200.0 | 28.8[12] | 1/0 |
| ACHIRIDAE | | | | | | |
| *Achirus achirus* (Linnaeus, 1758) | 12.6 – 15.1 M<br>– P | 43.1 – 70.4 M<br>– P | 2 M<br>0 P | 37.0 | – | 0/0 |
| *Achirus* spp. | 6.8 – 17.0 M<br>– P | 5.2 – 106.0 M<br>– P | 2 M<br>0 P | – | – | 0/0 |
| EPHIPPIDAE | | | | | | |
| *Chaetodipterus faber* (Broussonet, 1782) | 13.4 – 13.6 M<br>– P | 74.0 – 88.8 M<br>– P | 2 M<br>0 P | 91.0 | – | 0/1 |
| ARIIDAE | | | | | | |
| *Aspistor quadriscutis* (Valenciennes, 1840) | 27.6 M<br>– P | 174.3 M<br>– P | 1 M<br>0 P | 50.0 | – | 0/1 |
| *Bagre marinus* (Mitchill, 1815) | 22.8 M<br>– P | 78.1 M<br>– P | 1 M<br>0 P | 69.0 | 33.0 | 1/0 |
| PARALICHTHYIDAE | | | | | | |
| *Citharichthys macrops* Dresel, 1885 | 12.1 M<br>5.7 P | 17.8 M<br>2.1 P | 1 M<br>1 P | 20.0 | – | 0/0 |
| LUTJANIDAE | | | | | | |
| *Lutjanus synagris* (Linnaeus, 1758) | 16.3 M<br>15.9 P | 63.1 M<br>60.8 P | 1 M<br>1 P | 60.0 | 23.8 | 0/1 |
| MONACANTHIDAE | | | | | | |
| *Aluterus monóceros* (Linnaeus, 1758) | 20.9 M<br>– P | 91.7 M<br>– P | 1 M<br>0 P | 76.2 | – | 1/0 |
| CLUPEIDAE | | | | | | |
| *Harengula jaguana* Poey, 1865 | 11.1 M<br>– P | 16.8 M<br>– P | 1 M<br>0 P | 21.2 | – | 0/0 |

[1]Silva Jr. *et al*. (2015), [2]Lima (2018), [3]Freire *et al*. (2020c), [4]Lira *et al*. (2019), [5]Monteiro (2014), [6]Oliveira (2012), [7]Silva (2015), [8]Nunes *et al*. (2020), [9]Medeiros e Silva *et al*. (2012), [10]Bezerra *et al*. (2001), [11]Meurer & Andreata (2002), [12]Akadje *et al*. (2019).

categories: *L. breviceps, P. brasiliensis, S. brasiliensis, Ctenosciaena gracilicirrhus, Stellifer rastrifer, Micropogonias furnieri, I. parvipinnis, Menticirrhus martinicensis, M. ancylodon, Cynoscion jamaicensis, Cynoscion leiarchus, N. microps, Cynoscion virescens, Ophioscion punctatissimus, P. virginicus, C. nobilis, Haemulopsis corvinaeformis, Genyatremus cavifrons, Upeneus parvus, Lepophidium brevibarbe, Diapterus rhombeus, Citharichthys* *macrops*, *Lutjanus synagris*, and *Sphyraena guachancho.* Amongst the species with the highest numerical abundance, the percentage of specimens smaller than the size at first maturity were: 98.6% for *P. virginicus*, 18.5% for *L. breviceps*, and 6.1% for *C. nobilis*. All specimens of *P. brasiliensis* and *S. brasiliensis* were larger than the size at first maturity.

Fish species caught in waters off Sergipe are reported by common name in bulletins of catch statistics, similarly to other Brazilian states. Only eight out of the 35 fish species sampled here were reported individually in the local bulletins at least in one of the years analyzed (2010-2014): *L. breviceps, M. furnieri, P. virginicus, C. nobilis, L. brevibarbe, D. rhombeus, C. faber,* and *L. synagris* (representing 55.8% and 56.7% of the total abundance and biomass sampled, respectively; Table I). Additionally, 18 species were reported in groups at least in one of the five years analyzed (Table I), with three of them also reported individually in some of these years. It is worth pointing out that groups reported included two to five species, e.g., ‘roncador-corró-coroque’ (*C. nobilis* and *P. corvinaeformis*), ‘tinga’ (*D. rhombeus* and *Eucinostomus* spp.), ‘bicuda’ (*S. guachancho* and *S. barracuda)*, ‘papa-terra’ (*S. brasiliensis, S. rastrifer, Stellifer* spp., and *M. martinicensis*), and ‘pescada’ (*C. virescens, C. microlepidotus, C. leiarchus, N. microps*, and *M. ancylodon*). In some cases, the group included up to nine species, as occurred with ‘bagre’, which included: *Aspistor parkeri* (Traill, 1832), *Aspistor luniscutis* (Valenciennes, 1840), *Bagre bagre* (Linnaeus, 1766), *B. marinus, Cathorops spixii* (Agassiz, 1829*), Sciades herzbergii* (Bloch, 1794), *Sciades couma* (Valenciennes, 1840), *Genidens genidens* (Valenciennes, 1839), and *Notarius grandicassis* (Valenciennes, 1840).

The result of the Wilcoxon test for paired samples indicated no statistical difference in the proportion of species between the categories ‘miunça’ and ‘pescadinha’ (V=365; p=0.4174). Even though no statistical difference was found in the general proportion of species included in these categories, when the proportions are analyzed by month, the cluster analysis indicated the presence of three groups based on the relative abundance of each species per category and month: one group including only samples of ‘pescadinha’ (from May to November), another one including samples of ‘pescadinha’ and ‘miunça’ (which probably defined the result of the Wilcoxon test), and one small group including only two very distinct samples of ‘miunça’ (for September and October) (Fig. 2A). We would like to highlight the presence of the samples M219 and P219, both obtained in February, occupying the same position in the second group. This occurred because 11 of 16 species were common to both samples. Additionally, *S. guachanch*o occurred only in February in both categories (even though in small number) and in no other sample. Another important feature was the third group composed only by ‘miunça’ samples (M918 and M1018), which were characterized by the presence of *A. achirus*, *A. quadriscutis*, and *S. stellifer* in small numbers, but not found in any other sample. These results imply that even though approximately 70% of all species were found in both categories, the proportion among species in different months was sufficiently different to put then in different groups in some cases

In terms of species, we found four groups well-separated (Fig. 2B). As expected, for a by-catch of shrimp fisheries, there was a very self-contained group of sciaenids composed by ten species: *C. gracilicirrhus, C. jamaicensis, I. parvipinnis, L. breviceps, M. martinicensis, M. furnieri, N. microps, P. brasiliensis, S. brasiliensis*, and *S. rastrifer*. Included in this group were also *P. virginicus* and *H. corvinaeformis*. Another important feature is the fact of *M. cuiaranensis* and *M. martinicensis* being included in different groups. This occurred because *M. cuiaranensis* was found only in two samples of miunça, in small number, and it did not co-occur with *M. martinicensis*.

The total length of all individuals included in the category ‘miunça’ ranged from 6.8 to 27.6 cm TL (mean±standard deviation: 15.8±1.8 cm) (Fig. 3A). Conversely, the individuals included in the category ‘pescadinha’ were 13.7 to 31.2 cm long (18.8±2.1 cm) (Fig. 3A). The weight of individuals belonging to the category ‘miunça’ ranged from 11.5 to 174.3 g (43.4±14.8 g) (Fig. 3B). For ‘pescadinha’, the weight ranged from 29.9 to 209.7 g (70.6±26.0 g) (Fig. 3B). Thus, overall, individuals landed and sold as ‘miunça’ tend to present smaller length and weight than those included in the category ‘pescadinha’ (Fig. 3).

Total length was not normally distributed ($W=0.96112$; $p<0.0001$) and the assumption of homoscedasticity among months and categories was not met ($F=3.8226$; $p<0.0001$). Weight data were neither normally distributed ($W=0.92849$, $p<0.0001$), nor homoscedastic ($F=8.7824$; $p<0.0001$). Thus, a two-way comparison of medians was used and indicated that there was no statistical

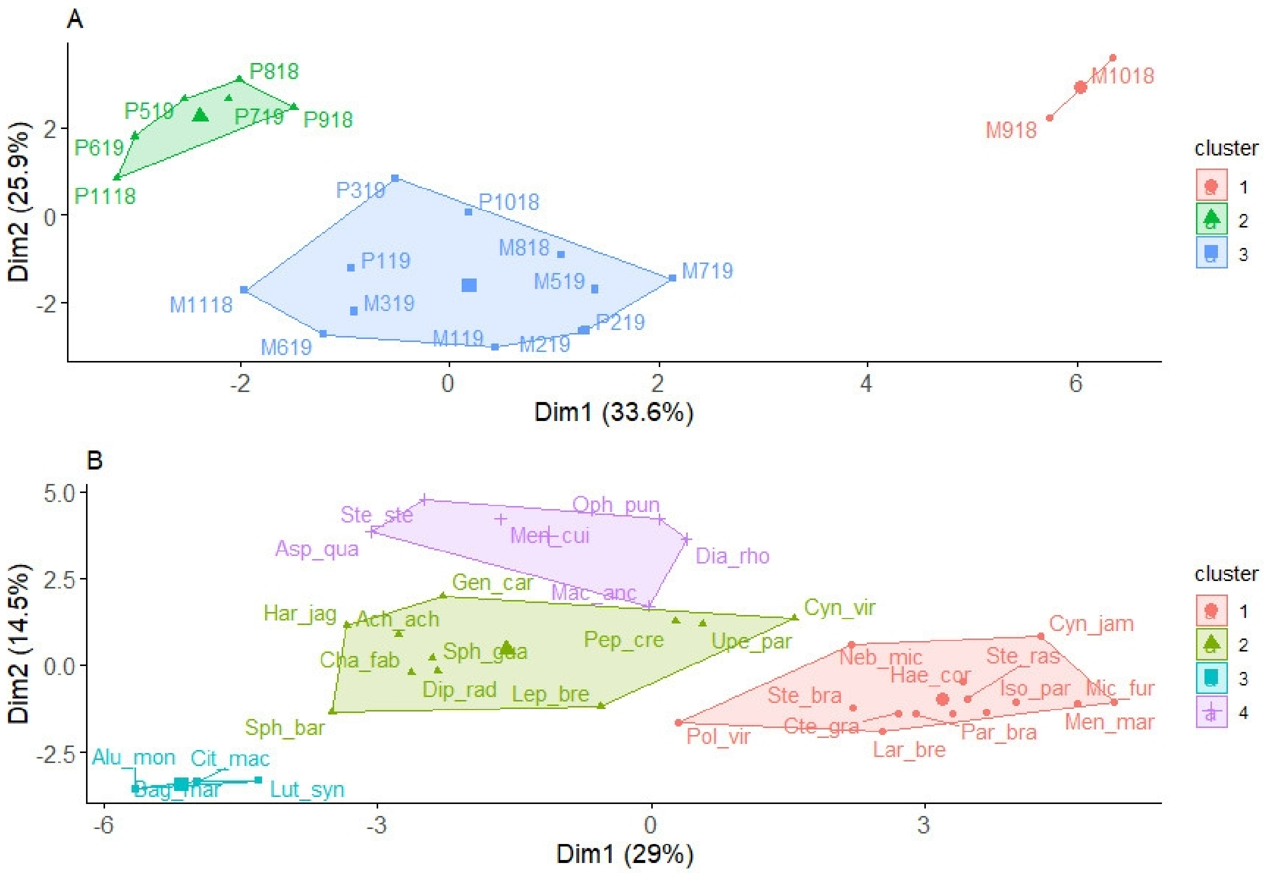


**Figure 2.** Cluster analysis showing: (A) the similarity of samples obtained in different months for the categories 'miunça' and 'pescadinha', after adjusting the numerical abundance of each species within each sample and using the *kmeans* function; the letters M and P indicate the categories 'miunça' and 'pescadinha', respectively, the last two digits indicate the sample year (2018 or 2019), and the first or the two first digits indicate the month when the sample was obtained. Thus: M1018 = 'miunça' obtained in October 2018; (B) Cluster analysis showing the co-occurrence of species in both categories ('miunça' and 'pescadinha'). For complete species names, refer to Table I.

difference in total length and weight among months but there was between categories ('miunça' and 'pescadinha'), even though there was interaction between categories and months for both variables (Tables II and III). Individuals landed as 'miunça' were always smaller than those landed as 'pescadinha', but the difference was higher in May and September, as highlighted by the higher slope of the lines shown in the interaction graph (Fig. 4A), and smaller in February. The lowest median total length for 'miunça' and 'pescadinha' were observed in May and February, respectively (Fig. 4A). The same general pattern was observed for total weight, even though the lowest mean weight for 'miunça' was observed in September (Fig. 4B).

**Discussion**

In this study, we observed that 'miunça' included small specimens (mean: 15.8 cm and 43.4 g), most of them represented by the Sciaenidae family, which corresponded to 61.6% of the numerical abundance and 61.2% of the biomass sampled. Another study, conducted in São Paulo, indicated that a similar proportion of 'mistura' (61.1%) corresponds to sciaenids if we consider 'miunça' as synonymous of 'mistura' (Souza *et al*. 2007). Nevertheless, when the species were analyzed individually, *P. virginicus* was the most abundant, representing 23.6% of the numerical abundance and 24.0% of the biomass sampled (Polynemidae family). Thus, based on our study, we can confirm that 'miunça' landed by the shrimp fleet based in the Fishing Port of Aracaju (Sergipe) is indeed represented by small specimens of fish species with low commercial value as pointed out by Thomé-Souza *et al.* (2014a), Thomé-Souza *et al.* (2014b), Thomé-Souza *et al.* (2012), Thomé-Souza *et al.* (2013), and Araújo *et al.* (2016). Conversely, Thomé-Souza *et al.* (2014a) and Araújo *et al.* (2016) state that 'pescadinha' includes *M. ancylodon*, *N.*

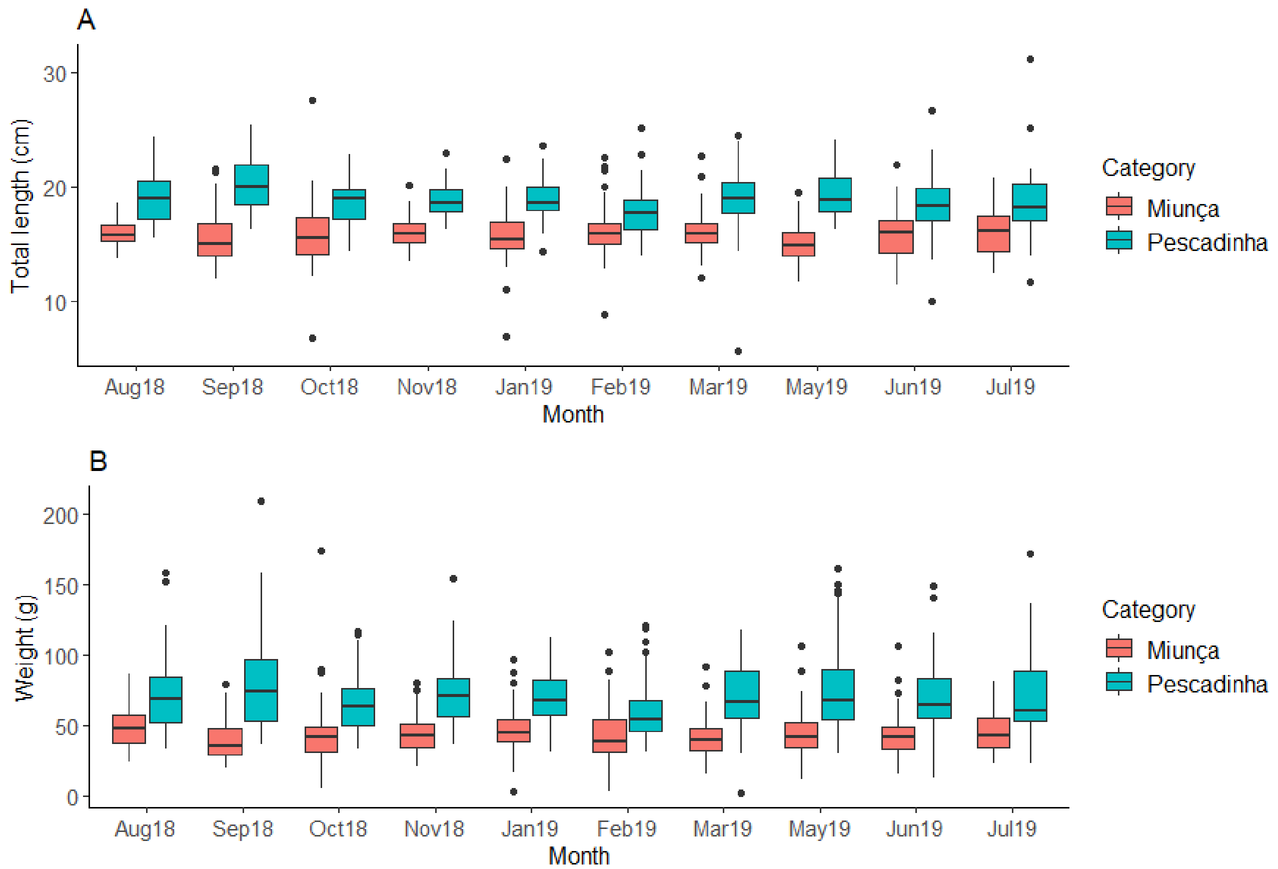


**Figure 3.** Total length (A) and weight (B) for all individuals sampled from the categories 'miunça' and 'pescadinha' landed by month from the shrimp fleet at the Fishing Port of Aracaju in Sergipe (2018-2019). No sample was obtained during the closed seasons (December 1st to January 15th and April 1st to May 15th). The central horizontal lines correspond to the median, box boundaries to the first and third quartiles, and the far ends of the vertical lines to the minimum and maximum values excluding outliers (circles).

**Table II.** Results of the two-way comparison of medians for total length (cm) and total weight (g) between the categories 'miunça' and 'pescadinha' and among 10 months (no sample collected was during the closed seasons from December 1st to January 15th and from April 1st to May 15th.

| Variation source | Total length | | Total weight | |
|---|---|---|---|---|
| | Value | p-value | Value | p-value |
| *Category* | F = 443.8401 | <0.0001 | F = 231.3879 | <0.0001 |
| *Month* | F = 1.4024 | 0.1805 | F = 3.9716 | <0.0001 |
| *Interaction* | $\chi^2$ = 97.9581 | <0.0001 | $\chi^2$ = 54.1575 | <0.0001 |

*microps* and *I. parvipinnis*, all belonging to the Sciaenidae family. Nevertheless, the results presented here indicated this affirmative is only partially true, as this category includes a higher number of species (25), 14 of which belonging to the Sciaenidae family. The remaining 11 species found belong to eight families: Polynemidae, Haemulidae, Mullidae, Ophidiidae, Gerreidae, Shyraenidae, Paralichthyidae, and Lutjanidae. In fact, the species mentioned by Thomé-Souza *et al.* (2014a) and Araújo *et al.* (2016) for this category correspond to only a reduced proportion of the number and weight of all samples combined: 10.6% and 11.2%, respectively.

Our results indicated a high proportion of sciaenids in both categories 'miunça' and 'pescadinha' landed by the shrimp fleet based in Aracaju (not considering the discarded portion). Barreto *et al*. (2018) had previously studied the general composition of the bycatch of the shrimp fishery in Sergipe (after discard) and found a predominance of sciaenids, together with Ariidae, Pristigasteridae, and Haemulidae. According to Braga *et al.* (2001) and Silva Jr. *et al.* (2015), sciaenids suffer a strong impact of shrimp fisheries

**Table III**. Results of *post hoc* comparisons after applying a two-way test of comparison of medians considering interactions. Only significant differences are presented. CI = confidence interval. Results for total length (TL; cm) are in the line Category1 – TL and right below. Results for total weight (TW; g) are in the line Category1 – TW and right below.

| | psi $_{hat}$ | CI $_{lower}$ | CI $_{upper}$ | p-value | Month 1 | Month 2 | Category 1 | Category 2 |
|---|---|---|---|---|---|---|---|---|
| **Category1 - TL** | -30.60 | -32.90 | -28.30 | 0 | — | — | miunça | pescadinha |
| Category1:month1 | -1.45 | -3.10 | 0.25 | 0.02003 | Aug | Sep | miunça | pescadinha |
| Category1:month9 | 1.70 | -0.50 | 3.90 | 0.01836 | Aug | Jul | miunça | pescadinha |
| Category1:month10 | 1.40 | 0.30 | 2.90 | 0 | Sep | Oct | miunça | pescadinha |
| Category1:month13 | 1.20 | -0.10 | 2.50 | 0.00668 | Sep | Feb | miunça | pescadinha |
| Category1:month14 | 2.20 | 1.20 | 3.90 | 0 | Sep | Mar | miunça | pescadinha |
| Category1:month16 | 1.60 | -0.10 | 2.90 | 0.00668 | Sep | Jun | miunça | pescadinha |
| Category1:month17 | 3.15 | 1.25 | 4.90 | 0 | Sep | Jul | miunça | pescadinha |
| Category1:month18 | -1.15 | -2.95 | 0.55 | 0.02504 | Oct | Nov | miunça | pescadinha |
| Category1:month21 | 0.80 | -0.55 | 2.40 | 0.04174 | Oct | Mar | miunça | pescadinha |
| Category1:month24 | 1.75 | -0.20 | 3.40 | 0.01169 | Oct | Jul | miunça | pescadinha |
| Category1:month27 | 1.95 | 0.30 | 3.65 | 0 | Nov | Mar | miunça | pescadinha |
| Category1:month30 | 2.90 | 0.50 | 4.95 | 0 | Nov | Jul | miunça | pescadinha |
| Category1:month32 | 1.65 | 0.30 | 3.45 | 0 | Jan | Mar | miunça | pescadinha |
| Category1:month35 | 2.60 | 0.70 | 4.60 | 0 | Jan | Jul | miunça | pescadinha |
| Category1:month36 | 1.00 | -0.50 | 2.55 | 0.01503 | Feb | Mar | miunça | pescadinha |
| Category1:month39 | 1.95 | 0.05 | 3.90 | 0.00167 | Feb | Jul | miunça | pescadinha |
| Category1:month40 | -1.40 | -2.95 | 0.00 | 0.00334 | Mar | May | miunça | pescadinha |
| Category1:month44 | 2.35 | -0.10 | 4.40 | 0.00501 | May | Jul | miunça | pescadinha |
| Category1:month45 | 1.55 | -0.30 | 3.90 | 0.01002 | Jun | Jul | miunça | pescadinha |
| **Category1 - TW** | -243.55 | -271.80 | -222.70 | 0 | — | — | miunça | pescadinha |
| Category1:month1 | 17.80 | -8.20 | 36.15 | 0.04341 | Aug | Sep | miunça | pescadinha |
| Category1:month13 | -22.85 | -48.55 | -1.05 | 0.00501 | Sep | Feb | miunça | pescadinha |
| Category1:month17 | -20.85 | -40.45 | 8.05 | 0.03172 | Sep | Jul | miunça | pescadinha |
| Category1:month26 | -12.00 | -26.85 | 0.50 | 0.00668 | Nov | Feb | miunça | pescadinha |
| Category1:month36 | 12.10 | -0.30 | 27.80 | 0.00668 | Feb | Mar | miunça | pescadinha |
| Category1:month37 | 10.20 | -3.00 | 26.20 | 0.01669 | Feb | May | miunça | pescadinha |
| Category1:month38 | 7.90 | -3.30 | 26.50 | 0.01002 | Feb | Jun | miunça | pescadinha |

as they forage in the shrimp fishing ground (Andrade-Tubino *et al.* 2008, Bernardo *et al.* 2011, Menezes & Figueiredo 1980). Considering the total biomass landed in Sergipe in 1950-2010, the

Sciaenidae family also composed most of the total catch of fishes, followed by Lujanidae, Ariidae, and Centropomidae (Freire & Araújo 2016). Sciaenidae was also the family mostly represented in the bycatch of shrimp fisheries in other regions in Brazil, namely: North (Maia *et al.* 2016, Sedrez *et al.* 2013), Northeast, particularly in Bahia and Sergipe (Alcântara & Siqueira 2018, Santos *et al.* 2008), Southeast (Coelho *et al*. 1986), and South (Branco & Verani 2006, Freitas et al. 2011, Schwarz Jr et al. 2006).

The species composition of 'miunça' and 'pescadinha' was similar, as 70% of the 35 species found were present in both categories, but with some differences among months. Similarly, even though individuals landed as 'pescadinha' were always larger and heavier than those landed as 'miunça', this difference may be higher or lower depending on the month. Seasonal variability occurs even in regions close to the Equator (Pauly 2019), as observed in Sergipe, which presents a Northeast-Eastern Coastal Tropical climate (Mendonça & Danni-Oliveira 2007). The occurrence of some species in certain areas is related to a series of factors. One of the factors that can explain, at least partially, these monthly variations are the occasional

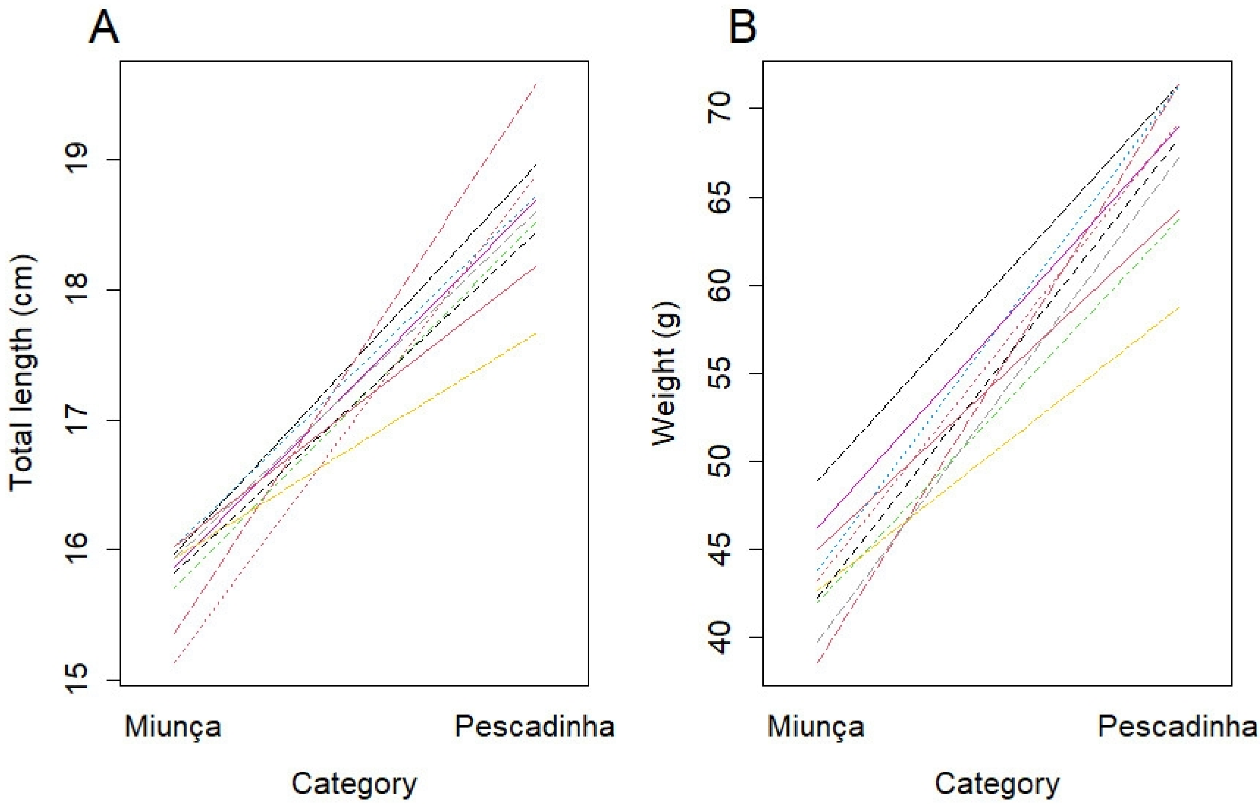


**Figure 4.** Result of the comparison of medians indicating the interaction between the category ('miunça' and 'pescadinha') and the month (February to November) for total length (A) and total weight (B) using all individuals sampled from the shrimp trawling fleet in the Fishing Port of Aracaju in 2018-2019.

or seasonal oscillations, which lead to the appearance of visitant or occasional species with movements associated with reproduction, feeding, and growth (Araújo *et al*. 1998, Coelho *et al*. 1986, Godefroid *et al*. 2004, Ruffino & Castello 1992, Santos *et al*. 2008). Seasonal movements, in their turn, are related to changes in sediment, temperature, salinity (associated with river discharge), and instability in the coastal area (Magris & Giarrizzo 2020, Santos *et al.* 2008). Thus, even if the species composition did not vary, the relative proportion of coastal species such as the ones found in this study probably vary due to short distance movements.

One of the main concerns when studying bycatch is the proportion of specimens below maturity size ($L_m$). No study was found addressing the size of specimens landed as 'miunça' and 'pescadinha' in coastal waters of Sergipe in general. Nevertheless, one study, dealing only with *P. brasiliensis* originating from 'miunça' and 'pescadinha', found out that despite the small size of the specimens of this species, they were almost entirely above the maturity size in 'miunça' and entirely in 'pescadinha' (Freire *et al.* 2020b). In our study, some of the species had specimens below the estimated maturity size, such as *P. virginicus*, *L. breviceps*, and others not, as *P. brasiliensis* and *S. brasiliensis*. *Polydactylus virginicus*, one of the main species landed in the categories 'miunça' and 'pescadinha', had 98.6% of the specimens landed below the maturity size. It is worth pointing out that no information on maturity size was found for 11 out of the 35 species sampled here. For the remaining species, $L_m$ from other localities were used, as there was no local information available. In general, smaller size specimens of several species are landed in Sergipe as 'miunça' and larger specimens, mostly of the same species, are landed as 'pescadinha', with a high proportion below $L_m$, mainly for 'miunça'. Additionally, a proportion of even smaller specimens are discarded back into the sea.

According to Decken (1986), most of the shrimp bycatch in Sergipe was landed until early 1980s. After this period, when industrial shrimp boats started operating in Sergipe, about 80% of the bycatch started to be discarded back into the sea. However, this proportion is currently unknown, and the previous estimate should be revisited. In some cases, discards may lead to an ecological imbalance due to the high mortality of discarded individuals (Rodrigues *et al.* 1985). We suggest that future studies analyze the discarded proportion of the shrimp fishery in Sergipe in relation to the total shrimp catch, and the species and size composition of the portions of fish species that are discarded and landed. Additionally, it is essential the size at first maturity is studied for all fish species landed and/or discarded (representing target species or not), to better understand the impact of shrimp trawling as the main fishery in waters of Sergipe.

As it could be seen above, the comprehension of the common names used by local fishers and people in general to refer to some species or group of species is very important. In some cases, it may be even misleading, mainly when names such as 'pescadinha', which is expected to refer only to some species of Sciaenidae, in fact refer to 25 species, including 11 non-sciaenids. This is even more important when working on a regional or national scale due to the difference of names used in different Brazilian states, municipalities, and beaches. Freire *et al*. (2015), e.g., considered that 'pescadinha' referred essentially to *Macrodon* spp. when reconstructing the marine catch statistics for the entire Brazil. A previous study indicated that Brazilian marine fish species have an average of six common names, with the highest richness associated with higher commercial interest and medium richness to species inhabiting pelagic, reef-associated, and demersal habitats (Freire & Pauly 2005). This high richness of common names has a large impact on the analysis of fishery statistics and hence on the management of the fishery sector, as it is not possible to define precisely to which species the catches reported by a given common name should be associated with.

Santos & Vianna (2017) highlighted this issue of taxonomic resolution, particularly for sciaenids, more precisely for *Cynoscion*. These authors indicated the existence of an area between 10ºN and 21ºS that is impacted by the absence of detailed catch and biological data for *Cynoscion* (locally known as 'pescada'), despite its high catches in Brazil. The coast of Sergipe is included in this area, and we were able to demonstrate the problem is not restricted only to 'pescadas' but also includes 'miunça' and 'pescadinha'. Moreover, the nomenclatural issue does not affect only fishes. Freire *et al.* (2020a), e.g., reported problems with common names used to represent shrimps in Sergipe, despite being the major fishery in this state. Even worse, the correspondence used may have changed throughout time, and this is particularly worrisome if the status of the main stocks is to be defined. Thus, besides the interruption of the national collection system of catch statistics in Brazil in 2007 (Freire *et al.* 2021), the Brazilian catch statistics are pervaded with uncertainties. Therefore, the real biological, ecological, economic, and sociocultural impacts of fishing activities on target species and mainly on bycatch species may not be properly assessed. Moreover, there is an additional impact of recreational and subsistence fisheries, which were not satisfactorily studied on a national level, despite some recent attempts (Freire *et al.* 2015, Freire *et al.* 2016). It is worth pointing out that recreational fishers and those who depend on fisheries for subsistence may use different common names for the same species.

Initiatives such as those of Barbosa & Nascimento (2008) and Freire & Carvalho Filho (2009) suggest that the standardization of common names should be expanded to include all fish species occurring in Brazil that present multiple names, especially those species of commercial importance. In the case of the present study, the lack of a proper definition of which species are included in 'miunça' and 'pescadinha' may lead to distortions in the local catch statistics, which are then carried over to the national statistics. Future updates of the reconstruction of the catch statistics for the state of Sergipe (Freire & Araújo 2016) should consider the results here presented, splitting catches attributed to 'miunça' and 'pescadinha' to the species listed here in the estimated proportion. Additionally, it is suggested the composition of the category 'pescada' is also investigated in future studies, as it may not include only sciaenids as expected. This composition must be monitored through time considering the impact of shrimp trawling due to the high capture of juveniles of commercial species. It is necessary to train data collectors to refine the identification of the species landed and to standardize the reporting system, which may require changes in the sheets used to register catch statistics. Moreover, a local electronic system of data collection could be implemented, such as that proposed by Noleto-Filho *et al.* (2021), to improve efficiency and speed in the process of data collection. Thus, it is expected that, in the future, Sergipe may have a better system of management for its fishing resources based on more adequate data.

**Acknowledgements**

The authors would like to thank Mr. Diógenis Lopes for helping us to obtain samples from shrimp boats anchored at the Fishing Port of Aracaju, to the masters of shrimp boats for allowing us to collect our samples before the bycatch was landed, to Felipe Mendes for helping us to identify, measure and weigh all fish specimens, and to Roberto Schwarz Jr. and Marcelo Brito for valuable comments on previous versions of this manuscript.

**Ethical statement**

Specimens in the present investigation were obtained from commercial fisheries landings and their use did not require approval by an Ethical Committee

**References**

Akadje, C. M. A., Amon, Y. N., N'Da, K. & Loc'h, F. L. 2019. Reproductive biology of barracuda, *Sphyraena guachancho*, on Ivorian Coasts (eastern Central Atlantic). **Vie et Milieu / Life & Environment**, 69(2-3): 177-185.

Alcântara, A. V. & Siqueira, K. L. F. 2018. Ictiofauna demersal da plataforma continental de Sergipe e Sul de Alagoas. Pp. 379-419. *In*: Carneiro, M. E. R. & Arguelho, M. L. P. M. (Eds.). **Plataforma continental de Sergipe e Alagoas: geoquímica e comunidade bêntica**. Editora Universidade Federal de Sergipe, São Cristóvão - Sergipe.

Alverson, D. L., Freeberg, M. H., Murawski, S. A. & Pope, J. G. 1994. A global assessment of fisheries bycatch and discards. **FAO Fisheries Technical Paper**, 339: 1-233.

Andrade-Tubino, M. F., Ribeiro, A. L. & Vianna, M. 2008. Organização espaço-temporal das ictiocenoses demersais nos ecossistemas estuarinos brasileiros: uma síntese. **Oecologia Brasiliensis**, 12(4): 640-661.

Araújo, A. R. R., Barbosa, J. M., Santos, J. P., Carvalho, B. L. F., Garciov Filho, E. B., Deda, M. S., Silva, C. O. & Chammas, M. A. 2016. **Boletim estatístico da pesca nos litorais de Sergipe e extremo norte da Bahia - 2014** Editora UFS, São Cristóvão, 82 p.

Araújo, F. G., Cruz-Filho, A. G., Azevêdo, M. C. C. & Santos, A. C. A. 1998. Estrutura da comunidade de peixes demersais da Baía de Sepetiba, RJ. **Revista Brasileira de Biologia**, 58(3): 417-430.

Barbosa, J. M. & Nascimento, C. M. 2008. Sistematização de nomes vulgares de peixes comerciais do Brasil: 2. Espécies marinhas. **Revista Brasileira de Engenharia de Pesca**, 3: 76-90.

Barreto, T. M. R. R., Freire, K. M. F., Reis-Júnior, J. J. C., Rosa, L. C., Carvalho-Filho, A. & Rotundo, M. M. 2018. Fish species caught by shrimp trawlers off the coast of Sergipe, in north-eastern Brazil, and their length–weight relations. **Acta Ichthyologica et Piscatoria**, 48(3): 277-283. https://doi.org/10.3750/AIEP/02334

Bernardo, C., Spach, H. L., Schwarz Jr., R., Stoiev, S. B. & Cattani, A. P. 2011. A captura incidental de cienídeos em arrasto experimental com rede-de-portas utilizada na pesca do camarão-sete-barbas, *Xiphopenaeus kroyeri*, no estado do Paraná, Brasil. **Arquivos de Ciências do Mar**, 44(2): 98-105.

Bezerra, R. S., Vieira, V. L. A. & Santos, A. J. G. 2001. Ciclo reprodutivo da carapeba prateada *Diapterus rhombeus* (Cuvier, 1829), no litoral de Pernambuco – Brasil. **Tropical Oceanography**, 29(1): 67-78.

Braga, M. S. C., Salles, R. & Fonteles-Filho, A. A. 2001. Ictiofauna acompanhante da pesca de camarões com rede-de-arrasto na zona costeira do município de Fortaleza, estado do Ceará, Brasil. **Arquivos de Ciências do Mar**, 34: 49-60. https://doi.org/10.32360/acmar.v34i1-2.11652

Branco, J. O. & Verani, J. R. 2006. Pesca do camarão sete-barbas e sua fauna acompanhante, na Armação do Itapocoroy, Penha, SC. Pp. 153-170. *In*: Branco, J. O. & Marenzi, A. W. C. (Eds.). **Bases ecológicas para um desenvolvimento sustentável: estudos de caso em Penha, SC**. Editora da Univali, Itajaí, Santa Catarina.

Brito, M. F. G. & Magalhães, A. L. B. 2017. Brazil's development turns river into sea. **Science**, 358(6360): 179. https://doi.org/10.1126/science.aap9525

Carneiro, M. E. R. & Arguelho, M. L. P. M. 2018. **Plataforma continental de Alagoas e Sergipe: geoquímica sedimentar e comunidade bêntica.** Editora UFS, São Cristóvão, Sergipe, Brasil, 445 p.

Carpenter, K. E. 2002a. **The living marine resources of the Western Central Atlantic. Volume 2: Bony fishes. Part 1**

**(Acipenseridae to Grammatidae).** Food and Agriculture Organization of the United Nations, Rome, 784 p. http://www.fao.org/3/y4162e/y4162e.pdf

Carpenter, K. E. 2002b. **The living marine resources of theWestern Central Atlantic. Volume 3: Bony fishes. Part 2 (Opistognathidae to Molidae), sea turtles and marine mammals.** Food and Agriculture Organization of the United Nations, Rome, 753 p. http://www.fao.org/3/y4162e/y4162e.pdf

Clauzet, M. 2009. **Etnoictiologia e uso de recursos naturais por pescadores artesanais costeiros no Brasil**. Universidade Estadual de Campinas. São Paulo, Brasil, 157 p.

Clucas, I. 1997. **A study of the options for utilization of bycatch and discards from marine capture fisheries.** FAO Fisheries Circular. N. 928.

Coelho, J. A. P., Puzzi, A., Graça-Lopes, R. d., Rodrigues, E. S. & Preto Jr, O. 1986. Análise da rejeição de peixes na pesca artesanal dirigida ao camarão sete-barbas (*Xiphopenaeus kroyeri*) no litoral do Estado de São Paulo. **Boletim do Instituto de Pesca**, 13(2): 51-61.

Decken, K. v. d. 1986. **O setor pesqueiro na economia do estado de Sergipe**.

Figueiredo, J. L. & Menezes, N. A. 1978. **Manual de peixes marinhos do sudeste do Brasil. II. Teleostei (1).** Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil, 110 p.

Figueiredo, J. L. & Menezes, N. A. 1980. **Manual de peixes marinhos do sudeste do Brasil. III. Teleostei (2).** Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil, 90 p.

Figueiredo, J. L. & Menezes, N. A. 2000. **Manual de peixes marinhos do sudeste do Brasil. VI. Teleostei (5).** Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil, 116 p.

Fonseca, P., Campos, A., Larsen, R. B., Borges, T. C. & Erzini, K. 2005. Using a modified nordmøre grid for bycatch reduction in the Portuguese crustacean-trawl fishery. **Fisheries Research**, 71: 223 - 239. https://doi.org/0.1016/j.fishres.2004.08.018

Fonseca, V., Vilar, J. W. C. & Santos, M. A. N. 2010. Reestruturação territorial do litoral de Sergipe. Pp. 40-61. *In*: Vilar, J. W. C. & Araújo, H. M. (Eds.). **Território, meio ambiente e turismo no litoral sergipano**. Editora UFS, São Cristóvão, Sergipe, Brasil.

Freire, K. M. F., Almeida, Z. S., Amador, J. R. E. T., Aragão, J. A., Araújo, A. R. R., Ávila-da-Silva, A. O., Bentes, B., Carneiro, M. H., Chiquieri, J., Fernandes, C. A. F., Figueiredo, M. B., Hostim-Silva, M., Jimenez, É. A., Keunecke, K. A., Lopes, P. F. M., Mendonça, J. T., Musiello-Fernandes, J., Olavo, G., Primitivo, C., Rotundo, M. M., Santana, R. F., Sant'Ana, R., Scheidt, G., Silva, L. M. A., Trindade-Santos, I., Velasco, G. & Vianna, M. 2021. Reconstruction of marine commercial landings for the Brazilian industrial and artisanal fisheries from 1950 to 2015. **Frontiers in Marine Science**, 8: 659110. https://doi.org/10.3389/fmars.2021.659110

Freire, K. M. F., Aragão, J. A. N., Araújo, A. R. R., Ávila-da-Silva, A. O., Bispo, M. C. S., Velasco, G., Carneiro, M. H., Gonçalves, F. D. S., Keunecke, K. A., Mendonça, J. T., Moro, P. S., Motta, F. S., Olavo, G., Pezzuto, P. R., Santana, R. F., Santos, R. A., Trindade-Santos, I., Vasconcelos, J. A., Vianna, M. & Divovich, E. 2015. Reconstruction of catch statistics for Brazilian marine waters (1950-2010). **Fisheries Centre Research Reports**, 23(4): 3-30.

Freire, K. M. F. & Araújo, A. R. R. 2016. Analysis of marine catches off the state of Sergipe (1950-2010). **Arquivos de Ciências do Mar**, 49(1): 13-29.

Freire, K. M. F. & Carvalho Filho, A. 2009. Richness of common names of Brazilian reef fishes. **Pan-American Journal of Aquatic Sciences**, 4(2): 96-145.

Freire, K. M. F., Diniz, J. V., Barreto, T. M. R. R., Brito, M. F. G., Canuto, I. F. L. & Silva, T. M. 2020b. Population structure of *Paralonchurus brasiliensis* (Steindachner, 1875) (Perciformes: Sciaenidae) in the coast of Sergipe, northeastern Brazil. **Scientia Plena**, 16(11): 117401. https://doi.org/10.14808/sci.plena.2020.117401.

Freire, K. M. F., Nascimento, F. P. & Rocha, G. R. A. 2020c. Shore-based competitive recreational fisheries in southern Bahia, Brazil: a baseline study. **Marine and Fishery Sciences**, 33(2): 1-21. https://doi.org/10.47193/mafis.3322020301103.

Freire, K. M. F. & Pauly, D. 2005. Richness of common names of Brazilian marine fishes and its effect on catch statistics. **Journal of Ethnobiology**, 25(2): 279-296. https://doi.org/10.2993/0278-0771(2005)25[279:ROCNOB]2.0.CO;2

Freire, K. M. F., Rosa, L. C., Reis-Júnior, J. & Barreto, T. M. R. R. 2020a. Understanding what is what in marine shrimp fisheries. **Ocean and Coastal Research**, 68: e20322. https://doi.org/10.1590/S2675-28242020068322

Freire, K. M. F., Tubino, R. A., Monteiro-Neto, C., Andrade-Tubino, M. F., Belruss, C. G., Tomás, A. R. G., Tutui, S. L. S., Castro, P. M. G., Maruyama, L. S., Catella, A. C., Crepaldi, D. V., Daniel, C. R. A., Machado, M. L., Mendonça, J. T., Moro, P. S., Motta, F. S., Ramires, M., Silva, M. H. C. & Vieira, J. P. 2016. Brazilian recreational fisheries: current status, challenges and future direction. **Fisheries Management and Ecology**, 23: 276–290. https://doi.org/http://10.1111/fme.12171

Freitas, M. O., Spach, H. L. & Hostim-Silva, M. 2011. Variação espaço-temporal da assembleia de peixes demersais em uma área de pesca do camarão sete-barbas no sul do Brasil. **Neotropical Biology and Conservation**, 6(1): 44-54. https://doi.org/10.4013/nbc.2011.61.0

Froese, R. & Pauly, D. 2022 (Eds.). **FishBase** - World Wide Web electronic publication, accessible at https://fishbase.net.br/search.php (Accessed 17/06/2022).

Godefroid, R. S., Spach, H. L., Santos, C., MacLaren, G. & Schwarz-Junior, R. 2004. Mudanças temporais na abundância e diversidade da fauna de peixes do infralitoral raso de uma praia, sul do Brasil. **Iheringia, Série Zoologia**, 94(1): 95-104.

IBAMA. 2007. **Estatística da Pesca. 2007. Grandes regiões e unidades da federação**. Brasília: Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, Brasília, 113 p.

Keledjian, A., Brogan, G., Lowell, B., Warrenchuk, J., Enticknap, B., Shester, G., Hirshfield, M. & Cano-Stocco, D. 2014. **Wasted catch: unsolved problems in U.S. fisheries**. Oceana.

Kelleher, K. 2005. Discards in the world's marine fisheries: an update. **FAO Fisheries Technical Paper**, 470: 1-134.

Legendre, P. & Legendre, L. 1998. **Numerical ecology.** Elsevier, Amsterdan, 853 p.

Lima, R. R. S. S. 2018. Catálogo de peixes costeiros de Pernambuco, Nordeste do Brasil. **Master thesis**. Universidade Federal Rural de Pernambuco. Recife, 238 p.

Lira, A. S., Viana, A. P., Eduardo, L. N., Lucena-Fredóu, F. & Frédou, T. 2019. Population structure, size at first sexual maturity, and feeding ecology of *Conodon nobilis* (Actinopterygii: Perciformes: Haemulidae) from the coasts of Pernambuco, north-eastern do Brazil. **Acta Ichthyologica et Piscatoria**, 49(4): 389-398. https://doi.org/10.3750/AIEP/02578

Magris, R. A. & Giarrizzo, T. (2020). Mysterious oil spill in the Atlantic Ocean threatens marine biodiversity and local people in Brazil. **Marine Pollution Bulletin**, 153, 110961.

Maia, B. P., Nunes, Z. M. P., Holanda, F. C. A. F., Silva, V. H. S. & Silva, B. B. 2016. Gradiente latitudinal da beta diversidade da fauna acompanhante das pescarias industriais de camarões marinhos da costa Norte do Brasil. **Biota Amazônia**, 6(1): 31-39. http://dx.doi.org/10.18561/2179-5746/biotaamazonia.v6n1p31-39

Mair, P. & Wilcox, R. 2020. Robust statistical methods in R using the WRS2 package. **Behavior Research Methods**, 52: 464–488. https://doi.org/10.3758/s13428-019-01246-w

Marceniuk, A. 2005. Chave para identificação das espécies de bagres marinhos (Siluriformes, Ariidae) da costa brasileira. **Boletim do Instituto de Pesca**, 31(2): 89-101.

Marceniuk, A. P., Caires, R. A., Rotundo, M. M., Cerqueira, N. N. C. D., Siccha-Ramirez, R., Wosiacki, W. B. & Oliveira, C. 2020. Taxonomic revision of the *Menticirrhus americanus* (Linnaeus, 1758) and *M. littoralis* (Holbrook, 1847) (Percomorphacea: Sciaenidae) species complexes from the Western Atlantic. **Zootaxa**, 4822(3): 301-333. https://doi.org/10.11646/zootaxa.4822.3.1

Medeiros e Silva, A., Oliveira, M. R. & Chellappa, S. 2012. Biologia reprodutiva do coró, *Pomadasys corvinaeformis* Steindachner (Osteichthyes: Haemulidae) das águas costeiras do Rio Grande do Norte, Brasil. **Biota Amazônica**, 2(2): 15-24. http://dx.doi.org/10.18561/2179-5746/biotaamazonia.v2n2p15-24

Mendonça, F. & Danni-Oliveira, I. M. 2007. **Climatologia: noções básicas e climas do Brasil.** Oficina de Textos, São Paulo, 208 p.

Menezes, N. A. & Figueiredo, J. L. 1980. **Manual de peixes marinhos do sudeste do Brasil. IV-Teleostei (3).** Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil, 96 p.

Menezes, N. A. & Figueiredo, J. L. 1985. **Manual de peixes marinhos do sudeste do Brasil. V-Teleostei (4).** Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil, 105 p.

Meurer, B. C. & Andreata, J. V. 2002. Aspectos reprodutivos de *Diplectrum radiale* (Quoy & Gaimard, 1824), na Baía da Ribeira, Angra dos Reis, Rio de Janeiro, Brasil. **Bioikos**, 16(1-2): 53-59.

MMA. 2004. **Instrução Normativa N. 14, 14 de outubro de 2004**, acessible at https://www.gov.br/agricultura/pt-br/assuntos/aquicultura-e-pesca/legislacao/arrasto/instrucao-normativa-mma-no-14-de-14-10-2004.pdf/@@download/file/instrucao-normativa-mma-no-14-de-14-10-2004.pdf. (Accessed 09/07/2022).

Monteiro, H. S. 2014. Análise quali-quantitativa dos Sciaenidae na pesca do camarão sete-barbas (*Xiphopenaeus kroyeri*), litoral de Santa Catarina, Brasil. Universidade Federal de São Carlos. São Paulo, Brasil, 95 p.

Noleto-Filho, E. M., Angelini, R., Steenbeek, J. & Carvalho, A. R. 2021. New, flexible and open-source fisheries self-reporting app: the Shiny4SelfReport. **SoftwareX**, 16: 100843. https://doi.org/10.1016/j.softx.2021.100843

Nunes, Y. B. S., Aranha, M. B., Freitas, J., Fernandes, J. F. F., Silva, L. R. & Figueiredo, M. B. 2020. Length at first sexual maturity of economically important fishes in the Brazilian northeast coast. **Ocean and Coastal Research**, 68: e20311. http://dx.doi.org/10.1590/S2675-28242020068311

Oliveira, R. A. 2012. Aspectos reprodutivos dos peixes Sciaenidae, entre as isóbatas de 10 a 30 metros, na armação de Itapocoroy Penha, Santa Catarina. **Undergraduate thesis**. Universidade do Vale do Itajaí. 69 p.

Pauly, D. 2019. **Métodos para avaliação dos recursos pesqueiros.** Tradução de Freire, K. M. F.; Teles e Almeida, A. J.; Marques, A.; Ré, P**.** Edusp, São Paulo, 256 p.

R Core Team. (2021). *R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria*. Retrieved May 2020 from http://www.R-project.org/

Reis Jr., J. J. C., Freire, K. M. F., Rosa, L. C., Barreto, T. M. R. R. & Pauly, D. 2019. Population dynamics of Atlantic seabob *Xiphopenaeus kroyeri* (Decapoda: Penaeidae) off the state of Sergipe, Northeastern Brazil. **Journal of the Marine Biological Association of the United Kingdom**, 99(1): 143-153. https://doi.org/10.1017/S0025315417001916

Rodrigues, E. S., Graça-Lopes, R., Pita, J. B. & Coelho, J. A. P. 1985. Levantamento das espécies de camarão presentes no produto da pesca dirigida ao camarão sete-barbas (*Xiphopenaeus kroyeri* Heller, 1862) no estado de São Paulo, Brasil. **Boletim do Instituto de Pesca**, 12(4): 77-85.

Ruffino, M. L. & Castello, J. P. 1992. Alterações na ictiofauna acompanhante da pesca do camarão-barba-ruça (*Artemesia longinaris*) nas imediações da Barra de Rio Grande, Rio Grande do Sul - Brasil. **Nerítica**, 7(1-2): 43-55.

Santos, M. C. F. 2010. Ordenamento da pesca de camarões no nordeste do Brasil. **Boletim Técnico Científico do CEPENE**, 18(1): 91-98.

Santos, M. C. F., Almeida, L. & Silva, C. G. M. 2008. Avaliação quali-quantitativa da ictiofauna acompanhante na pesca do camarão sete-barbas, *Xiphopenaeus kroyeri* (Heller, 1862) no município de Caravelas (Bahia – Brasil). **Boletim Técnico Científico do CEPENE**, 16(1): 99-107.

Santos, M. C. F., Dias, A. C. C., Freitas, A. E. T. S. & Santana, G. 2007. Prospecção de camarões marinhos (Crustacea: Decapoda: Penaeidae) na plataforma continental do estado de Sergipe-Brasil. **Boletim Técnico Científico do CEPENE**, 15: 47-56.

Santos, S. R. & Vianna, M. 2017. Scientometric analysis of the fisheries science for the species of *Cynoscion* (Sciaenidae: Perciformes) from the Western Atlantic, with emphasis in the comparison of the North American and Brazilian fisheries catch data. **Reviews in Fisheries Science & Aquaculture**, 26(1): 55-69.

https://doi.org/10.1080/23308249.2017.1337078

Schwarz Jr, R., Franco, A. C. N. P., Spach, H. L., Sarpedonti, V., Pichler, H. A. & Nogueira Queiroz, G. M. L. 2006. Composição e estrutura da ictiofauna demersal na Baía dos Pinheiros, Paraná. **Brazilian Journal of Aquatic Science and Technology**, 10(1): 27-39.

Sedrez, M. C., Branco, J. O., Freitas Júnior, F., Monteiro, H. S. & Barbieri, E. 2013. Ictiofauna acompanhante na pesca artesanal do camarão sete-barbas (*Xiphopenaeus kroyeri*) no litoral sul do Brasil. **Biota Neotropica**, 13(1): 165-175. https://doi.org/10.1590/S1676-06032013000100019

Silva, J. P. C. 2015. Biologia reprodutiva, idade e crescimento da pescada branca *Cynoscion leiarchus* (Actinopterygii, Sciaenidae) na Baía de Sepetiba, RJ. **Master thesis**. Universidade Federal Rural do Rio de Janeiro. Rio de Janeiro, 89 p.

Silva Jr., C. A. B., Viana, A. P., Frédou, F. L. & Frédou, T. 2015. Aspects of the reproductive biology and characterization of Sciaenidae captured as bycatch in the prawn trawling in the northeastern Brazil. **Acta Scientiarum. Biological Science**, 37(1): 1-8. https://doi.org/10.4025/actascibiolsci.v37i1.24962

Silva Júnior, C. A. B., Lira, A. S., Eduardo, L. N., Viana, A. P., Lucena-Frédou, F. & Frédou, T. 2019. Ichthyofauna bycatch of the artisanal fishery of penaeid shrimps in Pernambuco, northeastern Brazil. **Boletim do Instituto de Pesca**, 45(1): e435. https://doi.org/10.20950/1678-2305.2019.45.1.435

Souza, M. R., Carneiro, M. H., Quirino-Duarte, G. & Servo, G. J. M. 2007. Caracterização da “mistura” na pesca de arrasto-de-parelha desembarcada em Santos e Guarujá, São Paulo, Brasil. **Boletim do Instituto de Pesca**, 33(1): 43-51.

Thomé-Souza, M. J. F., Carvalho, B. L. F., Garciov Filho, E. B., Silva, C. O., Deda, M. S., Félix, D. C. F. & Santos, J. C. 2014a. **Estatística pesqueira da costa do estado de Sergipe e extremo norte da Bahia 2013.** Editora UFS, São Cristóvão, 108 p.

Thomé-Souza, M. J. F., Carvalho, B. L. F., Silva, C. O., Deda, M. S., Filho, E. B. G., Félix, D. C. F. & Santos, J. C. 2014b. **Estatística pesqueira da costa do estado de Sergipe e extremo norte da Bahia 2012.** Editora UFS, São Cristóvão, 102 p.

Thomé-Souza, M. J. F., Dantas Júnior, J. F., Silva, F. C. B., Félix, D. C. F. & Santos, J. C. 2012. **Estatística pesqueira da costa do Estado de Sergipe e Extremo norte da Bahia 2010.** Editora UFS, São Cristóvão, 88 p.

Thomé-Souza, M. J. F., Deda, M. S., Santos, J. P., Carvalho, B. L. F., Araújo, M. L. G., Filho, E. B. G., Félix, D. C. F. & Santos, J. C. 2013. **Estatística pesqueira da costa do estado de Sergipe e extremo norte da Bahia 2011.** Editora UFS, São Cristóvão, 92 p.

Zar, J. H. 2010. **Biostatistical analysis.** Pearson Prentice Hall, New Jersey, 5th Edition, 960 p.

Received: January 2022
Accepted: August 2022
Published: December 2022