



## Artisanal fishery versus port activity in southern Brazil



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### ABSTRACT

The objective of this study is to describe the artisanal fishery practices in the community of Farol de São Tomé in Campos dos Goytacazes city, north of the state of Rio de Janeiro. We aim to analyze the perception of artisanal fishermen and their families in relation to activities of Logistic Industrial Complex of Farol-Barra do Furado (CLIFABA) and to evaluate the conditions of fishery maintenance together with the port activities. Between 2014 and 2015, we conducted 90 ethnographic interviews with fishermen (30), spouses of fishermen (30) and children of fishermen (30). The fishermen are mostly male, all the spouses are female, here denominated as 'wives', and the children are male and female. In this region, the artisanal fishery is practiced in the marine environment with trawler boats and involves the use of nets, mainly bottom trawl, fishing lines and traps. Due to the absence of a mooring, tractors are used to launch and remove boats from the sea. Regarding the future of the artisanal fishery together with CLIFABA activities, the fishermen affirm that the fishery will ultimately end (37%;  $n = 11$ ). The wives (40%;  $n = 12$ ) and children of fishermen (43%;  $n = 13$ ) believe that with the movement of ships during the activities of CLIFABA, the coastal marine fauna can disappear, ultimately changing the dynamics of fisheries in the region. As a solution to the interference of CLIFABA in the artisanal fishery, the interviewees suggest the repeal of restrictions related to fishery activities, as well as the ability of fishermen to work along any area of the coastline.

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### 1. Introduction

Artisanal fishery practice is a traditional activity that involves local actors of the fishery community and their knowledge of techniques and strategies related to fishing operations (Diegues, 2000; MPA, 2011). In these practices, the fishermen typically work alone, utilize the familiar labor or are self-employed; they typically explore the environment along the coastline because the boat and the equipment that they use have little autonomy (Clauzet et al., 2005). In some areas along of coast of Rio de Janeiro State in southeastern Brazil, the artisanal fishery on sea presents

characteristics of greater autonomy. Generally, the fishery starts at dawn until late afternoon, but in some communities the artisanal fishermen can board until 15 days (Di Benedetto et al., 1998; Di Benedetto, 2001; Silva et al., 2014; Zappes et al., 2014, 2016b).

The state of Rio de Janeiro is considered the third largest national producer of fish (Vianna, 2009). According Prozee (2005) there are 20,000 fishermen in the state with an average annual of extractive production of fishing on sea was 62 thousand tons with annual revenue of approximately R\$ 180 million (approximately US\$ 52,252,670.69; R\$ 1,00 ≈ US\$ 3.44). In 2012 the annual of extractive production of fishing on sea was 90,689 thousand tons (Fiperj, 2013). The principal resources captured involves pelagic species as corvina (*Micropogonias furnieri*), sardinha (*Cetengraulis edentulus*), bonito-listrado (*Katsuwonus pelamis*), peroá (*Balistes* spp.), cavalinha (*Scomber japonicus*), xerelete (*Caranx latus*), dourado (*Coryphaena hippurus*) and albacora-de-laje (*Thunnus albacares*). The principal shrimps species captured are Atlantic seabob shrimp

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(*Xiphopenaeus kroyeri*), Argentine stiletto shrimp (*Artemesia longinaris*), white shrimp (*Litopenaeus schimitti*) and pink shrimp (*Farfantepenaeus paulensis F. brasiliensis*) (Vianna, 2009; Fernandes et al., 2011).

Along the north coast of the state (~22°S–42°O), the operations of artisanal fisheries are conducted mainly by the communities of Barra de Itabapoana, Guaxindiba, Gargaú, Atafona, Farol de São Tomé and Macaé, with the use of various types of nets, fishing lines and traps (Di Benedetto, 2001; Vianna, 2009). The community of Farol de São Tomé (22°02'S–41°02'O), in the municipality of Campos dos Goytacazes, has the largest fishery production of marine shrimp in coastal waters (Semensato and Di Benedetto, 2008; Costa and Di Benedetto, 2009). The headquarters of two shipyards that construct fishing vessels are located in this community, indicating their regional importance for artisanal fisheries (Vianna, 2009).

This community is located next to the enterprise of port Logistic Industrial Complex of Farol-Barra do Furado (CLIFABA) (22°07'S–41°10'O) (Fig. 1). CLIFABA is currently under construction along the margin of Bar of Canal das Flechas, occupies an area of approximately 170 km<sup>2</sup> in the borderline of the municipalities of Campos dos Goytacazes and Quissamã. This enterprise will allow the construction of ships and will serve as a base of logistic support to the port and to the activities *off-shore* in Basin of Campos, working to support the extraction and production of oil and gas in the region (UFF/FEC, 2010). According to the government of the state of Rio de Janeiro and the prefectures of the municipalities of Quissamã and Campos dos Goytacazes, the activities of CLIFABA, functioning as a port logistic industrial complex, were set to begin in the first half of

2011, but the deadline was not met. In this period, the construction was started.

Social problems resulting from conflicts between fishery communities and port activities have been reported along the coast of Brazil (Lopes, 2013; Castro and Almeida, 2012). Along the north coast of the state of Rio de Janeiro, this reality has already reached the fishery communities in Atafona and Barra do Açu, which have both been affected by the deployment of the Logistic Industrial Complex of Porto do Açu (Souza, 2010). However, there are no studies related to the cultural and social impacts of CLIFABA in the region, but there are indications of possible threats in the economic and territorial context (UFF/FEC, 2010).

The assessment of environmental changes caused by port enterprises can be understood using qualitative data obtained through interviews with stakeholders (Jung et al., 2011). These data present the potential to demonstrate environmental conditions from the past and present, as well as what the environmental future might look like. This demonstrates that interdisciplinary research can help in the management and conservation of the environment and human culture that are involved (Jung et al., 2011). In this sense, it is necessary to understand the intention of the participation of stakeholders in the implementation process and the management of major technological projects to avoid value conflicts that may arise between the local community and entrepreneurs (Ravesteijn et al., 2014). Thus, the objective of the present study is to describe the artisanal fishery practices of the Farol de São Tomé community and to analyze the perception of artisanal fishermen and their families regarding port enterprise by assessing the

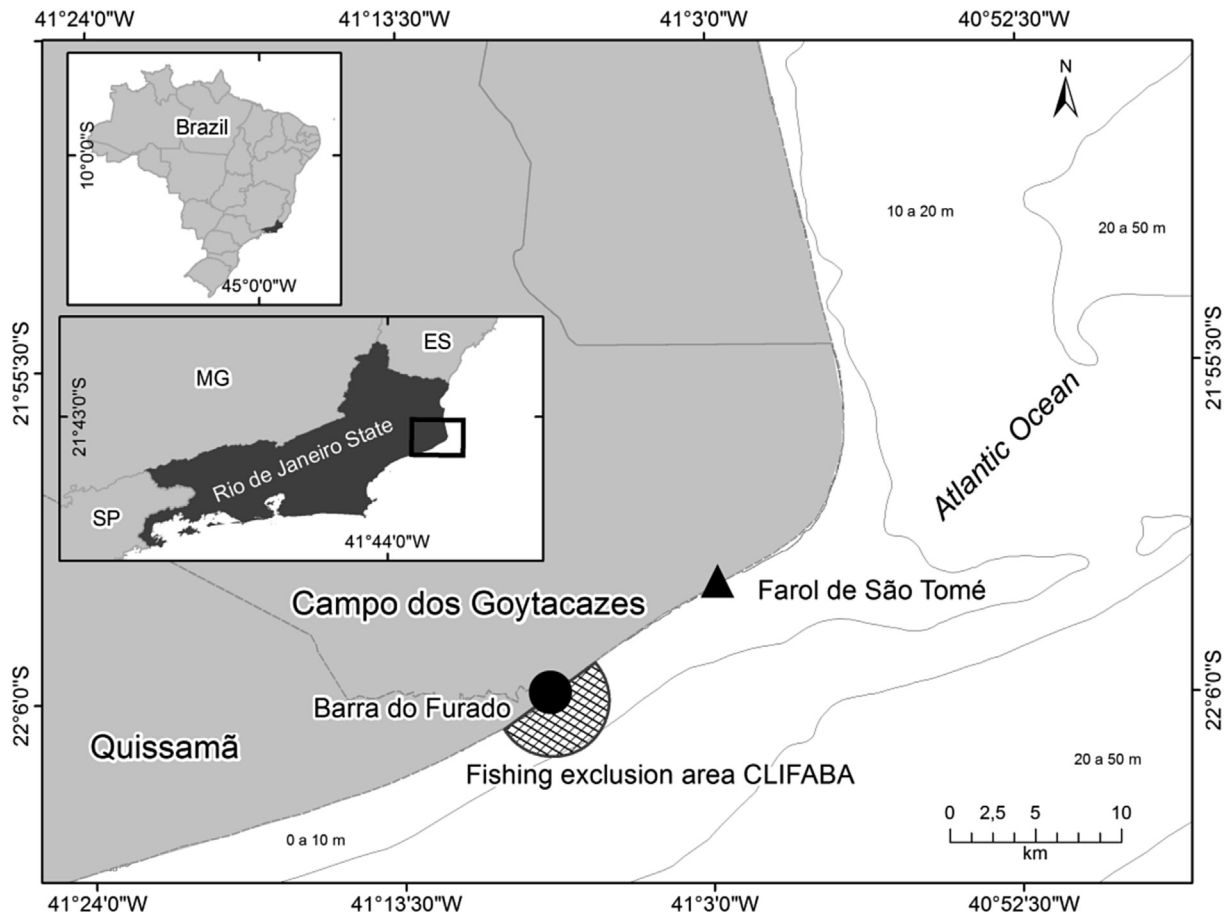


Fig. 1. Locations of the communities of Barra do Furado and Farol de São Tomé, Rio de Janeiro state, southeastern Brazil. Headlines (dotted) indicate the fishing exclusion zone in the coastal marine environment due to CLIFABA activities.

fisheries service conditions together with the initial activities of CLIFABA.

## 2. Materials and methods

### 2.1. Study area

The fishing community studied involves fishermen and their families that reside in the coastal strip of the municipality of Campos dos Goytacazes in Farol de São Tomé, located on the north coast of the Rio de Janeiro state (Fig. 1). These fishermen are registered in Fishermen's Colony Z-19, totaling 300 associated professionals. According to the president of Fishermen's Colony Z-19, the effective number of fishermen who perform this activity is smaller than denoted in official records because there are fishermen who no longer perform the activity.

The coastal strip of Campos dos Goytacazes is located in Campos Basin on Brazil's eastern coast (Muehe, 1998). In this region, we highlight the cape of São Tomé, a protruding sedimentary feature that has its geological history understood from the last two major sea level transgressions (and later regressions) and is associated with fluvial deposits (Paraíba do Sul river) throughout the late quaternary. Southward of the cape, sand barriers are exposed to storm waves and overwash processes that promote the migration of this feature toward the mainland. Northward sand barriers have typically prograding features that are directly influenced by the current fluvial sedimentation. Thus, this portion of the coast marks a borderline position of distinct geomorphological characteristics that are reflected in convergent coastal transport conditions (Cassar and Neves, 1993) and mark the inflection of the northern Rio de Janeiro coast. The south portion of the cape turns to the southeast direction, and the north portion turns to the northeast direction, which is significant in terms of exposure to storm waves, sediment transport and the morphodynamic characteristics of beaches.

Our surveys indicate that the morphological characteristics average of this coastal strip are 28 km long between Barra do Furado to Barra do Açú. Mean width of 145 m with a wider pattern on the ends and narrower in the central portion of the coastline. Mean heights of the beach are 4 m above mean sea level with a tendency to occur incipient foredunes toward the north portion of the shoreline. Under the morphodynamic point of view, the coastal strip is directly exposed to ocean waves, consisting of sand of medium and coarse grain size and beach profiles that range from reflective (coarse sand and steep slopes) to the south and intermediate (medium sands, average slope and submerged sandbanks) to the north (Bulhões, E.M.R., *personal communication*).

Blowing winds predominate from the northeast quadrant with intensities between 4 and 8 m/s, with peaks often reaching over 12 m/s. The tide has amplitudes of 1.5 m during spring tide conditions. The average wave heights are between 1 and 2 m (Pinho, 2003) and mostly come from south-southeast and east-northeast. In the storm wave season (from April to September), the average of maximum wave heights reaches up to 3.2 m, with incoming waves usually from the south (Souza et al., *in press*).

### 2.2. Data collection

Data were collected from December 2014 to February 2015 in 90 ethnographic interviews with artisanal fishermen ( $n = 30$ ) and their families [spouses ( $n = 30$ ) and children ( $n = 30$ )]. In studies in which reports are obtained from local actors, if the sample is too large, new data do not introduce new information related to the objectives of the research, leading to repetition (Mason, 2010). In ethnoscience studies, an ideal sample size between 30 and 60 interviews has been recommended (Morse, 1994; Bernard, 2000).

Thus, the frequencies are rarely important because these studies are concerned with meaning and not with generalized hypothesis statements (Crouch and McKenzie, 2006).

The method of participant observation was applied as the first step of this study; we observed the activities related to the fishery (preparation and maintenance of gear, prepared bait, fishing operation itself, fishing landings), and we recorded the data in Field Diary to obtain information about the local fishing culture (Schensul et al., 1999).

The selection of interviewees for interviews was conducted as follows: 1) assistance provided by the president of the Fishermen's Colony Z-19 (Sanchez, 2004); 2) snowball sampling technique (Biernacki and Waldorf, 1981; Bailey, 1982); and 3) randomization of the sample (Zappes et al., 2016a, 2016b). The selection of the first interviewee involved collaboration with the president of the Fishermen's Colony Z-19, while the second respondent was identified using the snowball sampling technique. The snowball method could be stopped, and the approach for the next fisherman occurred at random through opportunistic encounters.

Three criteria were established for the application of these methods during the interviews with fishermen: 1) all respondents should be artisanal fishermen; 2) fishing should be their main professional activity; and 3) artisanal fishery activities should be practiced in northern Rio de Janeiro state, southeastern Brazil. Respondent's spouses should live in the same house as the fisherman for at least one (1) year. The children interviewed should meet the following criteria: i) have a maximum of 18 years of age, ii) live in the same house as their father, as a fisherman, or their mother, as a fisherwoman, and iii) be enrolled in elementary school, high school or have left school for less than one (1) year.

Before each interview, the objectives of the research were explained to the interviewees, who were also asked whether they would be willing to participate (Librett and Perrone, 2010). In addition, the researchers explained to the interviewees that only first names were requested for the purpose of polite communication. We requested a permission document from the president of Fishermen's Colony Z-19, as the president is the legal representative of this professional category in the community. The document was issued by the president to allow the study to include traditional knowledge (Azevedo, 2005) while obeying the laws of Brazil (Federal Law 13.123/15).

For each group of interviewees (fishermen, spouses and children of fishermen), we applied specific questions guided by a pre-established questionnaire containing semi-structured, open-ended questions (Schensul et al., 1999). The questionnaire for each group was composed of the following categories of questions: i) Fishermen: social aspects, description of artisanal fisheries and viability of fishery activity; ii) Spouses: social aspects and viability of fishery activity; and iii) Children of fishermen: social aspects and viability of fishery activity (Box 1). To avoid the interference of one informant on the testimony of the others, each interview was conducted individually (Opdenakker, 2006).

### 2.3. Data analysis

The reports were organized into categories following the standard questionnaires used in previous studies (Ryan and Bernard, 2000). By using this information, it was possible to describe local knowledge and compare the perceptions of fishermen, their spouses and children regarding the maintenance and viability of artisanal fisheries in the region to confront the initial activities CLIFABA. These comparisons were calculated using the percentage frequencies of the questionnaire responses.

Descriptions related to ethnospecies that are targeted by artisanal fisheries were compared with the literature to verify

**Box 1**

Topics of the issues of the semi-structured questionnaires by interviewee group in northern Rio de Janeiro state, southeastern Brazil.

**Fishermen***1. Social aspects*

Gender

Age

Time period of fishing work in the region

Education

*2. Description of artisanal fisheries*

Area of fishing

Gear technology

Boats (length, engine)

Target species and justification

Declining species

*3. Viability of fishery activity*

Future of artisanal fishery together with the activities of CLIFABA

Solutions to minimize the interference of CLIFABA

**Spouses***1. Social aspects*

Gender

Age

Education

*2. Viability of fishery activity*

Future of artisanal fishery together with the activities of CLIFABA

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**Children of fishermen***1. Social aspects*

Gender

Age

Education

*2. Viability of fishery activity*

Future of artisanal fishery together with the activities of CLIFABA

Solutions to minimize the interference of CLIFABA

(n = 29), with only one female recorded in this study. The age of these fishermen interviewees ranges from 31 to 66 years old, with the predominant age group between 51 and 66 years old (53%; n = 16). The performance period of work in artisanal fisheries ranges from 6 to 52 years, with more frequency between 31 and 40 years (40%; n = 12). All the spouse interviewees are female and will be referred to in this study as 'wives'. The age of the wives ranges from 20 to 56 years old, with more frequency between 31 and 40 years old (40%; n = 12). Among the children of fishermen, 60% (n = 18) are female between the ages of 8 and 18 years old, and 40% (n = 12) are male between the ages of 7 and 18 years old. The majority of fishermen (80%; n = 24) and 15 their wives (50%) have not completed elementary school, whereas 80% (n = 24) of their children are attending elementary school (Table 1).

*3.2. Description of artisanal fisheries*

The artisanal fishery practiced by the Farol de São Tomé community occurs mainly near the coastline of the municipality of Campos dos Goytacazes but may extend between São João da Barra (21°38'S, 41°03'O) and Macaé (22°22'S, 41°47'O), as well as along continental shelf. The most common types of boats used include trawler, hull, deck and wooden marry (Fig. 2A). The length varies between 10 and 13 m, and the engine horsepower ranges from 20 to 120 HP. Fishermen may embark on fishing excursions lasting one (1) to 15 days (where the fishery occurs along continental shelf), but they typically begin fishing early in the morning and cease activity in the early afternoon, returning to the mainland on the same day.

In this community, there is no mooring for boats. Thus, the boats are launched and taken from the sea ('leave' and 'pull' of water) with the help of a tractor that drags the sand from the beach (Fig. 2B). The cost of this method varies between R\$ 60.00 and R\$ 80.00 per day (approximately US\$ 17.44 to US\$ 23.25; US\$ 1.00 ≈ R\$ 3.44), per vessel. This represents a monthly cost between R\$ 1800.00 to R\$ 2400.00 (approximately US\$ 523.25 to US\$ 697.67; US\$ 1.00 ≈ R\$ 3.44). For boats of 12 and 13 m lengths that are loaded with catch, it takes two tractors, which doubles the cost. The cost of this method is divided between the master of the vessel and the fishermen who accompany him in the fishery (comrades). The owners of tractors are former fishermen and other locals who obtain income from this activity.

The artisanal fishery in the region involves the use of nets (bottom trawl or bottom trawl for shrimp and gillnet), fishing lines (handline) and traps (cage) (Table 2). Some fishermen indicated more than one fishing gear type, which explains why the number of reports (n = 34) is larger than the number of respondents (n = 30).

The fishing gear types used by the Farol de São Tomé community are described below:

- i) Bottom trawl: net with a tapered shape in which wooden doors (n = 4) are installed on the sides to keep the net mouth open during the completion of the drag. Each port weighs between 35 and 45 kg. This net is dragged across the seabed, usually late at night or early in the morning. Each trawl can last from 30 min to four hours and occurs six days a week, with the exception of the closed period (01 March to 31 May) when fishing is suspended. The net is 5–26 m long and 3–16 m wide. The net mesh size is 5–25 mm, and the bigger mesh size is 12–20 mm between adjacent nodes.
- ii) Gillnet: rectangular net formed by lines made of interwoven monofilament yarn (nylon or silk), which can be extended close to the surface, the middle of the water column or near the bottom of the water column. This net has up to four buoys and sinkers every 2 m to keep it stretched in the water

correspondence regarding the current nomenclature. These data do not represent the taxonomic identification itself but instead represent an indication of the likely target species.

**3. Results***3.1. Characteristics of interviewees*

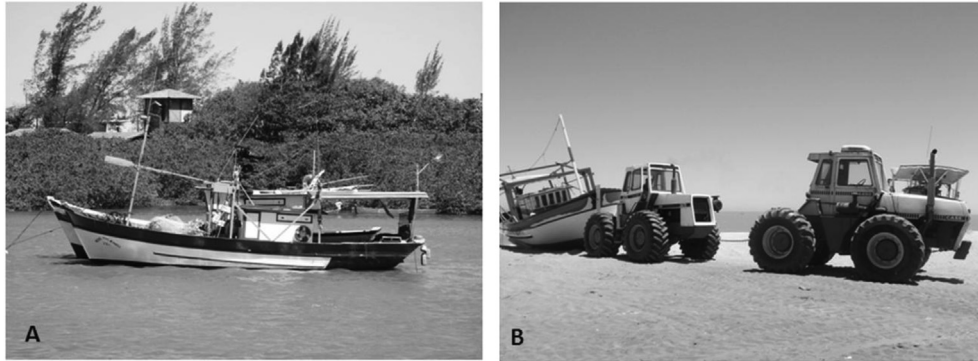
The fishermen of Farol de São Tomé are mostly male (97%;



**Table 1**

Education of fishermen, wives of fishermen and children of fishermen from the fishing community of Farol de São Tomé in northern Rio de Janeiro state, southeastern Brazil.

Level of education	Fishermen <sup>a</sup>	%	Wives <sup>a</sup>	%	Children <sup>a</sup>	%
Not studied	02	07	03	10	–	–
Elementary school - incomplete	24	80	15	50	–	–
Elementary school - complete	–	–	02	07	–	–
Elementary school – in course	–	–	–	–	24	80
High school - incomplete	–	–	04	13	–	–
High school - complete	04	13	06	20	–	–
High school – in course	–	–	–	–	06	20
Total	30		30		30	

<sup>a</sup> Number of reports.**Fig. 2.** Boats used during artisanal fishery practices in Farol de São Tomé, in northern Rio de Janeiro state, southeastern Brazil: A – Trawler boat; B – Vessel being removed from the water by two tractors. Photos: Camilah Antunes Zappes.**Table 2**

Frequency of use of fishing gear in Farol de São Tomé in northern Rio de Janeiro state, southeastern Brazil.

Fishing gear	Number of reports	%
Bottom trawl	25	83
Handline	04	13
Gillnet	03	10
Cage	02	07
Total	34	

column. The length of the net varies from 5 to 1000 m in length, with a height of 1.5–2 m and a mesh size of 35 mm between adjacent nodes. The net is cast into the sea twice a day with an immersion time of up to 5 h; it is positioned at depths of 10–300 m. It can be used up to six days a week throughout the year.

- iii) Handline: monofilament yarn (nylon or silk) with a thickness of 0.6–0.8 mm and a length of 60–80 m (main line), which runs 18 to 50 secondary lines. On the sidelines, there may be 3–200 hooks in which bait is attached (shrimp or pieces of fish). The buoys are installed every 20 m with a single sinker (800 g–1 kg). Handlines are launched in areas with depths of 15–300 m, and the period of immersion ranges from 8 to 12 h; handlines may be used during the day and night throughout the year.
- iv) Cage: fishing trap of rectangular shape with dimensions of 1.80 m in length and 70 cm in width. The trap is made from iron rebar soldier covered with nylon net. The cage is kept submerged by a sinker 5 kg. On the sides of the cage, there are openings for entry of the target species, which is attracted inside by the bait (fish or shrimp). Cages are installed at depths ranging from 15 to 200 m, usually in the morning, for two days a week and may be submerged for up to one (1) hour.

The target species of the artisanal fishery and the gear used for their catch are described in Table 3. The fishermen describe 15 ethnospecies as the more important species for the artisanal fishery; these species are highly sought after by consumers due to their pleasant taste. Of these important species, the fishermen consider the following species to be endangered: pink shrimp (*Farfantepenaeus paulensis*), red shrimp or ‘santana’ shrimp (*Farfantepenaeus brasiliensis*), the ‘goibera’ or ‘goibira’ fish (*Oligoplites saliens*) and the ‘salemo’ or ‘salema’ fish (*Anisotremus virginicus*). According to the fishermen, these species are declining due to excessive fisheries exploitation practiced mainly by vessels registered in the city of Macaé, Rio de Janeiro State, southeastern Brazil, followed by boats originating from São Paulo state, southeastern Brazil and Paraná and Santa Catarina states, southern Brazil, which operate trawls in the region.

### 3.3. Artisanal fishery versus Logistic Industrial Complex of Farol-Barra do Furado (CLIFABA)

When asked about the future of artisanal fisheries in the face of the initial activities of CLIFABA, fishermen said that fishing will end because of the fishing exclusion zone (37%;  $n = 11$ ) (Table 4). On the other hand, 27% ( $n = 8$ ) say that fishing may increase in the region (Table 4). These fishermen believe that it will be possible in the future to use CLIFABA as a mooring location. According to the fishermen, the fact that they can embark and disembark in this port will eliminate the daily costs of using the tractor, stimulating the participation of other local residents in the artisanal fishery community. The wives (40%;  $n = 12$ ) and children of fishermen (43%;  $n = 13$ ) reported that with the movement of many ships to the coast, coastal marine life could disappear, which would force the fishermen to find new fishing sites (Table 4).

As a solution to reduce the possible interference of CLIFABA on artisanal fishing, all groups of respondents said they should allow

**Table 3**  
Target species captured in the artisanal fishery of the community of Farol de São Tomé in northern Rio de Janeiro state, southeastern Brazil.

Ethnospecies	Probable family	Probable scientific name	Fishery gear
'Pescada'	Sciaenidae	<i>Cynoscion</i> sp. <sup>a,d</sup>	Gillnet
'Corvina'	Sciaenidae	<i>Micropogonias furnieri</i> <sup>a,d</sup>	Gillnet
'Pescadinha'	Sciaenidae	<i>Isopisthus parvipinnis</i> <sup>a,c</sup>	Gillnet
'Papa terra'	Sciaenidae	<i>Menticirrhus americanus</i> / <i>M. littoralis</i> <sup>c,d</sup>	Gillnet
'Goete'	Sciaenidae	<i>Cynoscion jamaicensis</i> <sup>a,c,d</sup>	Bottom trawl
'Bagre'	Ariidae	<i>Genidens</i> spp. <sup>c</sup>	Gillnet
'Bonito/Serra'	Scombridae	<i>Euthynnus alletteratus</i> <sup>a,d</sup>	Handline
'Goibera/Goibira'	Carangidae	<i>Oligoplites saliens</i> <sup>a</sup>	Gillnet
'Pargo'	Sparidae	<i>Pagrus pagrus</i> <sup>a,c,d</sup>	Handline/Cage
'Namorado'	Centropomidae	<i>Pseudopersis numida</i> <sup>d</sup>	Cage
'Salemo/Salema'	Pomadasyidae	<i>Anisotremus virginicus</i> <sup>a</sup>	Gillnet
'Pegereba/ Pregereba'	Lobotidae	<i>Lobotes surinamensis</i> <sup>e,g</sup>	Gillnet
Atlantic Seabob shrimp	Peneidae	<i>Xiphopenaeus kroyeri</i> <sup>d,f</sup>	Bottom trawl
Argentine stiletto shrimp	Peneidae	<i>Artemesia longinaris</i> <sup>b,d</sup>	Bottom trawl
Pink Shrimp	Peneidae	<i>Farfantepenaeus paulensis</i> <i>F. brasiliensis</i> <sup>d</sup>	Bottom trawl
Red shrimp or 'santana'			

<sup>a</sup> Di Benedetto, 2001.

<sup>b</sup> Dumont and D'Incao, 2004.

<sup>c</sup> Monteiro-Neto et al., 2008.

<sup>d</sup> Vianna, 2009.

<sup>e</sup> Pincinato, 2010.

<sup>f</sup> Fernandes et al., 2011.

<sup>g</sup> Icmbio, 2011.

**Table 4**  
Perception of interviewees regarding the future of artisanal fisheries in Farol de São Tomé in northern Rio de Janeiro state, southeastern Brazil, with the initial activities of Logistic Industrial Complex of Farol-Barra do Furado (CLIFABA).

Response categories	Fishermen <sup>a</sup>	%	Wives <sup>a</sup>	%	Children <sup>a</sup>	%
Fishing will end	11	37	07	23	05	17
Fishing will increase	08	27	01	3	05	17
CLIFABA does not interfere with fishing	02	6	03	10	04	13
Ships will cause fish to leave coastal area	06	20	12	40	13	43
DNK <sup>a</sup>	03	10	07	24	03	10
Total	30		30		30	

<sup>a</sup> Number of reports; DNK – do not know.

the fisherman to act in any area of the coast: fishermen (40%; n = 12); wives (47%; n = 14) and children (37%; n = 11) (Table 5). All interviewees that reported 'do not know' (DNK) said that they still have no definite perception about the actual changes to artisanal fishing that the activities of CLIFABA can promote in the region.

## 4. Discussion

### 4.1. Characteristics of interviewees

Artisanal fishermen residents in the community of Farol de São Tomé are mostly males who have not completed elementary school. This scenario is repeated in several fishing communities of the country and demonstrates that the prospects and possibilities

of work and income outside traditional fishing are limited for these professionals, showing the high degree of dependence on this activity (Maruyama et al., 2009; Alencar and Maia, 2011; Dias and Oliveira, 2015). The local marine fisheries are an economic activity practiced mainly by men who have reached middle age, as reported previously in Ditty and Rezende (2013). This feature also makes it difficult for fishermen to access new job opportunities.

A low education level was also recorded among the wives of fishermen. This condition reflects the culture observed in most fishing communities, where women begin families early, are responsible for the domestic duties, take care of the children and may have a role in fishing by, for example, performing the fish processing. Therefore, these responsibilities may affect their dedication to education and may explain the low level of education in

**Table 5**  
Perception of interviewees in relation to possible solutions to decrease the interference of the activities of Logistic Industrial Complex of Farol-Barra do Furado (CLIFABA) on artisanal fisheries in Farol de São Tomé in northern Rio de Janeiro state, southeastern Brazil.

Response categories	Fishermen <sup>a</sup>	%	Wives <sup>a</sup>	%	Children <sup>a</sup>	%
Reduce the operation area of the port	–	–	03	10	02	07
Allow the fisherman to act in any coastal area	12	40	14	47	11	37
Teach other activities so the fisherman can obtain alternative income	03	10	04	13	03	10
Nothing, because CLIFABA does not interfere	04	13	02	07	05	17
Move CLIFABA to another region	01	03	02	07	06	20
DNK <sup>a</sup>	10	33	05	17	03	10
<b>TOTAL</b>	30		30		30	

<sup>a</sup> Number of reports; DNK – do not know.

this portion of the community (Motta-Maués, 1999; Martins, 2008).

To participate in this study, one of the children interviewee selection criteria allowed children to have left or completed school for less than one (1) year. Nevertheless, all children respondents were enrolled in elementary school or high school, and the education level reflected the age group. According to Ranzani de Paiva et al. (2006), fishermen encourage their children to obtain a more formal education than they may have completed in their lifetime. In many situations, the education of fishermen's children is higher than that of their parents (Alves da Silva et al., 2009).

#### 4.2. Description of artisanal fisheries

The fishing practiced by the community of Farol de São Tomé is preferably along coastal areas, and bottom trawl is the most commonly used gear type. Di Benedetto (2001) reported the same characteristics in this region, and Semensato and Di Benedetto (2008) indicated that the Argentine stiletto shrimp (*A. longinaris*) and Atlantic Seabob shrimp (*X. kroyeri*) are the main target species. Therefore, it is important to note that the fishing mode in the region and the main catch species remain the same, at least over the last decade.

The way in which local fisherman throw themselves overboard and are subsequently towed to the mainland is quite peculiar in that community because there is no fishing dock. In coastal segments exposed to alternating periods of fair weather (low energy) and storm weather (high energy), there are complexities and high costs associated with building and maintaining a fishing dock, as well as other shelter structures such as breakwaters and groynes (Alfredini and Arasaki, 2009). There are still predictable and significant impacts of those buildings on the morphology of the coastline and adjacent areas that could lead to coastal erosion. In this sense, the search for location alternatives, such as estuarine fishing terminals (e.g., Barra do Furado, southward; Paraíba do Sul river mouth, northward) or naturally sheltered beaches, is appropriate to ensure the safety of docking activities.

In the central area and also northward of Sao Tomé cape, the coastline has a high beach mobility index with periods of erosion and deposition due to geomorphological factors (Bastos and Silva, 2000) and the incidence of storm waves (Souza et al., in press), which leads some coastal segments to erode. Southward of the cape, dynamic characteristics of the beach become more stable, and the beach profile is reflective (lower mobility). The slope of the beach is steeper, and the sedimentation of the underwater area hinders the formation of submerged sandbanks. This allows a sharp transition from depths between the beach and underwater area, allowing the fishermen to navigate closer to the emerged beach.

Therefore, the artisanal fisheries in Farol de São Tomé developed from the ability to launch and dock in the less adverse conditions of exposed beach operations. However, the fishery is dependent on the tractor towing vessels (for docking), making the cost of local fishing higher than when compared to other fishing communities installed in sheltered areas. This high cost reduces the profit margin of the directly involved fishermen in the fishing activity practiced in the Farol de São Tomé coast. The Fishermen's Colony Z-19 does not have its own resources for the execution of a project of this magnitude (wharf and port housing structures) and depends directly on government investment.

#### 4.3. Artisanal fishery versus Logistic Industrial Complex of Farol-Barra do Furado (CLIFABA)

Respondents linked the installation of CLIFABA with future losses in artisanal fishing in the region, such as the establishment of fishing exclusion zones and increase of vessel traffic. In 2011 when

the construction of CLIFABA began, future difficulties for the exercise of fishing activities due to the occupation of areas used for the displacement of fishing vessels were already being predicted (UFF/FEC, 2010). In other regions of Brazil, artisanal fisheries also suffer losses in the delimitation of areas of exclusion related to the operation of port development (e.g., Souza, 2010; Lopes, 2013; Castro and Almeida, 2012).

On the other hand, respondents acknowledged overfishing as a current cause of the reduction of local fish stocks, leading to declining activity in the medium or long term. Similar conditions have been reported in several areas along the Brazilian coast and have mainly been attributed to the high capture effort promoted by industrial fishing vessels that operate in fishing grounds near the coastline (Seckendorff and Azevedo, 2007; Vianna, 2009). Therefore, if there has been a decline in fish production in the region after the start of CLIFABA operations, it is difficult to assess the share of responsibility of the port project. In general, newly installed port enterprises are liable for problems or difficulties in socio-economic and environmental areas.

The fact that the respondents say that with the installation of CLIFABA, artisanal fisheries in the region 'will increase' because they may use it for fishing landings demonstrates the misinformation of the local population regarding the use and access requirements of these enterprises. Unfortunately, this perception is common because the language and means of communication used by those responsible for these enterprises disregards the low education level of the surrounding population and the difficulty of local actors in understanding technical information (Zhou, 2008; Ditty and Rezende, 2013).

Among the solutions suggested by respondents as a means of minimizing the negative impacts of CLIFABA on local fishing, there is the repeal of the rules of restrictions on fishing practice, allowing the execution of the activity on any fishing ground in the area. This is not feasible because the areas of fisheries exclusion surrounding port projects are aimed at preventing accidents involving local people and enterprise employees (UFF/FEC, 2010).

The installation of a large project near community use areas with artisanal practices can change the daily lives of the local population, such as an increase in the resident population, environmental damage, demand for services related to health, housing, transport and education, and the levels of violence (Pires, 2009; Ribeiro, 2010). All these impacts have been reported since the installation of CLIFABA (UFF/FEC, 2010; Zappes et al., 2016a), but to date there is no record of action to solve or mitigate these problems. The installation of CLIFABA near the fishing community of Farol de São Tomé can be characterized as a process of urban-industrial expansion that generates few jobs and promotes strong environmental degradation (AGB, 2011). Enterprises with such features change the traditional systems of access to the common use of resources of the communities involved (Villela et al., 2012; Lopes, 2013).

There is yet another situation that involves risks and threats to wildlife. This enterprise may interfere with the survival of two populations of coastal dolphins, the franciscana (*Pontoporia blainvillei*) and estuarine dolphin (*Sotalia guianensis*). These dolphins suffer with the human interference in coastal environments and specifically in north of the state of Rio de Janeiro these animals are described as endangered (Siciliano, 1994; Di Benedetto et al., 1998; Di Benedetto, 2003). Waterbirds species too can suffer with the installation of CLIFABA, because coastal lagoons in Quissamã are important areas of staging site of 17 species of migratory birds (Tavares and Siciliano, 2013a, 2013b; Tavares et al., 2015).

According to Ribeiro (2010), governments and big business operating in the northern state of Rio de Janeiro aim to extinguish the traditional economy of low productivity as justification for

building an economically rich and egalitarian society. However, environmental public policies for the coastal zone in Rio de Janeiro state have not targeted efforts to ensure a balance between socio-economic development and the conservation of natural and cultural heritage (Souza, 2010). This scenario leads to a social crisis that intensifies the low quality of life of the communities near these enterprises (Webler et al., 1995). Nevertheless, the legislative actions, which have been manipulated to maintain the interest of private port proponents, must be considered (Sahoo, 2014). Such manipulation disregards the clear public planning and participatory management of stakeholders (Gleason et al., 2010).

## 5. Conclusions

The continuity and stability of artisanal fishing in the community of Farol de São Tomé could be compromised due to overfishing, the high cost of renting tractors to move the fishing boats and the exclusion of fishing grounds from the establishment of CLIFABA. This community is based in the direct area of influence of the enterprise, which increases the interference in the daily lives of families who depend on fishing.

The negative effects of CLIFABA that are related to restricted access to fishing grounds and vessel traffic are clearly recognized by the local actors. In this scenario, the government, the private sector responsible for port development, and research institutions in the region should develop a socio-economic and cultural development plan with help from the local community to ensure that the quality of life of local artisanal fishery communities is maintained.

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