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Fishery Aspects and Social-Economic Profile of the Artisanal Fishermen in the City of Pinheiro, Maranhão, Brazil

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Abstract: The city of Pinheiro is located in the Baixada Maranhense microregion, north of the state of Maranhão, Brazil, and forty-eight kilometers from the coast. This region is in the western limits of the legal Amazonian region. The city of Pinheiro is at the left margin of the Pericumã river. Thus, it was developed a descriptive study of the artisanal fishery activities of the continental fishermen of Pinheiro by means of a structured questionnaire. Fifty-nine fishermen were interviewed from this universe, sixteen women (27.1%) and forty-three men (72.9%). This fishery is characterized by the use of unmotorized canoes with one or two fishermen, with eight hours of fishing activity by day and variation of three to twenty-four hours fishing activity. The fishing gears are gillnets (monofilament with 3 cm between opposite knots), casting net, socó and hand line, in that order of importance. The main captured species are: traíra (Hoplias malabaricus) and capadinho (Trachelyopterus galeatus). The level of education presented indicates predominance of incomplete elementary school (33.9%), followed by incomplete elementary school (23.7%), while complete or incomplete high school was registered in about 15.3% of fishermen. Fishermen's age ranges from 25 to 69 years (mean = 48.7 years and standard deviation = 8.3 years) and their fishing time ranges from 6 to 60 years. The declared monthly income was below the minimum wage (R$ 954.00 or US$ 289.78) and the number of family dependents averaged 3.46 people, ranging from 1 to 8 people. Most fishermen claimed to depend on fishing as their main source of income and 45.8% reported fishing as their only source of income. Preliminary results suggest a heavy reliance on fishing activity and a low general education of fishermen, making it impossible to search for income alternatives that do not depend on unprocessed natural resources. Thus, it is necessary to develop public policies for the training of fishermen and break this pernicious cycle.

Key words: small-scale fishery, Pericumã river

1. Introduction

The extension of the Amazon Rainforest biome in the State of Maranhão covers the hydrographic basins of the rivers Tocantins, Gurupi, Pindaré, Turiaçú, Maracacumé and Pericumã, the former three intrinsic from Maranhão. The regional ichthyofauna is represented by 109 species distributed in 33 families, while in the Pericumã river 26 species in 15 families are reported [1].

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The microregion of Baixada Maranhense is composed of the city of Pinheiro (2°30'-2°45'S; 45°00'-45°15'W) and twenty other cities, considered by fish traders as one of the most important regional fish markets. Regionally known by its sazonal floodplain which extends over the grasslands along the rainy season (January to June) and retracts along the dry season (July to December). The impressive number and extension of these rivers also determined the foundation and growth of most of these cities. The city of Pinheiro is located on the Pericumã river basin, which springs in the city of Pedro do Rosário, extends for 115 km and flows out in the Cumã bay, between the cities of Guimarães and Alcântara. The total basin area

is of 3.856,50 km², crossing 14 cities and an estimated population of 374.477 citizens - Codevasf/IBGE 2018. The river is also considered an important protein supply for the mainly poor local population, and for a better flow and level control it was built in 1981 a small floodgate by the Brazilian Departamento Nacional de Obras Contra a Seca – DNOCS.

Artisanal fisheries provide food and job for a variety of river communities, specially in tropical and/or developing countries [3]. According to the Brazilian Environmental Agency (IBAMA), the state of Maranhão has recorded a total catch of continental species of 21.000 tons in 2007.

Here is presented a descriptive study of the continental artisanal fishery in the city of Pinheiro based mainly on social and economic aspects in order to provide support for an environmentally sustainable growth and fisheries ordination.

2. Material and Methods

2.1 Study Area

Pinheiro is a city of the state of Maranhão located at the Baixada Maranhense microregion, a RAMSAR area along the Amazonian coastal region in the north of Maranhão [4]. The population was estimated as 81.924 citizens (Brazilian Institute of Biogeographic and Statistics - IBGE, 2016) in an area of 1.559 km^2 by the right margin of the Pericumã river. The fishermen colony reports 600 active members, while the Ministry of Transparency and the Comptroller General of the Union report 588 members requesting the Closed-Season Insurance.

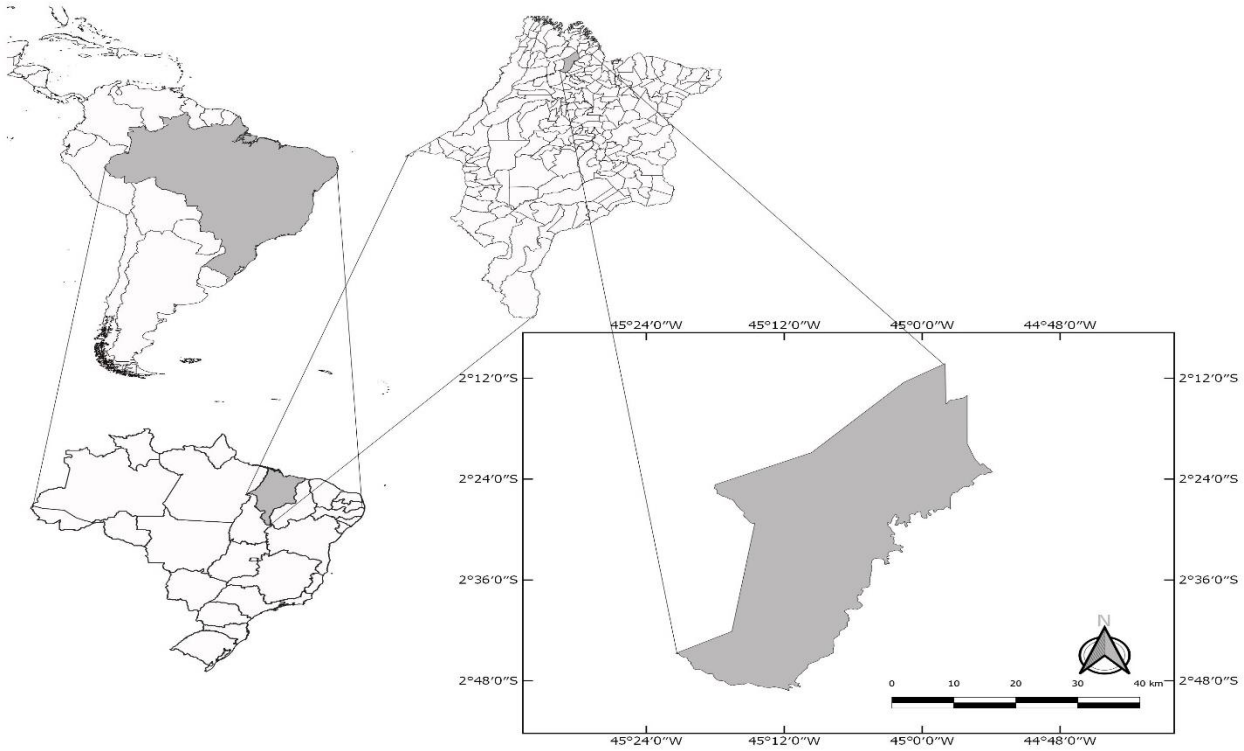

Fig. 1 Position of the city of Pinheiro in the state of Maranhão-MA.

2.2 Methodology

Fifty-nine fishermen were interviewed from December of 2017 to March of 2018. All information was collected by a structured interview and individually performed. Aspects of social-economics, fisheries technology and environmental perception were included in the interview. All interviews were randomly performed directly to the fishermen in their landing sites along the river or in the fishermen colony.

Fishermen answers were categorized in two perceptions: 1) when fishermen notice fish species disappearance due to the fishery, and 2) when fishermen noticed fish size reduction due to the fishery. For practical purposes, predatory fishery was considered all fishing activities realized out of the permitted period according to the Brazilian Environmental Agency-IBAMA, or by illegal gear (Figueira, 2000). All data was prepared and analyzed in Microsoft® Excel 2016 worksheets.

3. Results and Discussion

3.1 Socioeconomic Aspects of the Artisanal Fishermen

From the sample of fifty-nine interviewed fishermen, forty-three were men (72.9%) and sixteen were women (27.1%), a very similar scenario reported by Carli et al. (2016) [5] in which 76% were men. However, Costa et al. (2015) [6] observed in São Bento - MA, distant from Pinheiro by 38.4 km [7], a higher disproportion where 91% were men and 9% were women. The General Registry of the Fishery Activity (RGP) reports a substantial presence of women in fisheries activities in Brazil, specially in the North and Northeast regions [8], where the diversified fauna provides a large number of resources that women and children explore with cheaper or handmade fishing gears. Though, based on the actual results and published values it seems that these proportions may vary substantially due to regional particularities.

All interviewed fishermen ranged in age from 25 to 69 years ($\bar{x}$ = 48,7 years and s = 8.3 years), with a larger frequency in the 43-51 years age-class, while time of experience in fishery ranged from 5 to 60 years, suggesting that the activity seems to be proportionally less attractive to younger ages.

The level of education was mainly low with the majority having only the incomplete Fundamental Level (1o to 5o grades) (33.9%), followed by incomplete Fundamental II (6 to 9 grades) (23.7%) and complete or incomplete High School level by 15.3%. The low fishermen's level of education probably increases their dependence on the fishery activity [9], explaining the observed long professional experience. One possible second assumption is that the ageing of the fishermen's workforce reflects the lack of interest from young, which would search for other employment opportunities/continuity of studies, reducing the fishermen's force renewal.

As observed by Carli et al. (2016) [5], monthly-informed incomes (Fig. 2) were inferior to a

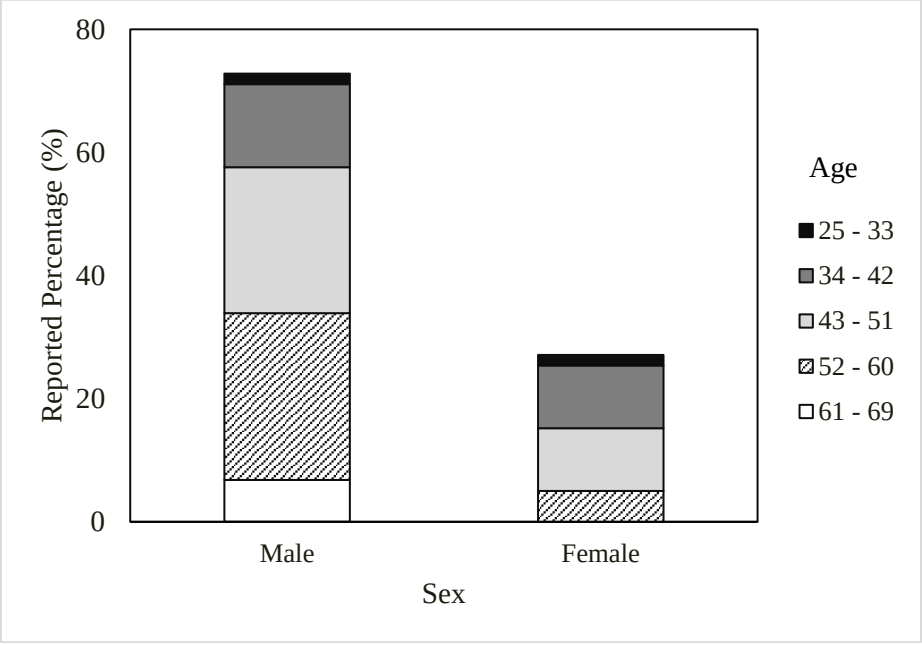

Fig. 2 Histogram of age distribution by sex in the fishery activity.

minimum wage (determined by Brazilian law and currently R$954,00 or US$289,78), and similarly to Assunção et al. (2016) [10]. The majority of the fishermen depend on the fishery activities as their main income 54.23%, while 45.8% declared that fishery was their only income. However, this level of dependency may shift from community to community [9].

The inconstant volume and frequency pattern of the main captured species forces the fishermen to search for temporary and marginalized jobs (agriculture, commerce and construction) in order to survive in subsistence level along part of the year. This irregular fishery income may also be responsible for the high proportion of closed-season insurance requests allied to a lack of government control on these insurance concessions.

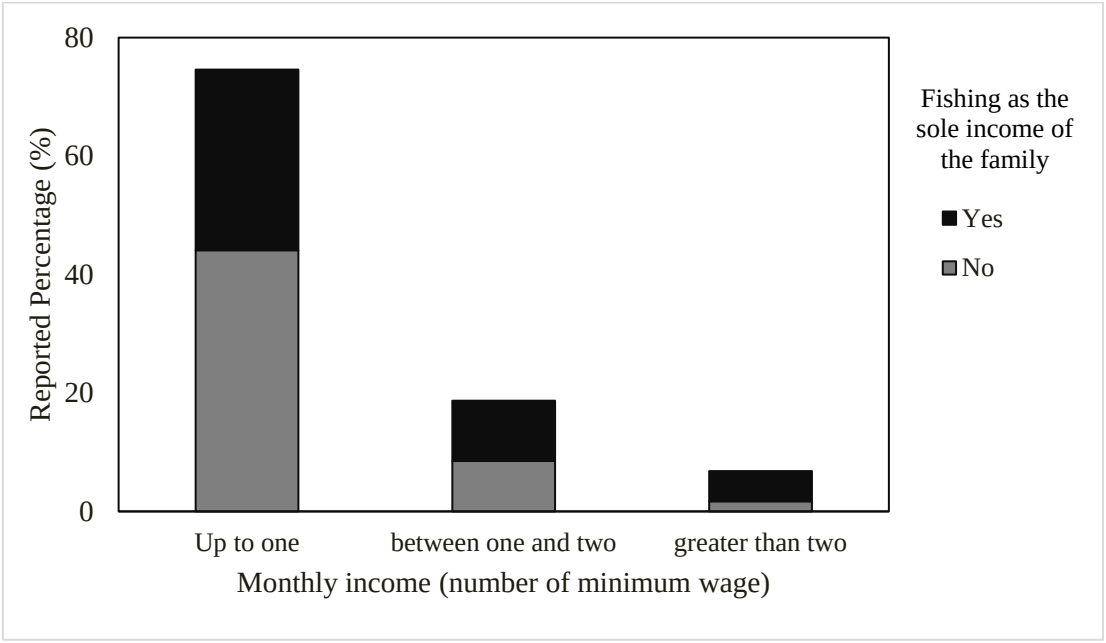

Fig. 3 Fishermen income in numbers of minimum wage.

3.2 Fishing Boats Characteristics and Fisheries Technics

The regional artisanal fleet is characterized by the predominance of unmotorized large canoes manned by one or two people. The use of canoes was also observed in the river Tracajuba in the state of Amapá, however, in this river they were motorized [11]. The use of canoes is related to the size and flux of the mainstream, access to the margin and type of used fishing gear. The need of a motor is mostly related to the travelled distance from the port to the fishing ground and the area covered to realize the capture. The use of ice extends the time of fishing activity, but the fishermen in Pinheiro hardly make use of ice, only 47.5% of fishermen reported the use of ice, and many fishermen prefer to bring the capture still alive, agonizing or recently dead, what is a strong evidence that the fleet does not move far away from the port and that motorized canoes are not an impeditive necessity.

The fishing gears are the gill nets, casting nets, socó (an artisanal kind of fishing trap), and hand line, in this order of importance. As in Costa; Santana; Teixeira (2015) [6] the fishing gears identified in this study, even though targeting mainly on a single species, they are not selective and often catch more than one species.

Gill nets and casting nets are mostly used fishing gears. While gill nets are fixed and passive fishing gears, casting nets are active with a limited fishing time after they were casted; both are artisanally handmade by the fishermen. Gill nets are prepared using nylon lines of different sizes and meshes with weights on the

bottom line and floats on the upper line. The socó is a regional fishing gear consisted of a conical basket made with the fiber of Marajá (Bactris brongniarti) and opened at both ends, one end twice the size of the other [12].

The average capture was 9.9 kg/fishermen/day (Fig. 4) with amplitude of 2-50 kg. Thirty-two fishermen reported they fish every weekday, mainly along the morning period (78%) and the months of June and September were reported as the most profitable, along the dry season, when the river level decreases and reaching the lowest level in December. The fishery activity extends, in average for 8 hours a day, but may vary from 3-24 hours depending on the targeted species and fishing gear, which also varies along the year according to the river level, flow and water transparency.

The analysis of the average yield (kg) by fishing effort (hours) (Fig. 4) indicate that 90% of the fishermen fish for a period inferior to 15 hours and 70% for a period inferior to 10 hours, yielding respectively 378 kg and 259 kg or 69 and 47.5 percent of the total catch reported.

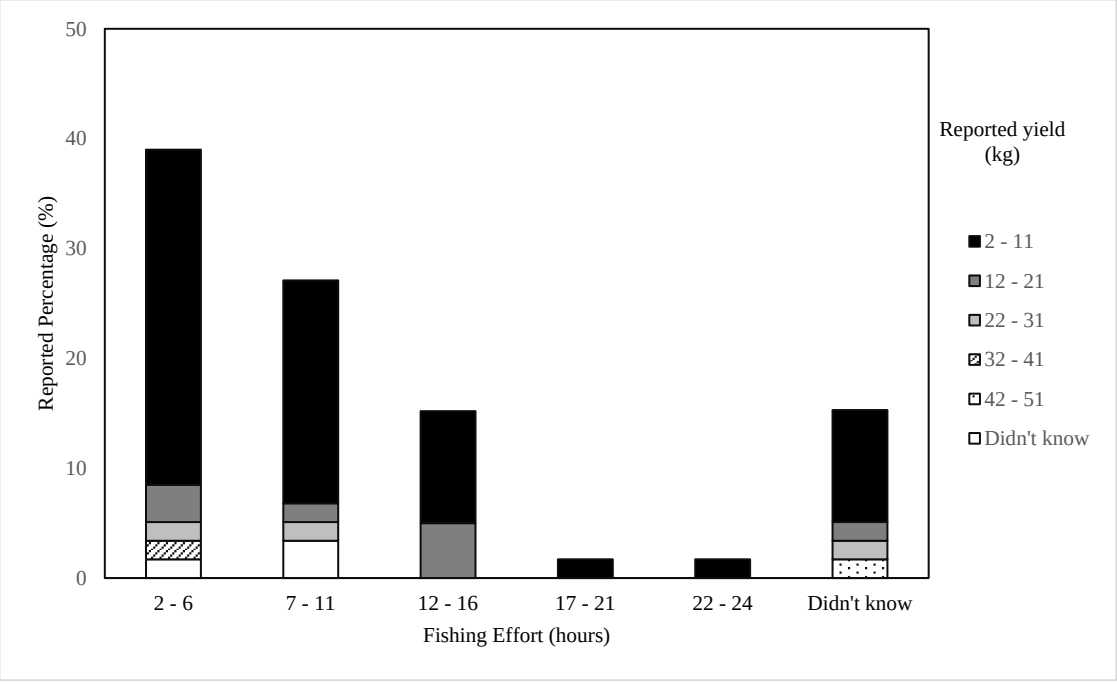

Fig. 4 Percentage of reported average yield (kg) *per* fishing effort (hours).

3.3 Captured Species

Fourteen species are commercially captured by the artisanal fleet of Pinheiro, in order of importance: traíra (Hoplias malabaricus), bagrinho (Trachelyopterus galeatus), cabeça-gorda (Leporinus frederici), camurim (Centropomus spp.) e acará (Cichlasoma orientale).

The fishermen were questioned about the species they have noticed the highest decline in frequency of capture (even tending to the disappearance), and bagrinho (Trachelyopterus galeatus) and traíra (Hoplias malabaricus) were the most simultaneously remembered (44.1%), being the former also related to a noticeable size decrease along the past years. Traíra frequency of occurrence reduction and size of capture was reported by 25% and 41% of the fishermen, respectively. The traíra highest reproductive activity in the area (Lago do Coqueiro-Baixada Maranhense) was in the rainy season, especially in January [14]. Fishermen (30%) also identified the rainy season with the highest yields (December-May), but 31.4% stated not respect the legislation (Portaria nº 85/2003 IBAMA) and continuing fishing along the season. Subsistence

fishery is allowed along the morning period, but almost all fishermen exceed this subsistence level and capture for trade and commerce.

The causes for the fish population declines and species specific catches in the Baixada Maranhense area are all predatory fishery related to the fishermen and their communities: commercial fisheries through the closed-season for most of the captured species (subsistence capture is allowed by law); use of forbidden fishing gears, mainly with net meshes of smaller sizes than those allowed; marginal deforestation and construction of draining channels and sluices that change the rhythm of the flood during the rainy season as well as the excessive exposure of the floodplain in the dry season.

Table 1 Most relevant captured fish species.

	Espécie/nome comum	%
Família Acestrorhynchidae	*Leporinus friderici* (Bloch, 1794)/ Cabeça-gorda	
	Schizodon vittatus (Valenciennes, 1850)/ Piau	
Família Characidae	Astyanax bimaculatus (Linnaeus, 1758)/Piaba	
	Metynnis maculatus (Linnaeus, 1758)/ Pampa	
Família Serrasalmidae	*Serrasalmus brandtii* Reinhardt, 1874 / Piranha	
Família Prochilodontidae	*Prochilodus lacustres* Steindachner, 1907/ Curimatá	
Família Erythrinidae	*Hoplias malabaricus* (Bloch, 1794)/ Traíra	
Família Prochilodontidae	*Hoplerythrinus unitaeniatus* (Agassiz, 1829)/Jejum	
Familia Centropomidae	*Centropomus* sp/Camurim	
Família Auchenipteridae	*Trachelyopterus galeatus* (Linnaeus, 1766)/ Bagrinho	
Família Callichthyidae	*Hoplosternum littorale* (Hancock, 1828)/ Cascudo	
Família Gymnotidae	*Gymnotus carapo* Linnaeus, 1758/ Sarapó	
Família Cichlidae	*Cichlasoma orientale* Kullander, 1983/ Acará	
Família Heptapteridae	*Pimelodella cristata* (Müller & Troschel, 1848)/Jundiá	

4. Conclusions

These preliminary results are evidence of a strong dependence on the fishery activity and low level of education of the fishermen in the city of Pinheiro, what makes any effort to remove or decrease the fishery impacts an even more delicate question. In order to break this pernicious cycle, educational programs for adults should be prioritized with classes on local ecology and fisheries aspects, alternative income work, correct garbage disposal and leadership, along with an increase of the state presence with electrical energy, treated water, schools and garbage collection. All these actions together will decrease the dependency of these communities on the natural resources and will decrease the impact of their interaction.

The studied fishery is partially of subsistence, but for most of the interviewed fishermen, it is fundamental for their survival as the main income source or providing the largest portion of their income. The methods and fishing gears are mostly handmaid, traditional and even not based on industrialized materials. The fishery activity was related to the decline in frequency and size of some species and the fishermen agree with this statement, but they can't break this chain of actions since they directly depend on the fishery for their survival, what bring concern to the future of the fishery activity in the region for the near future.

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