



## **DIAGNOSIS OF ARTISANAL FISHING IN THE AREA OF INFLUENCE OF PORTO DO MUCURIPE, FORTALEZA (CE): SUPPORT TO REGIONAL FISHERIES MANAGEMENT**

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### **ABSTRACT**

The area of influence of Porto do Mucuripe, Fortaleza (CE), is a site of extensive artisanal fishing activity, whose socioeconomic value demands a diagnosis in the context of regional fisheries management. In order to provide support for the social and environmental management of the port's activities, a daily diagnosis of artisanal fishing was elaborated. For this, the Rapid Participatory Diagnosis (*Diagnóstico Rápido Participativo* – DRP) methodology was used with artisanal fishermen distributed in the communities of Barra do Ceará, Goiabeiras, Arpoador, Porto da Marinha, Mucuripe, Praia Mansa, and Serviluz. The results show a great diversity of vessels, with emphasis on the pallets and rafts that are the most commonly used in artisanal fishing. The most commonly used fishing gear among artisanal fishers are line and the hook, and gillnet, distributed throughout the area where fishing is practiced. Regarding fish, it was observed that a diversity of species is caught by fishing communities, which are traded in different ways according to their market value.

**Keywords:** Artisanal Fishing; Fishing Communities; Participatory Diagnosis



## 1. INTRODUCTION

Port activities are of great importance for the development of the regions where they operate, having a large modal capacity that translates into economic growth, also considering the logistics operations related to goods and the creation of direct and indirect jobs (Garcia, 2012). In the case of Brazil, port activity stands out as the second most important sector when it comes to the transportation of goods, especially abroad (Rocha and Morato, 2009). More than 80% of Brazil's foreign trade is estimated to be through national port systems (Falcão and Correia, 2012).

On the other hand, ports occupying coastal regions usually overlap with other socioeconomic activities in these environments, causing both positive and negative impacts (Kitzman et al., 2014). In general, the port activity causes environmental and maritime space dynamics changes, causing conflicts with communities present in the area of influence of the enterprise. Specifically with artisanal fishing, the main conflicts arise from the prohibition of activity near the construction site, even the insertion of a physical barrier to the passage of fishing vessels, lack of signaling, water pollution and the scare away from fish (Castro and Almeida, 2012).

Artisanal fishing is carried out solely and exclusively by the manual work of the fisherman, including the making and repairing of fishing gear and repairs, the repair of small boats and the processing of the fishery product (Soares et al., 2018). Such activity is of great importance to coastal populations due to the high employment potential, generating income and the socioeconomic development of these populations (Ramires et al., 2012). However, artisanal fishing has been losing ground in its territory in favor of more robust development actions, such as the oil and port industry, which may be definitive or transitory, but with resources to cause disruptions in artisanal models.

According to FAO (1999), small-scale artisanal fishing is almost always of "open access" in developing countries, usually related to a household economy scheme. In the Brazilian coast, it is the predominant modality, and it is developed through several types of nets, lines and traps (Di Benedetto, 2012). The Brazilian fishing fleet has about 30 thousand vessels; nearly 90% of them are related to artisanal fishing which, according to the Institute of Applied Economic Research (*Instituto de Pesquisa Econômica Aplicada* – IPEA, 2006), generates 800 thousand direct jobs. According to a study by Vasconcellos et al. (2007), it is estimated that approximately 700,000 fishermen are involved in the activity, represented by 400 colonies distributed among 23 State Federations. In the

Northeast Region alone there are approximately 160 colonies. In this sense resides the importance of this study in the diagnosis of artisanal fishing in the area of direct influence of the Port of Mucuripe (Fortaleza - CE), as a way to support fisheries management and resolve conflicts with other regional economic activities.

## 2. LITERATURE REVISION

The impacts resulting from multiple uses of the same space have generated conflicts in terms of land use and occupation issues. Especially in coastal regions, whose socioenvironmental characteristics are extremely diverse, disputes over the same area have increased, resulting in the need to define more rational control and management protocols for conflict situations (Ribeiro and Castro, 2016). Among the main impacts resulting from port activities are reduced availability of aquatic community habitats, pollution from industrial effluents, the burial of fisheries (Carvalho-Neta et al., 2012) and others that at some point reach local fishing communities, especially artisanal (Kury et al., 2010; Souza e Oliveira, 2010).

In Ceará, one of the largest producers in northeastern Brazil, artisanal vessels constitute 78.17% of the maritime fishing fleet and account for 64.66% of all fish production landed on the Ceará coast, estimated at 15.5 thousand tons (IBAMA, 2002). The artisanal fishermen in the coast of Ceará use the most diverse types of fishing gear and techniques, especially lines and nets.

Porto do Mucuripe is located in Fortaleza, the northeastern city with the largest area of regional influence, and it is an important industrial and commercial center in Brazil (IBGE, 2017). It was designed for the mooring of ships and for the landing / embarkation of goods and passengers (Ceará Docks – *Docas do Ceará*). Its area of influence extends to the states of Piauí, Maranhão, Rio Grande do Norte, Pernambuco and Paraíba.

The fishing community in the municipality of Fortaleza is divided into seven communities (Barra do Ceará, Goiabeiras, Arpoador, Porto da Marinha, Mucuripe, Praia Mansa and Serviluz) located along its coast, whose artisanal fishermen are under the representation of Colony Z-8 (**Figure 1**). According to the data provided by the Fishing Colony, there are a total of 2,500 affiliated fishermen, of which about 10% are women mainly engaged in mangrove collection. Among male fishermen, 80% are engaged in sea fishing and the remaining 20% are engaged in inland fishing, not considered in this study. Inshore fishing occurs for a period of nine months between May and January.



The fishing communities Porto da Marinha, Arpoador and Goiabeiras are located west of Porto do Mucuri, on Pirambu beach. This beach has a landing place known as Porto da Marinha (for being located in front of the Ceará Sailing Apprentice School), and others near the communities of Arpoador and Goiabeiras, located on the outskirts of Fortaleza. In addition to these, at the west end is located the fishing community of Barra do Ceará (located at the mouth of the Ceará river).

The region of Mucuri is configured as the main fishing spot because it comprises the largest artisanal fishing fleet in Fortaleza. Praia Mansa is a community located in the Porto do Mucuri area next to the Passenger Terminal, formed from the construction of the breakwater. Nearly 85 fishermen in this community are registered and authorized by Companhia Docas to have access to Praia Mansa and to carry out fishing activity. To the east of the port is the community of Serviluz, whose fishermen practice fishing in the coastal region of Titanzinho and Serviluz beaches.

### 3. SCIENTIFIC METHODOLOGY

The field campaign for data collection to diagnose fisheries in Porto do Mucuri took place from June 13 to 20, 2018, and had as its starting point a meeting with the local leadership of Fortaleza Z-8 Fishing and Aquaculture Colony, which represents the fishermen of the city of Fortaleza. On this occasion, the data collection objectives were presented to community leaders, traditional fishermen and boat owners.

For the diagnosis, the Rapid Participatory Appraisal (*Diagnóstico Rápido Participativo* – DRP) methodology was used. This methodology presupposes the making of maps and diagrams in conjunction with the knowledge of communities with technical information (Antunes et al., 2018). Thus, DRP procedures were worked out, such as analysis of secondary sources, social cartography, semi-structured questionnaires and seasonal calendar, in order to find certain information. (**Chart 1**).

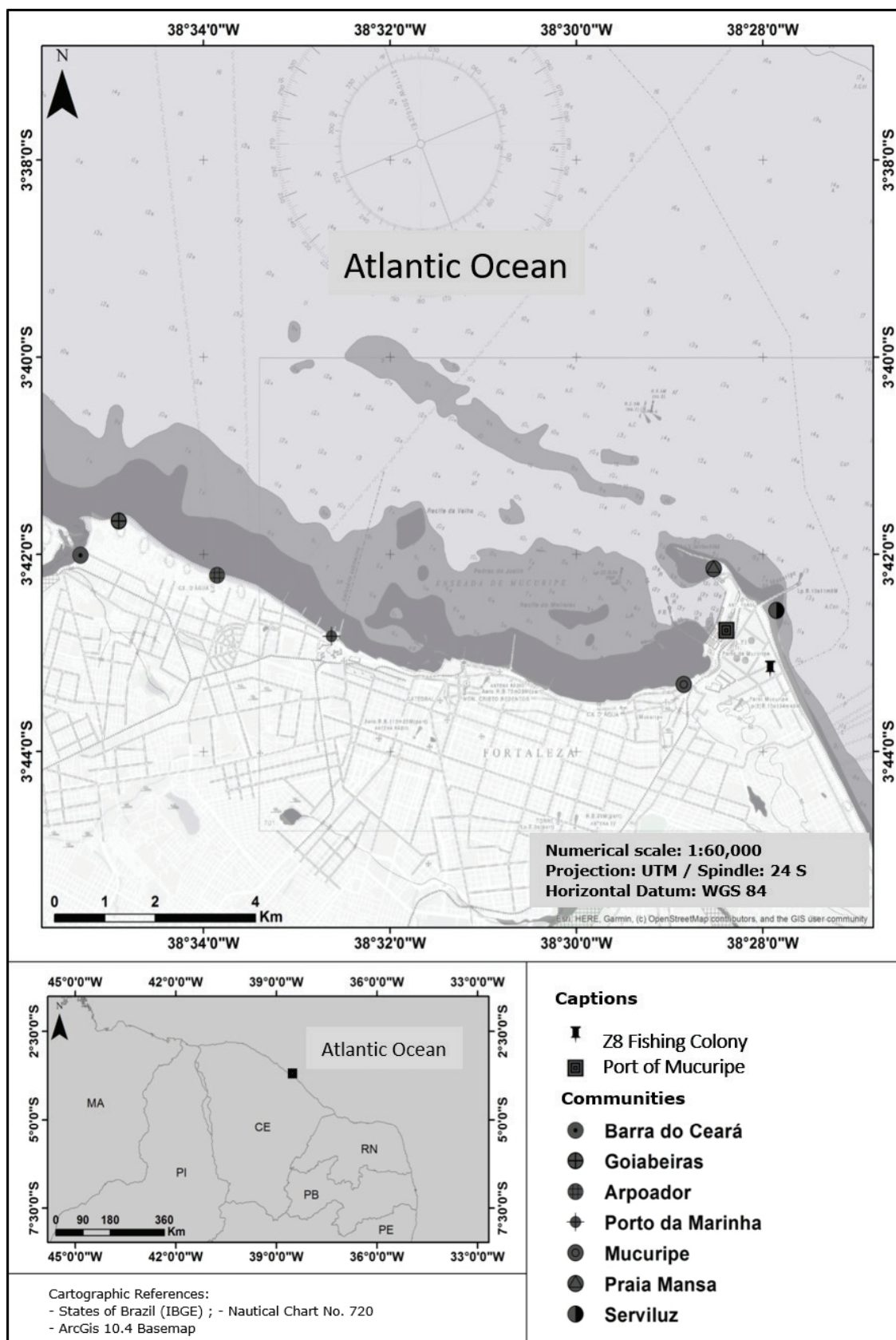
**Chart 1.** Information raised for the diagnosis of the fishing community of Fortaleza

Number of Fishermen registered and working in the assessment area
Number and type of fishing vessels
Fishing gear used
Main species caught
Traditional fishing areas
Main points of fish landing and marketing

Social cartography is seen as a process of collective construction that brings together, in the same category of importance, mapped researchers and social agents, and it is a process of joint construction (Costa et al., 2016; Santos, 2016). The graphic material used in this stage was the image of the nautical chart of Porto do Mucuri (chart 710, scale 1:50,000), where the fishing territories used by the fishermen consulted were identified. From the fishermen's indications polygons were drawn indicating the approximate fishing areas classified by the type of gear. These polygons were vectorized using Google Earth Pro to map fishing activity off the coast of Fortaleza.

The use of semi-structured questionnaires to survey the information of interest occurred through a script of questions and topics that needed to be addressed. The talks were held with fishermen from all communities in the presence of their respective local leaders. The records were made through notes, subject to the conference of the individuals. Another tool used was the seasonal calendar, which used the knowledge of artisanal fishers about the distribution of catches throughout the year and any other type of information that is linked to time (Carvalho Júnior et al., 2011).

The determination of the number of vessels dedicated to artisanal fishing in the study area was estimated through interviews and counting of vessels, since the colony Z-8 has no record of this quantity. For the characterization of local fishing vessels, it was used the nomenclature compiled in bibliography (Castro & Silva and Rocha, 1999; Freitas Netto and Di Benedetto, 2007; Chaves and Robert, 2003), in association with the description of local fishermen (**Table 1**).








**Figure 1.** Location of the fishing communities of Fortaleza, Colônia Z-8 and Porto do Mucuripe.





**Table 1.** Characterization of vessels used for fishing in Fortaleza

Type	Description	Boarded	Artes de Pesca
Rowing boat		Small (2m to 4m), without house, rowing.	1 or 2 fishermen Line and hook Gillnet
Packet-boat		Wooden vessels, filled with Styrofoam hull, between 2.5 m and 5.5 m in length. Propulsion can be by sail, outboard, sterndrive, and rowing.	2 to 4 fishermen Line and hook Gillnet Trap Beach drag Submarine hunt
Raft		Wooden vessels, ranging in length from 5 to 7.5m, and hollow hull. Sailing propulsion and tail motor.	3 to 6 fishermen Line and hook Gillnet Trap Bottom drag
Boton		Wooden boats, from 10 to 12m in length, without housework, sail and motor.	5 to 6 fishermen Line and hook Gillnet
Boat		Wooden boats, with length ranging from 10 to 12m, with house and inboard motor.	5 to 6 fishermen Line and hook Gillnet Trap Bottom drag



#### 4. ANALYSIS OF RESULTS

##### Fishing Fleet Characterization

Artisanal fisheries, both coastal and inland, represent sources of food and employment for many communities, especially in the developing and tropical countries where mostly consumed fish are caught through these fisheries (Fuzetti and Correa, 2009). Regarding the fishing activity of the area in focus, it was observed, in Fortaleza, the use of great diversity of vessels and fishing gear, which constitute the initial stage of the fishing production chain (Fonteles-Filho and Guimarães, 2000). In addition to vessels and fishing gear, other equipment, fuel, nets, ice, among others, are the factors of production and inputs necessary for the development of the activity.

As shown in Figure 2, among the vessels used for the artisanal fishing activity, the packet-boats (25%) and the rafts (24%) are more common in the coastal region of Fortaleza. The packet-boats are sail-powered vessels with a non-keel filled Styrofoam hull (Rodrigues and Maia, 2007). Regarding its displacement, Rodrigues and Maia (2007) state that it is performed through the combined use of the rudder, sail and bow (board inserted in the center of the vessel that works as a keel). In the capital of Ceará, its main propulsion is sailing; however, many packages have been adapted to outboard engines, aiming at greater autonomy and faster navigation.

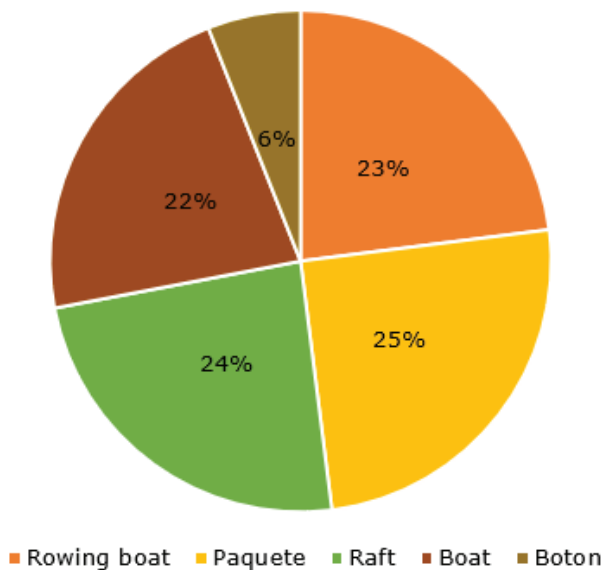


Figure 2. Vessels used in Fortaleza (CE)

Source: The Authors

The rafts, usually propelled by sail, are slightly larger than the packet-boats (between 5m and 7.5m in length). These boats are made of wood, have a keel, a deck and a small

compartment for the storage of groceries, fishing gear, and it is used sometimes as a "dormitory" for the crew (Marinho, 2005). They make longer trips than the packet-boats, and can stay up to seven days at sea, working in the fishing of several fish, including the lobster.

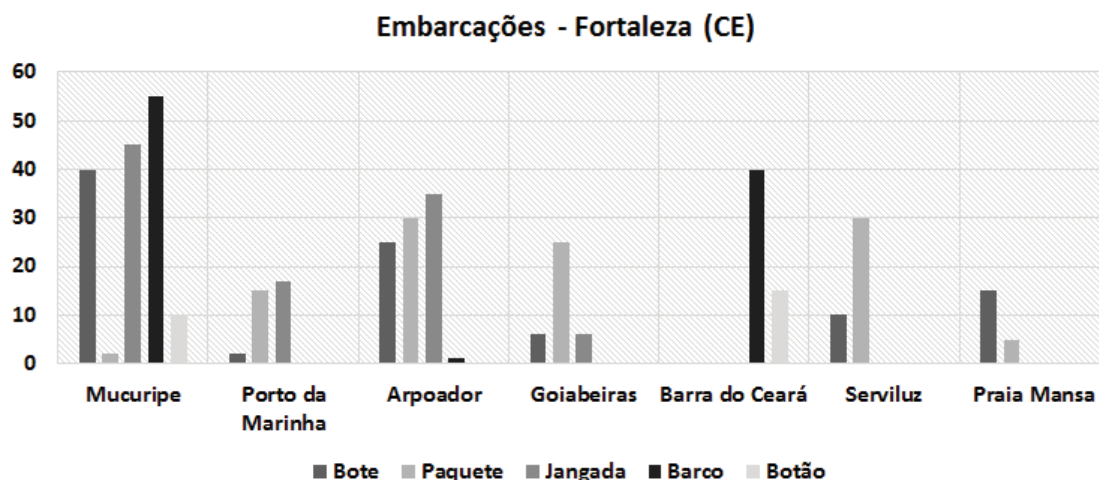
The packet-boats and rafts have similar characteristics regarding their conduction and manufacture. The movement of vessels is mainly done by the combined use of the rudder or outboard. Such vessels are made in the fishing village itself, in small yards, and their repairs and maintenance by the fishermen themselves, confirming the conditions presented by Silva (2004). Despite the similarities, the raft is currently considered more advantageous due to its greater durability (life span) and autonomy, according to the fishermen interviewed.

Rowing boats (23%), widespread among the communities visited, are the smallest vessels among those used in fishing activity. This vessel, which has a wooden hull without a keel and is lined internally with Styrofoam, varies from 2.5m to 3m in length. The crew is almost always made up of just one fisherman making "come and go" voyages within a limited range. Also known to fishermen as flatboat, the rowboat can also be used to transport people and materials from the beach to larger vessels (Castro and Silva and Rocha, 1999).

Regarding the distribution of small boats, it is observed that small boats and packet-boats appear in all communities except Barra do Ceará, which has only large vessels (Figure 3). On the beaches to the west of Porto do Mucuripe, Porto da Marinha, Arpoador and Goiabeiras, the fleet is basically made up of small and medium sized boats such as rowing boats, packet-boats and rafts, with a larger concentration of boats on Arpoador beach. Praia Mansa is mainly composed of rowboats and rafts, as well as the Serviluz community. The region of Mucuripe is configured as the main fishing spot because it comprises the largest artisanal fishing fleet in Fortaleza, consisting of larger and smaller vessels.

The boats (22%) and buttons (6%), larger vessels, have a length ranging from 10m to 12m. They have a wooden hull, hold up to six fishermen and operate in a more remote area, and can stay many days at sea. They stand out in lobster fishing, as they have space for cold boxes to store it, and the possibility of placing the manzuas on deck. This structure is composed of wooden or iron rods tied by nylon cables, characterizing the lobster vessels (Castro and Silva and Rocha, 1999).

Boats and buttons are the least common vessels in Fortaleza, being present only in the communities of Barra do Ceará and Mucuripe. This is due to the fact that these have higher operating costs, making them economically unfeasible for most fishermen in the capital of Ceará (Silva and Cavalcante, 1994). According to Castro and Silva & Rocha (1999), the



**Figure 3.** Distribution of fishing vessels in the communities of Fortaleza (CE)

(Source: The Authors)

high operating costs also contribute to the growth of the smaller fleet, also being involved in the lobster activity.

Motor boats and sail buttons can stay up to 12 days at sea and fish for over 20 km from the coast. The buttons of Barra do Ceará do not have a cabin and the propulsion is by sailing, while in Mucuripe the buttons are adapted with cabin and motor. The house and inboard motor, present in the boats and buttons of Mucuripe guarantee greater autonomy to fishermen in relation to time at sea and quantity of fish. In this locality, exceptionally, there are vessels authorized to carry out bottom trawl fishing.

### Characterization of fishing gear

The technique, usually derived from the traditional knowledge of fishing communities, applied in the use of a particular fishing gear is called by the same name, fishing gear. (Walter et al., 2012). In the survey, among the fishing gears used by the interviewed fishermen were: line and hook, gillnet, traps, trawl, spearfishing, and cast net (Table 2). Among the fishing communities of Fortaleza, it is common to use varied stocks in the same area, considering the harvests of each target species, or simply to increase the possibility of capture in the same trip.

Anglers using line and hook, gillnet, traps, bottom trawls and spearfishing remain farther from shore (**Figure 4 – A**). Other groups of fishermen using the line and hook concurrently with gillnet, netting or trawling (beach or bottom) are closer to shore. (**Figure 4 – B**).

Such distribution is also related to the type of vessel, since for smaller ones with lower potential (rowboats) it is

better to stay closer to the coast. Fishermen who use the smallest boats also tend to come and go every day of the sea, unlike those who use larger boats, who tend to spend more consecutive days at sea. In addition, it is noteworthy that fishermen with different types of gear share the same area of operation on the high seas, while near the coast, the overlap of fishing gear is not significant.

The line and hook and gillnets are the fishing gear most used by the fishermen of Fortaleza. In fishing with gillnets, the most common supplies are the *caceio* net and the *boieira* net, used by practically the whole artisanal fishing fleet of the municipality.

The trawl fishery in Fortaleza is divided into two modalities, bottom trawl and beach trawl, both using net. Bottom trawling takes place in a large area near the coast of Fortaleza, unlike the beach trawl whose area is limited to the Praia Mansa and Serviluz beaches. The cast net is also a fishing gear widespread in study area near the coast.

Spearfishing, which occurs in a very large area along the coast of Ceará, is performed in apnea using a spear gun, without the aid of a compressor or compressed air cylinders. Trap fishing, in turn, occurs along the same length, mainly used to catch lobster seasonally and demersal fish throughout the year. Lobster fishing is quite representative for fishermen, as there are approximately 550 of them involved in this type of fishery, according to Colony Z-8, and receiving lobster closure insurance from January to April (Silva, 2004).

According to Pinheiro and Farias (2016), normally the composition of landed fish presents a great diversity of species, carnivorous eating habits, and inhabitants of coastal rocky environments and with a wide variety of



**Table 2.** Fishing gear used by the fishing community in Fortaleza.

LINE AND HOOK	HAND LINE	Description: Fishing tackle widely used for bottom fishing, consisting of nylon line (60 to 180mm), sinker and hook.	
		Target species	Priority fishing periods
		Tarpon, whiting, redfish, goldfish	From April to August
		Mackerel, Serra Spanish mackerel, white grunt, snapper, guaiuba	From September to March
	BOTTOM TRAWL	Description: Characterized by a main line, where the secondary lines, which have hook and sinker are connected.	
		Target species	Priority fishing periods
		Camurupim	From April to August
		tilefish, white grunt, catfish	Whole year
GILLNET	BOTTOM GILLNET OR "RENGAIO"	Description: It is a type of net arranged vertically attached to the bottom by means of poitas, and armed with a buoy system on its top, keeping the net cloth stretched.	
		Target species	Priority fishing periods
		Sea bass, carapeba, Serra Spanish mackerel, mackerel, hake, amberjack, guarajuba (xerelete)	Whole year
	CACEIO NET	Description: Caceio is a type of fishing carried out with a rectangular nylon gill-net where one end of the net remains fixed while the other end is free. They can work in the bottom or "cattle" (at half water).	
		Target species	Priority fishing periods
		Sea bass, Serra Spanish mackerel, mackerel, stingray, snapper, tilefish, hake, guarajuba	Whole year
	SURFACE GILLNET OR "BOIEIRA"	Description: It is a type of gillnet, arranged vertically in the water column, not anchored, drifting attached to the vessel or not.	
		Target species	Priority fishing periods
		Camurupim, Sea bass	From August to December
TRAP	MANZUA AND CREELS	Description: Transportable, funnel-opening, cylindrical, semi-cylindrical or rectangular shaped articles made of wood, wire or mesh. Very effective fishing gear for catching low-moving species that live near the bottom.	
		Target species	Priority fishing periods
		Lobster (manzua)	From 1st June to 30th November
		Demersal fish (creels)	Whole year
TRAWLING	BOTTOM TRAWLING	Description: Bottom trawling consists of the use of a conical, bag-shaped net that is pulled by boat using cables attached to the floats at a speed that allows fish to be trapped within the net.	
		Target species	Priority fishing periods
		seabob-shrimp, white shrimp	Whole year
	BEACH TRAWLING	Description: It occurs when a net is thrown into the sea, to be later pulled by cables, by fishermen on the beach. The net has varied meshes, being 20mm in the bagger, and 40-60mm meshes in the sleeves, which are kept open with the help of a "slang" (beams) attached to the meshes.	
		Target species	Priority fishing periods
		Coastal fish and crustaceans in general	Whole year





SPEARFISHING Target species Fish in general	Description: Type of fishing that uses the speargun, without aid of compressor or compressed air cylinders and carried out in apnea.	
	Priority fishing periods	
	Whole year	
CAST NET Target species Mullet	Description: Circular shaped fishing net whose radius ranges from 2m to 4m, with small weights distributed around the entire circumference of the mesh. The net is usually thrown by hand so that it opens as wide as possible before reaching the water.	
	Priority fishing periods	
	August	

Source: The Authors

ecological niches. Such raised characteristics would justify the various capture methods employed in the fisheries, characterizing the first stage of the fish production chain in Fortaleza. The distribution stage is formed by the intermediate warehouses, free markets, supermarkets, fishmongers and, in some cases, the producers themselves. (Vianna, 2009).

In the capital of Ceará, most of the fish has low commercial value, being most often marketed as soon as it reaches the beach sand for local residents. On the other hand, the most valuable fish is sold according to an agreement previously signed between the fishermen and more specific middlemen, and may go to various paths of the production chain. In Fortaleza, the possible routes are the Fortaleza Fish Market or direct sale to hotels, restaurants and export companies.

Lobster fishing is the most economically important category of the municipality, whose participation in the Ceará fish export list represented 86% in 2009 (Etene, 2010). The commercialization of all lobster originating from the fishing communities of Fortaleza is carried out by specific brokers who send the product directly for export. The domestic lobster market is small compared to exports, mainly due to the high cost of the product, being restricted to hotels and restaurants.

## 5. CONCLUSION

The fishing communities in Fortaleza (CE) are located a short distance from each other, in communities along the entire coast of the municipality. The gathering of information about the fishing activity practiced made it possible to enrich the knowledge about artisanal fishing in the northeastern state. Information on fishing dynamics such as the strategies employed, the vessels used, the main species caught and the commercialization of fish are relevant, considering the great importance of Ceará in the northeastern

and Brazilian context as one of the major fishery producers.

The study shows a diversity of arts and vessels used in artisanal fishing activity in Fortaleza. Fishermen, in most cases, call the same types of gear and vessels in different ways, seeking to increase the possibilities of capture in the same trip. In addition, the study shows that fishing is necessary for the local community, enabling gains from the exploitation of fishing resources.

Regarding fish, there was a diversity of species caught by fishing communities; however, the treatment given to production varies according to the economic importance of the fish. Lobster is the main fish and marketed product and is also the product of greatest commercial value. Other fish include snapper, guaiuba, sardines, white grunt, less mackerel, Serra Spanish mackerel and pargo. In the rainy season, the abundance is twice as high as in the dry season and points to guaiuba, mackerel and sardines as the species with the highest abundance in biomass (kg).

The participatory diagnosis showed the configuration of the fish production chain in Fortaleza, which, despite its simplified form, must be taken into account in the coastal management of the municipality. Artisanal fishing is rich in community values and traditional culture and should be harmonized with the fisheries management of the state of Ceará.

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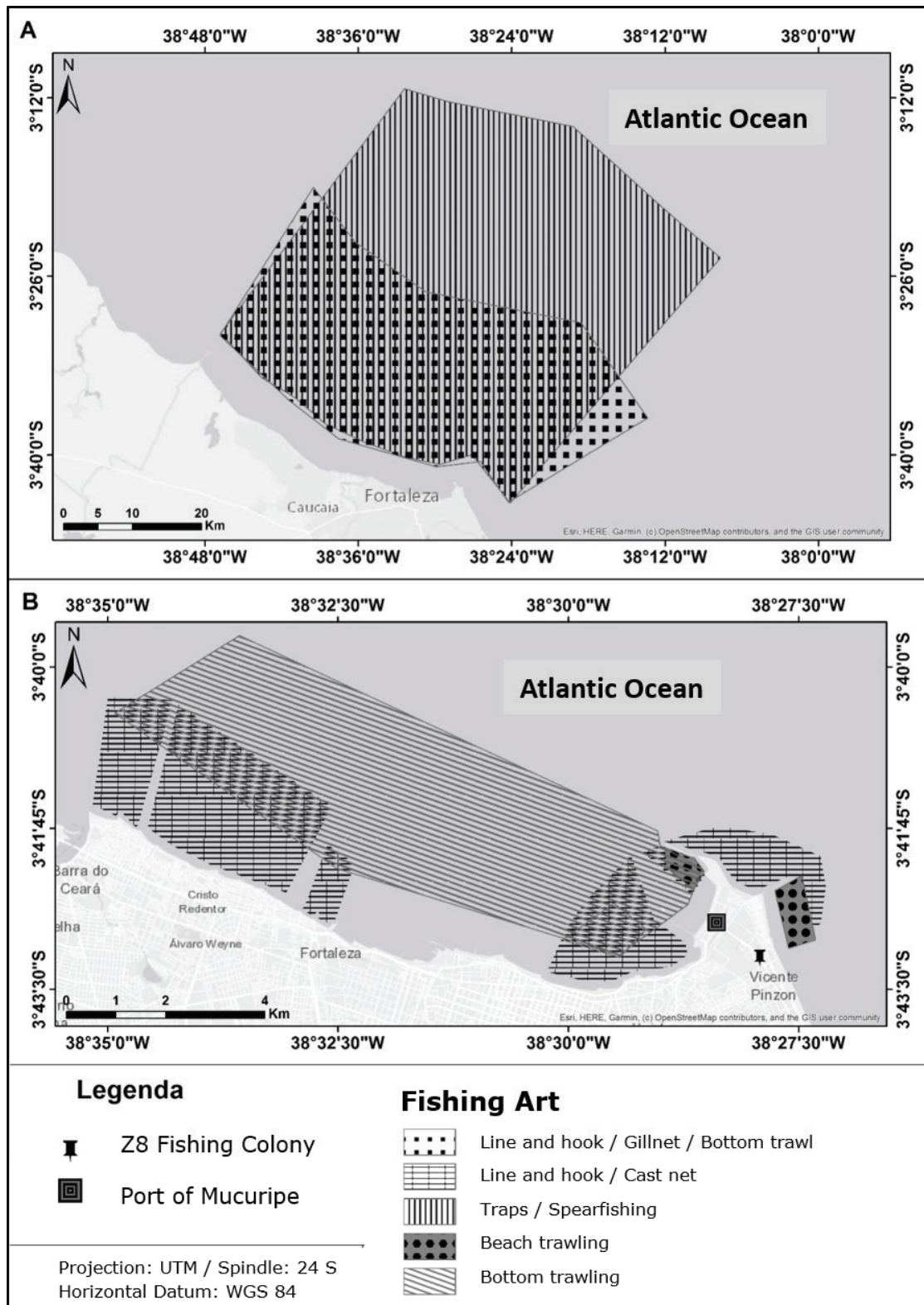


Figure 4. Areas of artisanal fishing in Fortaleza

Source: The Authors.



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