

CASE STUDY OF THE TECHNICAL, SOCIO-ECONOMIC AND ENVIRONMENTAL CONDITIONS OF SMALL-SCALE FISHERIES IN THE ESTUARY OF PATOS LAGOON, BRAZIL

A methodology for assessment



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A methodology for assessment

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PREPARATION OF THIS DOCUMENT

Small-scale fisheries in coastal lagoons provide livelihoods for many thousands of people worldwide. These fisheries are recognized globally by their data-poor condition. The paucity of data makes it difficult to identify and evaluate the types of management interventions needed to sustain resources and protect fishing livelihoods. This study, developed under a Letter of Agreement with the Federal University of Rio Grande, Brazil, was carried out in response to a proposal made by the Fishing Operations and Technology Service of the Fisheries and Aquaculture Resources Use and Conservation Division of the Fisheries and Aquaculture Department of the Food and Agriculture Organization of the United Nations (FAO) to elaborate a methodology that could be employed to assess the condition of artisanal fisheries in coastal lagoons. Challenged by this task, and motivated by the necessity for improving the knowledge base of small-scale fisheries in the Patos Lagoon estuary, Brazil, the authors devised a methodological approach to assess the technical, environmental and socio-economic conditions of local small-scale fisheries, to evaluate their vulnerabilities, and to recommend and discuss strategies to enhance livelihood security and sustainable use of resources. The same methodological procedure could be applied to other small-scale lagoon fisheries worldwide, with a view to evaluate their status, to establish benchmarks to monitor their trends, and to provide the needed improvement in the knowledge base to guide a better governance of these fisheries.

Kalikoski, D.C.; Vasconcellos, M.

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ABSTRACT

This document presents an assessment of small-scale fisheries of the Patos Lagoon estuary, Brazil, using a custom-designed fisheries census methodology. Complementary information was sourced from a literature review, secondary data and in-depth semi-structured interviews. The assessment provides a complete picture of the technical, environmental and socio-economic conditions of these fisheries, including information on the number of fishery-dependent people, fishing effort, technologies and practices, trends in production and resource abundance, income and market, livelihood strategies, community-based organizations, formal institutions established by co-management, and the access to public policies. Results obtained in this study contribute to an improved understanding of the current status and vulnerabilities of local small-scale fisheries. Based on these results, the document discusses and recommends strategies to enhance livelihood security and sustainable use of resources. Lessons learned using the study methodology is presented foreseeing its application and adaptation to assess small-scale lagoon fisheries in other locations.

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ABBREVIATIONS AND ACRONYMS

APA	areas of permanent preservation
APESMI	Association of Fishers of São Miguel Village (<i>Associação dos Pescadores da Vila São Miguel</i>)
BANCEN	Central Bank of Brazil
CECOV	Community Centre of Fishers and Farmers of Várzea Village (<i>Centro Comunitário de Pescadores e de Agricultores da Localidade da Várzea</i>)
CEPERG	Center of Fisheries Research and Management of Estuarine and Lagoon Fisheries
CONAB	Federal Government Agency of Food Supply
COOPANORTE	Cooperative of Fishers of São José do Norte (<i>Cooperativa dos Pescadores de São José do Norte</i>)
COOPESCA	Cooperative of Artisanal Fishers of the Pérola da Lagoa (<i>Cooperativa de Pescadores Artesanais Pérola da Lagoa</i>)
CPUE	catch per unit effort
DPA	Department of Fisheries and Aquaculture
ELETRORBRAS	Federal Electric Company
EMATER	Organization for Technical Assistance and Rural Extension
ENSO	El Niño Southern Oscillation
FAO	Food and Agriculture Organization of the United Nations
FEAPER	State Fund to Support the Development of Small Rural Enterprises
FURG	Federal University of Rio Grande
GDP	gross domestic product
GERCO	National Programme for Coastal Management
IBAMA	Brazilian Institute of Environment and Renewable Natural Resources
INSS	National Institute of Social Security
nm	nautical mile
MMA	Ministry of Environment
MPA	Ministry of Fisheries and Aquaculture
NP/TE	net profit/total earnings
PAA	Food Acquisition Program
PRONAF	National Program to Strengthen Family-based Agriculture
RDS	sustainable development reserve
RESEX	marine extractive reserve
RGP	Registry of Professional Fisher
ROI	return on investment
RS	State of Rio Grande do Sul
RS Rural	RS State Programme for Strengthening Family-based Agriculture
SEAP	Special Secretariat of Aquaculture and Fisheries
SUDEPE	Federal Sub-Secretary for Fisheries Development
Z1	Fishers' Colony of the municipality of Rio Grande
Z2	Fishers' Colony of the municipality of São José do Norte
Z3	Fishers Syndicate of the municipality of Pelotas
Z8	Fishers' Colony of the municipality of São Lourenço do Sul

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1. INTRODUCTION

Coastal lagoons are among some of the most productive ecosystems in the world and occupy 13 percent of coastal areas worldwide (Kjerfve, 1994). They function as important nursery, feeding and reproduction areas for both native and migratory species. At the same time, they are highly stressed by anthropogenic inputs and human activities, including fisheries. Artisanal fisheries in coastal lagoons provide livelihoods for many thousands of people worldwide, including in North and South America, Africa, Asia and the Pacific (Berkes *et al.*, 2001; Garcia *et al.*, 2008; Pomeroy and Andrew, 2011).

In these fisheries, there is often a lack of basic information about their technical, socio-economic and environmental conditions, including the number of fishers, livelihoods, fishing capacity and technologies, access rights, fisheries market and status of resources. The paucity of data makes it difficult to identify and evaluate the types of management interventions needed to sustain resources and protect livelihoods. Considering the importance of lagoons to livelihoods and ecosystem health and the limited financial resources to evaluate them, a low-cost, rapid assessment is required in order to provide a basis for assessing small-scale fisheries in lagoons.

The objective of this study was to design a methodology through which small-scale lagoon fisheries could be assessed to provide a complete picture of their technical, environmental and socio-economic conditions. The methodology was applied to study the small-scale fisheries of the estuary of Patos Lagoon, Brazil, with a view to understand their present condition and vulnerabilities and to recommend and discuss strategies to enhance livelihood security and sustainable use of resources.

Following the overview of the case study, which is in this chapter and presented below, Chapter 2 introduces the methodology used, and Chapters 3, 4 and 5 present the main results of the study. Finally, Chapter 6 discusses the lessons learned on the study methodology, the key findings of the case study and its recommendations for the future governance of small-scale fisheries in the estuary of Patos Lagoon.

General overview of the Patos Lagoon estuary

The estuarine region of the Patos Lagoon is located in the southern Brazilian coastal zone (State of Rio Grande do Sul), an area of the Biosphere Reserve (United Nations Educational, Scientific and Cultural Organization – UNESCO). With an area of approximately 10 000 km², the Patos Lagoon is recognized as the world's largest choked lagoon, stretching from 30°30'S to 32°12'S near the city of Rio Grande, where the lagoon connects to the Atlantic Ocean (Figure 1).

Diverse and abundant flora and fauna abound in the estuary. The abundant food resources and protection against predation provided by estuarine shoals make this region an ideal nursery ground for several commercially important fish species. The estuary is characterized by a shallow body of water (mean depth of 7 m) with variable temperature and salinity depending on local climatic and hydrological conditions (Castello, 1985). The dynamics of estuarine waters are mainly conditioned by the wind and rain regimes with only a minor influence by tides. In general, from September to April, the dominant winds are from the northeast, north-northeast and east-northeast, while in the winter period from June to August, the winds are from the east, south, southeast and southwest and are more frequent. While the former favour the discharge of freshwater into the ocean and create a low salinity regime in the estuary, the latter force the penetration of saltwater through the estuarine channel and create conditions for a marine regime in the estuary (Möller, Paim and Soares, 1991). The total mean annual precipitation (1 200–1 500 mm) varies strongly from year to year and is mainly related to the path and passage of cold fronts. Mean monthly rainfall is highest during the winter and spring (June to

October), but a second peak may occur in the summer. Interannual variations in precipitation with either a high amount of rainfall or dry periods seem to be a consequence of the effect on the El Niño Southern Oscillation (ENSO) cycle on the regional climate (Seeliger, Odebrecht and Castello, 1997). As a general rule, years of strong El Niño events cause flooding regimes in southern Brazil. This phenomenon directly influences the amount of continental freshwater runoff and the bio-geochemical processes in the estuary and coastal ecosystem (Ciotti *et al.*, 1995).

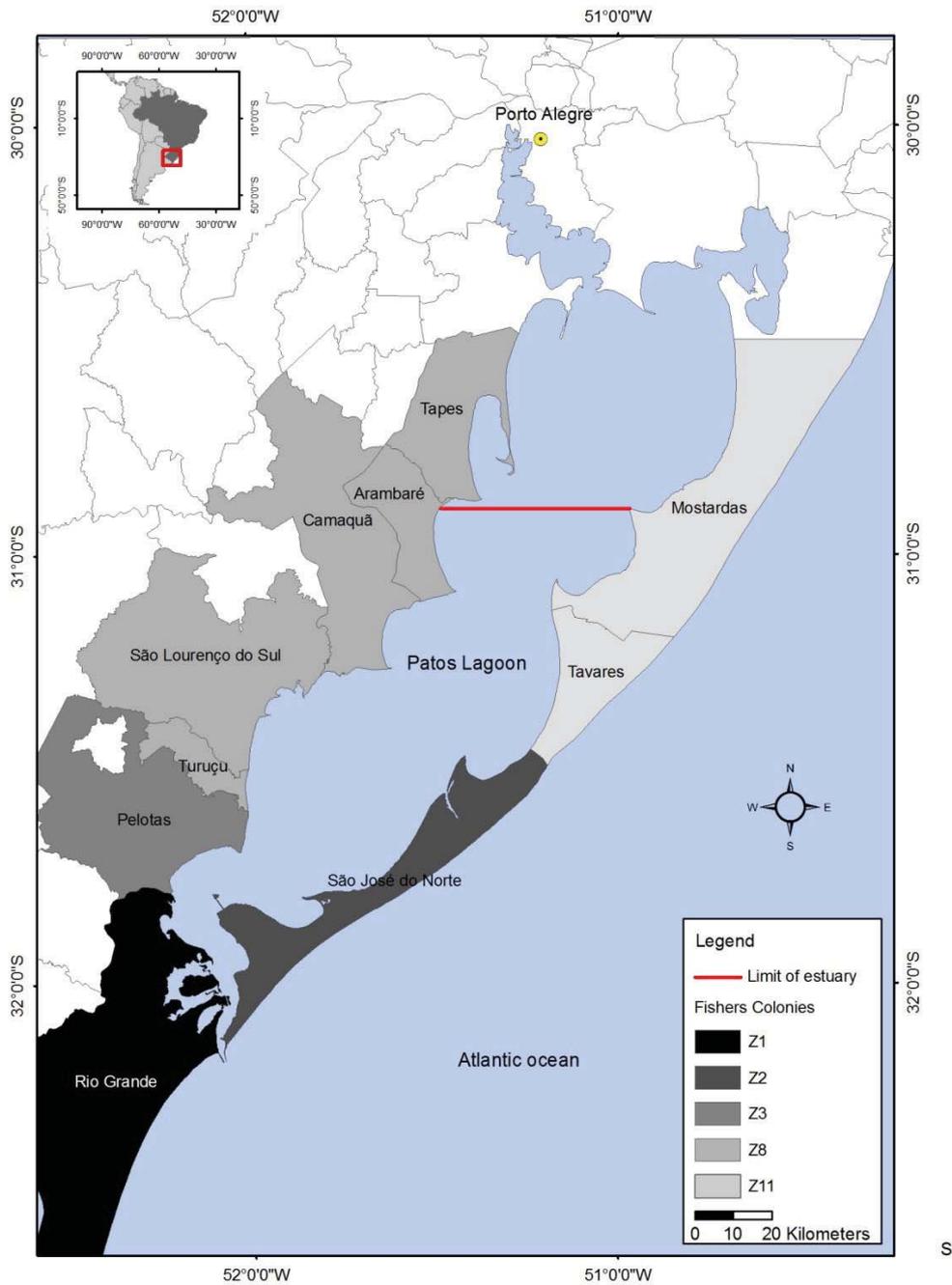


Figure 1: Map of the estuary of Patos Lagoon with the municipalities and fishers' colonies
Note: Fishers' colonies are professional organizations of fishers of a given municipality, which are legitimized by the Federal Constitution as one form of a working union.

Table 1: Summary of the biology and life cycle of main artisanal fisheries resources in the Patos Lagoon estuary

Pink shrimp (<i>Farfantepenaeus paulensis</i>)	An estuarine-dependent species. Adults spawn at sea on the continental shelf in waters deeper than 50 m, producing demersal eggs that hatch into planktonic larvae. Once they have entered the estuary, the larvae develop a benthic habit settling in shallow areas where they will grow for a few months until reaching the pre-adult phase, when they migrate to the ocean reinitiating the cycle. Larvae enter with varying success into the estuary all year round but mainly in the spring and summer, depending on the environmental forcing of wind and freshwater outflow. The growing phase in the estuary may last between 4 and 10 months, when they reach about 7 cm in length. The species is considered depleted.
Marine catfish (<i>Genidens barbus</i>)	Slow-growing anadromous species with a calculated life span of approximately 23 years, though adults may occasionally attain 36 years of age and a total length of 98 cm. At the end of the winter, the species migrates into the Patos Lagoon estuary. Reproduction takes place in the early spring in the estuary, followed by spawning in the coastal waters in the summer. <i>G. barba</i> has low fecundity and, after reproduction, the males incubate the eggs for up to two months in the buccal cavity. Between spawning seasons, adults disperse over the entire shelf. The species is considered collapsed.
Croaker (<i>Micropogonias furnieri</i>)	The species depends on the estuary of Patos Lagoon as a nursery and feeding ground. Croakers spawn during spring and summer in coastal waters under the influence of freshwater runoff from the Patos Lagoon. Adults normally migrate into the estuary in September–October and migrate out in December–January. Young and subadult croakers occur throughout the year near the coast and in the estuary of Patos Lagoon. Adults are dispersed over the shelf and migrate from Uruguay to southern Brazil during the fall and winter and towards Uruguay in the summer. The species is considered overfished.
Mullet (mainly represented by <i>Mugil platanus</i>)	Mullet occur year round in the Patos Lagoon and adjacent coastal waters. Juveniles are more abundant in the winter and spring in nursery areas of the lagoon. In the fall, adult mullet leave the estuary and initiate their reproductive migration. Spawning occurs in warmer offshore waters at about 27°S between the end of the fall and winter. Eggs and larvae are transported from spawning ground towards the surf zone, followed by long-shore migration to the estuary of Patos Lagoon. The species is considered fully exploited and threatened with overfishing.

Sources: D’Incao, 1991; Reis, 1986; Haimovici, 1997; Vieira and Scalabrin, 1991; Vasconcellos and Haimovici, 2006; Vasconcellos, Diegues and Sales, 2007.

The characteristics of the life cycles of species create a well-defined seasonal variability in the diversity and abundance of resources in the estuary and also in the availability of resources to artisanal fisheries. Fisheries landings also present a marked interannual variability, which is related to the occurrence of strong ENSO events (Figure 2; Möller, Castello and Vaz, 2009). ENSO events have an impact on the amount of rainfall in the region, and these events can directly influence the availability of resources to artisanal fishers in the estuary and thus impact the total landings.

The artisanal fishery operates in estuarine and shallow coastal waters. It is characterized by simple fishing technologies and, consequently, lower fishing effort compared with semi-industrial and industrial fisheries that operate in coastal waters (Haimovici *et al.*, 2006). Artisanal fishers normally own their vessels and work together with their kin. The main types of fishing gear used by artisanal fishers are gillnets, stownets and otter trawls.

The available data on artisanal fisheries landings indicate that total production increased from close to 10 000 tonnes in 1945, reached a peak of 43 640 tonnes in 1972, and steadily declined since then (Figure 2). Total landings in 2008, the last year of available data, were 6 592 tonnes. Landings of the main resources followed more or less the same pattern of decline after the mid-1970s, mainly as a result of overfishing. Today, the main artisanal resources are fully

exploited, overexploited or depleted, and catches are close to subsistence levels, with the exception of mullet and shrimps, which provide sporadic good economic returns during ideal environmental conditions (IBAMA, 1995; Reis and D’Incao, 2000). Trends are more difficult to interpret for silverside and blue crabs, which have been poorly monitored. The blue crab fishery has a much more recent history than the other fisheries.

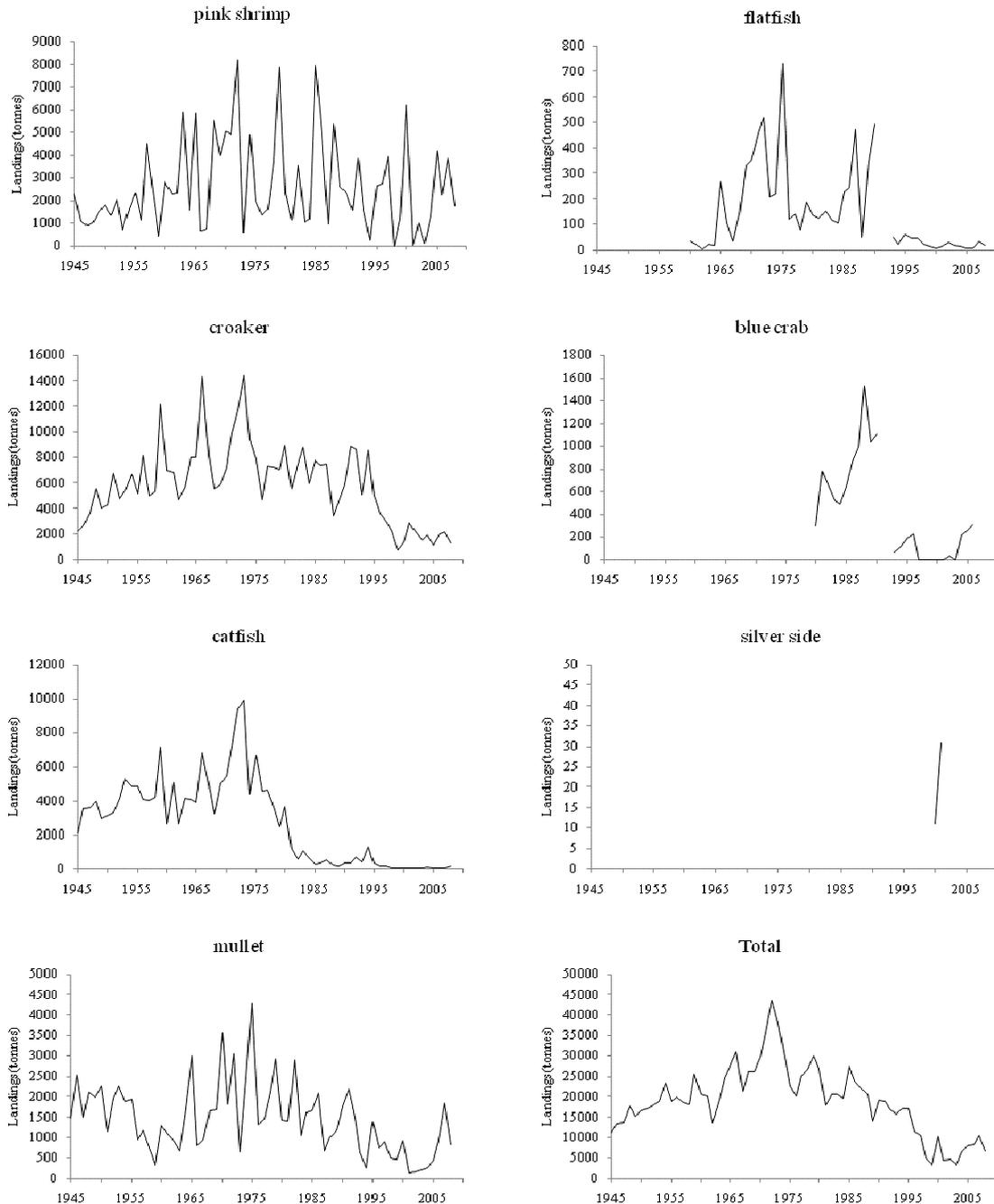


Figure 2: Artisanal fisheries landings, by resource and total, in the Patos Lagoon estuary
(Source: CEPERG/IBAMA)

Table 2 shows the distribution of the main fisheries resources exploited by artisanal fisheries. According to data from the Center of Fisheries Research and Management of Estuarine and Lagoon Fisheries (CEPERG) and the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), these species compose over 90 percent of total artisanal catches in southern Brazil. The shaded boxes in the table represent the aquatic zones where these resources occur (Vasconcellos *et al.*, 2005; Haimovici *et al.*, 2006). The table also shows that of the

31 most important species only 9 of these spend their entire life cycle in freshwater and another 10 completely in the marine environment. None of the species spend their entire life cycle in the estuarine environment. However, of the 12 species that spend part of their life cycle in the estuary, 11 of these migrate between marine waters and estuarine and 1 migrates between fresh and estuarine water.

Species, such as croaker, weakfish, Argentine croaker and bluefish, which are primarily marine species, migrate across international borders. In these areas, resources are also exploited by other types of fisheries using distinct technologies (Haimovici *et al.*, 2006).

Table 2: Distribution of the main fisheries resources exploited by artisanal fisheries (these species compose over 90 percent of total artisanal catches according to data from CEPERG/IBAMA)

Species	Local names	Environment		
	(Portuguese, English)	Freshwater	Estuarine	Marine
Fish				
<i>Brevoortia pectinata</i>	Savelha, menhaden			
<i>Cynoscion guatucupa</i>	Pescada olhuda, weakfish			
<i>Hoplias malabaricus</i>	Traíra			
<i>Hypostomus</i> spp.	Cascudo, catfish			
<i>Leporinus obtusidens</i>	Piava			
<i>Loricariichthys</i> spp.	Viola, catfish			
<i>Luciopimelodus pati</i>	Pati, catfish			
<i>Macrodon ancylodon</i>	Pescadinha, weakfish			
<i>Menticirrhus</i> spp.	Papa-terra, king croaker			
<i>Micropogonias furnieri</i>	Corvina, croaker			
<i>Mugil platanus</i>	Tainha, mullet			
<i>Genidens barbatus</i>	Bagre, marine catfish			
<i>Odontesthes bonariensis</i>	Peixe-rei, silverside			
<i>Odontesthes argentinensis</i>	Peixe-rei, silverside			
<i>Oligosarcus</i> spp.	Tambica			
<i>Paralichthys orbignyana</i>	Linguado, flatfish			
<i>Pimelodus maculatus</i>	Pintado, catfish			
<i>Pogonias cromis</i>	Miragaia, black drum			
<i>Pomatomus saltatrix</i>	Anchova, bluefish			
<i>Prochilodus lineatus</i>	Grumatá, streaked prochilod			
<i>Pseudocurimta gilberti</i>	Biru			
<i>Rhamdia</i> spp.	Jundiá, catfish			
<i>Rinobathos horkellii</i>	Viola,			
<i>Salminus orbignyanus</i>	Dourado			
<i>Sorubim lima</i>	Surubim, duckbill catfish			
<i>Squatina</i> spp.	Cação anjo, angel shark			
<i>Umbrina canosai</i>	Castanha, croaker			
<i>Urophycis brasiliensis</i>	Abrótea, codling			
Crustaceans				
<i>Callinectes sapidus</i>	Siri, blue crab			
<i>Farfantepenaeus</i>	Camarão-rosa, pink shrimp			
<i>Xiphopenaeus kroyeri</i>	Camarão-sete-barbas, seabob			

Source: Vasconcellos *et al.*, 2005; Haimovici *et al.*, 2006.

Fisheries resources also suffer from the impacts of human activities on the coast, such as pollution, contamination, dredging, and loss of nursery habitats (Seeliger, Odebrecht and

Castello, 1997). In the estuarine area of the Patos Lagoon, contamination by organic matter and metals in the water and the estuarine sediments is due to urban and industrial drainage, activities linked to the fishing terminals and to port activity. Alterations in the natural hydrological patterns and a series of impacts on the salt marshes caused by several human sources have also been reported (Seeliger, Odebrecht and Castello, 1997).

Despite its high ecological importance as a biosphere reserve, the Patos Lagoon estuary and its surrounding ecosystem are under heavy and constant anthropogenic pressure owing to economic development. The municipalities of Pelotas (about 328 000 inhabitants) and Rio Grande (about 197 000 inhabitants) are the most important urban centres in the region. The port and harbour facilities of the city of Rio Grande are important geopolitically and strategically for international economic market systems, and both state and federal governments have a keen interest to accelerate the economic development in the Patos Lagoon. The opportunities created for rapid and intense industrialization and development impacts negatively on the environment. Concurrent with the present depletion of fishery resources, natural features such as marshes, riparian forests, wetlands, lagoons and coastal beaches, which have an important role in the maintenance of the coastal ecosystems integrity, are being exploited by conflicting activities for short-term economic interests. Historically, socio-economic demand has tended to collide with ecological preservation, and increasing human alterations are jeopardizing the health of the coast and the estuarine region of the Patos Lagoon and thus compromising the quality of life of local communities whose livelihoods depend on coastal resources (Seeliger, Odebrecht and Castello, 1997).

2. METHODOLOGY

This chapter describes the steps that led to the scope and focus of the study and the methods used to conduct the research. The study design was prepared in a manner that allowed linkages between qualitative and quantitative data, iterative workshops, fieldwork and literature reviews (Jick, 1979; Payls, 1992; Creswell, 1994; Maxwell, 1996; Strauss and Corbin, 1997).

Operational definition of small-scale fisheries for this study

Small-scale fisheries or artisanal fisheries are used here interchangeably and generally emphasize relatively simple and easily available technologies used by household or family-based social units as compared with larger-scale and industrial or company-based fisheries. Importantly, small-scale fisheries incorporate both subsistence and commercial fisheries (Garcia *et al.*, 2008). Artisanal fishery is defined in this study as the activity practised by professional fisherfolk directly, independently or in a household system, with their own means of production or under contractual partnership, using small vessels (Law 11.959, 29 June 2009). Small vessels up to 12 m in length are allowed to fish in the Patos Lagoon estuary (Decree MMA/SEAP No. 03/2004).

Fisheries census methodology

The selection of a census methodology as the main survey instrument for studying small-scale fisheries in the Patos Lagoon estuary was decided on after preliminary analysis of information and data gathered from detailed interviews and meetings with representatives of the Ministry of Fisheries and Aquaculture, IBAMA, the Public Ombudsman, the Ministry of Labour and Employment, the Navy, the Forum of Patos Lagoon, Fishers' Colonies, associations and cooperatives, and universities. In addition, supplemental secondary data included reviews of scientific reports, local newspapers, the Forum of Patos Lagoon meeting minutes, as well as databases, laws, decrees and policy statements from the environmental agency (IBAMA), the former Federal Sub-Secretary for Fisheries Development (SUDEPE), the Ministry of Fisheries and Aquaculture, the Ministry of Labour and Employment, and the Bank of Brazil. From this review and the meetings, it became clear that the most basic information, such as the number of fishery-dependent people and fishing livelihoods strategies, were highly uncertain. In all fisheries, good and up-to-date information and data on the technical, socio-economic, resource and environmental aspects are necessary for appropriate management and governance of the fisheries. The preliminary analysis of the information and data available on the Patos Lagoon estuary indicated the need for establishing a benchmark for the technical, economic, social and environmental conditions of small-scale fisheries so as to know the actual status and eventually to measure the different trends within the fishery. The analysis also identified the major information gaps. Once these were identified, a simple, robust and easily replicated standard survey instrument for data collection was developed for the study. The main elements for data gathering to establish the status and trends identified are shown in Table 3.

Table 3: Relevant elements for data gathering to establish status and trends

Technical	Economic	Social	Environmental
<ul style="list-style-type: none"> • Fishing vessels • Fishing effort and catches • Fishing seasons and areas • Infrastructure and processing • Safety at sea • Documentation 	<ul style="list-style-type: none"> • Main sources of income • Marketing and commercialization • Microfinance • Assets 	<ul style="list-style-type: none"> • Availability of public services in communities • Fishing livelihoods • Fishing as part of family/cultural tradition • Collective formal and informal organizations (status and legitimacy) • Access to public policies/benefits • Fish consumption • Conflicts 	<ul style="list-style-type: none"> • Legitimacy of legal framework • Local ecological knowledge • Historical trends in catch and effort • Fisheries impacts

Census survey instrument

The census survey questionnaire was designed based on the preliminary information gathering process and the gap identification. The design was made to collect the data needed to assess the technical, socio-economic and environmental conditions of small-scale fisheries. The questionnaire was first drafted in August 2009 and, after two meetings with officers representing the Ministry of Fisheries and Aquaculture, the Secretary of Fisheries of the municipality of Rio Grande, the Public Ombudsman, the Ministry of Labour and Employment and fishers' representatives, a final draft was agreed to by all parties. The final agreed draft of the questionnaire was then used as a test survey with fishers from the main localities of the estuary to test the census survey questionnaire for both content and language. A final revision of this questionnaire was made, taking into account the results of the test. Once the final questionnaire was completed, it was presented at an inception workshop to a wide range of stakeholders.

The final survey questionnaire was divided into two parts and can be seen in Annex 1. The first part of the questionnaire identifies the interviewee, including his/her name, ID information, boat registry, access to social benefits, personal and family information, and aimed at gathering information at the household level. The second part of the questionnaire was designed to be anonymous because of the sensitive questions it contains; for example, the use of fishing gear and practices (some of them not allowed by law), fishing effort and capacity, livelihood strategies (some of them conflicting with the legislation), as well as trust in the institutions. By making the second part of the questionnaire anonymous, the survey design attempted to strengthen the veracity of the information declared during the interview and to capture the complexity of the fishery with accuracy without putting fishers at risk. This questionnaire was only directed at individual fishers who are involved in capture activities. The anonymous questionnaire was further divided into two other sections (A and B). Fishers who possessed the means of production (gear and boats) answered sections A and B, while fishers who were only crew members answered only section B. Despite the identification of respondents in part A of the anonymous questionnaire, the identity of all informants was held in complete confidence in the data analysis and results.

Inception workshop

An inception workshop was held at the *Centro de Convívio dos Meninos do Mar* (CCMAR-Federal University of Rio Grande [FURG]) on 19 October 2009 to officially launch the study

and to discuss the project's objectives and methodology with main stakeholders of the small-scale fisheries of Patos Lagoon. A total of 70 people participated in the inception workshop. They included representatives from various institutions and fisher communities. The relevant workshop documentation is in Annex 2.

At the workshop, a Letter of Intention was signed between FURG and the Ministry of Fisheries and Aquaculture with the objective to formalize a partnership with the Ministry, and thus obtain its logistic support to the project, and, most importantly, to secure a formal agreement that any results coming out of the project would be fully trusted by the Ministry and used as a basis for policy and management actions. The idea of pursuing a formal recognition of the study was a strategy to guarantee that the results could be used by government agencies without being challenged on the grounds that it was not an initiative of the Ministry or other institutions involved in fisheries management. This initiative was previously discussed and agreed between the parties and formalized at the workshop.

Following the presentation of the goals of the study and the methodology to be applied, the floor was open for comments and discussion. All comments received were supportive of the initiative and the questions raised demonstrated that the census questionnaire was fairly complete and relevant to the issues of interest to small-scale fishers. The inception workshop was also important for informing community leaders of the project's objective and approaches, and for helping to minimize any misunderstandings that could interfere with fieldwork in the fishing villages. One such misunderstanding identified before the workshop was that the study would be used as an instrument to prosecute fishers who are operating illegal fisheries. In this sense, making the questions related to fishing operations part of the anonymous questionnaire was fundamental to obtain acceptance from fishers to participate in the study. In addition, during the workshop and in radio interviews given by the study coordinators before and after the workshop, it was emphasized several times that: (i) the study would fill important data gaps on small-scale fisheries; (ii) it was in the best interest of fishers to tell the truth during the interviews so that any policy and management actions would be reflective of their actual situation; and (iii) the identity of fishers would not be revealed for any purpose besides the development of a registry of fishers by the Ministry of Fisheries and Aquaculture. This was an extremely important aspect of the study.

Selection and training of enumerators

To start the fieldwork, it was necessary to select and train the field staff. Qualified enumerators and field supervisors of this study included students registered at the university. They were selected based on their academic credentials and previous experiences with interviews and community members of local fishing villages. A total of 16 enumerators and 2 supervisors were hired to implement the survey. A training course was run for three days to train the selected enumerators in the survey questionnaires (including both content and survey methodology).

Enumerators were encouraged to record any additional information on the questionnaire that they obtained through conversation with the respondent, which would also be used in data analysis. The enumerators were trained to interpose a suitable statement that reassured the respondent of the confidential nature of the information they had reported and that the intention was to provide correct data on artisanal fisheries. They were also trained to enter "zero" or a cross bar on the questionnaire to make sure that they did not forget to ask a question in cases where a question should be skipped or could be answered.

In order to obtain the most reliable and accurate information, enumerators were thoroughly trained on key concepts, aspects and problems associated with artisanal fisheries and their management. In addition, they were provided with census materials available at the Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística*, www.ibge.gov.br) and key bibliography involving all aspects of artisanal fisheries in the Patos Lagoon estuary.

Census fieldwork

Fieldwork in the estuary of Patos Lagoon was carried out from October 2009 to October 2010. For the purpose of this study, the estuary was defined according to Decree MMA/SEAP No. 03/2004. This decree regulates small-scale fisheries in the estuary of Patos Lagoon, defined as “the area encompassed between Arambaré (32°50'S) and the mouth of Patos Lagoon in Rio Grande (32°10'S)”. The area is bordered by the municipalities of Rio Grande, Pelotas, São Lourenço do Sul, Turuçu, Arambaré and Tapes on the west shore and by the municipalities of São José do Norte, Tavares and Mostardas on the east shore, as shown in Figure 1. All these municipalities were covered in the study.

Census fieldwork was preceded by the mapping of fishing communities for the entire area covered by the census with the assistance of government officials and community leaders. Figure 3A shows a sample of the mapping exercise using satellite images. The location of fisher households within the communities was done using two types of approaches, depending on the characteristics of the communities.

For isolated rural communities, where the majority of the households depend on fisheries, households were mapped and identified using recent satellite images such as the ones available on Google Earth (Figure 3B). The mapping exercises were done with the participation of fishing community leaders. During the exercise, a preliminary estimate of the number of fishers was calculated in each locality.



Figure 3A: Example of the mapping in the municipality of Pelotas. **Figure 3B:** Fisher households identified in the rural community of Torotama in the municipality of Rio Grande

For communities inserted in urban areas, the mapping of households was preceded by an analysis of fishers' lists obtained from community leaders, government officials (Municipal Secretary of Fisheries and IBAMA), Fishers' Colonies and syndicates, and fishers' associations and cooperatives. From these different and complementary sources, a final list of people was produced and mapped according to the names and addresses provided. Also, through the snowball sampling technique in the field (Czaja and Blair, 1996), fishers identified other fishers in their neighbourhoods who were not on the original lists. The maps were also used to keep records and monitor areas where enumerators had covered or where they would need to return to in case of not finding a fisher at home. The data gathered through the census survey covered 100 percent of the artisanal fisheries localities of the estuary. In Figure 4, the areas in grey show the artisanal fishers' localities that were covered in the survey. No localities of artisanal fishers were identified in the municipality of Turuçu, which is shown in white.

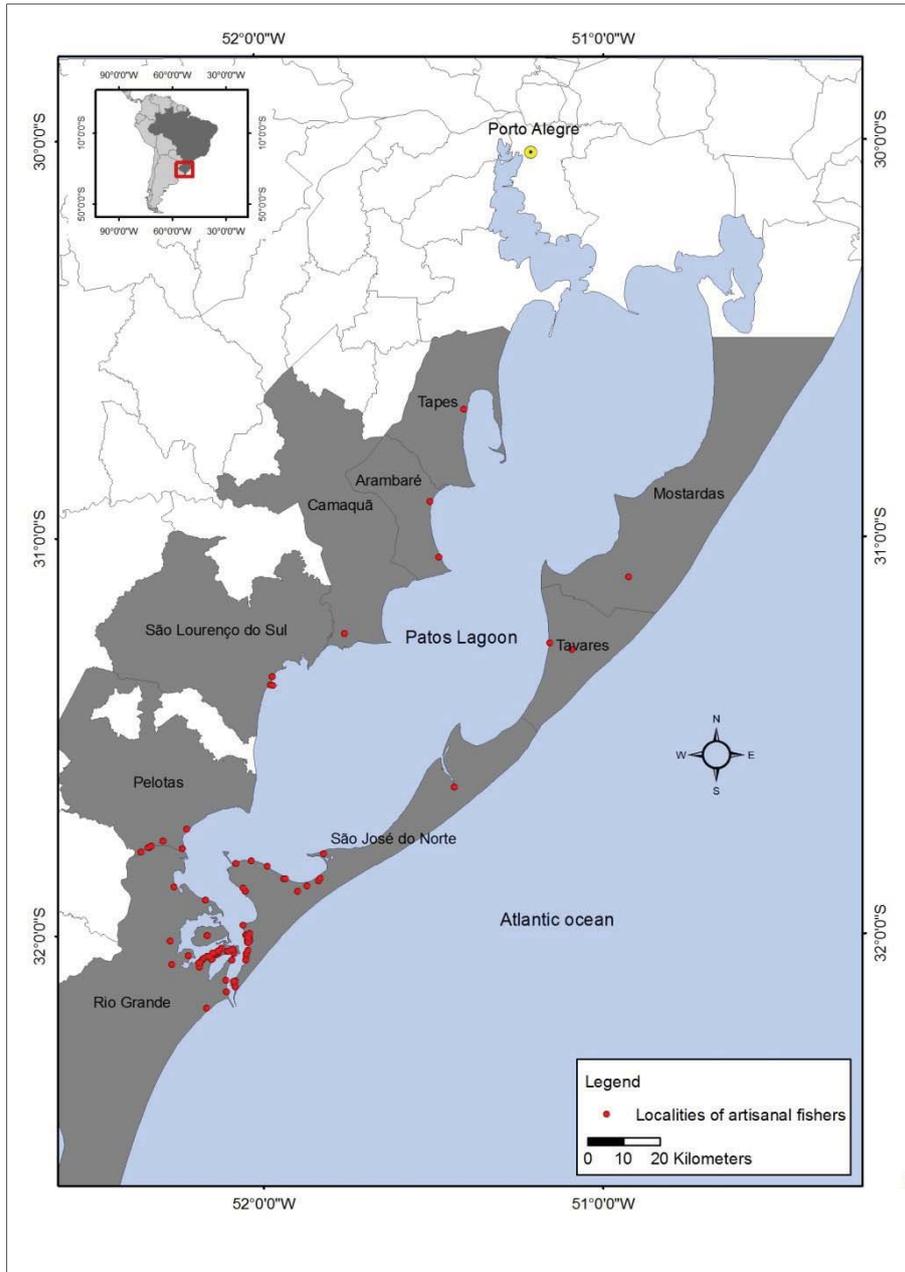


Figure 4: Location of artisanal fishers' localities in the municipalities of the Patos Lagoon estuary

A thorough analysis was necessary for determining the best season and most appropriate time during the day to carry out the survey work. This is crucial for a successful survey. After this analysis, it was decided to implement the survey during two periods: the first part was carried out between November 2009 to January 2010, and the second from May 2010 to October 2010. It was necessary to stop data collection from February to mid-May because these are the most active months of the shrimp fishing season and it is difficult to find fishers at their homes to conduct the survey. The closed season for fishing in the estuary is from 1 June to 30 September, and therefore the best period for conducting interviews, as almost all of the fishers were at their villages fixing their nets and maintaining their equipment.

Whenever possible, the schedule for the census was arranged in advance. In most cases, however, previous arrangements were difficult to make as most respondents did not have a phone. Repeated visits were necessary when fishers were not found at home. In some cases, the supervisors had a contact person (e.g. fisher and/or wives of fishers) in the locality who either

introduced enumerators to the fishers or arranged a place where the survey could be conducted. The contact person proved to be important in making the interviewing process more efficient.

The census was an enormous operation and extremely time consuming, as enumerators collected data every day, including some weekends and holidays, and worked at least eight hours per day (in some cases even more) in urban and rural fishing villages. Some fishing villages in the estuary are easy to reach while others are more isolated and journeys may take up to two-and-a-half hours by car or boat. In cases of bad weather, these villages are not accessible.

Census data were collected through face-to-face interviews at fishers' homes, warehouses or in the field (Figure 5). On average, the duration of each interview was 40 minutes. On some occasions, interviews were done through task forces of two types: a task force organized by community leaders for the purpose of the census and a task force organized by the Ministry of Labour and Employment for fishers' applications for unemployment benefits.



Figure 5: Enumerators conducting census interviews in the field

The enumeration operation followed a well-designed and controlled day-to-day plan, organized and carried out methodically and according to a predetermined plan and time schedule. Data collected were checked at the end of each day by supervisors to evaluate and give the enumerators an insight into the types of mistakes respondents may have made. They also assessed the nature and extent of errors, advised on what precautions should be taken to avoid them and made corrections where necessary. Supervisors collected questionnaires at the end of each day and stored them at the office to be coded and digitized.

The study team also identified measures that would improve the collection of data and data quality. For instance, enumerators visited villages only after a public announcement had been made for their arrival. In other villages, radio broadcasts turned out to be a more effective way of communicating. Radio interviews with project coordinators were held to explain the objectives and the importance of the fisheries census, as well as to inform fishers of the type of information that would be collected, what this information would be used for, the days the enumerators would arrive, and to encourage fishers to respond to and collaborate with the

census to ensure the maximum coverage. In other villages, a leading fisher accompanied the supervisors and enumerators to facilitate easy access into the communities, to find fishers to be interviewed, and also to make the presence of the enumerators the least awkward for the interviewees. These measures greatly improved data quality. In addition, a pamphlet indicating the purpose of the census was distributed to fishers and was placed in common public places normally frequented by fishers.

Once at the fishing village, supervisors distributed a map to enumerators indicating the village sectors and houses to be covered under the responsibility of each enumerator. Supervisors also walked through the village informing residents about the objectives of the census and explaining that fishers would receive a visit from an enumerator that day or during subsequent days.

All respondents were approached by acknowledging that they were selected as a potential respondent in the research project and asked about their availability and desires to participate in the census.

The following are the steps that enumerators followed before beginning the interview. They first identified themselves by showing an identification card, and then followed by giving a clear explanation about the project, stating: (i) the purpose and objectives of the census; (ii) the confidential nature of the interview, and that the data supplied were for statistical purposes only and would not be used against them by any organization or for law enforcement purposes, such as investigation against fraud for the unemployment benefit or for taking away their fishing licences; (iii) that individual information would not be made available to anyone outside the project, and that the census information would only be released in an aggregate or in such a way that it was impossible to identify individual data; (iv) why the respondent was selected; (v) the importance of their collaboration; and (vi) the possible benefits they could receive by accepting to participate in the census. All questions were asked in the same order and the enumerators were instructed not to provide comments that would influence the answers.

The fishers were very keen to participate in the survey. In fact, in many localities, several fishers asked to participate in the census. Two points contributed to this success: (i) questions were well developed beforehand and included the inputs and revisions given by fishers during the pre-test; and (ii) participants could clearly perceive the purpose of the questions and intuitively understood that the outcome of the census would be in their best interests.

There were also tough experiences, as some fishers had “researcher fatigue”. They had participated in many such interviews but saw little benefit from them. One fisher expressed his anger saying that he would not respond to the questions because every time “somebody like us” went to the community the end result was some law that worked against them instead of one that worked for them. When this situation occurred, enumerators and supervisors allowed fishers to talk and then they reinforced the objectives of the research and, most importantly, explained the importance of their collaboration with no promises made. Then time was given for reflection about their willingness to participate in the census. In all cases, after reconsidering, they agreed to participate.

Semi-structured interviews

While the census methodology provided an overall updated picture of the status of small-scale fisheries and served as a basis to identify the main characteristics of fisheries in the Patos Lagoon estuary, there was a need to explore the economic performance of selected typologies more deeply and to better understand the issues affecting the development of responsible small-scale fisheries in the estuary.

To secure this information, semi-structured interviews were carried out to obtain information on the technical and economic aspects of the various fishing units. The questions, interview

structure and language were along the lines of those previously tested. Fishers, who were recognized by the local fishing community as highly knowledgeable and representative of the type of fishing livelihoods in the community, were recommended for the interviews. These interviews were anonymous, which allowed the fisher to speak freely for two to three hours.

For this process, a total of ten fishers from some of the main fishing localities of the estuary were interviewed. Interviews focused on collecting data to characterize the fishing units, the fishing dynamics, and the economic and financial performance of the operations. Following Tietze *et al.* (2001), the information collected included the size and number of vessels, fishing gear used, vessel and gear acquisition costs, and the dynamics of costs and earnings of the fishing operation. The earnings were calculated as the volume of the main commercial species captured multiplied by the unit price during a typical year. Information on earnings they had obtained outside the fishery (e.g. working in the city or in agriculture) and/or from government aid (e.g. unemployment benefit during fishing closure) was also collected. In the calculation of costs, operational and fixed costs were considered. The operational costs included: labour, fuel, oil, gas for the gas lamps used in shrimp fyke net fisheries, ice, and vessel and gear maintenance. The fixed costs included: boat safety inspection fees, onshore facilities maintenance, fishing licence fees, union and association dues, vessel insurance, leasing and rental of vessels, vessel and gear depreciation, and loan payments, among other costs. All costs and earnings data are expressed in Brazilian reais (R\$1 = US\$0.64, 2010).

To assess the economic and financial performance of fishers, the following indicators were used:

- *net profit*: value of landings minus all costs;
- *net profit/total earnings*: expresses the net profit as a percentage of the total earnings;
- *rate of return on investment*: calculated as the ratio of the net profit and the invested capital, indicates the profitability of the investment in relation to other alternative investments; and
- *rate of economic dependence on fishing*: calculated as the ratio between the total earnings from the fishery and the total earnings from all economic activities in the household, this indicator assesses the economic importance of fisheries livelihoods.

Attempts were also made to calculate the above indicators in situations of increased risks (i.e. during bad fishing seasons) to better characterize the vulnerability of the different fishing units.

Data obtained in the semi-structured interviews were analysed in conjunction with census data to identify the vulnerabilities of fishing systems, to identify and analyze the most vulnerable groups of fishers, and to understand the features that make some fishers environmentally, economically and socially more vulnerable than others.

Data storage, processing and analysis

A database was created in Microsoft Excel to store all the data collected by the project. The main activities in data processing involved the following:

- *Monitoring and checking the questionnaires*: when enumerators returned the completed questionnaires, they were placed in a dedicated storage space to avoid damaging or misplacing them. Questionnaires were grouped according to localities and/or municipalities and identified by appropriate forms relevant to the filing system adopted.

Monitoring and control of questionnaires was key to avoid misplaced questionnaires because during the processing, questionnaires were removed from storage multiple times for manual editing, data entry and verification, and for double checking figures when computer editing detected potential errors.

- *Checking, editing and coding:* checking during data processing was done to achieve consistency within the data and consistency within and between tables to detect, verify, correct or eliminate outliers, as these extreme values are major contributors to errors. Random reviews of the checking and coding operations was done to develop a pattern for correcting errors and for interpreting difficult-to-read handwritten responses. Editing also involved revising or correcting the entries in the questionnaires. The need for revising recorded data occurred normally in cases of illegible editing and correcting the answers by the enumerators. Coding refers to the operation where original information from the questionnaire, as recorded by enumerators, is replaced by a numerical code required for processing.
- *Data entry and verification:* refers to the transfer of data from questionnaires to computer-readable media, which took up large amounts of time and resources. This operation was performed by data entry clerks and by enumerators when not in the field. All data for the questionnaire were entered as soon as possible after collection. Data entry was verified by the census supervisor who reviewed and/or corrected the work done by the initial data entry clerk. Verification was done on a sample basis so as to monitor the performance of the data entry clerks and to correct any mistakes made when the data were transferred from the questionnaire to the computer document.
- *Computer editing:* computer editing involved checking the general credibility of the data by computer with respect to missing data, range tests, and logical and/or numerical consistency. Examples encountered included non-responses, improbable or impossible entries and internal inconsistencies. Computer editing aimed at discovering not only errors in questionnaires, but also errors committed at the data entry stage. Data processing errors included those errors made when transferring information from the questionnaire to the computer document, either from illegible handwriting or other reasons. These errors were discovered by data entry verification, by computer checking for data consistency, and by routine controls comparing the computer data storage and the census questionnaire. The errors detected were corrected manually after comparison with the census questionnaire.

Both descriptive and simple statistical tools were used in the analysis of data generated by the census and the semi-structured interviews, including percentage distribution and measures of central tendency.

In some cases, comparisons were made between urban and rural localities. The rural localities were defined using criteria such as distance from urban centres and share of primary activities (including agriculture and fisheries) in employment and economic value (UNECE, 2007).

Estimating the number of artisanal fishers in the Patos Lagoon estuary

The census data enabled the study team to assess the total number of active fishers in the estuary of Patos Lagoon. To account for possible errors in fieldwork, an approach was developed to evaluate the accuracy of census point estimates. The level of error in the enumeration of fishers from each locality was assessed using the following criteria: (i) level of coverage of fisher households in the locality; (ii) number of households visited where no one was at home; and (iii) number of people interviewed who were unlikely to be fishers. While criteria (i) and (ii) would lead to an underestimation of the number of fishers, criteria (iii) would overestimate the numbers of fishers.

Each locality was assigned, by consensus among the study team, a maximum level of error related to each of the three criteria. The level of error followed a quali-quantitative scale: very good (5 percent); good (10 percent); medium (15 percent); poor (20 percent); and very poor (25 percent). For instance, a locality that had a good coverage (10 percent error), a low number of households visited with no interviews performed (10 percent error) and a perceived poor level of accuracy in identifying and interviewing fishers (20 percent error) was assigned a level of error varying from –20 percent to +20 percent around the point estimates.

The approach was applied only to the municipalities with the highest concentration of fishers, i.e. São José do Norte, Rio Grande and Pelotas (see Chapter 3). Confidence bounds for the total number of fishers per municipality and for the whole estuary were estimated through Monte Carlo simulations, where the estimated number of fishers from each locality was sampled from triangular distributions having the census enumeration as mode and the assigned errors (as defined above) as lower and upper limits. A total of 10 000 simulations were performed to obtain the confidence bounds.

Final workshop

Results of this study were presented to stakeholders during the workshop “Status and perspectives for the artisanal fisheries of the estuary of Patos Lagoon: results from the census of artisanal fisheries”, which was held on 13 April 2011 at the Federal University of Rio Grande. Besides serving as a venue to publicize the main findings of the study, the workshop was also useful to validate the results and to obtain further information from stakeholders that was used in the interpretation of the data collected.

3. THE STATUS OF ARTISANAL FISHERIES IN THE PATOS LAGOON ESTUARY

Technical aspects of artisanal fisheries

Number of artisanal fishers

Table 4 and Figure 6 show a summary of the number of artisanal fishers and the total number of people directly dependent on artisanal fisheries in the Patos Lagoon estuary. In total, 3 259 fishers in 153 localities in the nine municipalities that border the estuary were enumerated. The municipalities with the highest concentration of artisanal fishers are, in decreasing order of importance, São José do Norte (1 183 fishers), Rio Grande (1 080), Pelotas (608), São Lourenço do Sul (150) and Tavares (112). Together, they account for 96 percent of the total number of fishers in the estuary. The average number of fishers estimated based on assumptions about coverage and identification errors was 3 311. The minimum and maximum estimates were 3 176 and 3 475, representing an error between -3 percent and +7 percent from the total number of fishers enumerated.

The estimates shown in Table 4 are well below previously available estimates of the number of fishers in the region. Using information from different sources, including governmental agencies and Fishers' Colonies, Garcez and Sanchez-Botero (2005) and Haimovici *et al.* (2006) reported figures for the estuary of Patos Lagoon varying from 7 500 to 15 335 fishers. Another source of data commonly used to estimate the number of artisanal fishers is the number of beneficiaries of the unemployment benefit paid by the government to artisanal fishers during the months of fishing closure (see section on access to government aid in Chapter 4). This number has increased markedly since 1998, when a fishing closure was first established for artisanal fisheries in the Patos Lagoon estuary. According to the available data, there were 2 191 beneficiaries in 1999, 3 250 in 2003, 5 486 in 2005, and about 8 188 in 2008¹ (Haimovici *et al.*, 2006; Teixeira and Abdallah, 2005; DIEESE, 2009).

The reasons for the inflated numbers are many. Among these are that data from Fishers' Colonies are particularly unreliable because they are for the most part outdated and that there are no controls or criteria for membership. The numbers reported in Haimovici *et al.* (2006) include the estimates of occasional fishers, which were not the main target of the present study. The number of people receiving the unemployment benefit is also a problematic source because it includes people who have no relationship with fisheries but who accessed the needed documentation to receive the benefit. In fact, there has been an increasing number of fraud cases in this governmental programme, which costs annually close to R\$1 billion, or more than the annual budget of the Ministry of Fisheries and Aquaculture (according to the non-governmental organization Contas Aberta, <http://contasabertas.uol.com.br>; accessed on 16 November 2010). It is important to note that one of the reasons for the large uncertainties about the number of active fishers is that none of the documentation schemes implemented for the sector has proved effective, mainly owing to the lack of controls and improper criteria for documentation being among some of the reasons.

The number of fishers estimated in this study is, on the other hand, relatively close to the number of people requesting the environmental licence from IBAMA to fish in the estuary in 2010/2011. A total of 4 202 requests were made, and they are currently being cross-checked with the data from this study to investigate possible discrepancies.

¹ This figure was estimated based on the total number of beneficiaries in the State of Rio Grande do Sul (11 197) and assumes that 70 percent of this total is from fishers of the Patos Lagoon, as demonstrated by Teixeira and Abdallah (2005).

Table 4: Number of artisanal fishers and total number of fishery-dependent people enumerated in the municipalities of the Patos Lagoon estuary

Municipality	Localities	Fishery-dependent		Fishers	
		Enumerated	Estimated	Enumerated	Estimated
Rio Grande	47	1 435	1 462 (1 381–1 550)	1 080	1 100 (1 043–1 167)
São José do Norte	43	1 430	1 459 (1 411–1 524)	1 183	1 206 (1 164–1 259)
Pelotas	18	776	788 (743–842)	608	617 (581– 661)
Tavares	17	133	NA	112	NA
Mostardas	9	18	NA	17	NA
São Lourenço do Sul	8	165	NA	150	NA
Tapes	6	97	NA	79	NA
Arambaré	4	20	NA	18	NA
Camaquã	1	15	NA	12	NA
Total	153	4 089	4 157 (3 983– 4365)	3 259	3 311 (3 176–3 475)

Note: NA = not applicable.

The number of fishery-dependent people in Table 4 includes fishers and family members who are not necessarily involved in capture activities but who perform other duties in the fishery such as fish processing, commercialization, gear maintenance and cleaning. The total number enumerated was 4 089 people and the total number estimated was 4 157 people. The ratio of fishery-dependent people and fishers is about 1.25 to 1.

Of the 153 localities, the highest numbers of fishers are concentrated in only 34. Data by locality shown in the following sections of this report are, therefore, presented only for these localities.

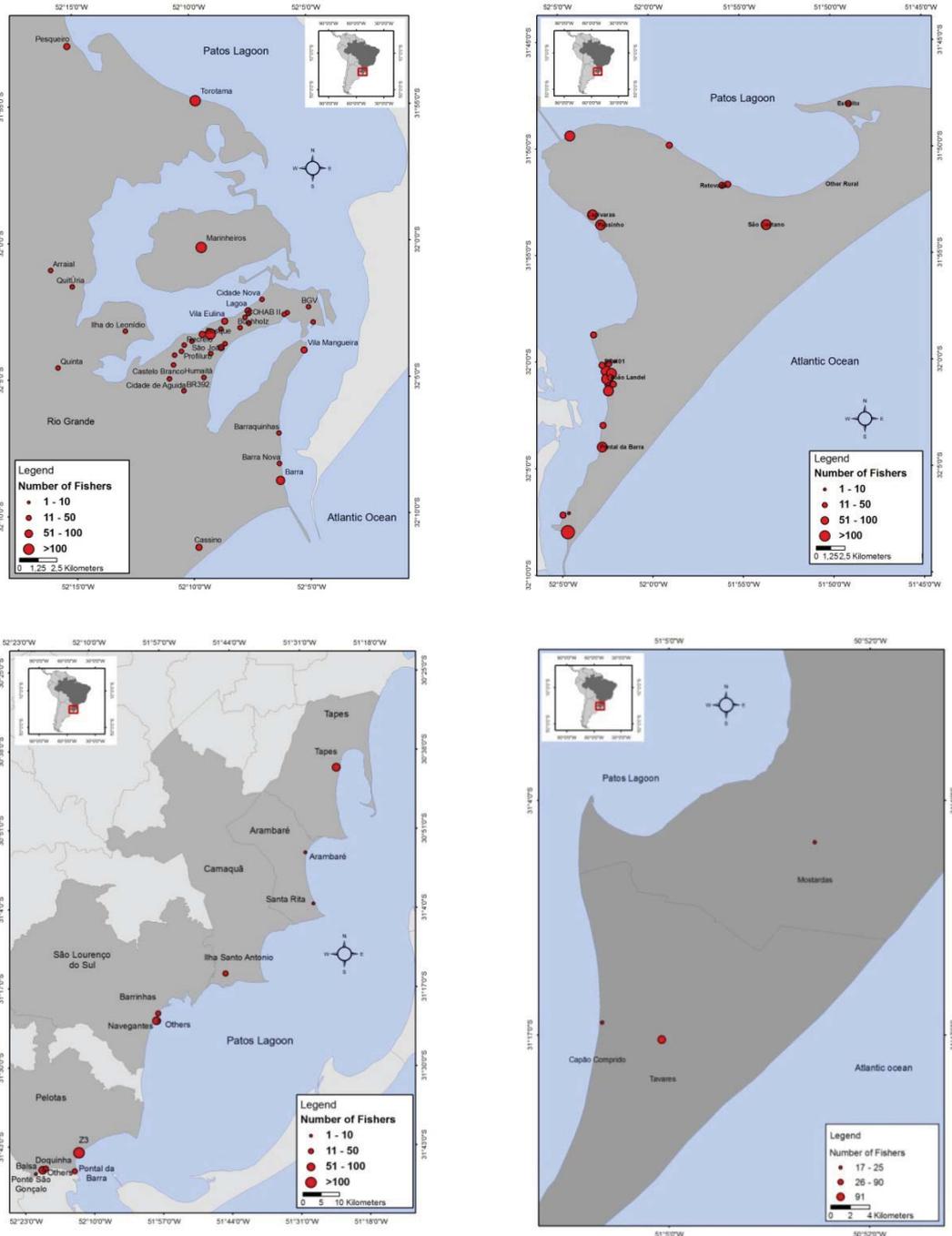


Figure 6: Distribution of artisanal fishers by localities in the Patos Lagoon estuary

Fisher identification and documentation

One of the difficulties in obtaining reliable estimates of the number of artisanal fishers relates to the deficiencies in the systems of registration and identification of fishers.

Artisanal fishers are required by law to have at least four types of documents in order to access different benefits and rights. These are as follows:

1. Registration in the Registry of Professional Fisher (RGP) issued by the Ministry of Fisheries and Aquaculture. This is the basic document required for any national engaged in professional fishing. The document is used in any instance where proof of

professional activity in fisheries is required. Since October 2010, with the enactment of Decree MPA No. 06 of April 2010, to obtain this registration fishers need to present, among other documents, producer receipt invoices for every month of production of the previous year, a fisheries activity report (similar to an annual logbook) validated by any fisheries association and/or colony or signed by two other fishers legally documented, and a certificate of negative debt with the enforcement agency (IBAMA). Specifically for the estuary, the environmental licence issued by IBAMA is also requested (see number 3 below), or the protocol confirming that the licence was requested. The government is in the process of reviewing and updating the registration system with a view to improve the management of the resources.

2. Registration (*matrícula*) issued by the Navy. This document is a requirement for any professional fisher working on board fishing vessels within national waters. To obtain this registration, fishers must have completed at least four years of elementary school, have passed a written examination, and have taken a physical endurance test that includes demonstrating his/her ability to swim and float. This document is one of the documents required when a fisher applies for pension in the national social security system. Individuals owning fishing vessels are also required to have an additional Registration (*matrícula*) issued by the Port State Control for their fishing vessel.
3. Environmental licence issued by IBAMA (Ministry of Environment). Since the enactment of Decree IBAMA No. 171 of 1998 (later revised in Decree MMA/SEAP No. 03/2004), artisanal fishers are required to obtain annually an environmental licence for fishing in the estuary of Patos Lagoon. Licensing was adopted as a means of limiting access to estuarine resources by artisanal fishers from the surrounding areas of the lagoon and impeding the access of outsiders. It was also viewed as a measure to set limits to fishing capacity inside the estuary. To obtain the licence, fishers are required to present the Registry document (RGP) from the Ministry of Fisheries and Aquaculture. Individual licences are issued only after the local co-management organization (Forum of Patos Lagoon) has verified that the person requesting a licence is a fisher. In recent years, as a way of combating fraud in the access to the unemployment benefit, the licence has become one of the required documents to apply for this benefit in the region.
4. Producer Receipt of Invoices document issued by the Secretary of Finance of the State of Rio Grande do Sul. This document is necessary for tax purposes and must be used in every commercial transaction. It also serves as proof of income for accessing formal credit, social security and governmental benefits such as the unemployment benefit. Since October 2010, invoices of fish commercialization of the previous year are required for fishers renewing in the RGP. To obtain the Producer Receipt of Invoices, it is necessary to present the RGP issued by the Ministry of Fisheries and Aquaculture (see number 1).

The percentage of fishers who have each of these documents is presented in Figure 7. The document that most fishers have is the RGP (91 percent). About 20 percent of the fishers interviewed did not have the environmental licence issued by IBAMA. The document less frequently obtained by fishers was the Registration issued by the Navy Port State Control (73 percent). By cross-checking the number of fishers that possess each of the documents, it was possible to conclude that only 64 percent of all fishers are fully documented.

The relatively high frequency of undocumented fishers reflects many issues, including the flaws in the registry and documentation systems and the lack of enforcement and incentives for fishers to comply with the law, which is compounded by their lack of credibility at the institutional level. It also reflects the degree of marginalization of the sector, given that the lack of documents deprives fishers from accessing social security services, benefits and formal credits.

One well-known issue with the Registry document issued by the Navy is the requirement for a minimal level of formal education, when a significant number of fishers are illiterate or functionally illiterate (see section on socio-economic aspects in Chapter 4).

On the other hand, the informality in the commercialization of fish products runs against the system of invoices established by the Secretary of Finance of the State of Rio Grande do Sul. Even though 85 percent of all fishers declared having the Producer Receipt of Invoices document, a much lower number actually use the invoices adequately. The reasons vary: from not knowing how to use invoices (a real problem for illiterate fishers); tax evasion (12 percent tax is charged for commercialization of fish products); and, most importantly, because buyers, who in the majority of cases are intermediaries (see access to credit section in Chapter 4), normally do not issue invoices for every transaction. Instead, they use an informal system of bookkeeping and receipts called *vales*, which keeps track of the amount bought from each fisher during a season and any money due. As mentioned above, one of the main uses of the invoices until now has been to serve as proof of income for social security purposes and for accessing credit and unemployment benefit. As the minimal requirement to access these benefits is the presentation of two invoices per year, these are the only invoices that fishers normally submit at the end of the season. In addition, many fishers opt not to use the invoices because when they need to access benefits they can use a receipt of contribution to social security as a valid substitute to the Producer Receipt of Invoices. Some of these deficiencies have been recognized, and, in view of the increasing number of fraud cases in the programme of unemployment benefit (Chapter 4), efforts are under way to make stricter rules and to improve the integration of the different registration and documentation systems. The recent changes in the RGP of the Ministry of Fisheries and Aquaculture, with enactment of Decree No. 06 of 2010, were an attempt to strengthen the integration with IBAMA and the Secretary of Finance of the State of Rio Grande do Sul. The practical results of this change are to be evaluated in the near future.

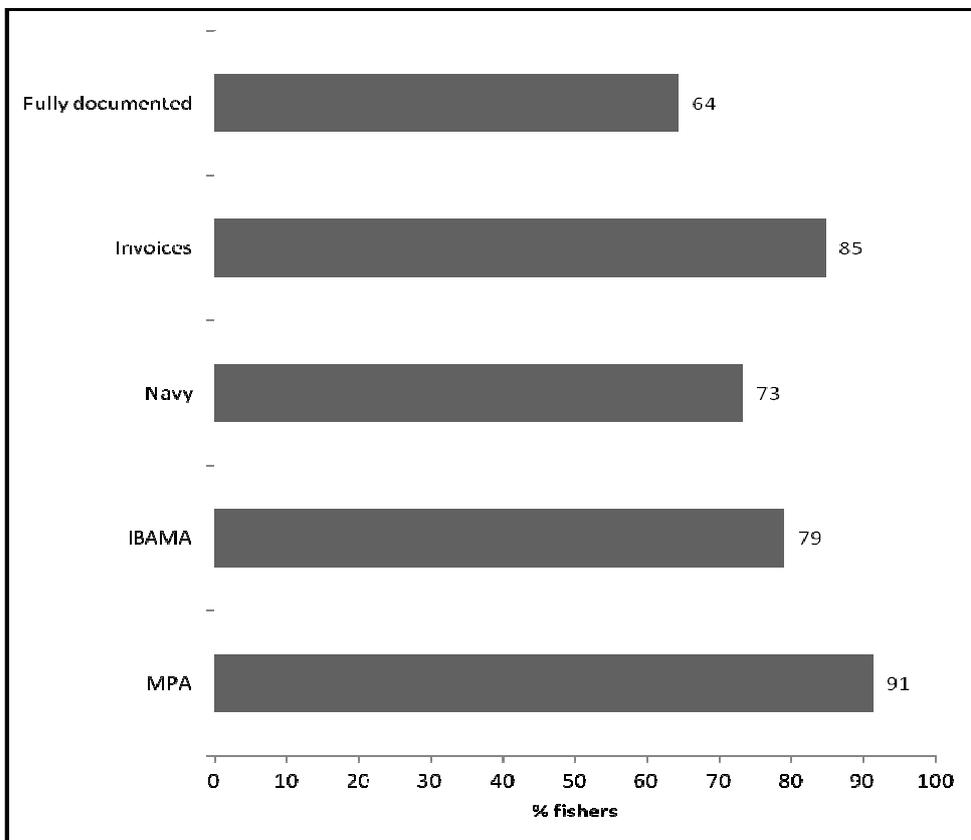


Figure 7: Percentage of fishers with basic required documents for professional artisanal fishers

Fishing vessels

A common characteristic of artisanal fishing vessels is that they are all constructed in plank wood without any permanent cabin. Tents and removable decks are used as shelter (Figure 8). The motorized boats are known as *botes* and *chalupas*; the latter has a flat stern and a “v” shaped hull. These are propelled by inboard diesel motors. Gasoline is less common as fuel and outboard motors are less common. Fishers normally have an auxiliary vessel (normally without an engine) called *caíco*, or *batera*, also of plank construction and flat bottomed. These vessels vary in size from 1.5 to 5.5 m and are used for fishing in shallow waters, such as in the fyke net shrimp fisheries, in the handling of nets, and in the transport of catches and fishers. In this document, this type of boat is referred to as canoes. Table 5 and Figures 9 to 11 show the number and general characteristics of fishing vessels in each of the main localities of the estuary.

A total of 1 091 canoes and 1 327 motorized boats were enumerated. Of the total number of canoes, 39 percent (431) have no vessel registry issued by the Port State Control. Of the total number of motorized boats, 24 percent, or 317, have no vessel registration. Not all fishers have motorized boats or canoes (Figure 9). A considerable number of fishers in each community have no boats or canoes but work mainly as crew members in the vessels of other fishers. The percentage of fishers without boats reaches more than 50 percent of the total in localities, such as Tapes, Navegantes in São Lourenço do Sul, Lagoa in Rio Grande, and in various urban and rural localities of São José do Norte.

Fishing vessels up to 12 m and not exceeding 18 gross tonnes are allowed to fish in the lagoon; motorized boats vary in size from 4 to 12 m. There are marked differences in boat sizes among the different localities. These are shown in Table 5 and Figure 10. Larger boats are found in localities of the upper estuary, including Pelotas, Arambaré, São Lourenço do Sul and Tapes, and smaller boats in rural localities of Rio Grande and São José do Norte, such as Torotama, Marinheiros, Barranco and São Caetano. The localities of Barra and Mangueira are the ones with the largest average boat size in the municipality of Rio Grande. In São José do Norte, the largest boats are found in 5^a Secção da Barra and Povoação da Barra (both are closer to the mouth of lagoon) and the urban localities of Centro and Tamandaré.

Engine power varies from 1 to 160 hp, with average power varying between 9.3 and 33.2 hp. There is a straight relationship between boat size and engine power, as can be seen from the similar geographical distribution of the two parameters in Figures 10 and 11. The more powerful vessels are found in the localities surrounding the mouth of the lagoon (Barra and Mangueira in Rio Grande and 5^a Secção da Barra and Povoação da Barra in São José do Norte), the urban localities of São José do Norte, and in selected localities of the upper estuary, such as Tapes, Santa Rita and Navegantes (São Lourenço do Sul). Also common in these localities are boats equipped with engine transmissions (gearbox) and echosounders, which increase their fishing capacity for some types of fisheries. Echosounders are particularly useful to locate the schools of croaker in the drift gillnet fishery that operates in estuarine and coastal areas surrounding the mouth of the lagoon. A total of 205 boats, or 15 percent of the total number of motorized boats, are equipped with echosounders. The gearbox is, on the other hand, particularly useful for otter trawling as it can increase the vessel's trawling capacity. Because adapting a gearbox to the engine is a much cheaper solution to increase a vessel's capacity to trawl than buying a larger engine, the use of gearboxes is widespread in the estuary. Some argue that the number of vessels with gearboxes can be a good indicator of the number of boats engaged in illegal otter trawling fishing. If this hypothesis is true, then it can be conjectured that at least 376 boats are equipped to conduct trawling, representing about 30 percent of the total number of motorized boats in the estuary. This number is well above the 170 fishers who declared that they carry out otter trawling for shrimp.



Figure 8: Examples of fishing vessels used in the estuary of Patos Lagoon

Table 5: Number and characteristics of fishing vessels in each of the main localities

Locality	Boat size Min-Avg-Max (m)	Gross tonnage Min-Avg-Max (tonnes)	Engine Min-Avg-Max (hp)	Number of canoes (not registered)	Number of boats	Gearbox	Echosounder
Rio Grande							
Barra	5.0 – 8.8 – 12.0	0.6 – 4.3 – 18	7.5 – 32.8 – 100.0	10 (7)	31 (5)	19	17
Bernadeth	4.6 – 6.7 – 8.4	0.5 – 2.4 – 6.0	5.0 – 13.5 – 55.0	24 (5)	19 (14)	3	–
Bosque	4.0 – 7.1 – 10.3	0.4 – 2.6 – 9.0	5.0 – 16.9 – 85.0	24 (10)	20 (4)	5	2
Marinheiros	4.0 – 6.7 – 10.2	0.3 – 1.9 – 7.0	4.0 – 12.4 – 89.0	109 (39)	129 (40)	25	3
Lagoa	6.0 – 6.8 – 7.5	2.0 – 2.4 – 2.5	9.0 – 9.7 – 11.0	16 (8)	5 (4)	–	–
Mangueira	7.0 – 9.0 – 12.0	1.5 – 4.7 – 10.0	9.0 – 19.4 – 100.0	7 (4)	8 (1)	3	2
São Miguel	5.0 – 7.3 – 10.0	0.2 – 2.4 – 9.0	5.0 – 12.9 – 24.0	116 (35)	105 (46)	13	4
Torotama	3.5 – 6.8 – 10.6	0.5 – 2.0 – 9	5.0 – 11.9 – 70.0	119 (40)	93 (14)	6	–
Vila Eulina	5.5 – 6.6 – 8.0	0.5 – 2.1 – 4.0	1.5 – 14.5 – 45.0	17 (5)	14 (5)	3	–
Other urban	5.0 – 6.8 – 8.9	0.5 – 2.8 – 8.0	3.5 – 13.5 – 70.0	34 (11)	23 (10)	4	–
Other rural	5.0 – 6.7 – 8.0	1.0 – 2.3 – 4.0	5.0 – 12.5 – 24.0	25 (5)	15 (5)	2	–
Pelotas							
Z3	4.6 – 8.1 – 13.2	0.5 – 4.0 – 16.0	3.5 – 24.9 – 140.0	69 (26)	198 (58)	72	18
Balsa	5 – 8.2 – 11.2	0.3 – 3.6 – 9.5	5.5 – 25.8 – 90.0	19 (14)	38 (4)	24	–
Pontal da Barra	5.7 – 8.3 – 10.0	0.5 – 3.1 – 8.0	3.0 – 25.6 – 96.0	3 (2)	14 (2)	8	3
Other	6.0 – 8.2 – 11.0	0.7 – 3.5 – 14.5	3.0 – 29.0 – 136.0	14 (11)	35 (6)	19	5
São José do Norte							
5ª Secção da Barra	5.0 – 8.0 – 11.3	0.5 – 3.6 – 12.0	9.0 – 29.7 – 100.0	20 (7)	28 (6)	20	17
Inhame	5.5 – 7.1 – 9.5	0.8 – 2.5 – 7.0	11.0 – 14.0 – 24.0	11 (4)	10 (4)	2	–
Barranco	4.5 – 6.5 – 10.1	0.5 – 1.8 – 7.0	5.0 – 16.2 – 100.0	22 (5)	23 (4)	5	1
Capivaras	4.9 – 7.9 – 10.7	0.4 – 2.7 – 6.0	8.0 – 22.9 – 80.0	16 (9)	35 (2)	13	11
Centro	5.0 – 8.0 – 12.0	0.2 – 3.6 – 18.0	5.0 – 25.5 – 118.0	25 (5)	43 (5)	15	19
Cidade Baixa	5.0 – 7.7 – 12.0	0.8 – 3.5 – 13.1	7.5 – 26.2 – 127.0	14 (10)	20 (2)	5	7
Com. Carlos Santos	4.5 – 7.7 – 10.2	1.0 – 2.8 – 6.0	5.0 – 21.2 – 160.0	15 (8)	27 (2)	7	7
Croa	4.9 – 7.9 – 9.6	0.5 – 3.0 – 5.5	5.0 – 31.9 – 75.0	8 (2)	15 (1)	6	9

Locality	Boat size Min-Avg-Max (m)	Gross tonnage Min-Avg-Max (tonnes)	Engine Min-Avg-Max (hp)	Number of canoes (not registered)	Number of boats	Gearbox	Echosounder
Passinho	4.5 – 7.4 – 10.2	0.5 – 2.6 – 8.0	5.0 – 18.6 – 75.0	23 (14)	30 (11)	2	6
Pontal da Barra	5.0 – 7.5 – 10.6	0.6 – 2.7 – 6.0	5.0 – 17.2 – 60.0	19 (10)	23 (1)	4	11
Povoação da Barra	5.4 – 8.3 – 10.0	0.6 – 4.1 – 8.0	5.0 – 33.2 – 89.0	4 (1)	17 (4)	10	12
Retiro	5.0 – 7.7 – 9.6	1.2 – 2.9 – 5.0	7.0 – 19.6 – 55.0	10 (5)	7 (0)	1	–
Retovado	5.0 – 6.6 – 9.7	1.0 – 2.3 – 6.0	8.0 – 9.3 – 14.0	7 (2)	7 (3)	1	1
São Caetano	5.0 – 6.2 – 12.0	0.4 – 2.3 – 11.0	0.9 – 15.8 – 100.0	48 (11)	41 (5)	7	2
Tamandaré	4.8 – 7.9 – 9.9	0.8 – 3.1 – 7.0	7.0 – 30.6 – 90.0	29 (6)	34 (3)	17	12
Várzea	4.9 – 7.6 – 11.2	0.4 – 3.2 – 9.0	8.0 – 26.3 – 75.0	32 (16)	32 (16)	3	4
Vila Verde – Veneza	4.7 – 6.6 – 9.3	0.7 – 2.1 – 4.5	7.5 – 22.4 – 120.0	16 (2)	10 (0)	2	2
Other urban	4.9 – 7.2 – 11.9	0.8 – 2.8 – 18.0	5.5 – 23.7 – 100.00	22 (8)	33 (5)	6	15
Other rural	4.9 – 6.7 – 10.0	0.3 – 2.5 – 5.0	5.0 – 9.3 – 18.0	6 (4)	11 (1)	–	–
São Lourenço do Sul							
Barrinha	4.5 – 6.5 – 8.3	0.6 – 2.8 – 9.9	7.0 – 14.9 – 65.0	7 (3)	23 (1)	6	2
Navegantes	5.1 – 8.4 – 11.7	1.5 – 4.6 – 10.0	4.0 – 23.6 – 60.0	7 (2)	37 (4)	5	8
Other	No info.	No info.	11.0 – 15.7 – 18.0	1 (0)	3 (0)	–	–
Camaquã							
Ilha Sto. Antonio	5.9 – 7.4 – 8.9	No info.	8.0 – 14.8 – 32.0	4 (4)	8 (7)	2	–
Arambaré							
Arambaré	7.0 – 9.0 – 9.8	1.0 – 2.7 – 6.0	5.0 – 11.2 – 16.0	5 (?)	5 (0)	1	–
Santa Rita	6.0 – 8.4 – 10.4	2.0 – 4.0 – 8.0	7.5 – 29.9 – 55.0	5 (?)	5 (1)	3	–
Tapes							
Tapes	5.0 – 8.9 – 12.7	0.5 – 3.9 – 15.0	4.0 – 22.8 – 90.0	32 (2?)	34 (1)	19	6
Tavares							
Capão Comprido	5.0 – 7.7 – 10.0	1.0 – 3.0 – 8.0	9.0 – 21.1 – 54.0	16 (13)	7 (5)	3	–
Other	5.8 – n.a. – 9.7	2.0 – n.a. – 3.0	40.0 – n.a. – 65.0	53 (48)	2 (1)	1	–
Mostardas	4.8 – 7.4 – 12.0	0.5 – 3.0 – 10.0	8.0 – 20.7 – 60.0	8 (8)	10 (4)	4	1

Note: The minimum, average and maximum size, capacity and engine power are presented. In brackets, the number of canoes and motorized boats without the RGP issued by the Port State Control. The number of motorized boats with gearbox and echosounder is indicated; (n.a. = not applicable).

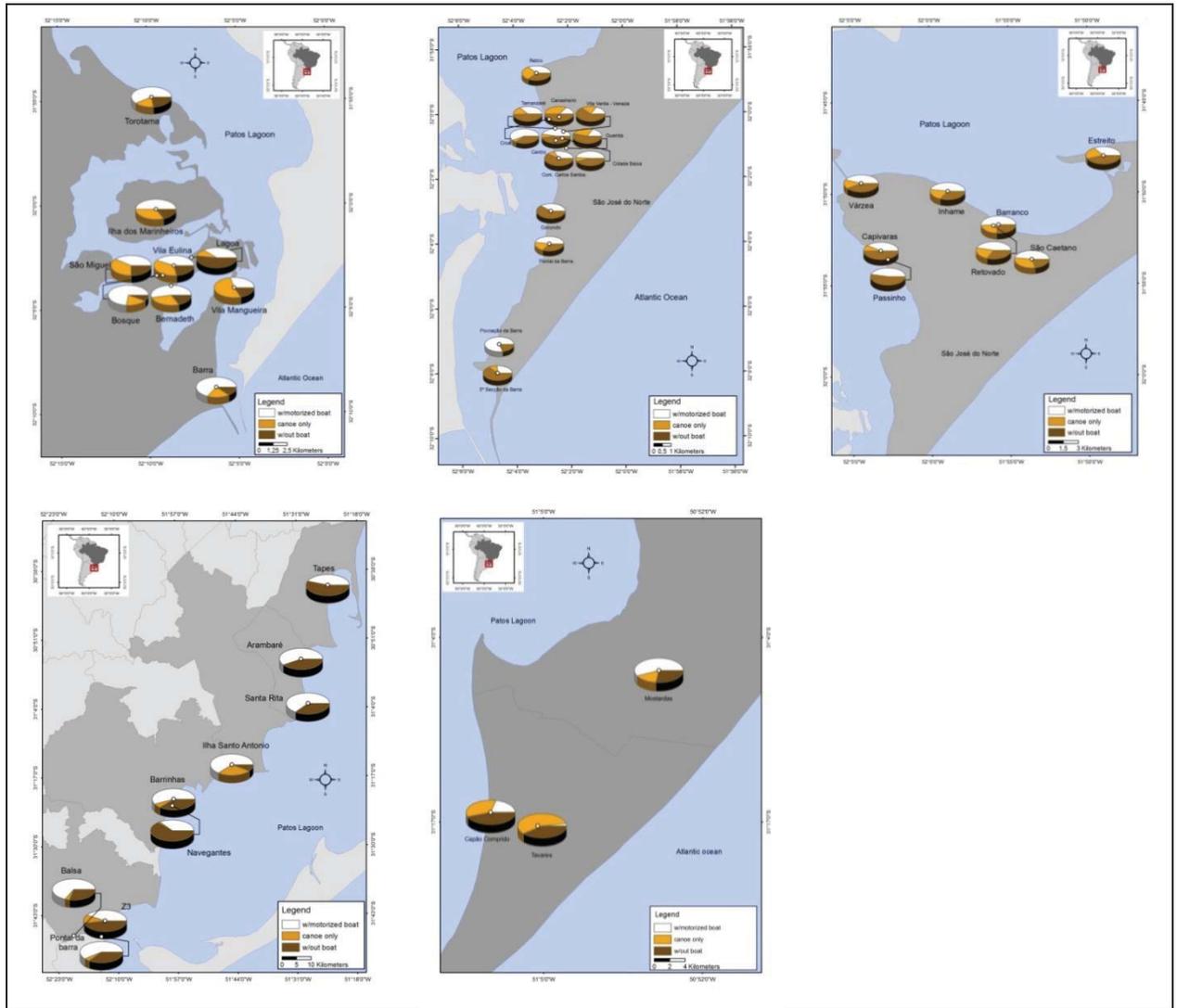


Figure 9: Percent of fishers with motorized boats, canoes and without boats in each of the main artisanal fisheries

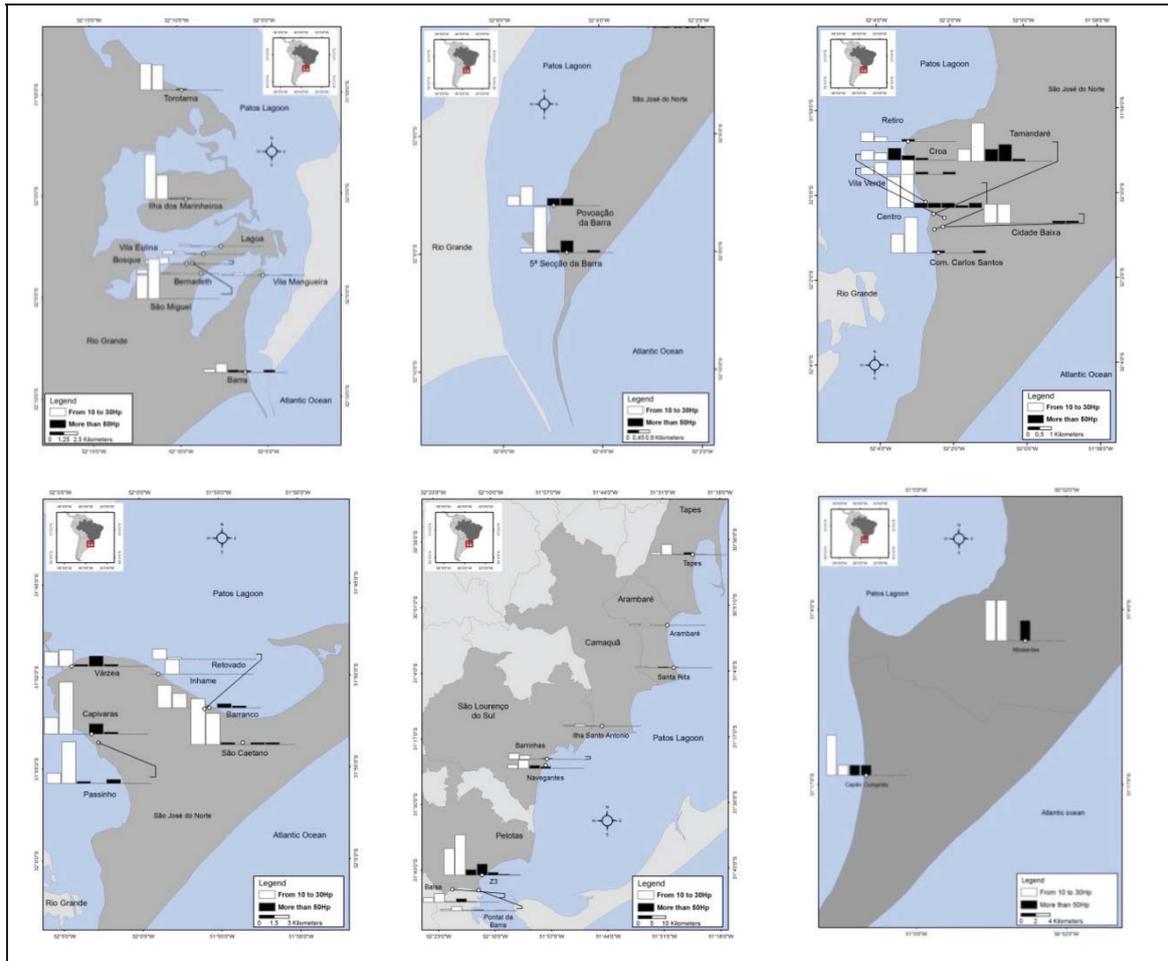


Figure 11: Distribution frequency of engine power (hp) in the main localities

Fishing gear and fishing effort

Finfish fisheries

Gillnets are the most common type of gear used in the capture of finfish. The characteristics of the main types of gillnets used in the capture of the main artisanal fisheries resources are described in further detail below and in Table 6. It is important to note that the total length of netting walls referred to in Table 6 does not necessarily reflect the length of netting walls used in a single fishing operation. Fishers often work with their kin (usually two to three fishers per boat; see for instance Table 9) and the actual length of nets used in a single fishing operation may vary according to the number of fishers on board. In effect, the length of netting walls used in each boat is frequently above the 1 000 fathoms (1 829 m) regulated by law.

Table 6: Characteristics of gillnets used by artisanal fishers

Type	Dimensions	Croaker	Flatfish	Silverside	Mullet	Catfish
Single wall	Average length (fathoms)/fisher	679	543	432	500	–
Fixed gillnets	Mesh size (mm)/stretched mesh	90	120	30	70	–
	Average height (number meshes)	26	23	28	33	–
	Fishers	948	397	216	736	–
Drift gillnets	Average length (fathoms)	795	–	–	846	–
	Mesh size (mm)	100	–	–	80	–
	Average height (number meshes)	35	–	–	51	–
	Fishers	1 152	–	–	132	–

Type	Dimensions	Croaker	Flatfish	Silverside	Mullet	Catfish
Seine gillnets	Average length (fathoms)	720	–	–	683	–
	Mesh size (mm)	90	–	–	70	–
	Average height (number meshes)	44	–	–	51	–
	Fishers	189	–	–	463	–
Trammel nets	Average length (fathoms)	–	–	–	–	563
	Mesh size (mm)	–	–	–	–	100
	Average height (number meshes)	–	–	–	–	29
	Fishers	–	–	–	–	246

Note: 1 fathom = 1.83 m.

Fixed gillnets

Fixed gillnets consist of single netting walls with variable length, height and mesh size depending on the target species. Nets are fixed on poles or anchors and can be attached together or placed in parallel to each other (Figure 12). The fishing operation with fixed gillnets is called *menjoada* or *manjoada*. The nets are placed in determined fishing areas and usually left in the water for one or more nights depending on the target species. Species considered more sensitive, such as croaker and flatfish, are removed daily from the nets, while more resistant species, such as catfish, are removed every couple of days. Single-wall fixed gillnets are mainly used to catch croaker, silverside, flatfish and mullets. The highest fishing efforts are directed to croaker and mullet. Minimum mesh sizes for fixed gillnets vary from 30 mm for silverside, 70 mm for mullet, 90 mm for croaker and 120 mm for flatfish.

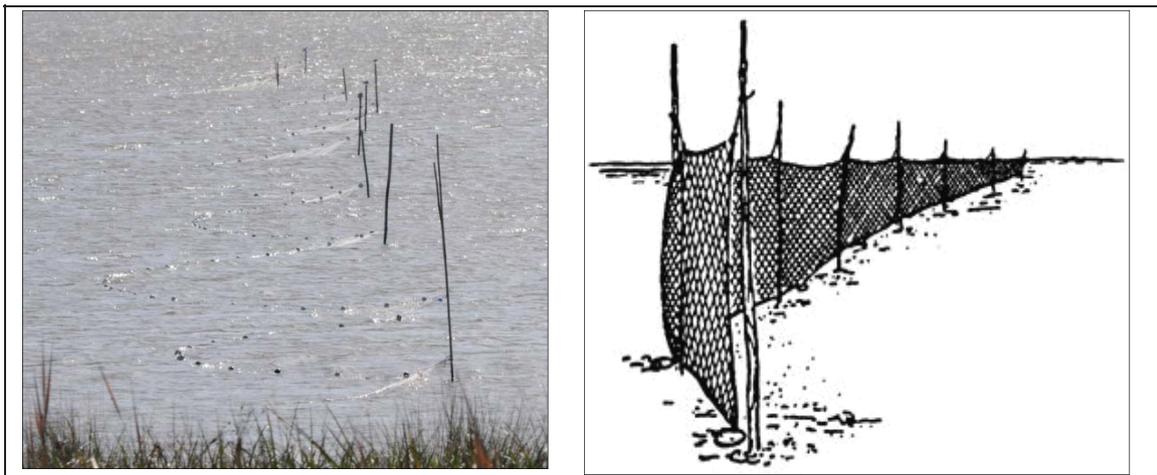


Figure 12: Left: Fixed gillnet. Right: general scheme of a fixed gillnet (Source: FAO, 1982)

The distribution of fishing effort with fixed gillnets for croaker, mullet, flatfish and silverside are shown in Figures 13 to 20. The maps presented in these figures were based on the declared fishing areas and effort by fishers of the different localities and represent the first complete picture of artisanal fishing effort in the Patos Lagoon estuary. Some peculiarities of these maps are briefly discussed below.

The areas with highest fishing effort for croaker are in the medium estuary, in areas bordering the municipalities of Pelotas, São Lourenço do Sul and São José do Norte (Figure 13). This differentiates from the distribution of the drift gillnet fishery for croaker, which is concentrated in the lower estuary and adjacent coastal waters (Figure 25). The maps by municipality make evident the high mobility of fishers, especially those from the northern areas of the lagoon who migrate to areas closer to the sea where salinity is higher and where the species is more likely to be found. In this respect, the higher concentration of effort in areas in the medium estuary, farther from the sea, was to a certain extent unexpected, considering the species characteristics

and life cycle. This finding, which needs to be further investigated, may relate to the lack of available fishing grounds, where to fix the nets in areas closer to the mouth of the lagoon, where there is a concentration of effort by fishers from Rio Grande (Figure 14).

Slightly different strategies are applied for mullet fishing with fixed gillnets, particularly by fishers in the northern localities of the lagoon (Figures 15 and 16). Fishers from Tapes concentrate most effort in areas in the opposite part of the lagoon used for croaker fishing. Fishing effort by fishers from São Lourenço do Sul and Tavares are also more widespread in direction to the inner parts of the lagoon compared with croaker. Mulletts spend part of their life cycle in freshwater environments and the distribution of fishing effort is in line with that. The end result of these distributions is, however, very similar to the fixed gillnet fishery for croaker, i.e. the area with highest concentration of fishing effort for mullets are in the medium estuary.

Maps with the distribution of effort for flatfish and silverside are presented in Figures 17 to 20. Noticeable in the silverside maps is the concentration of total effort in areas in the lower estuary. As this is the main area of silverside fishing by fishers from Rio Grande, and Rio Grande is the location with the highest effort directed to silverside, the total effort map mirrors that of Rio Grande. In general, there is higher spatial segregation of fishing effort for flatfish and silverside among localities compared with the fisheries for croaker, meaning that different areas of the lagoon are used as fishing grounds for the two species.

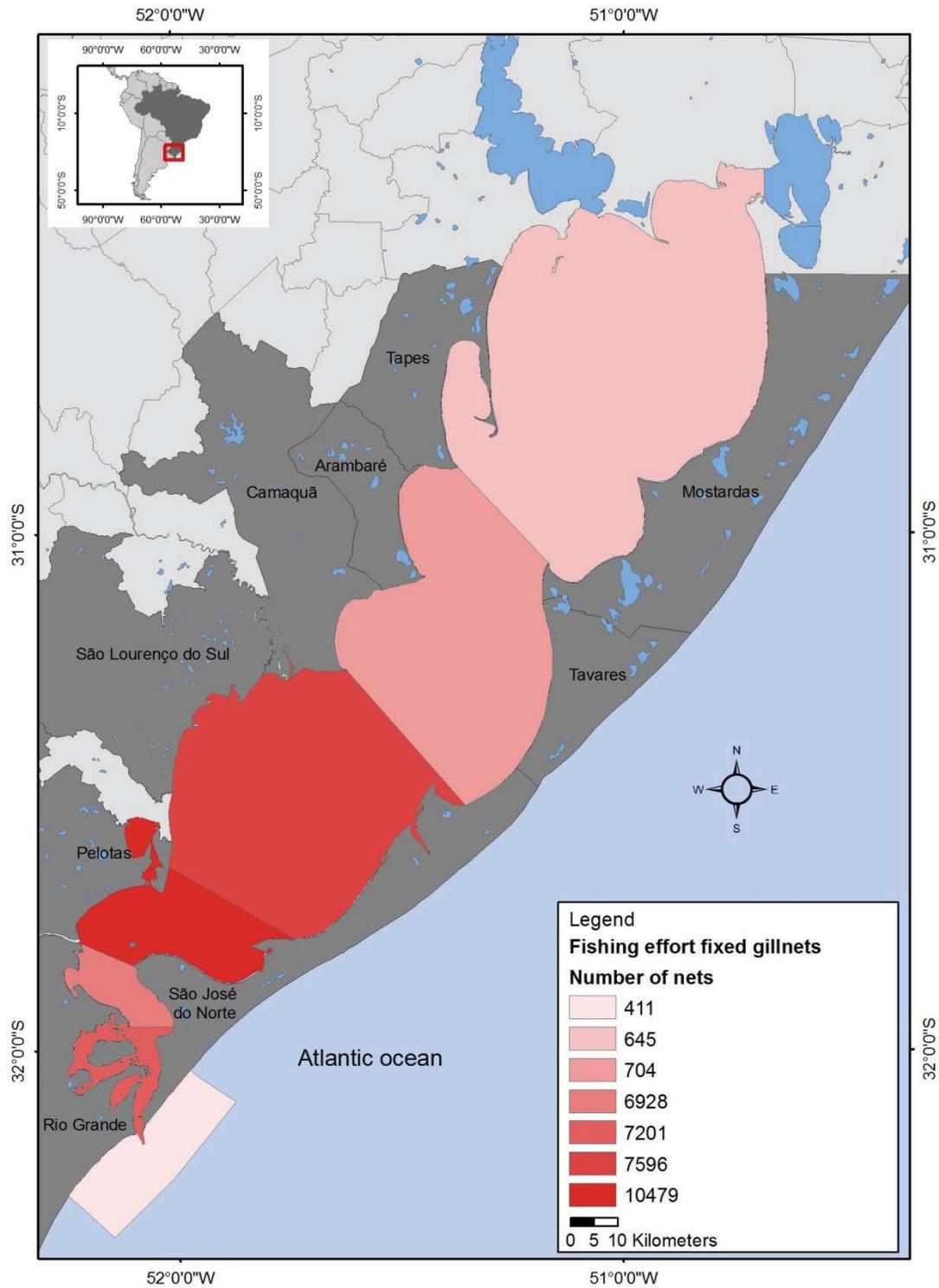


Figure 13: Distribution of total fishing effort with fixed gillnets for croaker

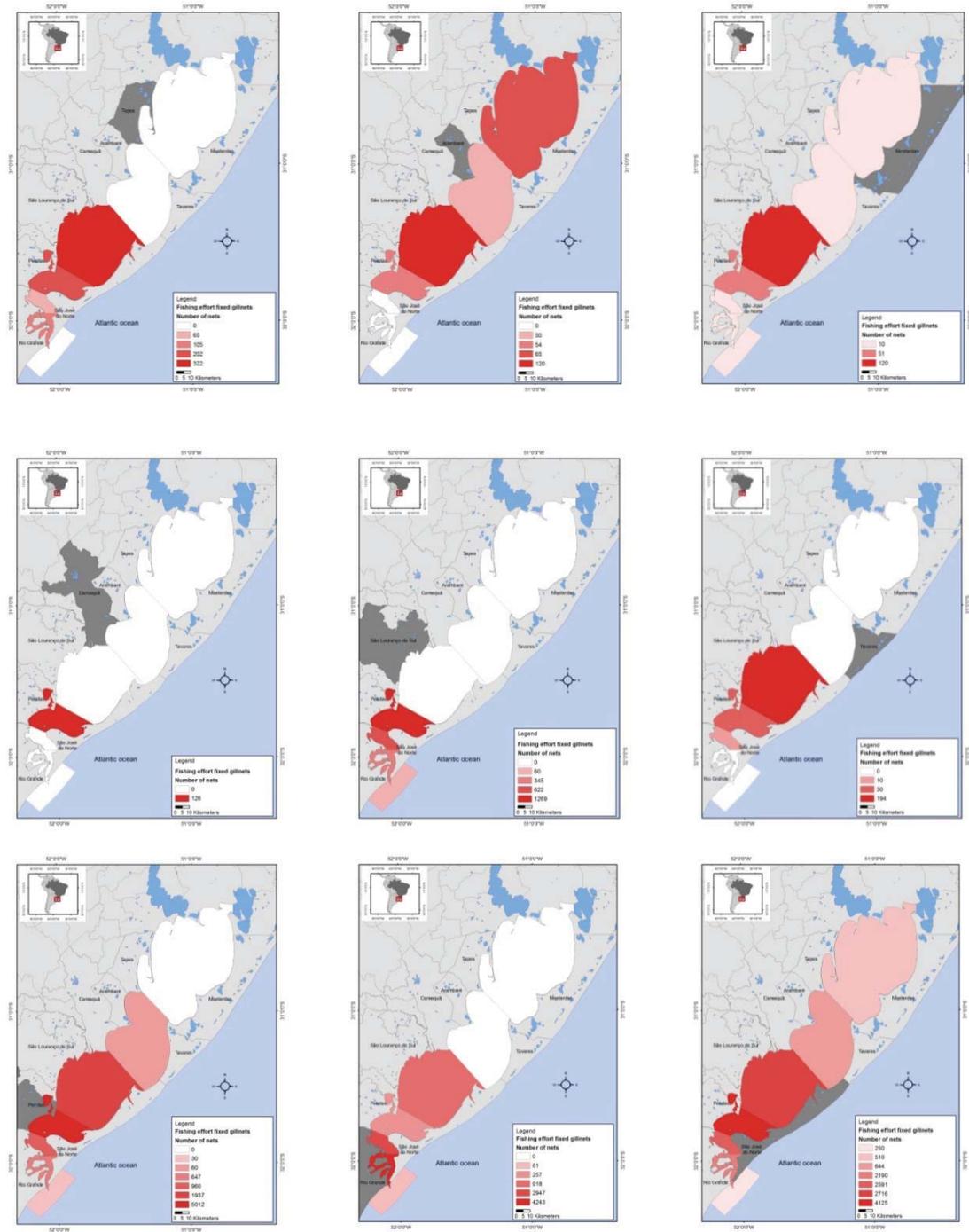


Figure 14: Distribution of fishing effort with fixed gillnets for croaker by municipality (in dark grey)

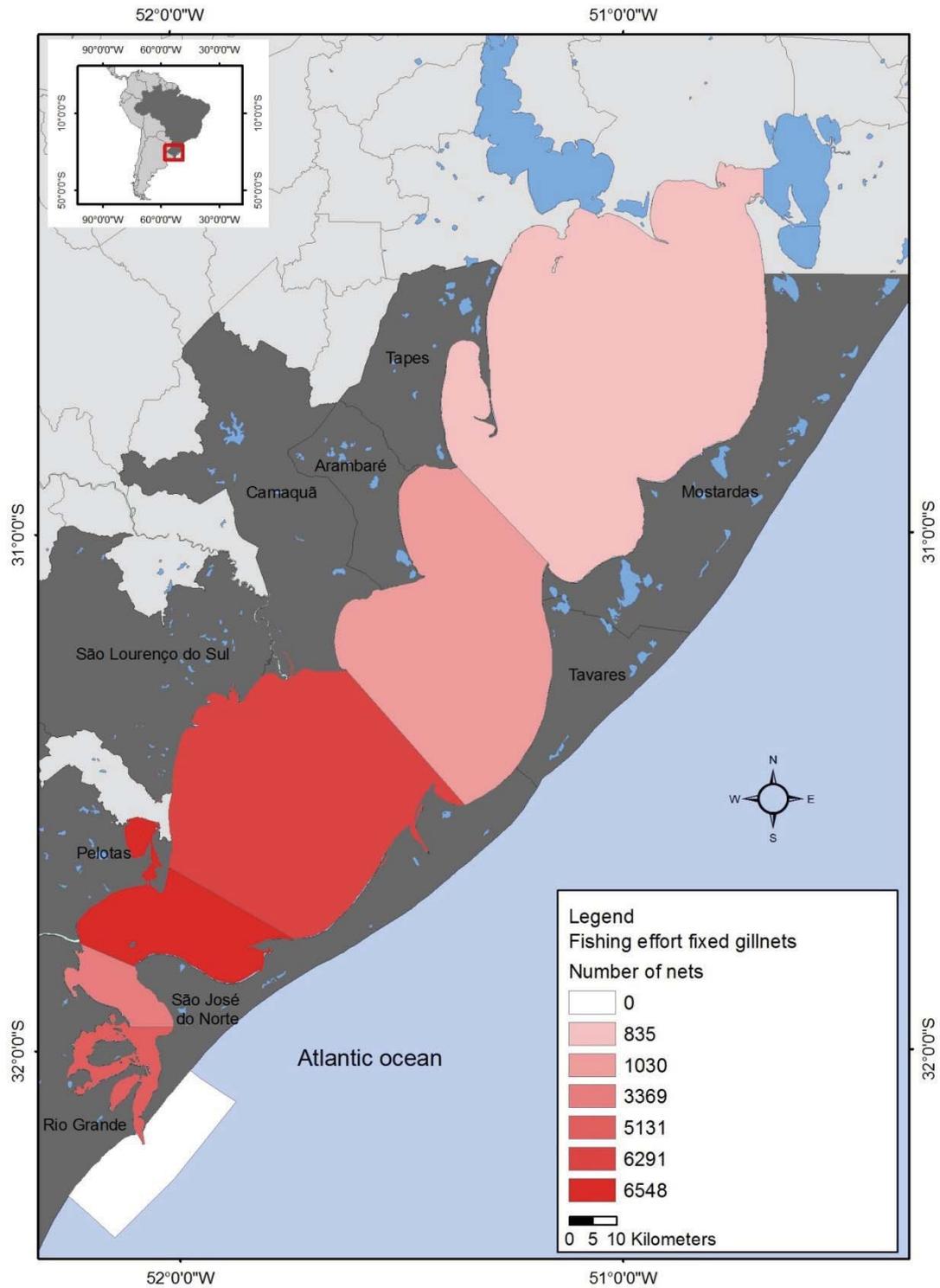


Figure 15: Distribution of total fishing effort with fixed gillnets for mullet

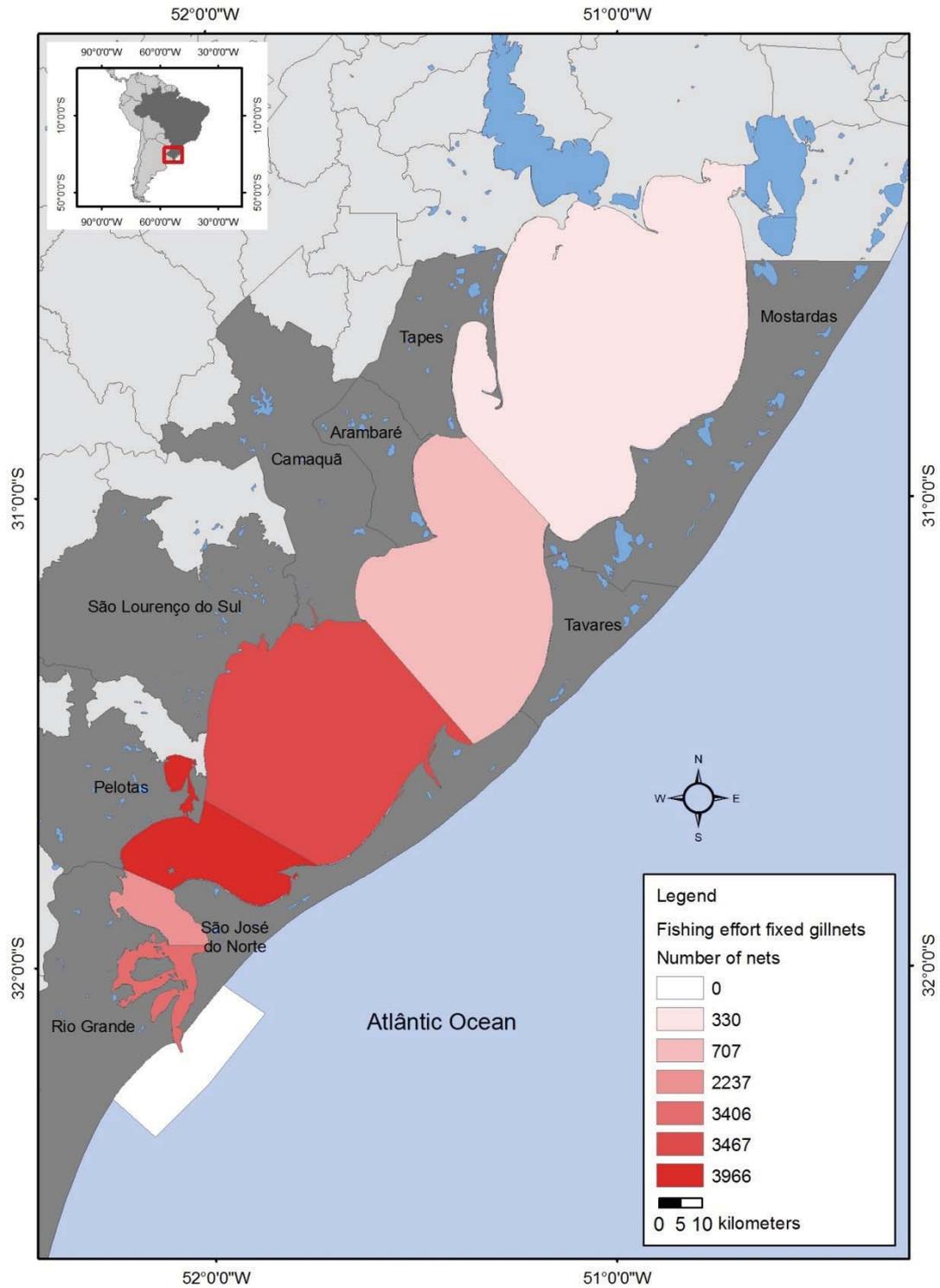


Figure 17: Distribution of total fishing effort with fixed gillnets for flatfish

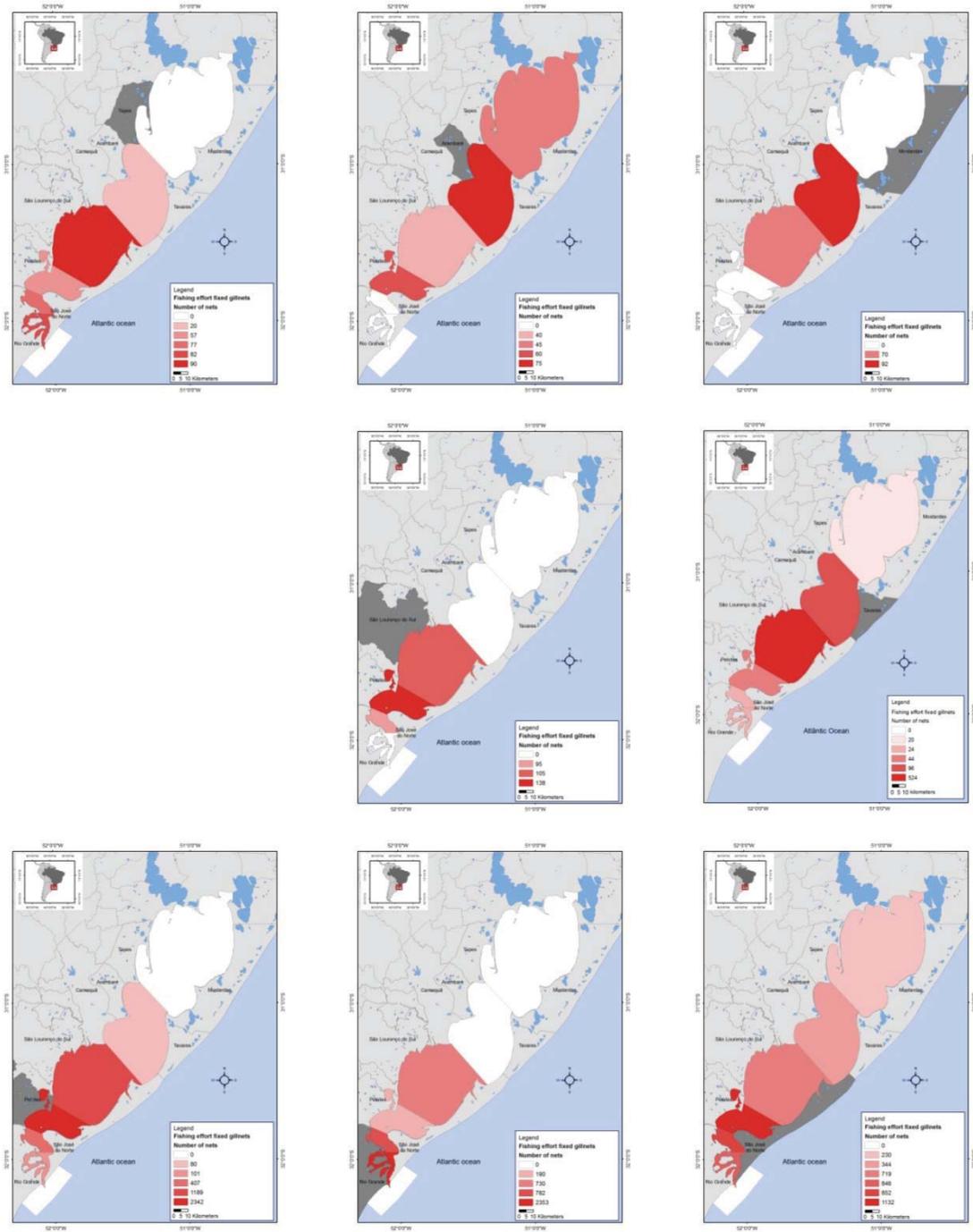


Figure 18: Distribution of fishing effort with fixed gillnets for flatfish by municipality (in dark grey)

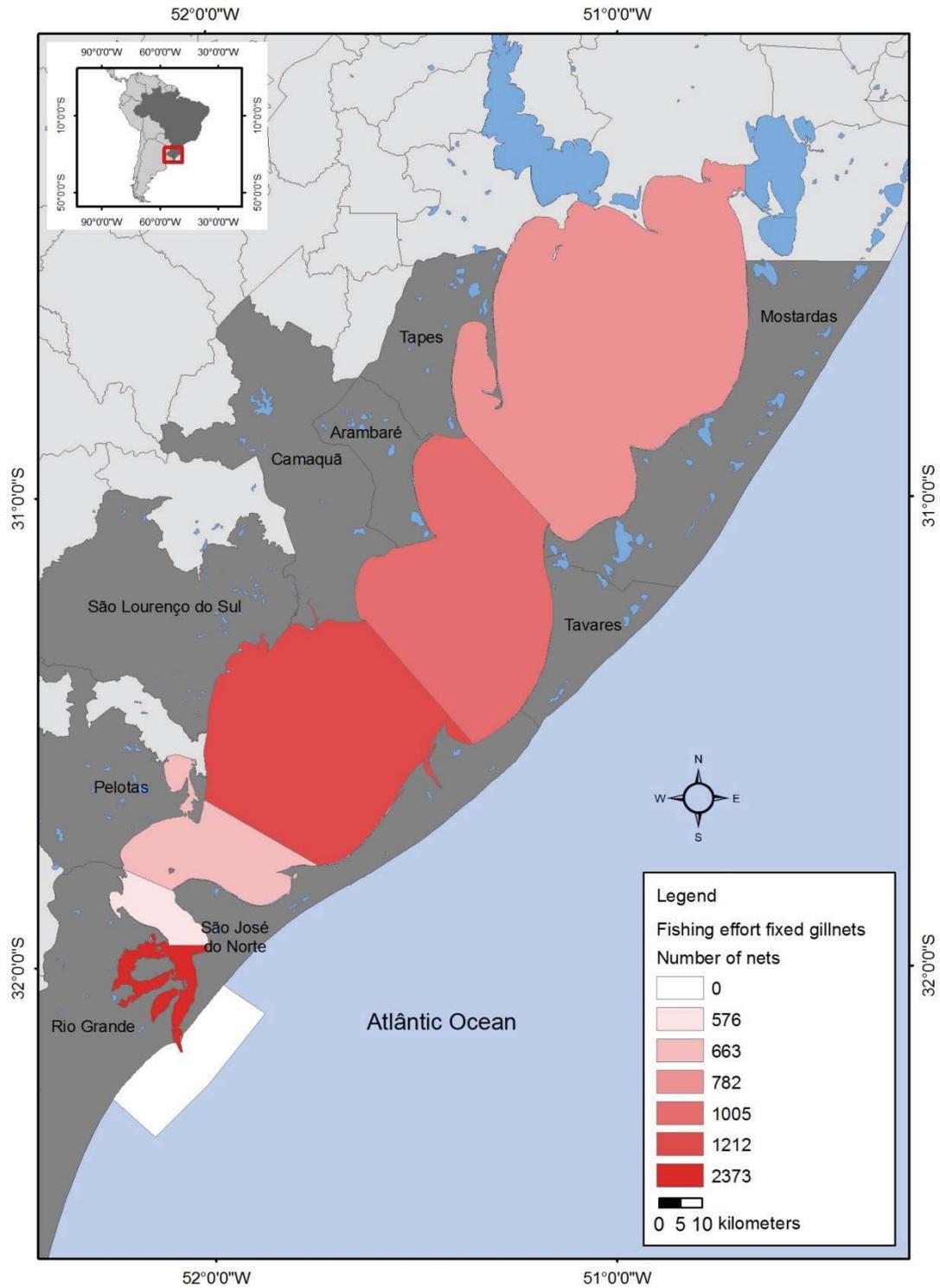


Figure 19: Distribution of total fishing effort with fixed gillnets for silverside

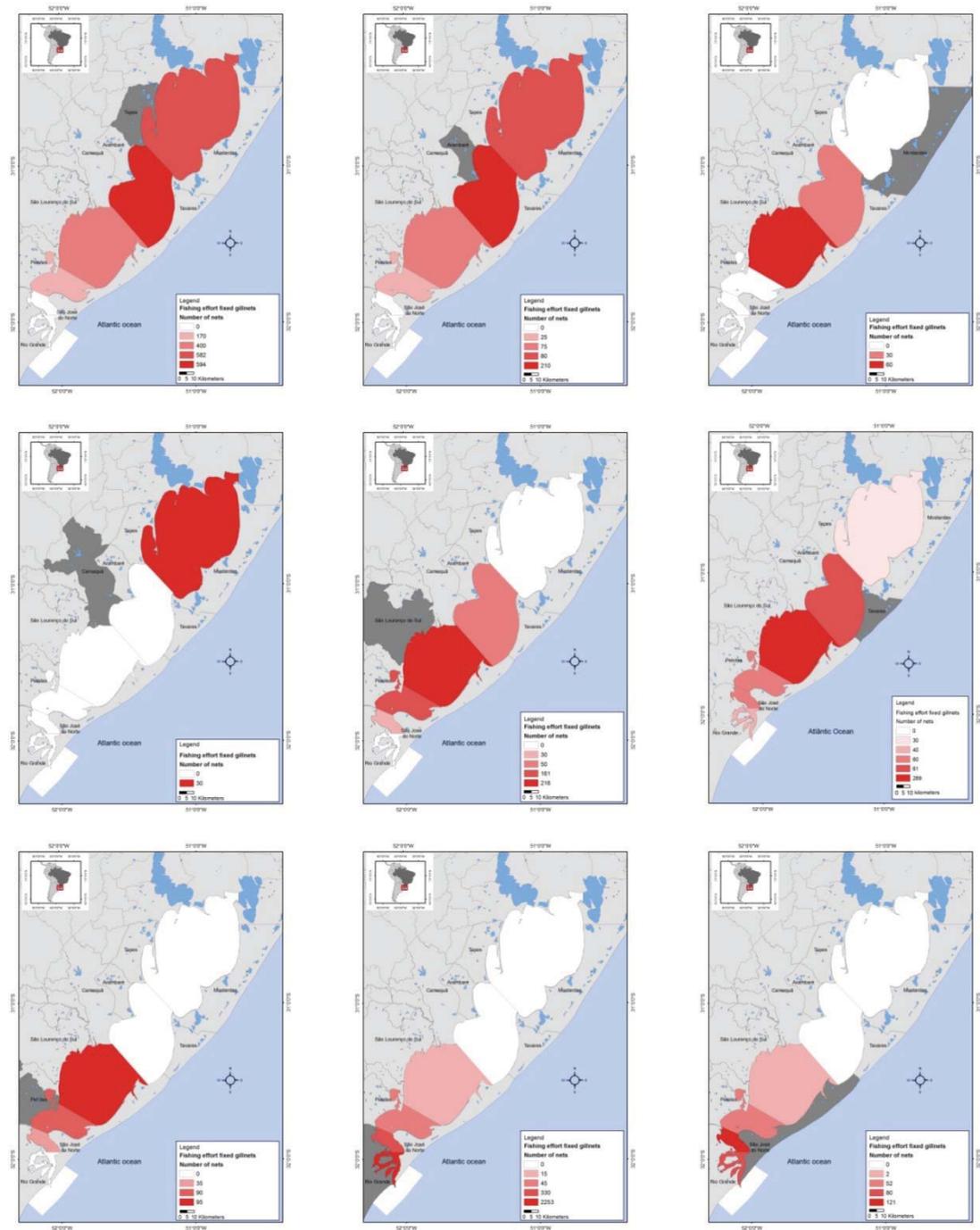


Figure 20: Distribution of fishing effort with fixed gillnets for silverside by municipality (in dark grey) (effort measured in number of fixed gillnets)

Fixed trammel nets

Fixed trammel nets consist of three layers of netting with a slack, small mesh inner netting between two layers of large mesh netting (*alvitanas*). The nets are known as *feiticeiras*. Differently from single netting gillnets, in trammel nets fish are captured by entanglement in the smaller mesh netting after passing through the outer larger mesh netting wall (Figure 21). For this reason, trammel nets are very effective and less selective than single netting gillnets. Nets are fixed on poles or anchors and can be attached together or placed in parallel to each other, as the single-wall fixed gillnets (Figure 12). These nets are mainly used to catch catfish, but they may also be used for flatfish. Minimum mesh size of the inner netting is 100 mm, while

the mesh sizes of the *alvitanas* are usually four to five times larger than the inner netting. The fishery for catfish used to be the second in importance for the region before the stock collapse in the early 1980s. Today, it is estimated that only 246 fishers are engaged in this fishery (Table 6).

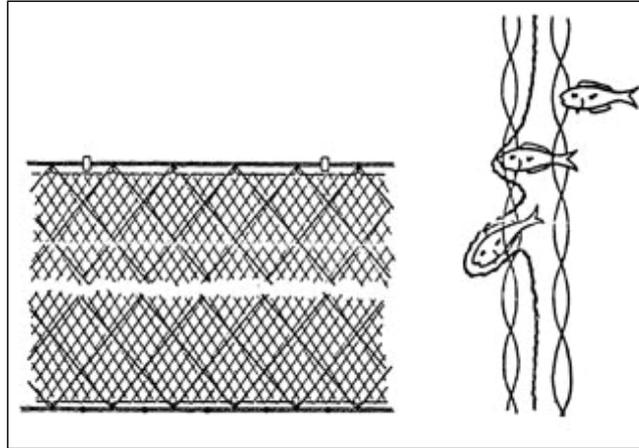


Figure 21: Scheme of operation of a trammel net (*Source:* FAO, 1982)

Fishing effort for catfish is mostly concentrated in the areas of the medium estuary bordering the municipalities of Pelotas, São José do Norte and São Lourenço do Sul (Figures 22 and 23). Most of the fishing effort directed to the species originates from localities in Pelotas and São José do Norte. Despite the lower levels of efforts, the fishery for catfish is also important for fishers from the northern localities of the lagoon, especially Arambaré, São Lourenço do Sul and Tapes.

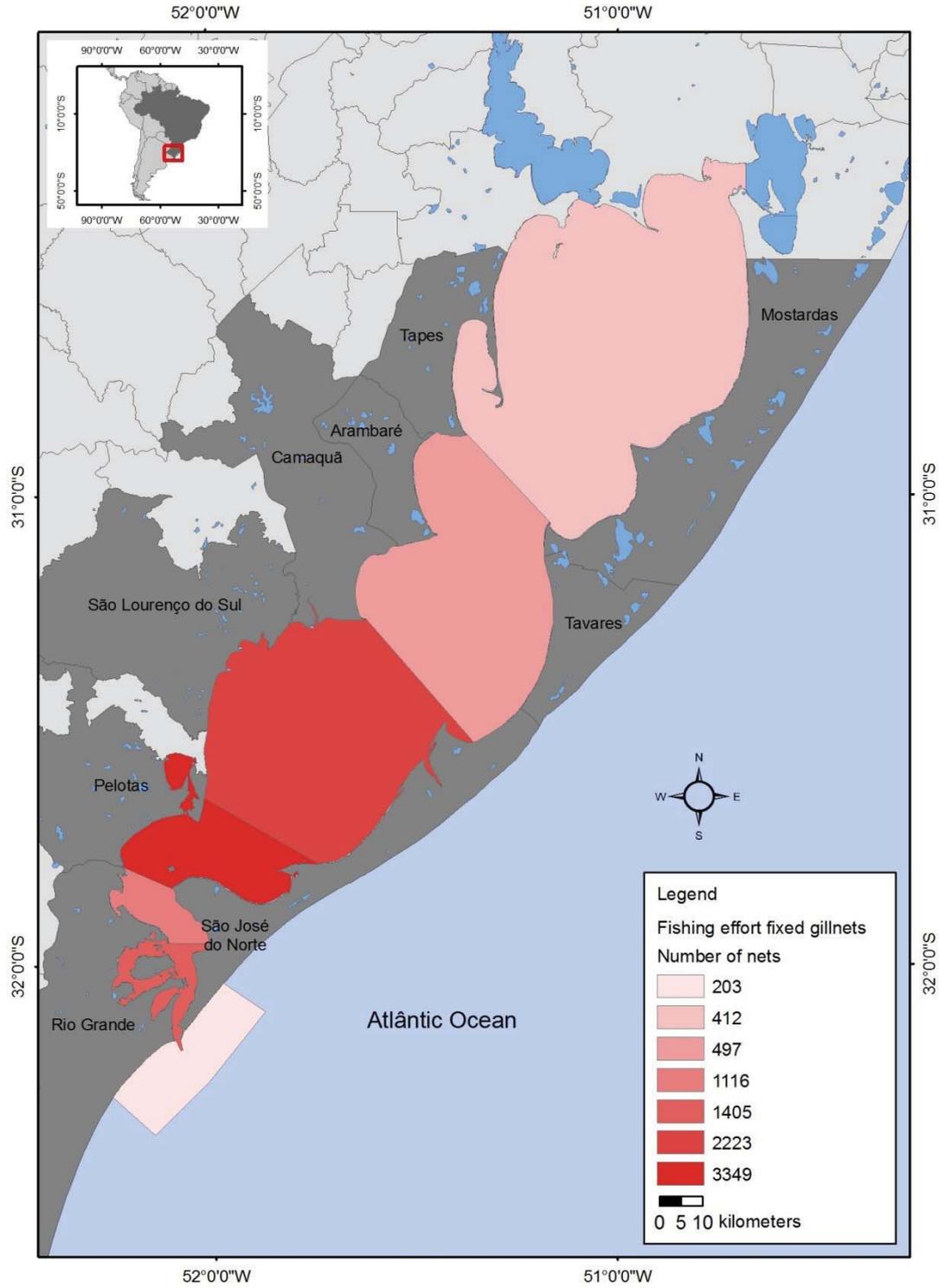


Figure 22: Distribution of total fishing effort with fixed gillnets (trammel nets) for catfish (effort measured in number of fixed trammel nets)

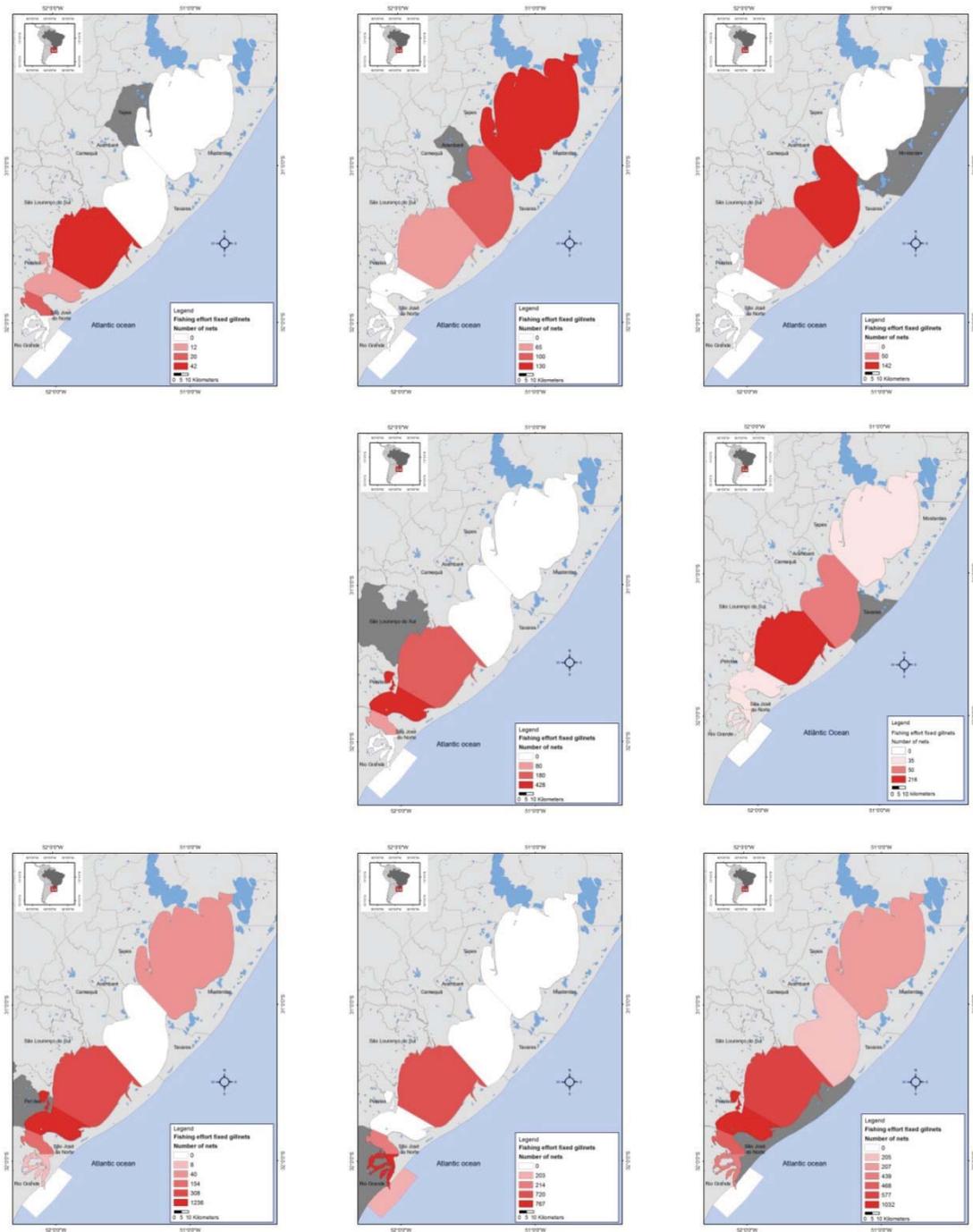


Figure 23: Distribution of fishing effort with fixed gillnets (trammel nets) for catfish by municipality (in dark grey)

Drift gillnets

Drift gillnets are single netting walls maintained close to the surface by attaching sufficient floats so that the buoyancy of the net is superior to the lead weights attached to the leadline of the net. One end of the net is usually attached to the boat and the other end to a buoy (Figure 24). In this fishing operation, both the boat and net drift together and are locally called *bomboi* or *caceio*. Shorter nets of 100–150 fathoms (183–274 m) are sometimes used, especially in areas of intense transit of vessels such as in the main navigational channel of the lagoon. Drift gillnets are mainly used to catch croaker, but they can also be used to catch mullet and, less commonly, catfish.



Figure 24: Setting a drift gillnet in shallow waters

Differently from the fixed gillnets, the area of operation of the drift gillnet fishery for croaker is mostly concentrated in the lower estuary and in coastal waters adjacent to the mouth of the lagoon (Figures 25 and 26). This fishery targets schools of croaker as they approach and enter the estuarine waters during springtime. The use of echosounders in this fishery has become more frequent in recent years.

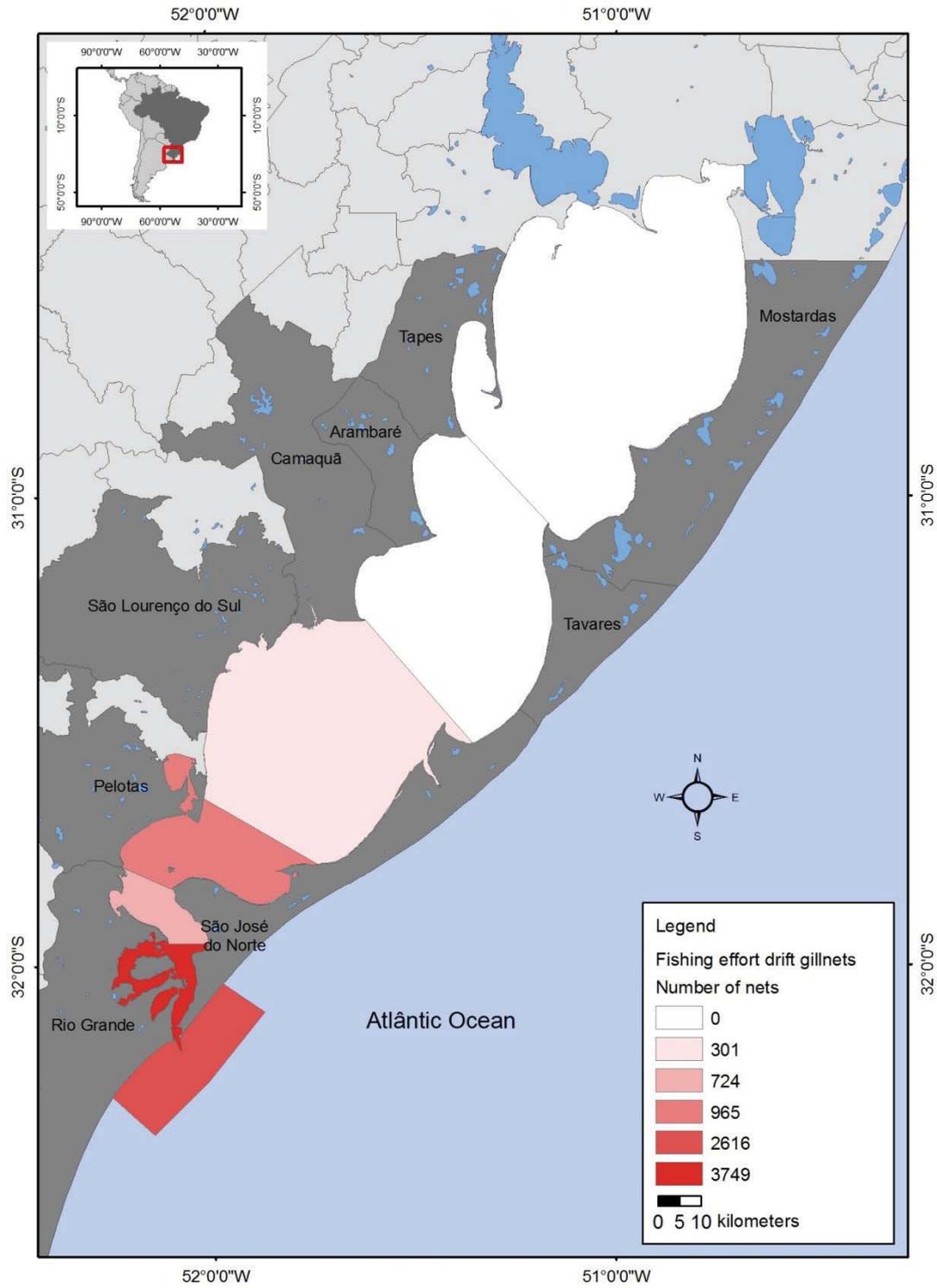


Figure 25: Distribution of total fishing effort with drift gillnets for croaker

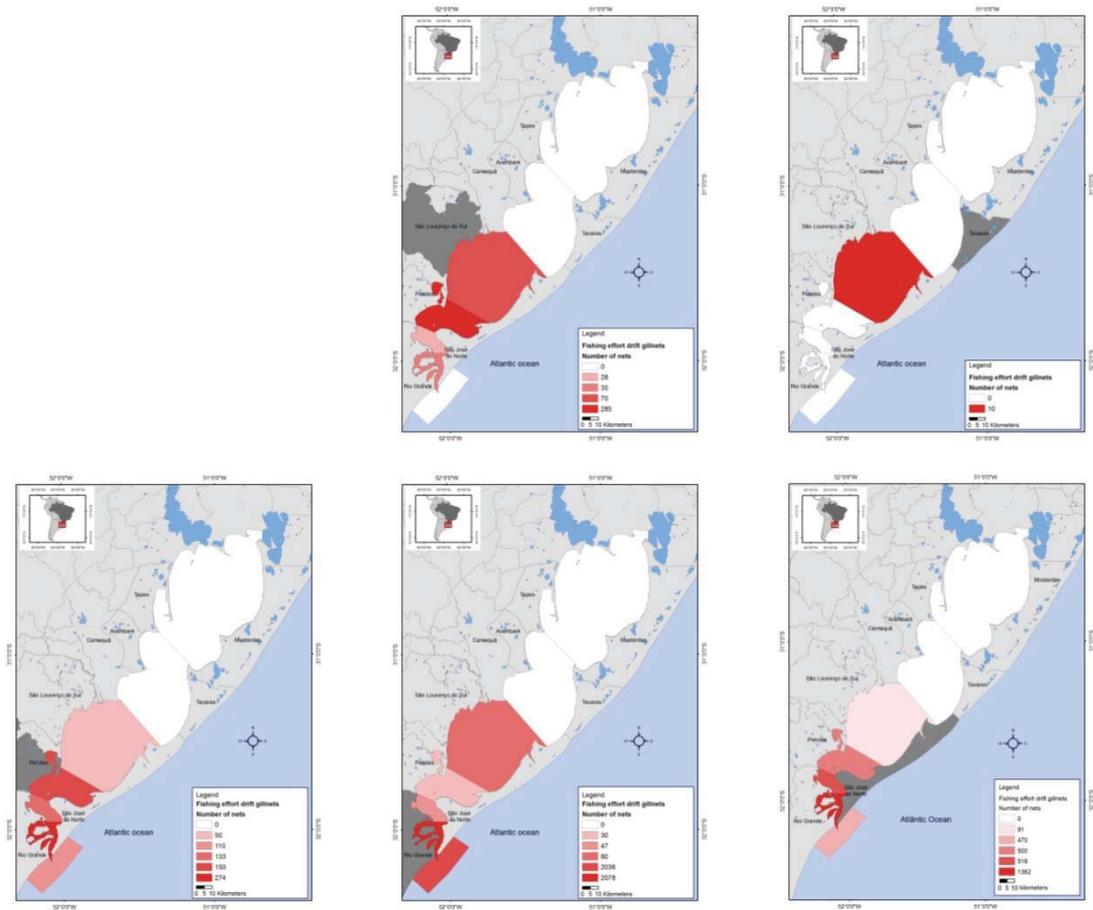


Figure 26: Distribution of fishing effort with drift gillnet for croaker by municipality (in dark grey)

Surrounding (seine) gillnets

This type of fishing gear targets schooling species, which can be captured in large numbers in a single set. It is mainly used to catch mullet but may also be used to catch croaker. The operation of surrounding gillnets demands a lot of skill and is often carried out by paired fishing units. When a school is spotted on the surface, it is encircled by one of the canoes carrying one end of the net. The circle around the school is completed when the canoe returns to the main boat. At this point, fishers start beating the surface waters vigorously with their oars, chasing fish to move in the direction of the netting wall to be gilled or entangled (Figure 27). A different encircling trajectory is sometimes used, where the net is made into a swirl. When two boats are fishing together two swirls can be made around the school (Vieira and Reis, 2005). These types of trajectories allow a faster manoeuvre and require larger nets. Netting walls are usually longer and higher than those used in the fixed gillnet fishery (Table 6). The height of the netting wall can also vary according to the depth of the water where it is operated (heights of up to 100 meshes can be used in deeper channel waters of the lagoon (Vieira and Reis, 2005). The fishery with surrounding gillnets for croaker is less common. However, when croakers are targeted by surrounding gillnets, echosounders are used to locate the croaker schools, which cannot be seen on the surface as mullets.

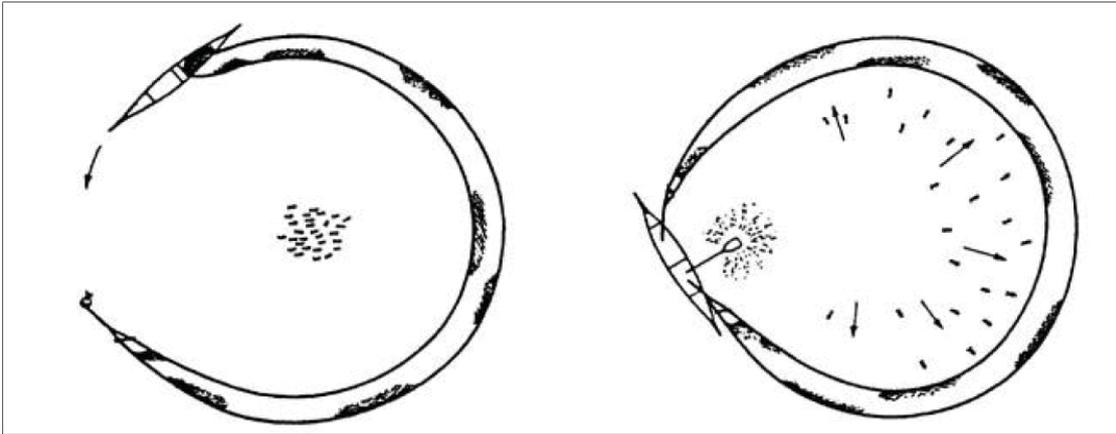


Figure 27: Operation of a surrounding (seine) gillnet (*Source:* FAO, 1982)

Not all localities are engaged in the surrounding gillnet fishery for mullet. The fishery is particularly important for fishers of Pelotas, Rio Grande and São José do Norte. The highest concentration of effort is found in the medium and lower parts of the estuary (Figures 28 and 29).

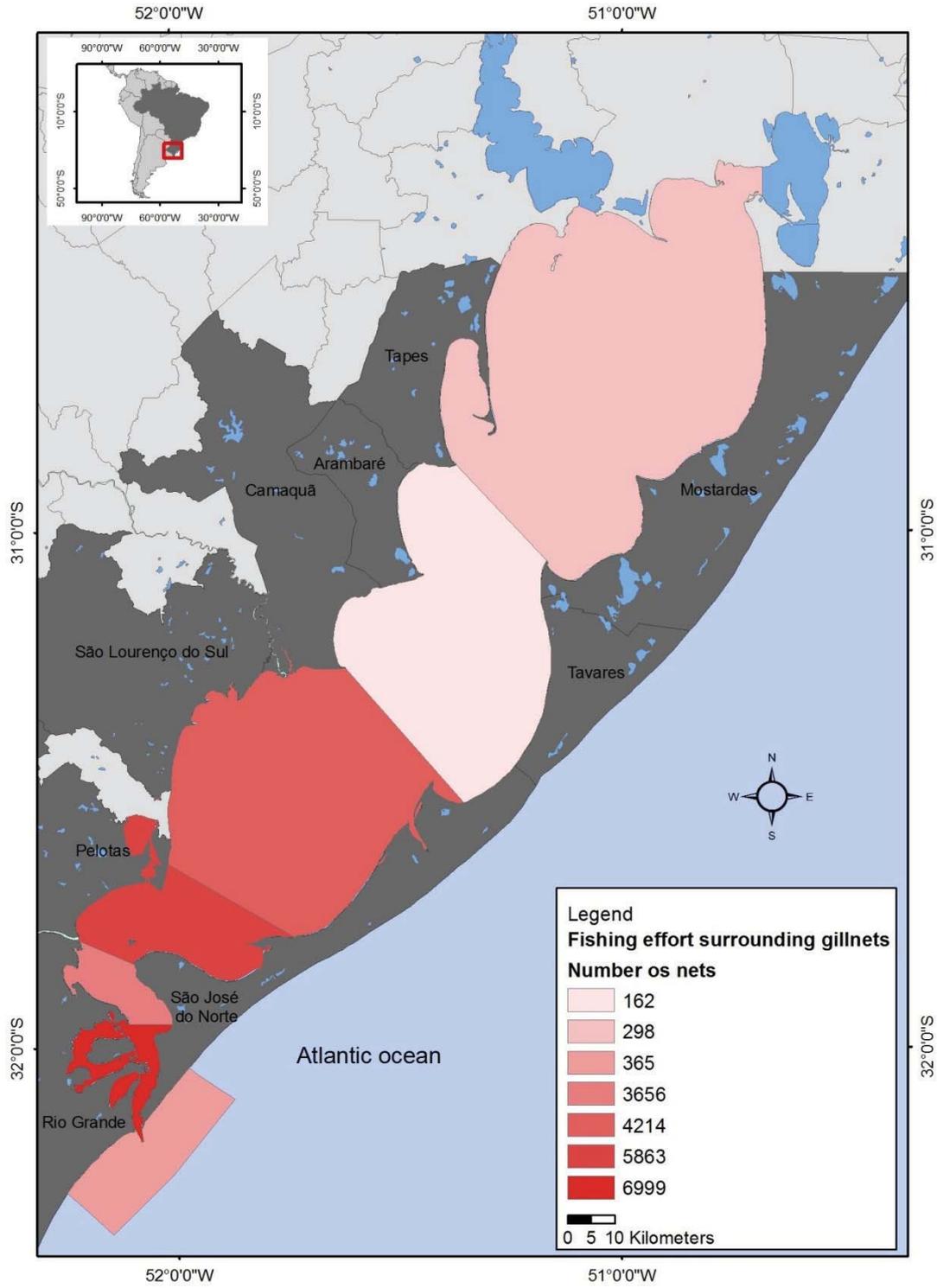


Figure 28: Distribution of total fishing effort with surrounding (seine) gillnets for mullet

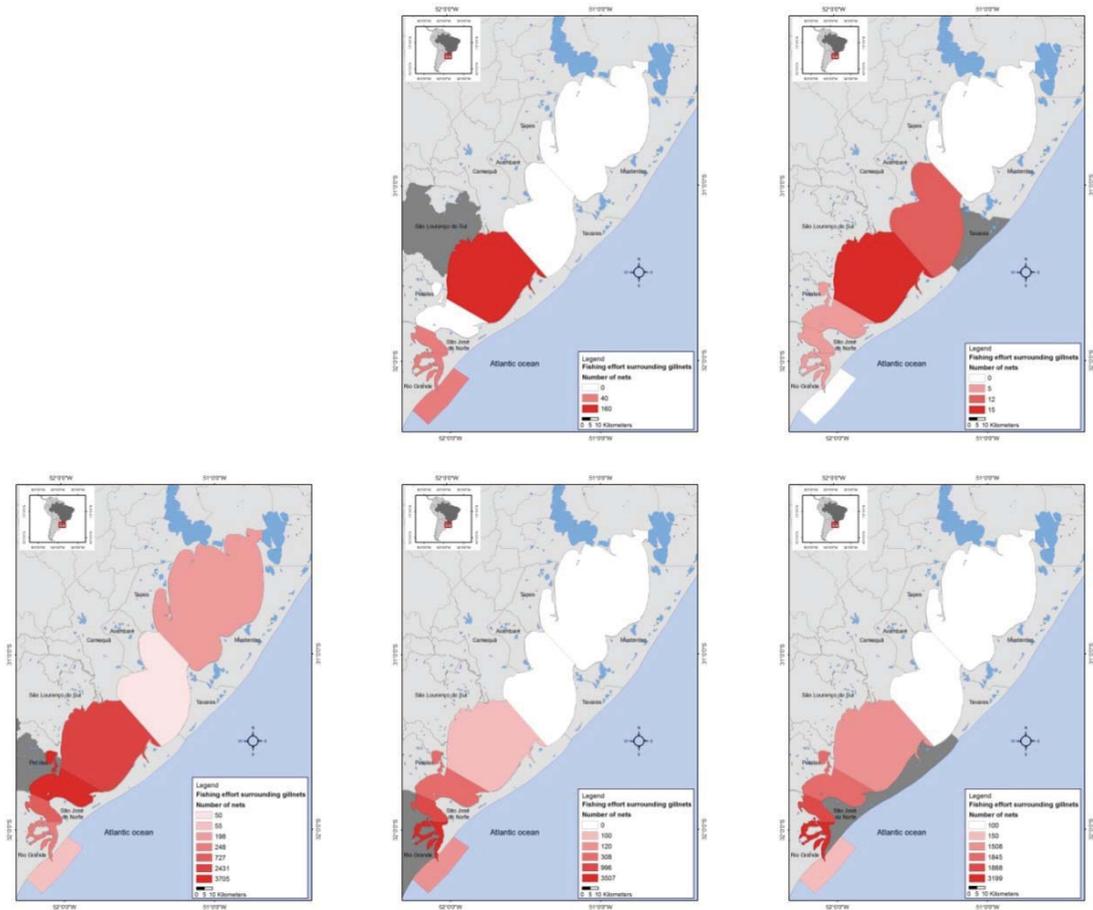


Figure 29: Distribution of fishing effort with surrounding (seine) gillnets for mullet by municipality (in dark grey)

Trolha

Trolha is a particular type of encircling net that is trawled by two boats (Figure 30; Vieira and Reis, 2005). The leadline scrapes the bottom and is closed at the end of the set by a cable that runs through a series of rings. Two concrete weights are attached to each end of the net. Very few *trolhas* were registered during the fieldwork. In total, 12 fishers from the localities of Z3 (Pelotas), São Miguel and Lagoa (Rio Grande), Passinho (São José do Norte) and Tapes declared using it to catch croaker. Because it is a forbidden gear in the estuary of Patos Lagoon, many more are probably in use by artisanal fishers but were not declared during interviews. Trawled gear are forbidden in the estuary making the *trolha* illegal. The information obtained from the few *trolhas* indicates that the net length varies from 250 to 1 000 fathoms (250–1 000 m) and mesh sizes from 20 to 100 mm. Height information provided by fishers was more difficult to interpret. *Trolhas* are usually used to catch demersal fish such as croaker and catfish in deeper areas of the lagoon where schools are found. Because of the small mesh size and the type of operation, *trolhas* are known to be non-selective and a very effective fishing gear. In fact, fishers who use *trolhas* reported the highest individual yields of croaker in the estuary, varying from 0.7 tonnes/day to 15 tonnes/day.

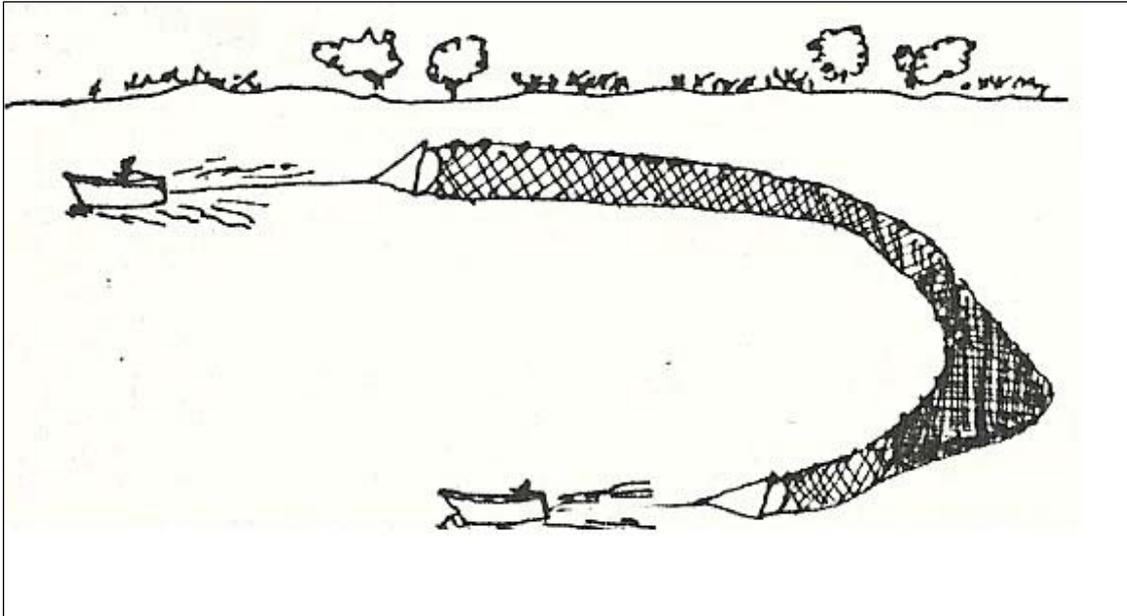


Figure 30: Operation of a *trolha* net used in the capture of demersal fish (Source: FURG, 1988)

Shrimp and blue crab fisheries

The fisheries for shrimp and blue crab have the highest diversity of fishing gear and techniques in use in the Patos Lagoon estuary. Both passive and active gear are used. The passive gear are fyke nets, stow nets and longlines, and the active gears are otter trawls, psin trawls, beach seines and *berimbau*. The characteristics of these gear and fisheries and the total fishing effort are described in detail below and in Table 7. The importance of the different types of gear varies among the fisheries localities, as shown in Figure 31. Fyke nets are the predominant gear in some urban and rural localities of Rio Grande and São José do Norte, while otter trawls are important in localities closer to the mouth of the lagoon and along the west shore of the upper estuary. The other gear have minor importance in some localities of Pelotas, Rio Grande and São José do Norte.

Table 7: Fishing effort in shrimp and blue crab fisheries

Shrimp			
Gear type	Total number	Number/fisher	Fishers
Fyke net	22 740	15.6	1 455
Stow net	1 258	11.1	114
Otter trawl	170	–	170
Psin trawl	2	–	2
Beach seine	30	–	30
<i>Berimbau</i>	21	–	21
Blue crab			
Gear type	Total number	Number/fisher	Fishers
Fyke net	3 354	13.2	254
Otter trawl	49	–	49
Longline	98	–	98
Other*	14	–	14

*Other gear includes beach seine and *gerere*.

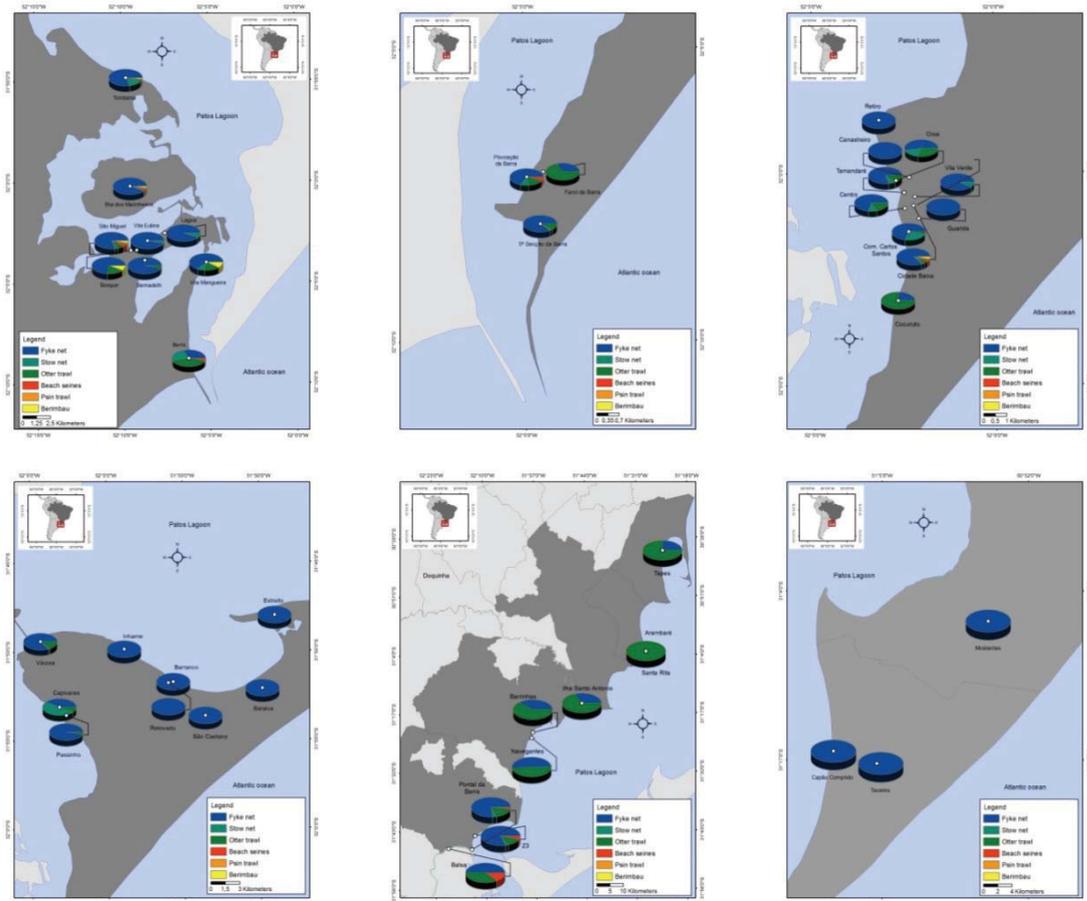


Figure 31: Proportion of fishers using different shrimp fishing gears in each of the main localities

Fyke nets

Fyke nets (known as *saquinho* or *aviãozinho*) are used mainly to catch shrimp but they often catch blue crab and finfish as bycatch. In more recent years, the net has also been used to target blue crabs (Ferreira, 2007). Fyke nets and stow nets are the only gears allowed to catch shrimp in the estuary of Patos Lagoon. Fyke nets have a conic shape composed of two “arms”, an intermediate body and a codend with a series of conic valves that impede the escapement of organisms (Figures 32 and 33). The nets are fixed in shallow waters of the estuary (0.6 to 4 m depth). In the shrimp fishery, the nets are used mainly at night-time. Different luminous sources are used to attract shrimp to the nets. These include gas lights and lamps powered by batteries or by electric generators. During the daytime, the nets are suspended in the air to avoid getting filled with dirt or they are taken away to avoid being stolen. The nets can also be used to fish during daytime in periods of strong northeast winds, when currents are favourable and water turbidity are high and shrimp can be caught passively. Likewise, the fishery for blue crabs with fyke nets is also conducted under the same conditions and normally does not employ lights. Fyke nets are tied to poles made of eucalyptus wood or bamboo and fixed side by side. A group of nets fixed together are known as *andainas*. Between 3 and 120 nets can be fixed together in the same *andaina*, which usually belongs to the same fisher (Benedet, 2006). The average number of fyke nets used is about 15 nets/fisher in the shrimp fishery and 13 nets/fisher in the blue crab fishery (Table 7). Both figures are above the maximum of 10 nets/fishers allowed in the legislation (Chapter 4). Fyke nets are the most widely used gear for the shrimp fishery, involving 1 455 fishers and a total of 22 740 nets (Table 7). It is also the gear most frequently used in blue crab fisheries, involving 254 fishers and 3 354 nets.



Figure 32: Fyke nets use in the shrimp fishery



Figure 33: Codend of a fyke net adapted for fishing blue crab

The fyke nets in an *andaina* can be fixed in different ways (Figure 34; Benedet, 2006): side by side with the mouths turned to the same direction; side by side with the mouths turned in opposite directions (*perfiadas*); and in the form of a circle or rose, with the light source at the centre. There are variations in the dimensions of the nets as well as in the number of conic trap doors used within the codend (two or three). Overall, the mouths of the nets vary in size from 5 to 12 fathoms (9–22 m) and mesh sizes from 24 to 26 mm. In the directed fishery for blue crabs, some fishers are also using codends adapted with larger mesh sizes (60–70 mm) to

decrease bycatch of small-size individuals. The variations in size and placement of the nets reflect strategies used by fishers to increase catchability and decrease costs of materials and fuel.

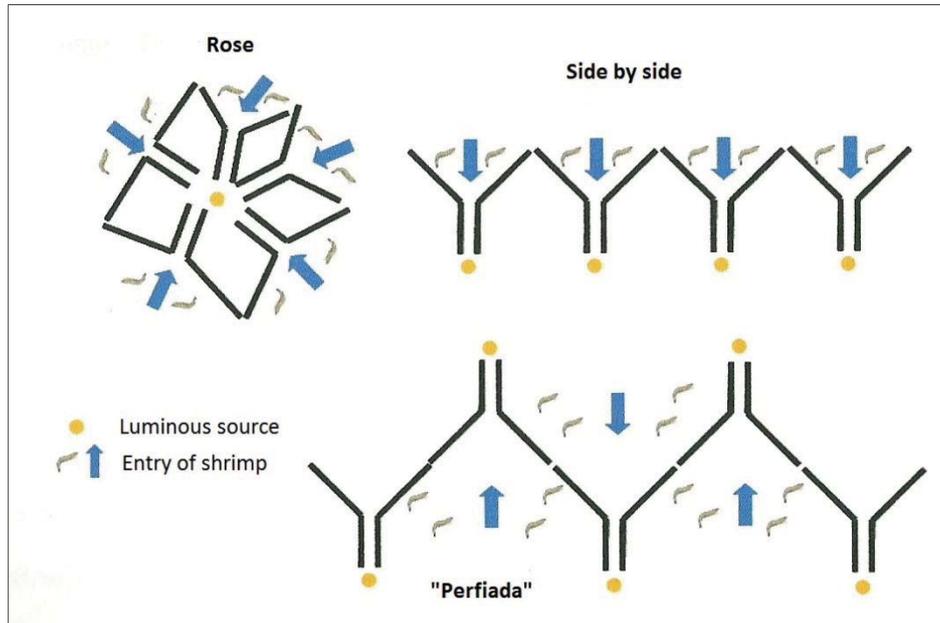


Figure 34: Schematic representation of an *andaina* (Source: Benedet, 2006)

The distributions of fishing effort with fyke nets for shrimp and blue crab are presented in Figures 35 to 38. These fisheries operate mainly in the lower estuary, with the highest concentration of nets in the shallow waters that border the municipalities of Rio Grande and São José do Norte. Only fishers from Pelotas, Rio Grande and São José do Norte participate in the blue crab fishery with fyke nets, with the highest effort originating from localities in Rio Grande.

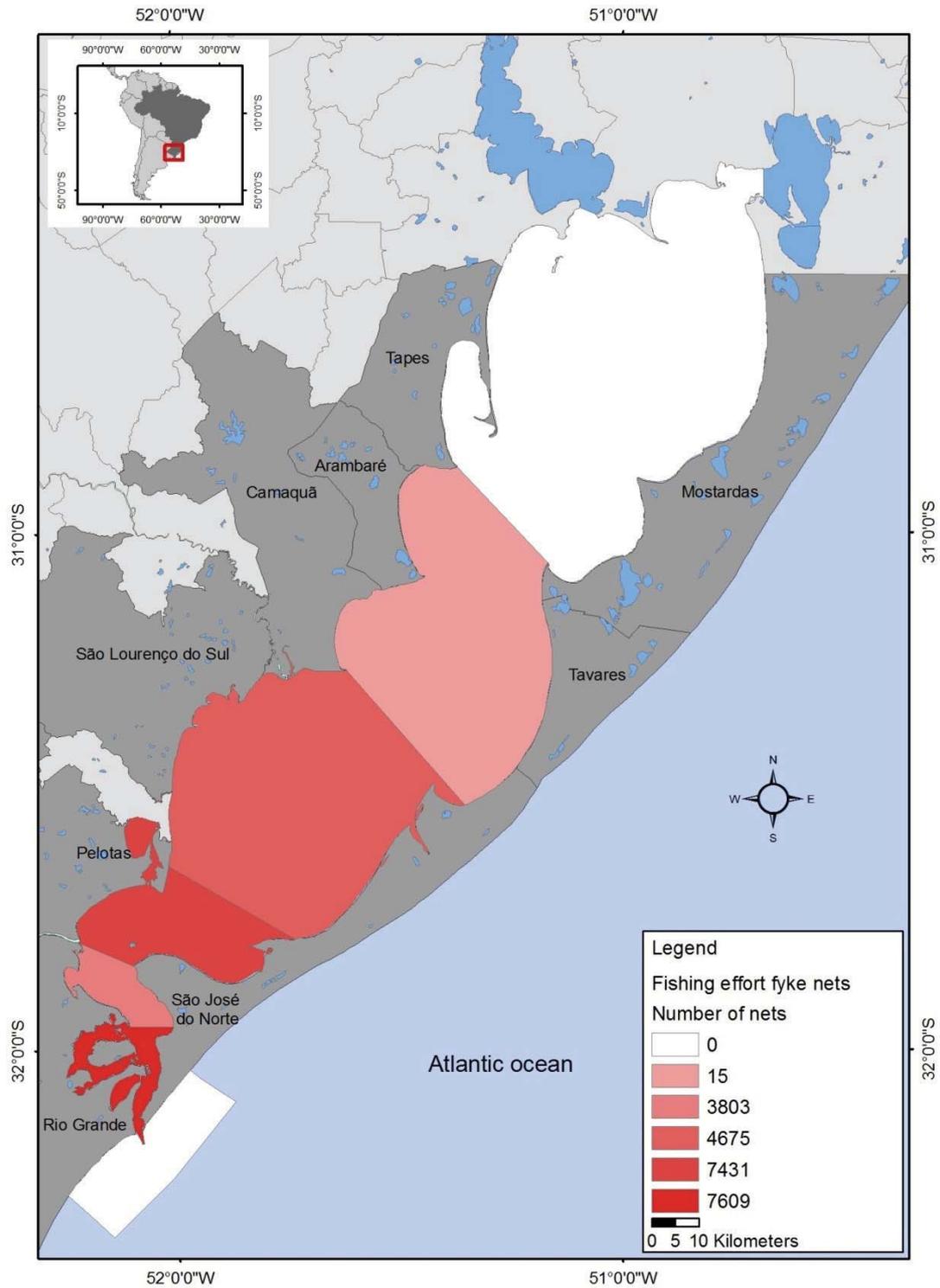


Figure 35: Distribution of total fishing effort with fyke nets for shrimp

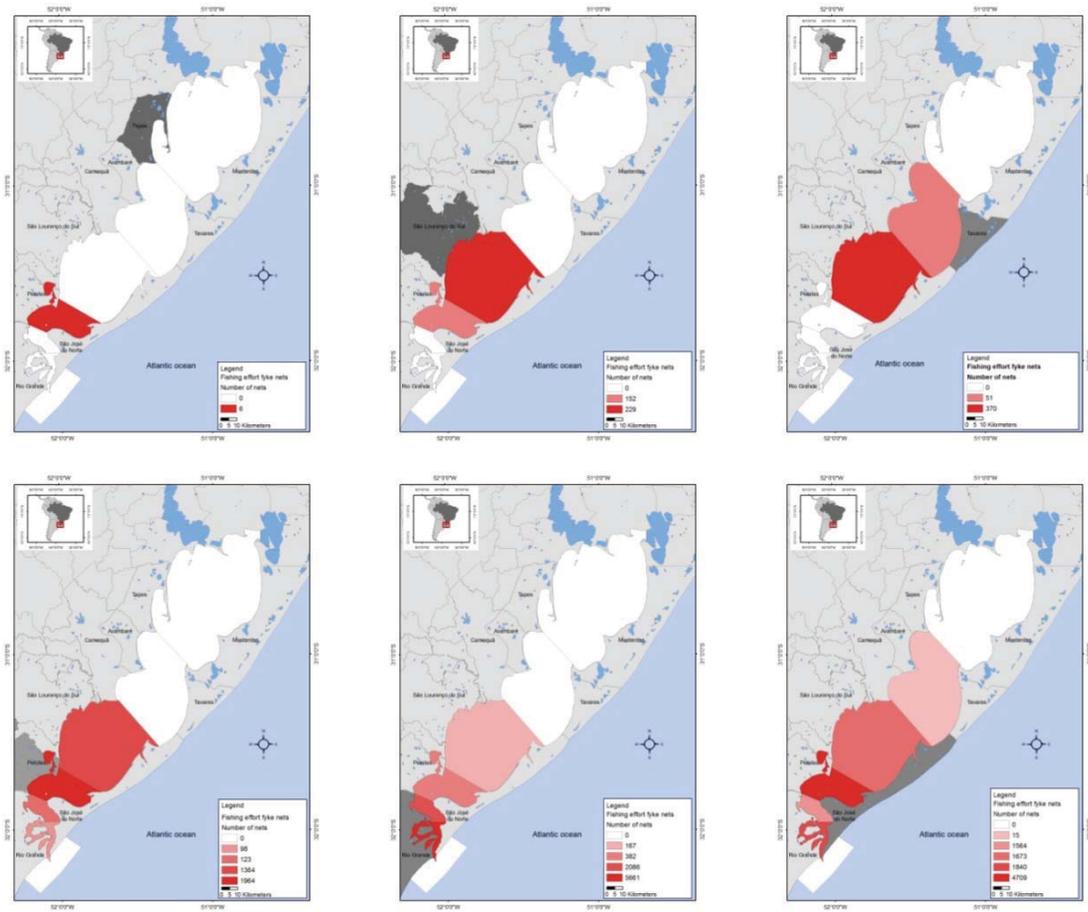


Figure 36: Distribution of fishing effort with fyke nets for shrimp by municipality (in dark grey)

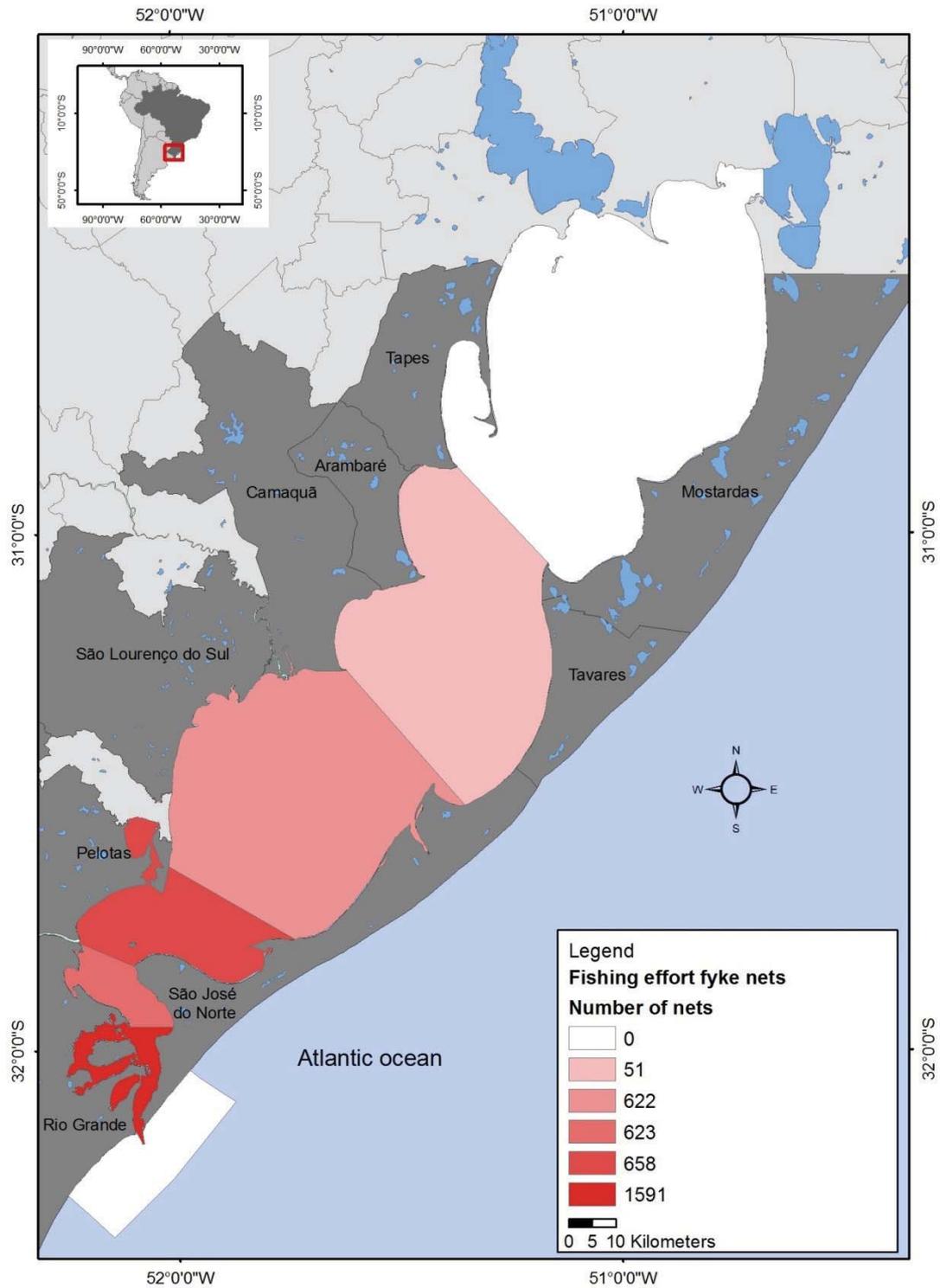


Figure 37: Distribution of total fishing effort with fyke nets for blue crab

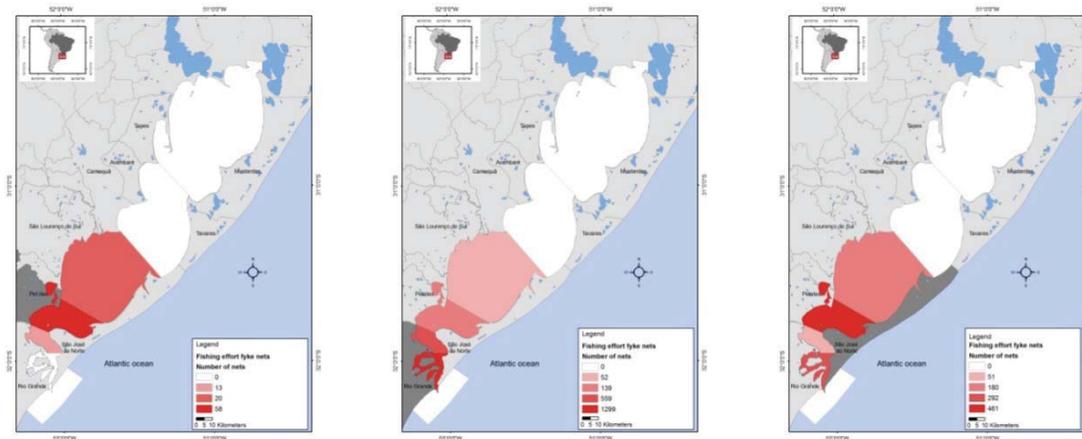


Figure 38: Distribution of fishing effort with fyke nets for blue crab by municipality (in dark grey)

Stow nets

The stow nets (*redes de sacco*) are fixed nets that have been used in shrimp fisheries for a longer time than fyke nets. Stow nets were widely used until fyke nets became popular in the 1980s. Although they are less common today, it is estimated that at least 114 fishers are involved in this fishery, with a total effort of 1 258 nets (Table 7). The nets have a conic shape similar to a trawl net but without the wings (Benedet, 2006). Stow nets are fixed in channel waters (between 3 and 14 m depth) and passively capture shrimp as currents filter through the nets. The fishery with stow nets is directed to shrimp that are initiating the return to the sea to join the adult stock. The nets are normally used during night-time without the use of a light source. Stow nets are tied to wooden poles buried deep into the bottom in order to withstand the strong currents. In deeper waters, the depth of operation of the net can be regulated according to the yield. The nets are checked regularly during the night and catches are hauled onto the boats. When the fishing operation is over, the nets are taken away or the mouth is closed to avoid the entry of sediment into the net. Up to 90 stow nets can be fixed side by side in one *andaina* (Benedet, 2006). The mouth of the net varies in size, from 4 to 6 fathoms (7–11 m), and can have up to 5.5 m of height (Benedet, 2006). Mesh sizes vary from 24 to 30 mm.

Otter trawls

Locally known as *prancha* or *plancha*, otter trawls are a common but forbidden type of gear used to catch shrimp and blue crabs. Trawl net sizes are adapted to the target species and to the type of vessel and engine power (the higher the power, the larger the net). Trawl nets used in shrimp fisheries vary from 5 to 10 fathoms (9–18 m) opening in the mouth and have mesh sizes from 24 to 40 mm in the codend. Otter trawls used in the blue crab fishery are normally smaller, having from 2.5 to 5 fathoms (5–9 m) opening in the mouth, and larger mesh sizes from 60 to 90 mm in the codend than the shrimp trawls (Figure 39A). Otter boards made of wood with an iron frame (Figure 39B) and weighing between 12 and 18 kg are used to keep the mouth of the net open during the fishing operation. The fishery operates both day and night throughout the region but preferably in soft substrates (mud or sand) without vegetation and in the channel waters with greater depths (1.5–14 m depth) (Benedet, 2006; Ferreira, 2007). Each tow lasts from 35 to 60 minutes, but shorter tows of about 15 minutes can be made to evaluate shrimp abundance before making the definitive tow (Benedet, 2006). The net is usually towed by a single boat, but sometimes two boats can also be used to increase the towing speed and facilitate the operation in vegetated areas (Benedet, 2006).



39 A

39 A

Figure 39A. Detail of a trawl net for blue crab. **Figure 39B.** Otter board showing angle of attack

A total of 170 fishers declared using otter trawls for shrimp fishing and 49 fishers declared using it for blue crab (Table 7). These numbers are likely to be underestimates of the real magnitude of this fishery, given its illegal status. As discussed in the section on fishing vessels, the number of boats apt to carry out trawling is in the order of 376, which is probably a best estimate of the number of fishers engaged in this fishery.

The distribution of fishing effort with otter trawls is shown in Figures 40 to 43. The shrimp fishery is more intense in areas of the medium estuary, differing from the fixed fyke net fishery, which has the highest effort in areas of the lower estuary (Figure 35). The trawl fishery for blue crab is, on the other hand, concentrated in the lower estuarine and shallow coastal waters. It is worth noting that the operation of this fishery in coastal waters adjacent to the mouth of the lagoon is illegal because the area is an important spawning site for the species during the summer (Ferreira, 2007).

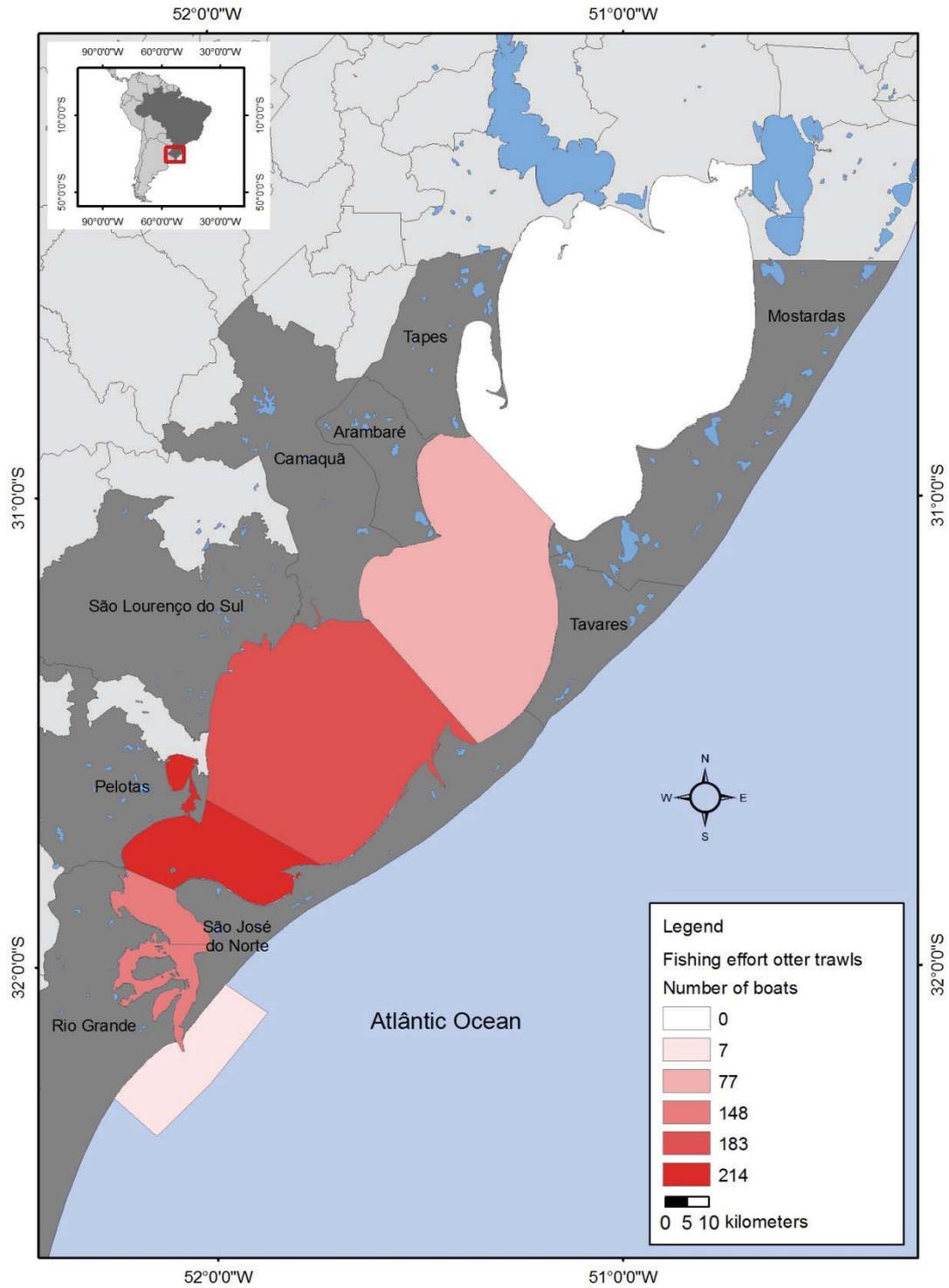


Figure 40: Distribution of total fishing effort with otter trawls for shrimp

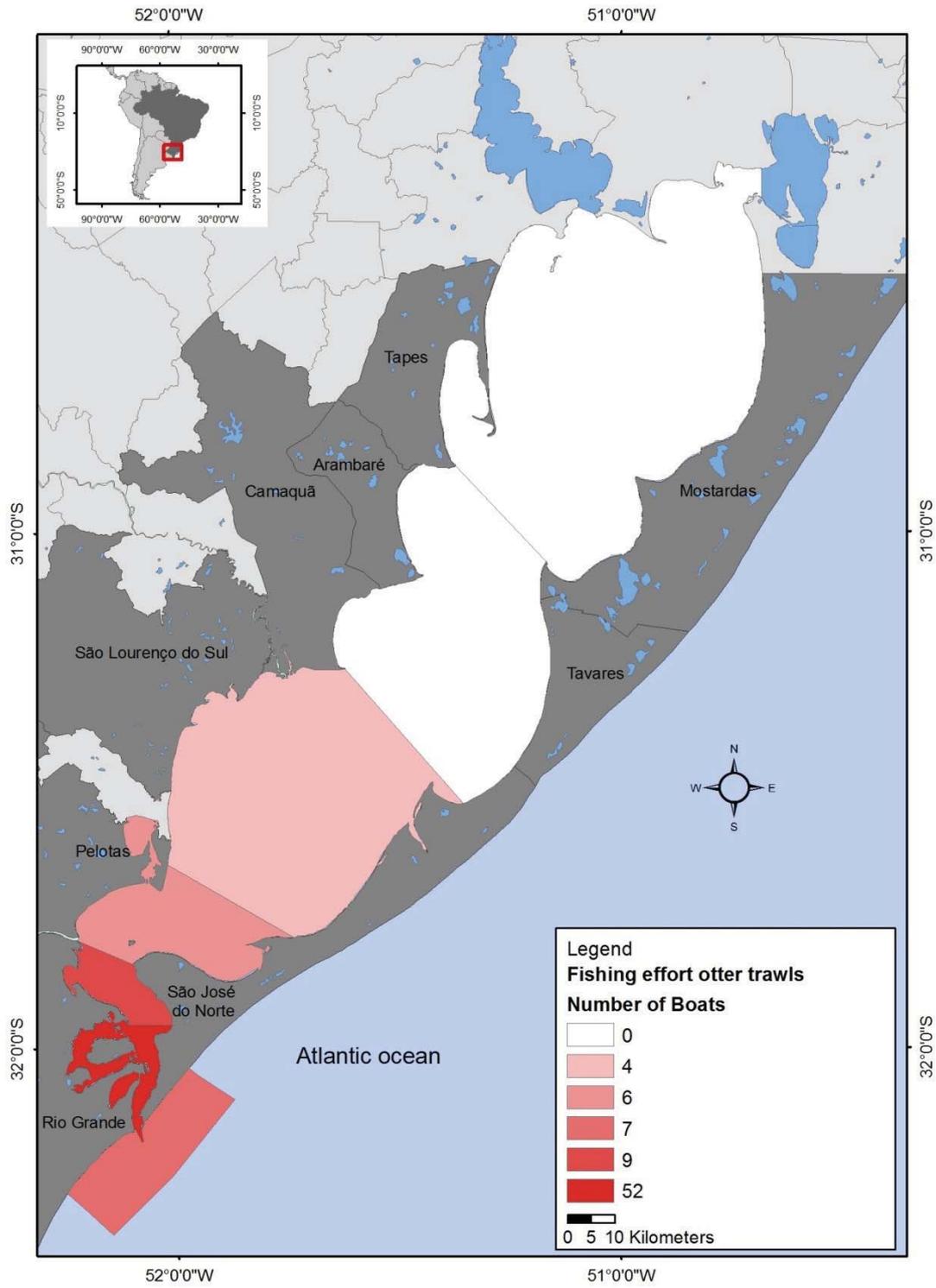


Figure 42: Distribution of total fishing effort with otter trawls for blue crab

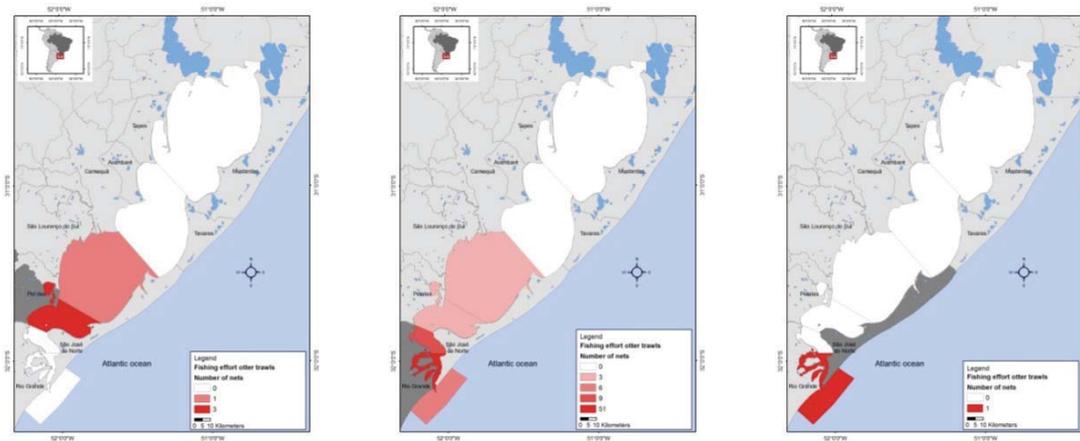


Figure 43: Distribution of fishing effort with otter trawls for blue crab by municipality (in dark grey)

Beach seines

Beach seines (*rede de coca*) have a conic shape similar to the stow nets, but without the long wings and valves inside the codend. The extremities are fixed on poles, which are used by two to four men to trawl the net in shallow waters of the estuary (0.6–1.5 m depth), usually close to urban centres (Figures 44 and 45). The low cost and ease of use of beach seines make it widely used by occasional fishers wanting to make extra cash in the shrimp fishery. Data from fieldwork, in fact, revealed that beach seines are not a common gear among full-time artisanal fishers. Only 30 fishers declared using it, but not exclusively. Benedet (2006) described the operation of the beach seine fishery in the estuary of Patos Lagoon: the fishery normally takes place at night with the assistance of a gas lamp held in a canoe or floating object (e.g. truck tyre inner tubes) that are towed together in the operation. Each operation lasts from 30 to 45 minutes. Mesh sizes vary from 20 to 30 mm, and the seine has a horizontal opening from 2 to 3 fathoms (5 m). The average vertical opening is 1.2 m (Benedet, 2006). Beach seines with larger mesh sizes (60–66 mm in the codend) are also used in fisheries targeting blue crabs (Ferreira, 2007). Only three fishers declared using these during fieldwork.



Figure 44: Operation of a beach seine (Source: Washington Ferreira)



Figure 45: Fishers getting ready for the beach seine fishery

Berimbau

Berimbau is the local name for a manually trawled net, which is also common in shallow waters around urban centres. Up to six nets can be towed side by side, but most commonly a fisher tows one or two nets. The net is made up of a body, which resembles a cast net, and a front end adapted with a valve and sac. A bamboo pole is fixed in the posterior part of the body and has the function of keeping the net stretched and 30–40 cm above the bottom to allow the entry of shrimp into the net (Benedet, 2006). The net operates by scrapping the bottom with the leadline in the rear end of the body (Figure 46). Once in contact with the net, shrimp jump into the conic valve and are captured in the sac. The net is towed during day or night-time, with each operation lasting from 30 to 60 minutes. Mesh size vary from 14 to 24 mm. The area of operation of *berimbau* is the same as the beach seines. *Berimbau* is mostly used by occasional fishers and very few (21) of the fishers interviewed declared having used it or using it in shrimp fisheries.



Figure 46: Fisher demonstrating the operation of a *berimbau*

Psin trawls

Psin trawls (*redes de pauzinho*) were widely used in shallow waters of the estuary (1.5 to 4 m depth) during the 1970s and 1980s (Benedet, 2006). It is currently in disuse because of the high operational costs and the popularization of the otter trawls. Only two fishers declared using it for shrimp fisheries. The net has a conic shape similar to a beach seine but with a higher vertical opening. Each extremity of the net is fit with a wooden pole or iron structure (Figure 47) responsible for maintaining the net open during the tow. Cables tied to these structures are used to tow the net by two boats, like pair trawlers (Figure 48). A third cable links the net to a canoe that is towed together and is used to lift the codend and land the catch after each tow. The leadline is fitted with chains that scrape the bottom during the fishing operation. The mouth of the net measures between 5 and 9 m and the total length is usually 10 m (Benedet, 2006). Mesh sizes in the body are 24 mm and may decrease to 20 mm in the codend. According to Benedet (2006), the use of *psin trawls* is restricted to particular areas, well known by fishers, where the substrate is free of any objects that could damage the towed nets.

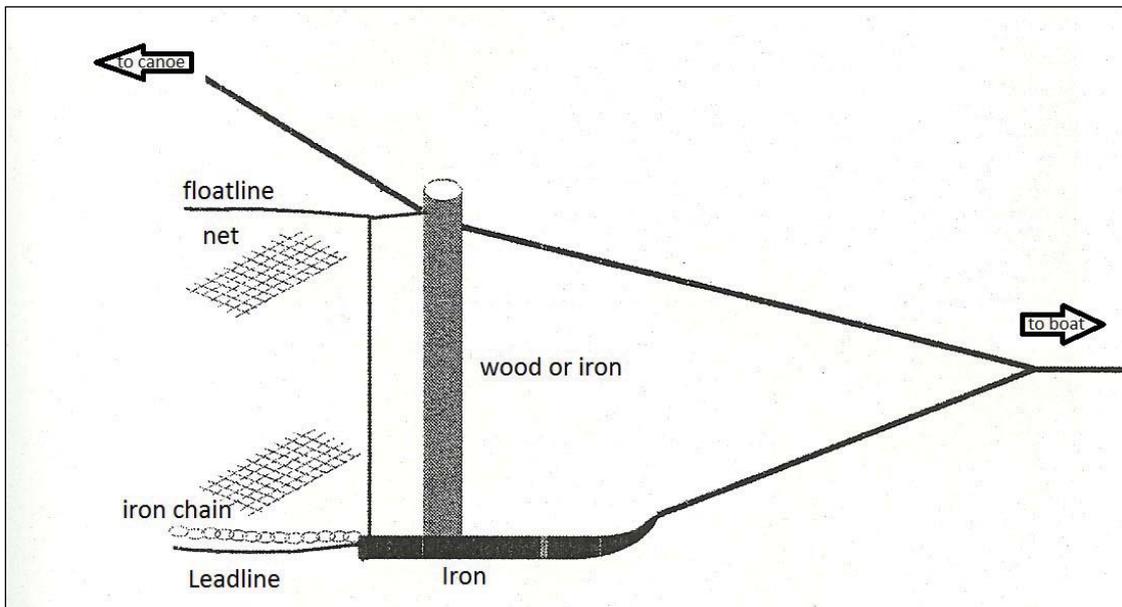


Figure 47: Detail of the mouth of the psin trawl during the tow (*source:* Benedet, 2006)

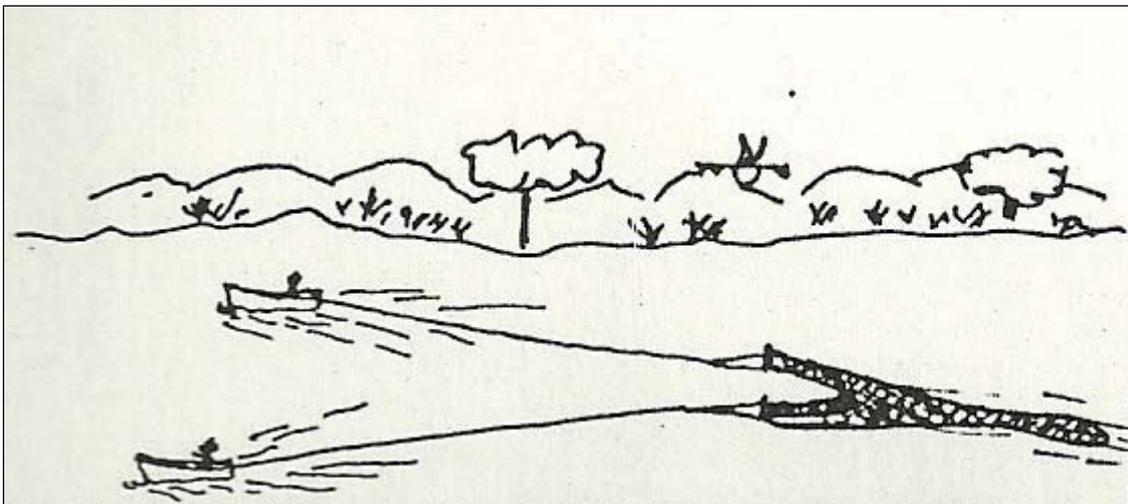


Figure 48: Scheme of operation of a psin trawl (*Source:* FURG, 1988)

Longline for blue crabs

The longline, known locally as *cordinha*, is a multifilament cable varying in length from 100 to 1 000 fathoms (1 829 m) with pieces of bait tied at intervals of approximately 1 m. The main types of bait used are bovine intestines, pieces of fish and shark skin. The baited longline is usually kept in a box with salt to conserve the bait. Ferreira (2007) described the operation of this fishery in the estuary of Patos Lagoon: the fishery is carried out during the day, in water depths ranging from 0.5 to 2 m. During the launching of the longline, one extremity is tied to a bamboo pole. During the harvesting, a boat runs in parallel to the longline and against the sun in order to avoid scaring the blue crabs. Blue crabs are usually collected manually from the line and into the boat using a small lift net (*gerere*; Figure 49A); however, when a motorized boat is used, the harvesting is carried out with the assistance of a device called *jacaré* (Figure 49B). The *jacaré* consists of a cylindrical structure fit with a bag net in which the blue crabs are collected as the longline runs through the device (Ferreira, 2007).

The longline and the *gerere* are the only gear allowed by law to capture blue crab in the estuary of Patos Lagoon. A total of 98 fishers declared using the longline for the blue crab fishery, and only a few fishers declared relying on the *gerere*.



A



B



Figure 49A: Detail of a *gerere*. **Figure 49B.** Detail of a *jacaré*
(Source: Ferreira, 2007)

Figures 50 and 51 show the distribution of fishing effort of the longline fishery for blue crab. As for other blue crab fisheries, effort is concentrated in the lower part of the estuary. The total effort map mirrors that of Rio Grande because most fishers originate from this municipality.

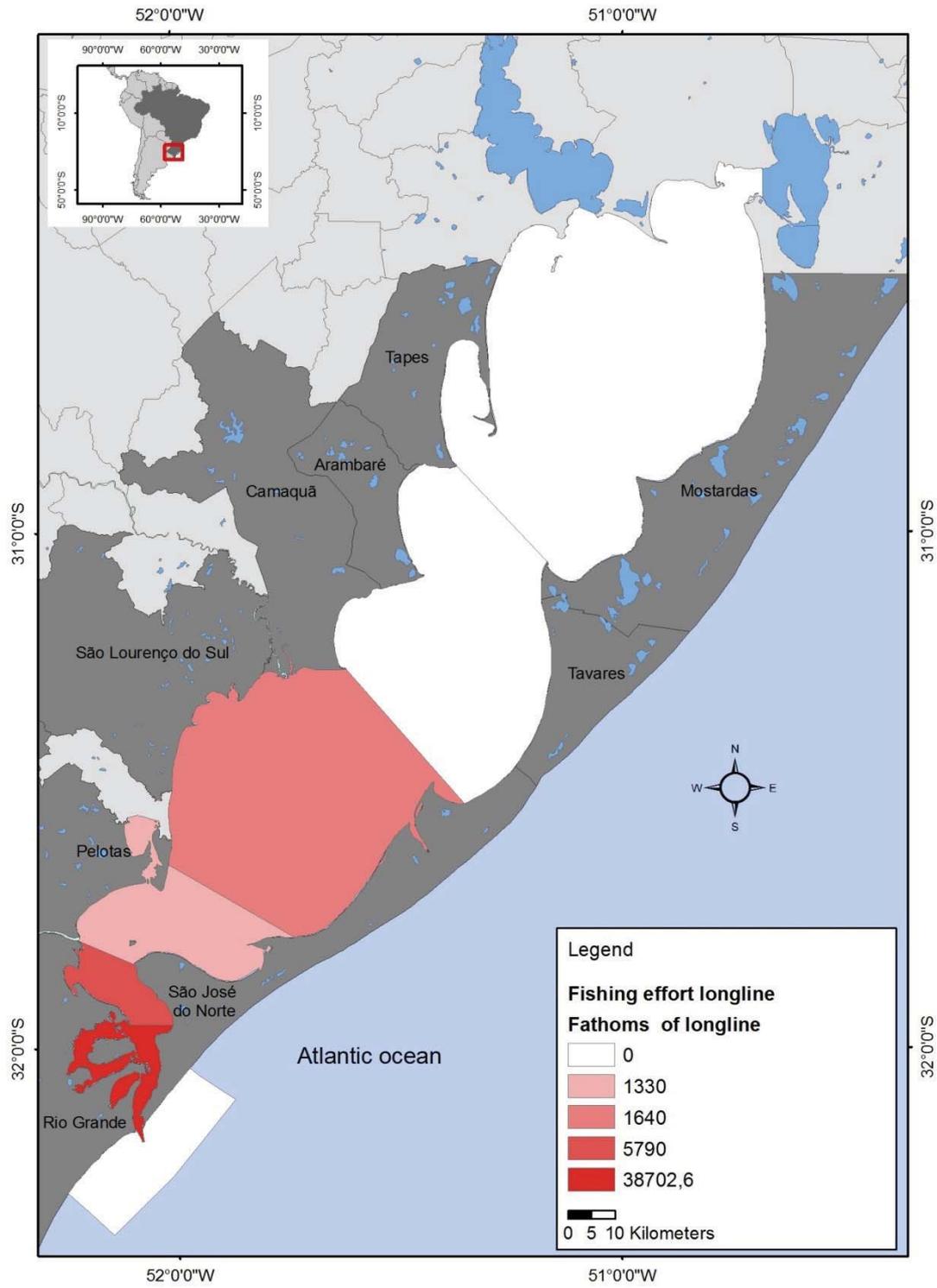


Figure 50: Distribution of total fishing effort with longline for blue crab

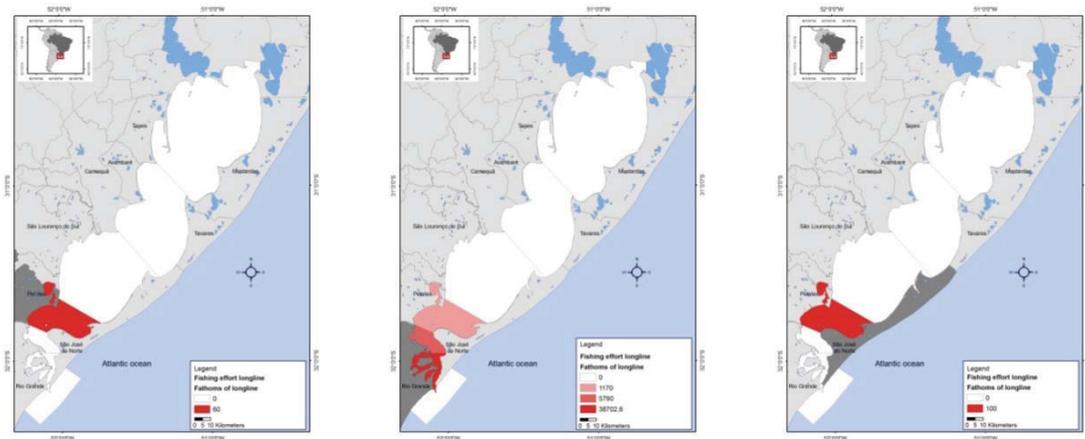
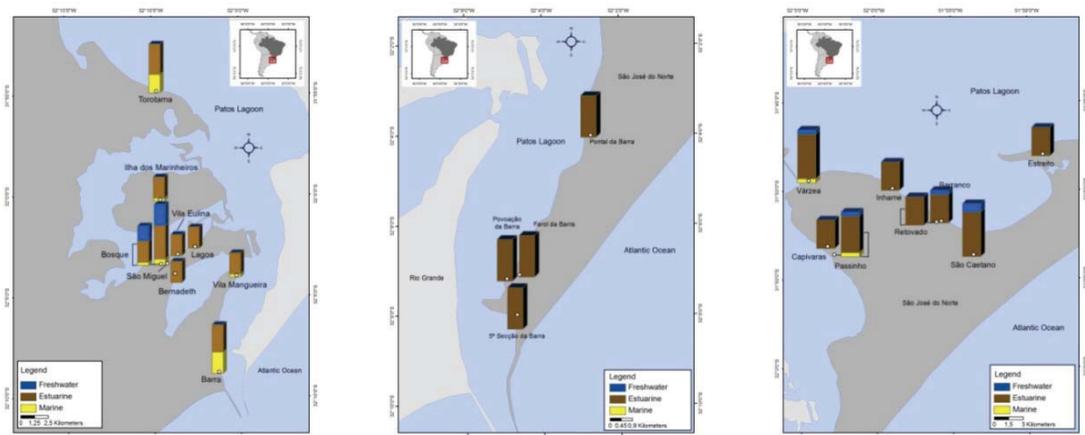


Figure 51: Distribution of fishing effort with longline for blue crab by municipality (in dark grey)

The maps of the distribution of fishing effort for the main finfish and crustacean species show, on the one hand, that the most important artisanal fishing grounds are the low and medium estuarine waters, or the areas comprised between the mouth of the lagoon and municipality of São Lourenço do Sul. On the other hand, they show that fishers often use the northernmost areas of the lagoon, outside the legal limits of the estuary, to catch finfish species such as mullet, catfish and silverside. Also, fishers from the localities outside the limits of the estuary (Tapes) fish intensively inside the limits of the estuary, participating in the majority of the main estuarine fisheries. The maps also reveal the importance of the coastal waters adjacent to the mouth of the lagoon for the croaker and blue crab fisheries. Besides being outside the legal limits of the estuary, the activity of artisanal fishing boats (boats <12 m) in this area is limited by the Port State Authority for safety reasons. The practical consequences of these patterns of use to the management rules defined for estuarine fisheries are currently in discussion in the local fisheries co-management arrangement (Forum of Patos Lagoon, see Chapter 5).

Catch volumes and species composition

There are important differences in the species composition of the catches in the estuary. These differences are demonstrated by the diversity of species caught from the different environments (Figure 52) and by the primary species of economic importance reported by fishers (Figure 53). The pie charts in this figure express the proportion of respondents who named a particular species as most important for household income. Table 2, which is in Chapter 1, presents the list of species commonly caught in the region.



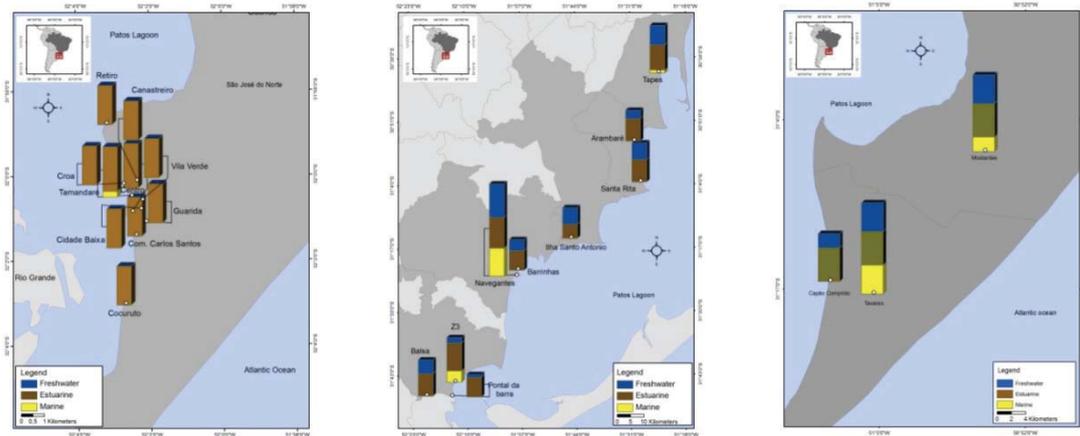


Figure 52: Relative frequency of occurrence of species caught from different environments (the height of the bar is proportional to the number of species)

As expected, an increase in importance of freshwater species occurs towards the inner part of the lagoon, while marine species appear with more importance in selected localities such as Torotama and Barra (Rio Grande), Z3 (Pelotas), Navegantes (São Lourenço do Sul), and Tavares and Mostardas. With the exception of the latter two localities, where marine species are caught along the beach, in coastal areas adjacent to the municipality, the appearance of marine species with some importance in the others normally reflect the higher operational capacity of boats to fish in shallow coastal waters adjacent to the mouth of the lagoon.

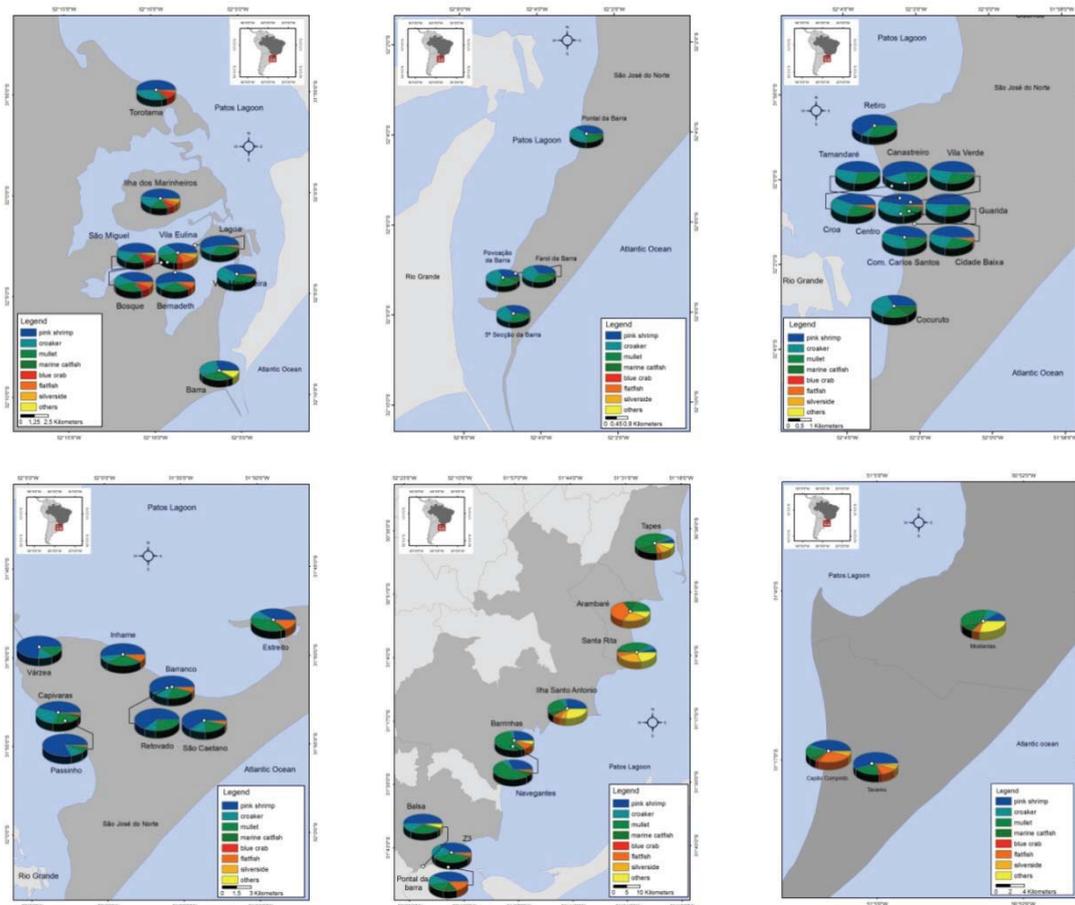


Figure 53: Main commercial fishery resources

Of the total number of species caught, some are more economically important than others because of catch volumes and/or prices. Figure 53 illustrates the differences among localities in terms of the species that contribute more to income. The pattern that emerges highlights the importance of shrimp to most localities in the lower estuary, followed by mullet and croaker. The importance of shrimp and croaker phases out towards the inner lagoon, while the importance of mullet tends to increase. The contrast is noticeable between the localities in urban and rural areas of São José do Norte, which rely on fewer species for income, and the localities in Rio Grande and in the upper estuary (Tapes and Santo Antonio), which have a larger number of target species. The advantages of a more diversified portfolio of resources can be related to an increased adaptive capacity of fishers to environmental and economic changes and to natural fluctuation of individual stocks. It was exactly in response to decreasing yields of the traditional estuarine resources (shrimp, croaker and mullet) that the blue crab fishery developed in some localities of Rio Grande during the 1980s. Today, it represents an important alternative source of income, particularly in years of low catches of shrimp.

Despite the diversity of species caught in the different localities, overall, the most important resources of the estuary of Patos Lagoon are shrimp, croaker and mullet. Production from these three species far exceeds the sum of the other species. Figure 54 is an attempt to calculate the total annual catches of the seven species of importance to artisanal fishers, based on the reported average catches of individual fishers in recent good seasons. It is estimated that the annual production of mullet, croaker and shrimp in a good season exceeds 4 000 tonnes each. The municipalities of Rio Grande, São José do Norte and Pelotas respond for the largest share of production.

The comparison of these figures with the registered landings by IBAMA and CEPERG is not straightforward because fishers' responses cannot be related to a specific year. However, when looking back to the time series of reported landings, it is possible to identify if and when such levels of production were registered in the past ten years (a reasonably long enough time to be considered recent past). For shrimp, the approximate estimated level of production (about 4 200 tonnes) was registered in 2005, in the last good shrimp season on record (Figure 2, Chapter 1). For croaker, the estimated catch in recent years was 4 400 tonnes. The last time this level of production was registered was in 1995 and 1996 when total catches amounted to 5 010 tonnes and 3 580 tonnes, respectively (Figure 2, Chapter 1). On the other hand, the estimated catches of mullet (about 4 700 tonnes) were only reported at the peak of the fishery in 1975, when 4 291 tonnes were registered (Figure 2, Chapter 1). The most recent good season for mullet was in 2007, when 1 840 tonnes were reported, a figure nearly 2.5 times lower than the catches estimated in this report based on fishers' knowledge. Finally, the estimated catches of catfish were about 1 000 tonnes. The last time this level of production was registered was in 1994 (1 302 tonnes). The highest reported catches of the species in the last ten years was 140 tonnes in 2008, which is seven times lower than the estimated recent catches. For flatfish, the last time the estimated level of production (388 tonnes) was registered was in 1990 (492 tonnes). The reporting of landings of silverside and blue crab has been less continuous and therefore more difficult to compare. Nonetheless, the figures around 400 tonnes/year estimated in this report for each of the two species is well above current figures for silverside (45 tonnes) and more or less at the same order of magnitude of blue crab catches reported in 2004–06 (about 250 tonnes/year).

It is the first time that indirect estimates of the total amount of catches of fisheries resources in the estuary of Patos Lagoon were made. The preliminary comparison conducted above point to serious underestimates of the volume of catches of some resources such as mullet and catfish, while a surprisingly good agreement was found between estimated and reported figures for shrimp. Further analysis based on these findings need to be carried out to understand the problem of unreported catches in the region.

Figure 54 shows the qualitatively estimated total catch volume of the main fishery resources, as reported by fishers. These were calculated based on the reported average catches of individual fishers during good seasons in recent years.

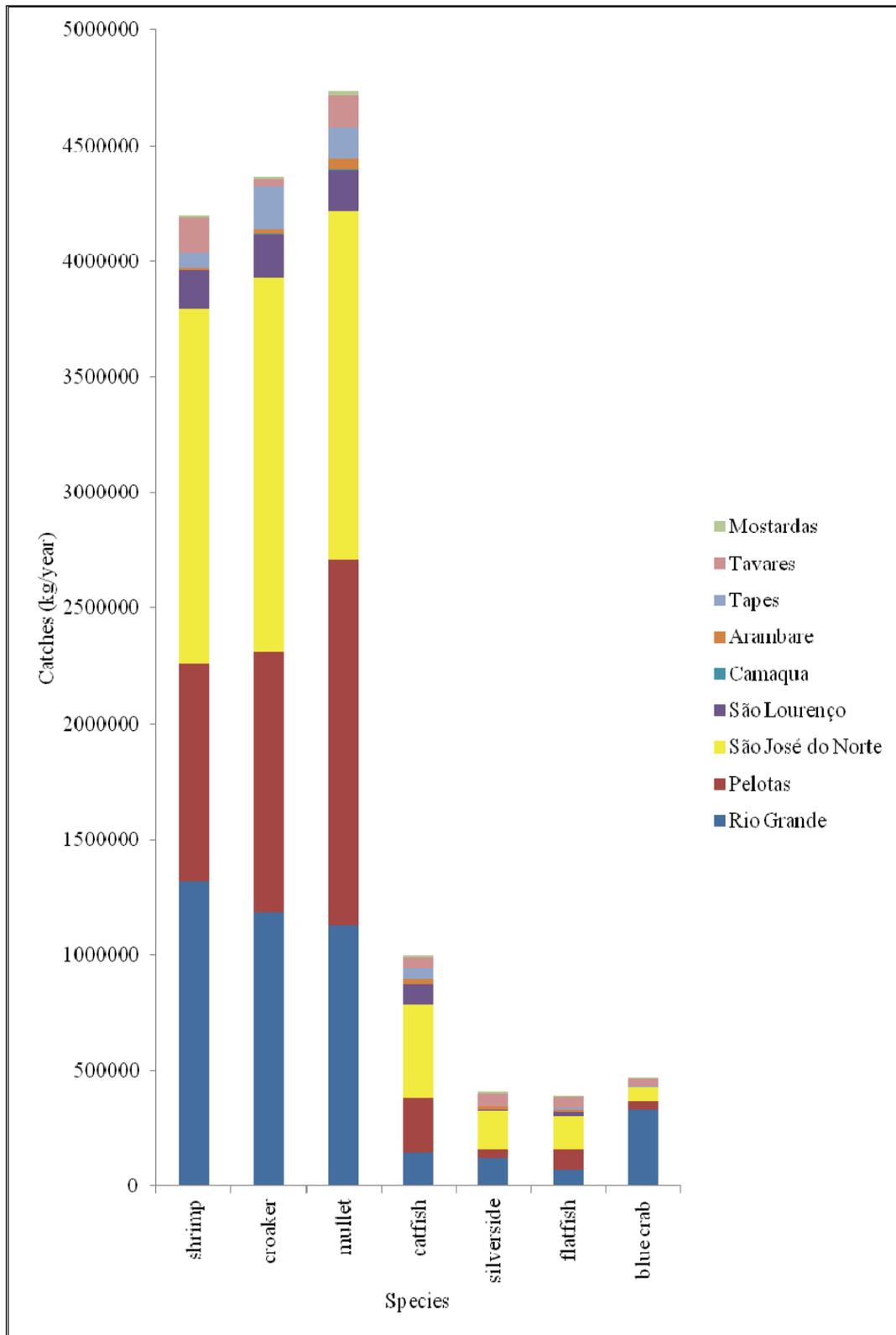


Figure 54: Qualitatively estimated total catch volume of the main fishery resources, as reported by fishers

Trends in catches and effort

One potential use of the data obtained in this study is in the assessment of historical changes in catches, fishing effort and catch per unit effort (CPUE) of the main artisanal fisheries. This type of information, which is essential to understand changes in fishing capacity and resource condition, is rarely available for artisanal fisheries because of their poor monitoring. Here, data obtained from fishers during the interviews are used to describe the changes in catches, effort and CPUE of some of the key resources in the last 30 years. Fishers were asked to report their current effort and annual catches in good seasons and when they first started in the fishery. The systematic analyses of the data obtained in selected localities are reported in Figures 55 to 61.

Data obtained from fyke net fishers of Torotama, Rio Grande, are used to describe changes in the shrimp fishery (Figures 55 to 57). Individual catches have dropped by half in the period, from an average of 3 407 kg/year some 30 years ago to 1 740 kg/year today. In the same period, individual effort has increased by about 40 percent, from an average of 9.5 nets/fisher to 13.4 nets/fisher. The calculated CPUE decreased from a high of 698 kg/net/year for fishers who entered the fishery up to 20 years ago to an average of 133 kg/net/year today.

Data obtained from fixed gillnet fishers of Z3, Pelotas, were used to evaluate the trends in the croaker fishery (Figures 58 to 60). Individual catches in good seasons decreased from an average of 7 177 kg/year some 30 years ago to 3 420 kg/year in 2010. On the other hand, average effort, measured in terms of the average length of fixed gillnets, increased only 17 percent in the period, from 611 fathoms/fisher to 715 fathoms/fisher (1 117 m/fisher to 1 308 m/fisher). Finally, the CPUE in this fishery dropped by approximately three times in the period, from 15.6 to 5.4 kg/fathom.

If these two examples are taken as representative of the changes in artisanal fisheries in the estuary of Patos Lagoon, the data depicts a situation of declining catches and resource abundance (CPUE), consistent with scientific assessments of the overexploited status of these resources (Vasconcellos and Haimovici, 2006; Reis and D’Incao, 2000). The interpretation of the trends in individual fishing effort is not straightforward. According to the data shown in Figures 59 and 60, the changes in fishing effort of fishers were relatively minor and perhaps not as significant to explain the drop in catches and CPUE. Some factors should be considered when interpreting these changes. First, the declared individual effort today could be underestimated if fishers misreported the number and length of nets used. Second, effort was measured in terms of number of nets and did not account for possible changes in fishing time or in the number of fishers participating in these fisheries that could have happened in the period. Third, it must be considered that both resources are also exploited by other fisheries (artisanal and industrial); hence, despite the relative stability in effort of the fisheries analysed, it is likely that the total effort has increased in the period. However, more important than relating the trends with the overall status of resources and fisheries, these findings point to a real decrease in performance of the fisheries, which can have direct consequences to income and long-term food security.

An attempt was also made to investigate trends in the fishery for mullet with fixed gear; however, given that fishers often combine the two fishing modalities for mullet (fixed gillnets and surrounding gillnets), it was impossible to isolate a large enough number of fishers that only use fixed gillnets to make comparable evaluations of trends in effort and CPUE. Therefore, only individual catch data is shown in Figure 61. One striking result of this analysis is the relative stability in catches of mullet during good seasons today compared with past years. Recent average catches (3 545 kg/year) are the lowest in the series, and do not differ much from the average catches obtained by fishers up to 20 years ago (3 971 kg/year). Though surprising, this result is, however, consistent with the data from official statistics that show similar levels of production during good seasons in the last two decades: 2 078 tonnes (1986); 2 187 tonnes (1991); 1 381 tonnes (1995) and 1 840 tonnes (2007) (Figure 2, Chapter 1). The stock of mullet has never been assessed formally by scientific methods. Nonetheless, there is a consensus that

the stocks are currently threatened with overfishing owing to the high fishing pressure from artisanal and industrial vessels operating in coastal waters (Vasconcellos, Diegues and Sales, 2007).

Figure 55 shows the changes in catches of shrimp by fisher in a good season in the fyke net fishery of Torotama, Rio Grande. The estimated confidence intervals (boxes), maximum and minimum catches (lines) reported by fishers today and by fishers who entered the fishery up to 10 years ago, between 10 and 20 years ago, and between 20 and 30 years ago.

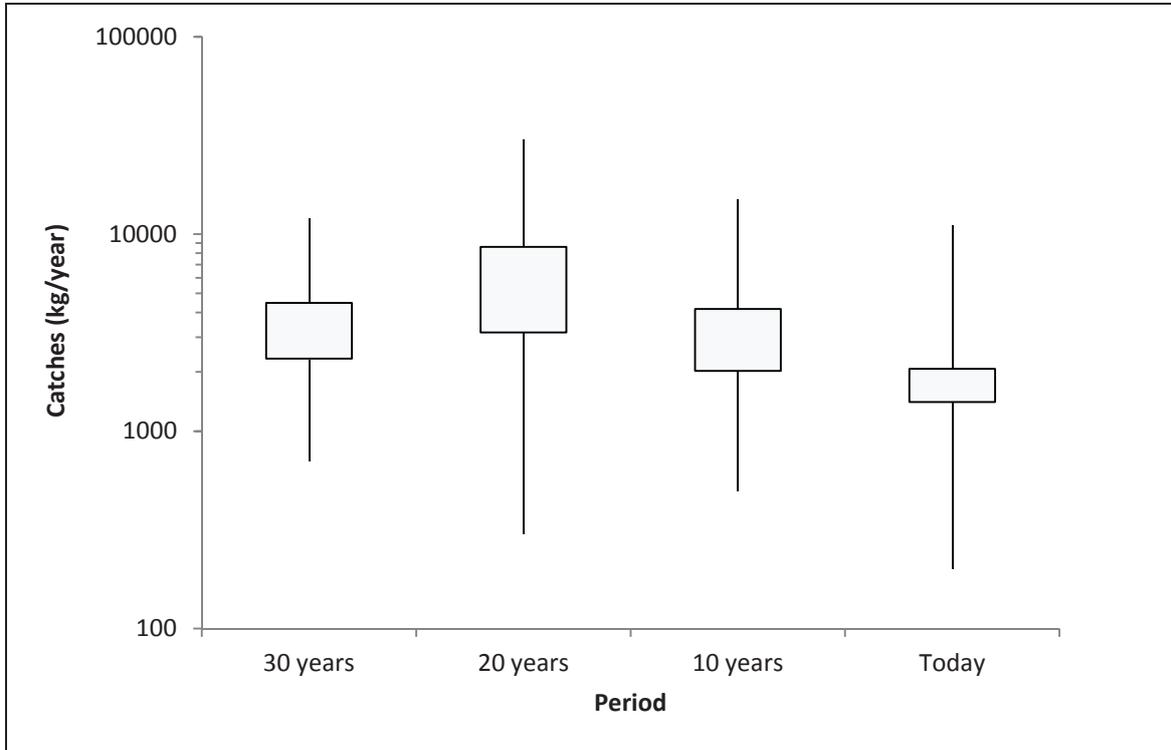


Figure 55: Changes in catches of shrimp by fisher in a good season in the fyke net fishery of Torotama, Rio Grande

Figure 56 shows the changes in fishing effort (nets/fisher) in the shrimp fyke net fishery of Torotama, Rio Grande. The estimated confidence intervals (boxes), maximum and minimum effort (line) as reported by fishers today and by fishers who entered the fishery 10, 20 and 30 years ago.

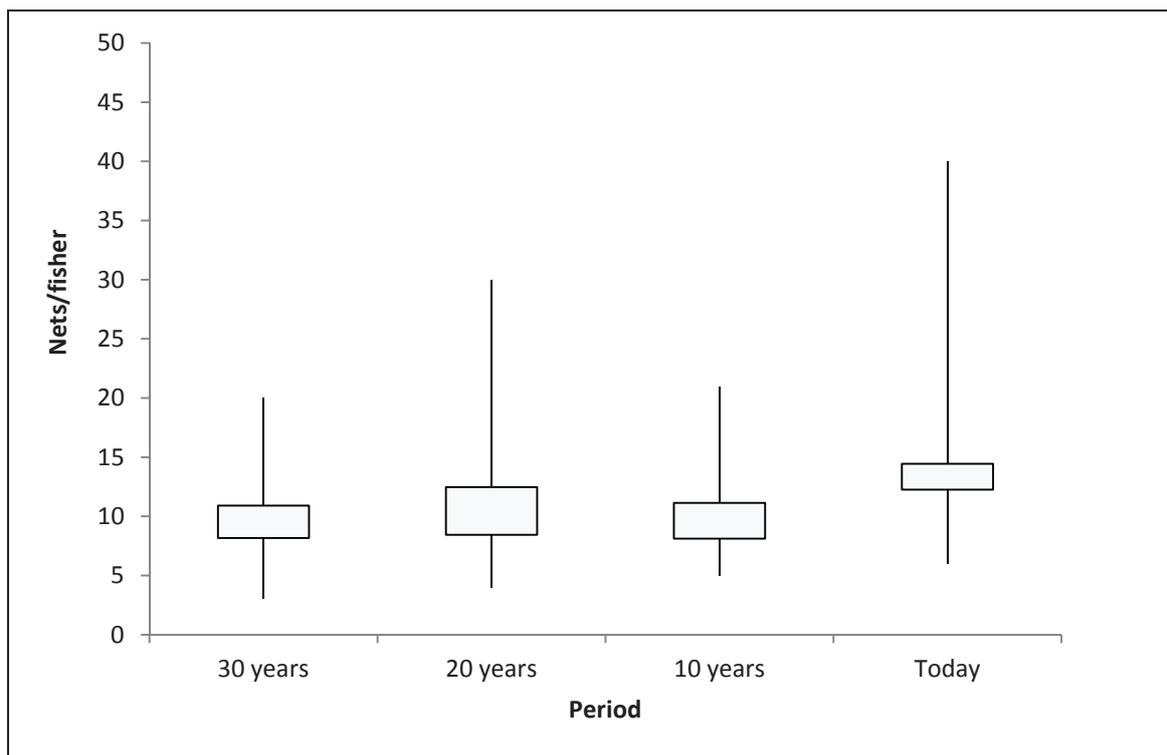


Figure 56: Changes in fishing effort (nets/fisher) in the shrimp fyke net fishery of Torotama, Rio Grande

Figure 57 shows the changes in CPUE (kg/net/year) of the shrimp fyke net fishery of Torotama, Rio Grande. The estimated confidence intervals (boxes), maximum and minimum CPUE values (lines) were calculated based on catch and effort data reported by fishers today and by fishers who entered the fishery 10, 20 and 30 years ago.

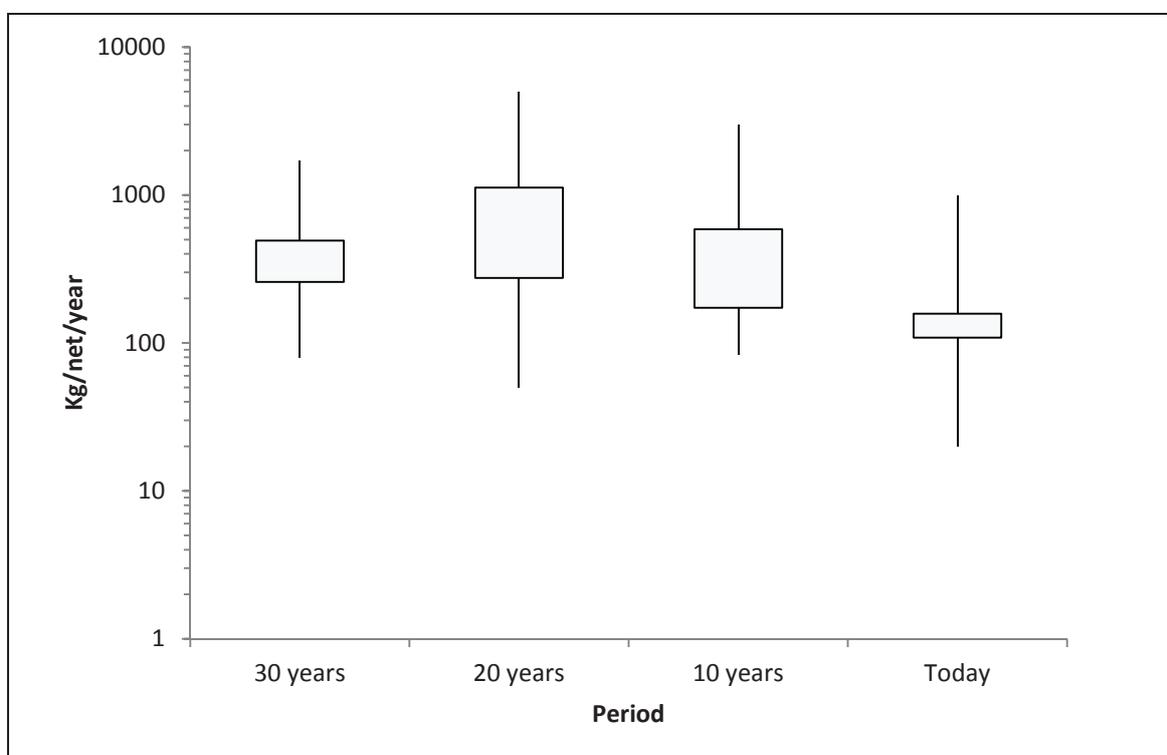


Figure 57: Changes in CPUE (kg/net/year) of the shrimp fyke net fishery of Torotama, Rio Grande

Figure 58 shows changes in catches of croaker as reported by fishers in a good season in the fixed gillnet fishery of Z3, Pelotas. The estimated confidence intervals (boxes), maximum and minimum catches (lines) as reported by fishers today and by fishers who entered the fishery between 10 and 20 years ago, between 20 and 30 years ago and more than 30 years ago

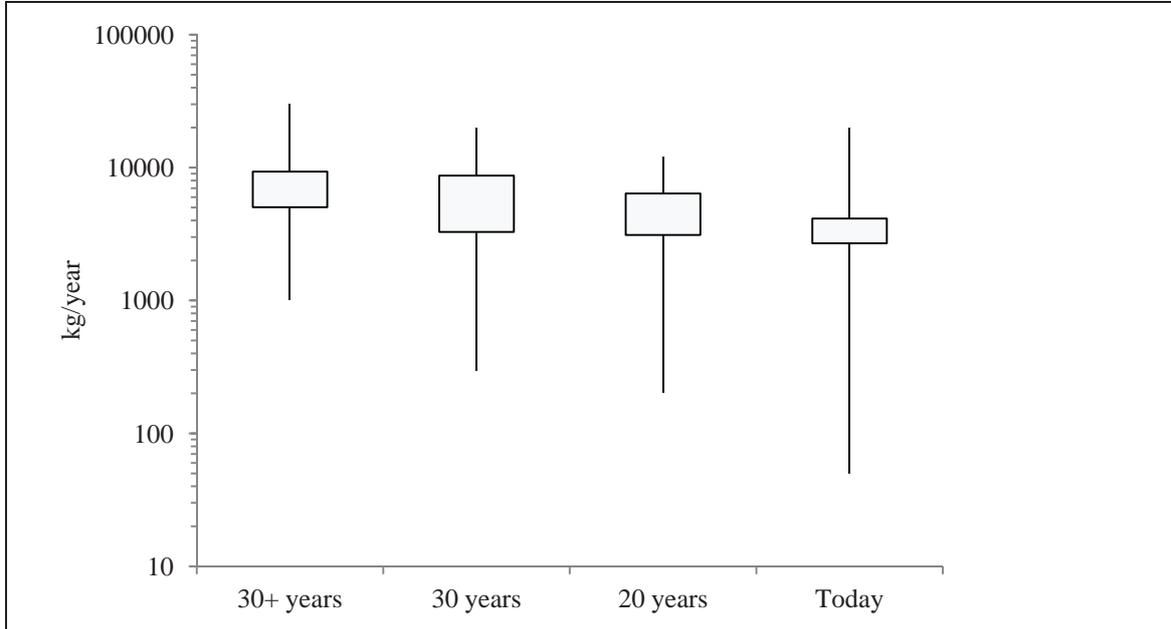


Figure 58: Changes in catches of croaker reported by fishers in a good season in the fixed gillnet fishery of Z3, Pelotas, over different time periods

Figure 59 shows the changes in fishing effort (fathoms of net per fisher) in the fixed gillnet fishery for croaker of Z3, Pelotas. The estimated confidence intervals (boxes), maximum and minimum effort (lines) as reported by fishers today and by fishers who entered the fishery between 10 and 20 years ago, between 20 and 30 years ago and more than 30 years ago.

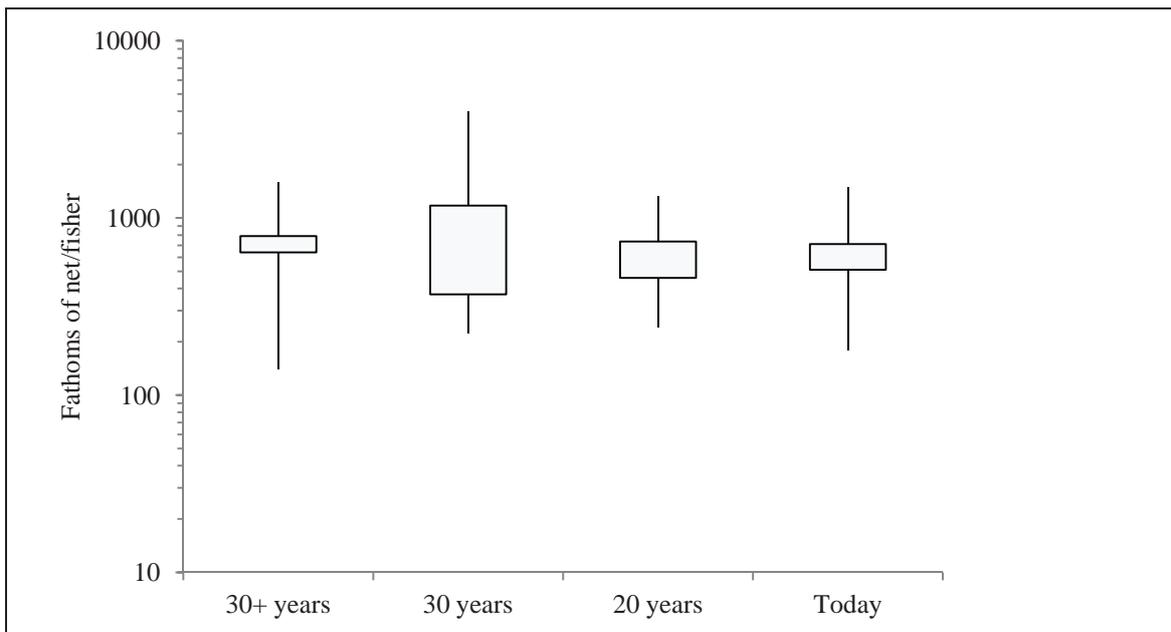


Figure 59: Changes in fishing effort (fathoms of net per fisher) in the fixed gillnet fishery for croaker of Z3, Pelotas

Figure 60 shows changes in individual CPUE (kg/fathom/year) in the fixed gillnet fishery for croaker of Z3, Pelotas. The estimated confidence intervals (boxes), maximum and minimum CPUE values (lines) were calculated based on catch and effort data reported by fishers today and by fishers who entered the fishery between 10 and 20 years ago, between 20 and 30 years ago and more than 30 years ago.

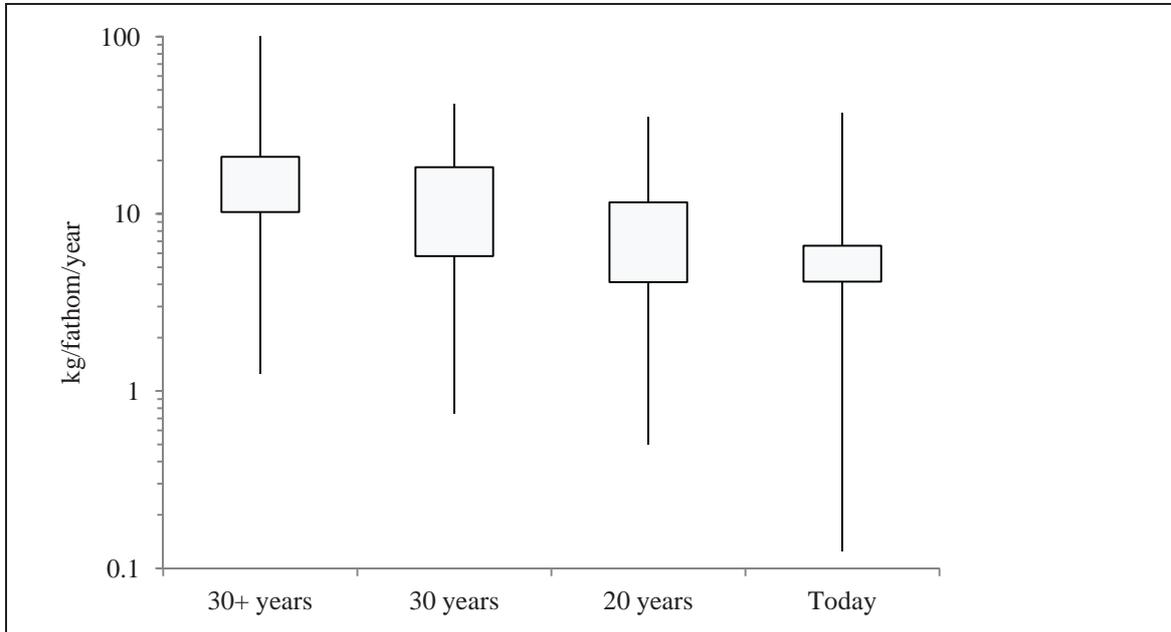


Figure 60: Changes in individual CPUE (kg/fathom/year) in the fixed gillnet fishery for croaker of Z3, Pelotas

Figure 61 shows changes in catches of mullet reported by fishers in a good season (all gear) in the municipality of Rio Grande. Estimated confidence intervals (boxes), maximum and minimum catches (lines) reported by fishers today and by fishers who entered the fishery up to 10 years ago, between 10 and 20 years, between 20 and 30 years, and more than 30 years ago.

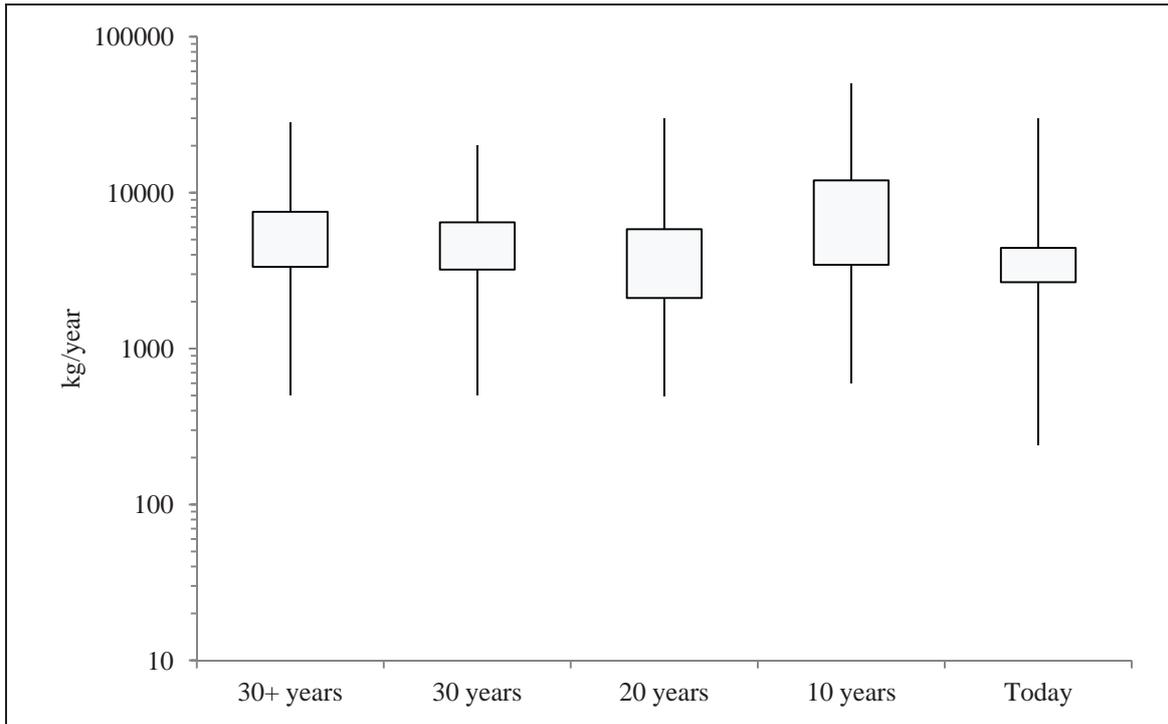


Figure 61: Changes in catches of mullet by fisher in a good season (all gear) in the municipality of Rio Grande

Economic value of fisheries production

Based on the reported landings and the range of reported first sale prices, as presented in the section on processing and marketing, it was possible to calculate the gross first sale value of fisheries production in the estuary of Patos Lagoon (Table 8).

Table 8 shows the percentage contribution of fisheries to municipal GDP in thousands of R\$. The columns “lower” and “higher” are the calculated gross first value using the lower and higher first sale price reported by fishers. The total value of fisheries production in a good fishing season varies from about R\$23 million to R\$46 million per year, depending on the first sale prices that are used in the calculation. This represents less than 1 percent of the total gross domestic product (GDP) of the municipalities in the region. The municipalities with the highest economic outputs are São José do Norte (R\$16 123 million, in the higher price scenario), Rio Grande (R\$13 268 million) and Pelotas (R\$11 630 million). The relative importance of fisheries production to the local economies is higher in the municipalities of São José do Norte (from 4.17 percent to 8.29 percent of the GDP) and Tavares (from 2.25 percent to 4.14 percent). Despite the higher economic outputs in Rio Grande and Pelotas, the relative importance of fisheries in these municipalities is lower because of the larger size of the two economies. The two municipalities have the largest populations in the region (Rio Grande: 197 253; Pelotas: 327 778) with important contributions to the GDP from the industrial and services sectors. This is best viewed when the value of fisheries production is compared with the agriculture share of the GDP. In this scenario, fisheries account for between 5 percent and 10 percent of the agriculture GDP in the two municipalities. In the case of São José do Norte and Tavares, the relative importance of fisheries increases from 12.9 percent to 25.7 percent and from 6.0 percent to 11.1 percent, respectively. Fisheries represent between 3 and 6 percent of the agriculture GDP in the region.

It must be emphasized that these figures represent an underestimate of the total economic value of fisheries in the region. A proper evaluation would require data on the economic rent and value added as fish is marketed from fishers to consumers, other use values (recreational,

ecological functions) and non-use values (e.g. option, existence and bequest values, *sensu* Hodge, 1995). It can be concluded that fisheries have significant contribution to the economy in the region. Therefore, when the fishing season fails, and economic outputs drop by 90 percent (see section on technical economic performance), there is a noticeable negative impact on the local economy.

Table 8: Gross first sale value of fisheries production in the municipalities and contribution to GDP (in thousands of R\$)

Municipality	Lower	Higher	GDP total	% GDP total (lower-higher)		GDP agriculture	% GDP agriculture (lower-higher)	
Arambaré	281.7	456.0	62 284.0	0.5	0.7	33 659.0	0.8	1.4
Camaquã	21.6	37.2	924 043.0	0.0	0.0	130 083.0	0.0	0.0
Mostardas	106.9	222.6	192 112.0	0.1	0.1	99 379.0	0.1	0.2
Pelotas	6 149.0	11 630.2	3 564 296.0	0.2	0.3	113 772.0	5.4	10.2
Rio Grande	5 940.5	13 268.3	5 402 761.0	0.1	0.2	122 347.0	4.9	10.8
São José do Norte	8 104.0	16 122.6	194 460.0	4.2	8.3	62 702.0	12.9	25.7
São Lourenço do Sul	862.5	1 741.9	483 616.0	0.2	0.4	155 917.0	0.6	1.1
Tapes	522.6	883.8	177 744.0	0.3	0.5	37 546.0	1.4	2.4
Tavares	1 161.2	2 138.5	51 672.0	2.2	4.1	19 205.0	6.0	11.1
Total	23 150.2	46 501.1	11 052 988.0	0.2	0.4	774 610.0	3.0	6.0

Source of GDP data: www.ibge.gov.br; accessed on 2 January 2011.

Landing sites and basic fisheries infrastructure

Landing sites

Figure 62 shows the types of landings sites used by fishers in each locality. Fishers land their catches on the beach, in community piers, directly to processors or to buying boats (Figure 63). The buying boats are usually owned by intermediaries or by processors. They buy catches directly from fishers in the fishing areas. It is also common for buying boats to carry materials for gear maintenance and ice, which is sold to fishers. The dominant mode of landing catches varies from locality to locality. In Camaquã, Pelotas, Rio Grande and Tapes, it is more common to use community piers. In São José do Norte, it is common to land the catches on the beach and to buying boats. In São Lourenço, fishers land directly at the local processors or to buying boats that are owned by the local processors.



Pier of the main fish market in Rio Grande



Beach landing site in Torotama, Rio Grande



Community piers in Mangueira



Buying boat in São José do Norte

Figure 63: Types of landing sites of artisanal fisheries**Fish conservation on board**

Ice on board to conserve catches is available in all localities, with the exception of those in Rio Grande and São José do Norte. The general low frequency of use of ice in Rio Grande and São José do Norte is explained by the type of fishery, the fishing capacity and the dominant mode of commercialization of fish products in these localities. The most important activity in both municipalities is the shrimp fishery (Figure 53). This fishery typically occurs in areas close to the landing site (as is the case in Rio Grande) or, when conducted farther from shore, shrimp is bought by buying boats in the fishing areas. The fishery is conducted at night and shrimp landed early in the morning is sold directly to intermediaries on the shore or in the water. Therefore, the use of ice is generally perceived as not necessary and an extra cost. The use of ice is more frequent in some finfish fisheries such as those for flatfish and mullet, especially when involving longer trips, which are performed by fishers with larger boats. The more frequent use of ice found in the other municipalities is also in part explained by the higher relative importance of finfish resources compared with shrimp, as shown in Figure 53.

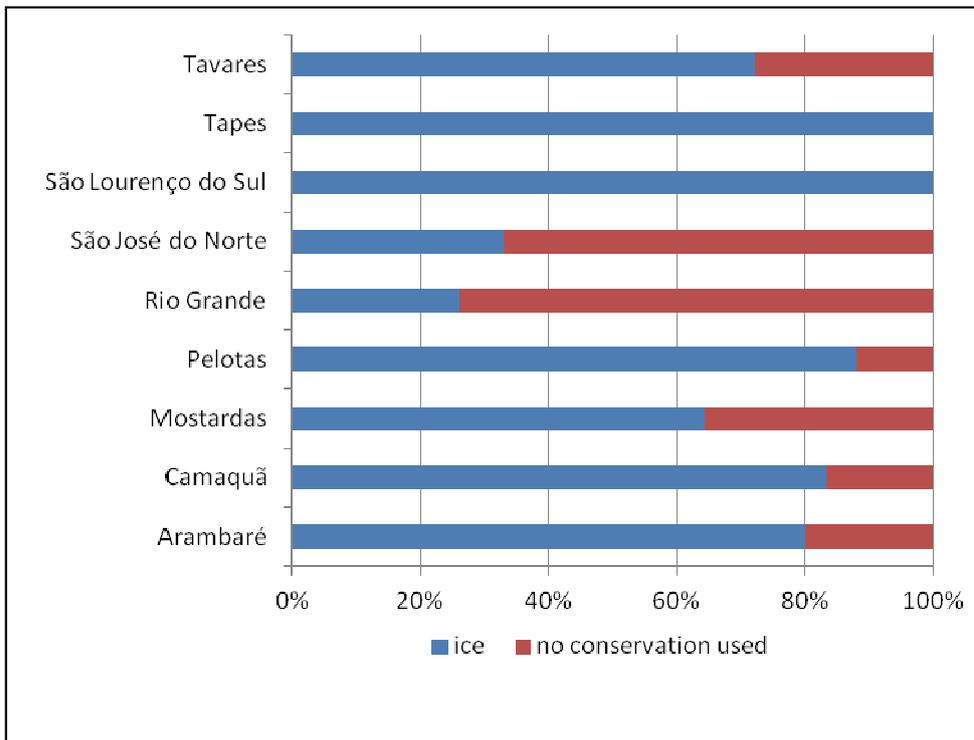


Figure 64: Percentage of fishers using ice on board to conserve catches by municipality

Data also show that the majority of fishers in the estuary sell their catches at the landing site (Figure 65). It was found that the practice of fish storage before selling is adopted with more frequency in the localities of Arambaré, Mostardas, Tapes and Tavares. In these localities, fish is mainly conserved in freezers (Figure 66).

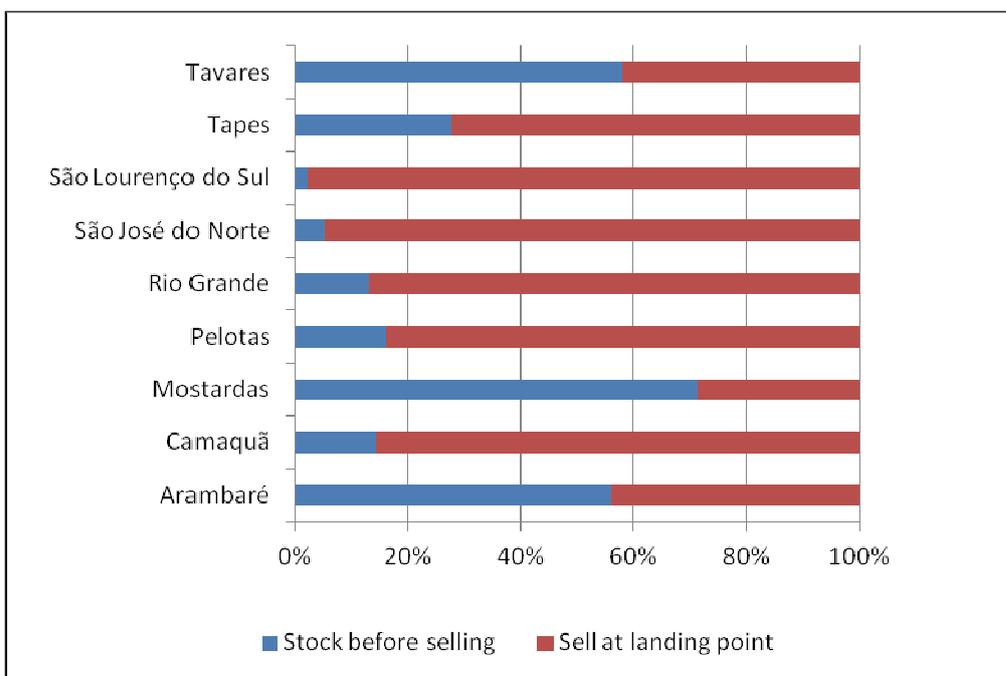


Figure 65: Percentage of fishers who sell the catches at landings point and who store fish before commercialization

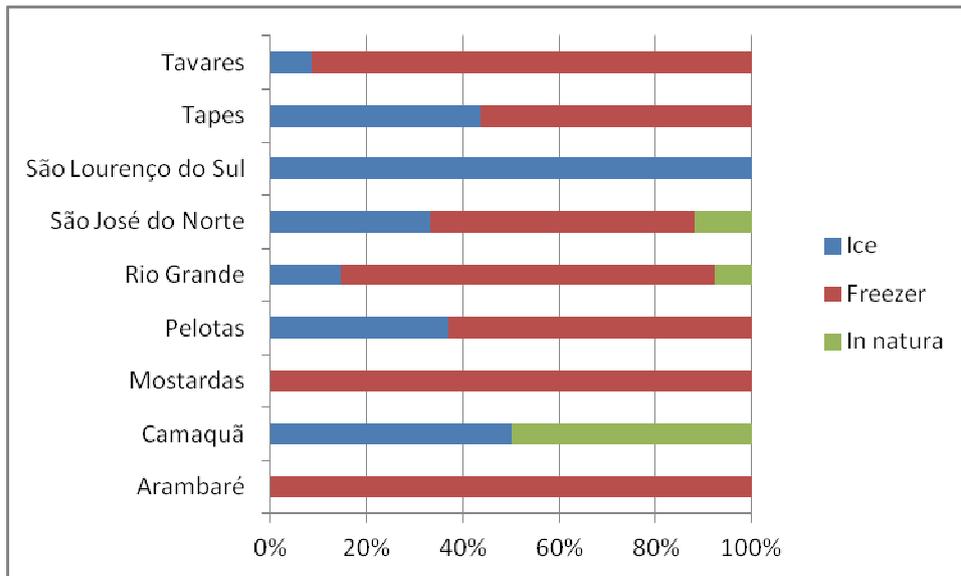


Figure 66: Percentage of fishers using different types of fish conservation before commercialization

Infrastructure for landing and conservation is adapted to the dominant forms of fish marketing, which for the majority of fishers in the estuary involve selling their production fresh to intermediaries. This type of commerce is most prevalent and is demonstrated by the importance of buying boats for some localities. It is a type of commerce that requires minimal investment in onshore infrastructure. The downside of it is the relationship of dependence that fishers have with buyers, who set low prices for the fish, which in turn contributes to generalized low income levels of fishers in the region.

Processing and marketing

Although the majority of fishers do not process catches before commercialization, some process part of their catch to add value to fish products and increase household income. The present status of processing is summarized in Figure 67. Shrimp and blue crab are the species most commonly processed by fishers of Rio Grande, São José do Norte and Tavares. The type of processing is very basic, involving peeling shrimp and shelling blue crab. The processed flesh can be sold in packages. The processing is conducted in the household by the wife and other family members or by women from the community (Figure 68). Fish processing occurs with higher frequency in Arambaré, Mostardas, Tapes and Tavares. Fish is either gutted or filleted before commercialization. Other species that are processed before commercialization are flatfish, silverside, trahira and freshwater catfish.

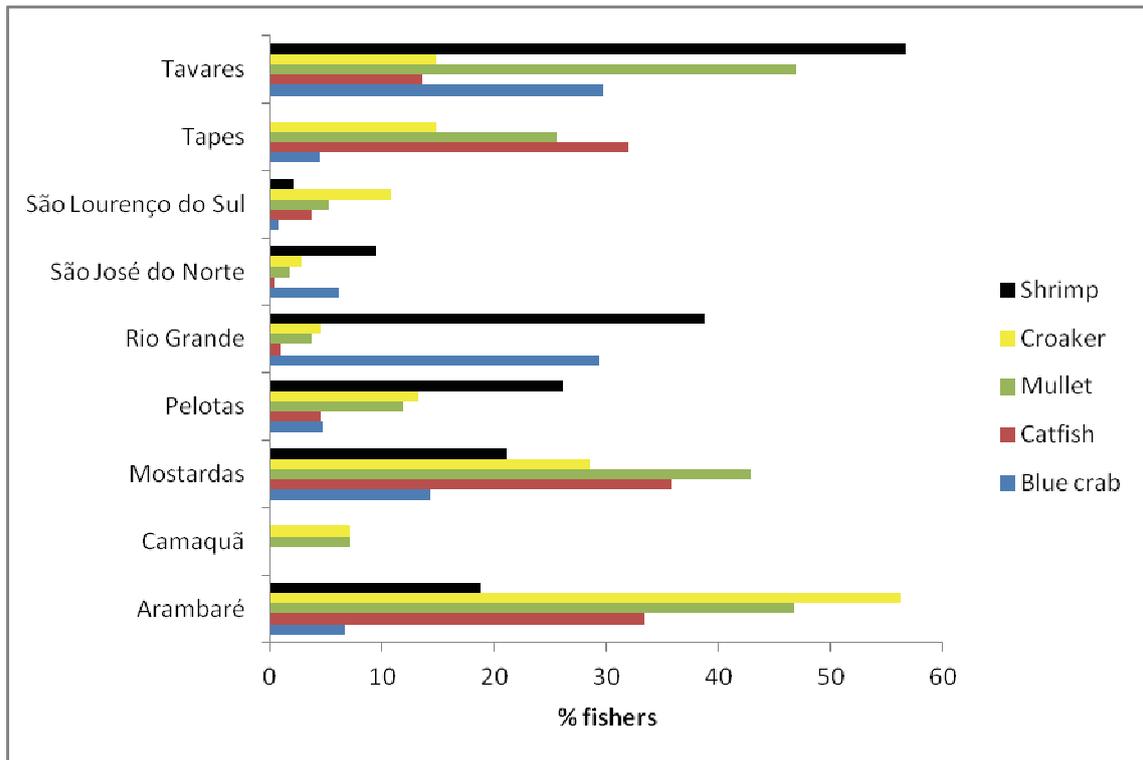


Figure 67: Percentage of fishers conducting some type of processing of catches before commercialization



Figure 68: Woman in a fishing village shelling blue crab before commercialization

Figure 69 shows the variation in prices of the main resources sold fresh and processed and the net value obtained per kilo of processed product, once the losses and costs with processing are taken into account.² Shrimp is by far the most valuable resource for artisanal fishers. Blue crab has the lowest price when sold fresh but becomes the second most valuable resource when processed before commercialization. Despite the large differences in price between processed and fresh products, results show that there is probably a small marginal gain with processing.

² To calculate the net value per kilo, the following conversion rates from fresh to processed product were considered: shrimp peeled: 2:1; croaker fillet: 2.5:1; mullet fillet: 3:1; catfish fillet: 3:1; blue crab shelled: 5:1. The cost of processing was considered to be about R\$1.5 per kilo of processed product. For blue crab, the processing is done at home, as is often the case, by fishers' wives; therefore, the cost is zero.

Gains increase when the costs of processing are internalized in the family, which is frequent for shrimp and blue crab. The small gain may be due to the fact that fishers sell their processed products to intermediaries and not to consumers, who could pay higher prices than the intermediaries.

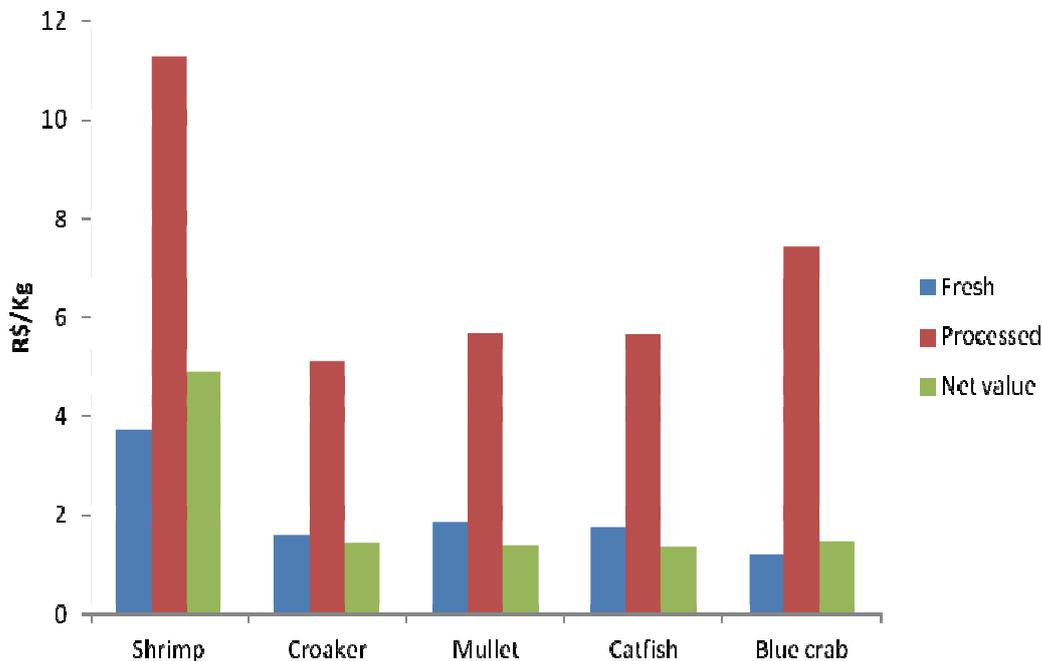


Figure 69: Average prices paid per kilo of fresh and processed shrimp (peeled), croaker (fillet), mullet (fillet), catfish (fillet) and blue crab (shelled). The calculated net value per kg is also shown (after the losses and costs with processing)

A critical problem faced by artisanal fishers in many localities is the system of commercialization, characterized by the large differences in the price received by fishers and the price paid by consumers at the end of the supply chain. The chain is often characterized by a number of intermediate buyers (intermediaries) that thrive in the absence of basic infrastructure for fish storage and conservation. Intermediaries dictate prices, exchange fish for goods, advance money between harvesting seasons and also provide the needed support in cases of emergency. This creates not only a financial dependence, but also a socio-economic dependence of fishers on the intermediary.

Fish supply chains are tied to intermediaries who buy fish directly from fishers and sell it to other intermediaries, to processors or directly to consumers. There could be many intermediate steps between fishers and processors and consumers, with more than two intermediaries (Costa, 2004; Garcez and Sanchez-Botero, 2005). A generalized supply chain of artisanal fisheries in the State of Rio Grande do Sul, based on Garcez and Sanchez-Botero (2005), is used in Figure 70 to express differences in marketing strategies adopted by fishers in the main artisanal fisheries localities of the estuary (Pelotas, Rio Grande, São José do Norte, São Lourenço do Sul, Tapes and Tavares). Because there is little variation among localities of the same municipality, only data by municipalities is shown. The figure shows the supply chain by municipalities. The numbers and width of the arrows indicate the percentage of fishers who declared using the different types of commercialization. Grey lines are market chains not quantified (figure adapted from Garcez and Sanchez-Botero, 2005).

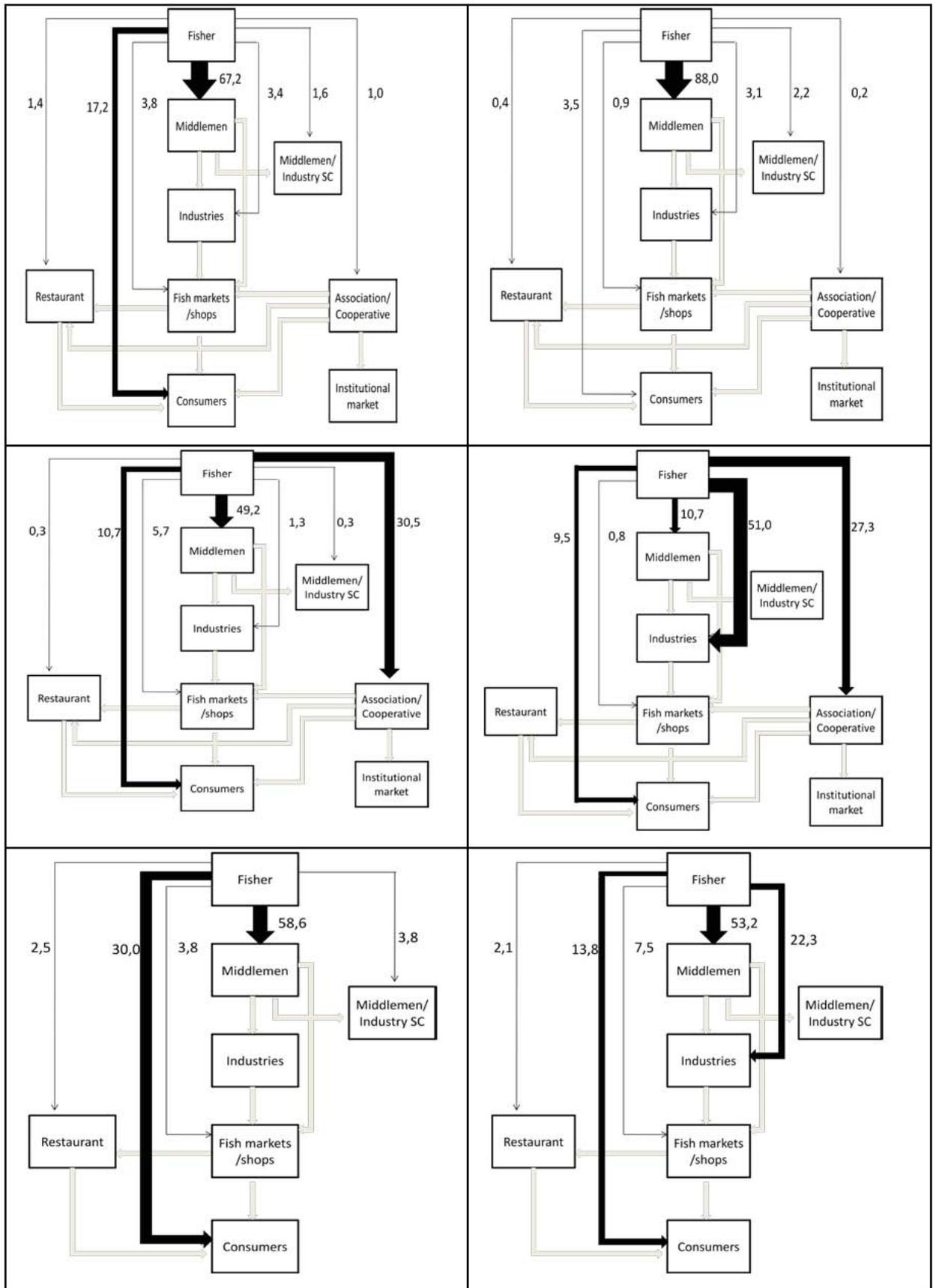


Figure 70: Supply chain for the municipalities of Rio Grande (upper left), São José do Norte (upper right), Pelotas (middle left), São Lourenço do Sul (middle right), Tavares (bottom left) and Tapes (bottom right)

Selling to local buyers and/or intermediaries is an important way of commercializing catches in all areas, being particularly important in the communities of Rio Grande and São José do Norte. The option of selling fish at home to consumers is a relatively frequent alternative in Rio Grande, and may be explained by the proximity of the fishing communities to urban areas. This is the option that gives the highest prices (Figures 71 and 72). Similar strategies were observed in less populated fishing communities of Tapes and Tavares as well as Mostardas, Arambaré and Camaquã. Tavares is the place with the highest prices paid to fishers by intermediaries and consumers. For one thing, the better infrastructure for fish storage and conservation in this municipality, demonstrated in previous sections, would give an advantage to fishers to sell their products when prices are higher. The proximity of Tavares to the large urban centres of the northern part of the State of Rio Grande do Sul also favours the commercialization of products at a better price. In São José do Norte, the option of selling to buyers from other localities and/or municipalities is also common and often involves selling products to buying boats, as was demonstrated in the section on infrastructure for landing sites. The importance of this type of commercialization to São José do Norte can be explained by the distance of some fishing localities and the poor road access. Selling directly to local processors and cooperatives was frequently observed in Pelotas and São Lourenço do Sul. Although also present in Rio Grande and São José do Norte, the role of associations and cooperatives in the commercialization of fish products is of minor importance in these two municipalities. Their importance is very localized and concentrated in the areas where they operate.

One result of the long supply chain is the large difference in price received by fishers and that paid by consumers. The difference in the case of shrimp can be as high as 263 percent (Costa, 2004). The price of shrimp at fish shops in Rio Grande³ varied from R\$7 to R\$18 per kilo of fresh shrimp and from R\$10 to R\$30 per kilo of processed shrimp. Compared with the prices received by fishers when selling to intermediaries (Figure 71), the above consumer price information indicates a difference in price for the fresh shrimp between fishers and consumers in the order of 200 percent.

One of the alternatives sought by fishers in the region to address problems in the commercialization of fish products is the organization of fishers' associations and cooperatives. In addition, different strategies to decrease the high rate of incidence of intermediaries in commercialization have been implemented by the government both at municipal and federal levels. Support to the organization of "fish fairs", where fishers could sell their products directly to consumers, was adopted with some success in the municipality of Pelotas. To the same end, a special programme of the federal government – "Programa Feira do Peixe" of the Special Secretariat of Aquaculture and Fisheries (SEAP) and the Federal Government Agency of Food Supply (CONAB) – made available to fishers kits with the basic infrastructure for fish commercialization in fairs. A network of associations and cooperatives in the region was also established to take part in a special programme where the federal government purchases products from family-based producers to supply institutional markets, created after 2003 within the framework of the national policy to fight hunger called "Fome Zero Program". Although some of these initiatives thrive, they are still incipient and do not benefit a sufficiently large number of fishers.

³ Collected by CEEMA/FURG in 2009 (www.ceema.furg.br/peixaria09.htm; accessed on 10 December 2010).

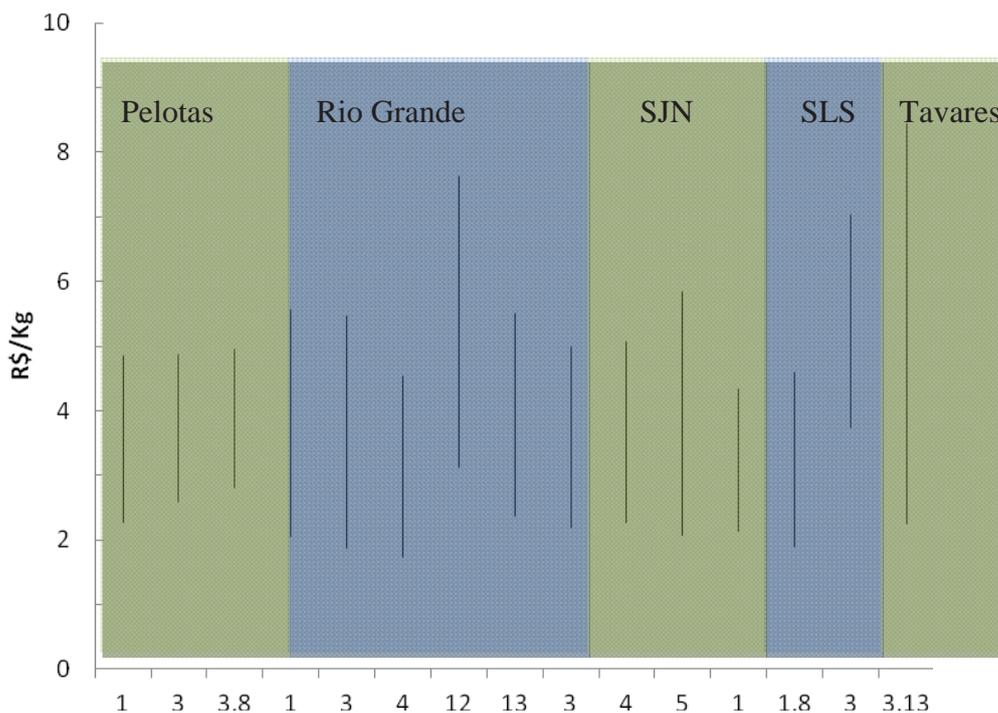


Figure 71: Price of fresh shrimp received by fishers according to the type of commercialization in each municipality (Note: SJN = São José do Norte; SLS = São Lourenço do Sul). Figure 71 shows the price of fresh shrimp received by fishers according to the type of commercialization in each municipality: 1) local industry/cooperative; 3) local buyer/intermediaries; 4) buyer/intermediaries from other locality; 5) buying boat; 12: selling to consumers in residences; 3.13: selling to intermediaries and consumers at home; 3.8: selling to intermediaries and to cooperatives; 1.8: selling to industry and to cooperatives.

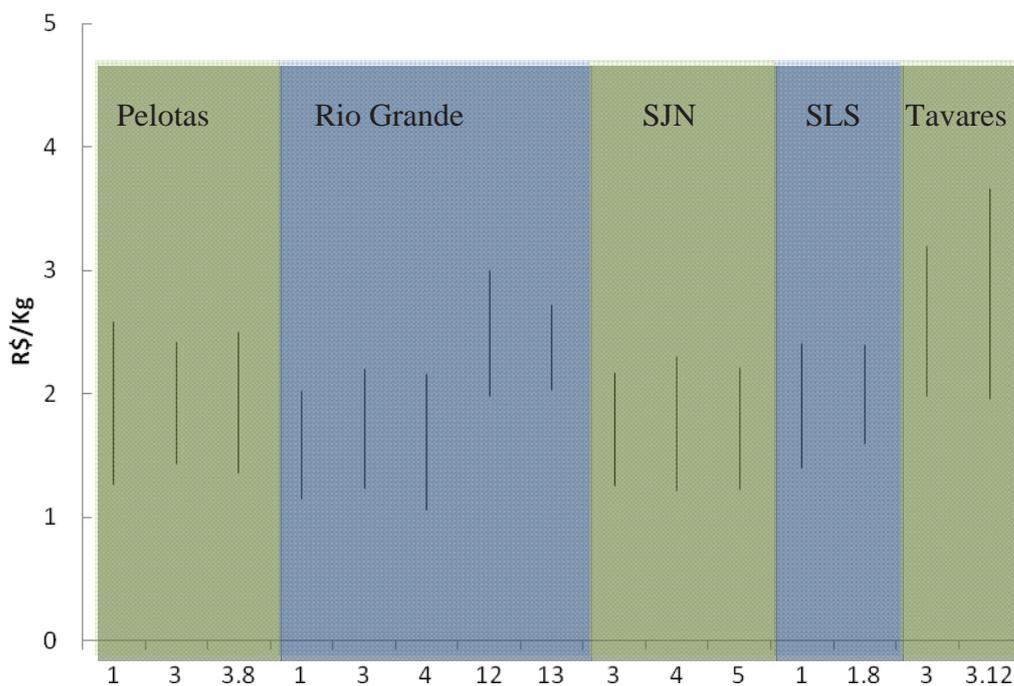


Figure 72: Price of fresh mullet received by fishers according to the type of commercialization in each municipality (Note: SJN = São José do Norte; SLS = São Lourenço do Sul). Figure 72 uses the same method as above but for mullet instead of shrimp. The prices shown are for fresh mullet received by fishers according to the type of commercialization in each municipality: 1) local industry/cooperative; 3) local buyer/intermediaries; 4) buyer/intermediaries from other locality; 5) buying boat; 12: selling to consumers in residences; 3.12: selling to intermediaries and to consumers in residences; 3.8: selling to intermediaries and to cooperatives; 1.8: selling to industry and to cooperatives.

4. SOCIO-ECONOMIC ASPECTS OF ARTISANAL FISHERIES

Livelihood strategies

To investigate the type of livelihood strategies adopted in the region, first, fishers were asked to identify among the following list of activities and sources of income which ones contributed more to their annual income:

- *Fish year-round*: fish different species throughout the year.
- *Shrimp fishing*: only fish for shrimp during the summer months.
- *Industrial fisheries*: work in industrial fisheries, including working as crew on industrial fishing boats operating in coastal waters of southern Brazil and unloading fishing vessels.
- *Boat owner*: owns a boat and receives income from renting the boat to fishers.
- *Intermediary*: work as intermediary in the commercialization of fish products.
- *Gear maintenance*: work repairing and building nets for other fishers, including industrial fisheries.
- *Fish processing*: work in the processing of fish in industrial plants and in artisanal fishers' cooperatives and/or associations.
- *Agriculture*: work on farms, either as landowner or as labour force.
- *City jobs*: have formal jobs in the city.
- *Occasional jobs*: have informal, occasional jobs, including construction work and general services.
- *Unemployment benefit*: receive unemployment benefit from the government during the closed season.
- *Pension*: receive pension from the government.
- *Other*: perform other activities not listed above or specified.

Results, shown in Figures 73 to 76, indicate that a combination of activities and other sources of income are commonly employed by fishers as part of their livelihood strategy. The options more frequently pointed out by fishers in all municipalities are fishing year-round, receiving unemployment benefits, maintaining gear and performing occasional jobs. Agriculture appears as an important option in some rural localities of Rio Grande (Marinheiros) and São José do Norte (Barranco and São Caetano). A relatively small percentage of fishers indicated shrimp fishing as the main fishery-related source of income; the highest frequencies were found in a few urban localities of Rio Grande (Bernadeth and Lagoa) and the rural localities of Barranco and São Caetano in São José do Norte.

Data also show that there are relatively low percentages of fishers who rely exclusively on fishing as source of income (Figure 77). Less than one-third of the fishers interviewed in the main localities of the estuary declared fishing year-round as the only main source of income. Slightly higher percentages were found in the municipalities of Tapes and Tavares. In some communities (Barrinha and Navegantes in São Lourenço do Sul and Passinho and Várzea in São José do Norte), all fishers declared having to rely on other sources of income in addition to fishing. In practically all localities, the unemployment benefit is frequently pointed out as one of the main sources of income. Further, as indicated in Figure 77, a significant percentage of fishers in various localities have fishing and unemployment benefit as their main income strategy. In the figures below, rural localities are shown in red and urban localities in blue.

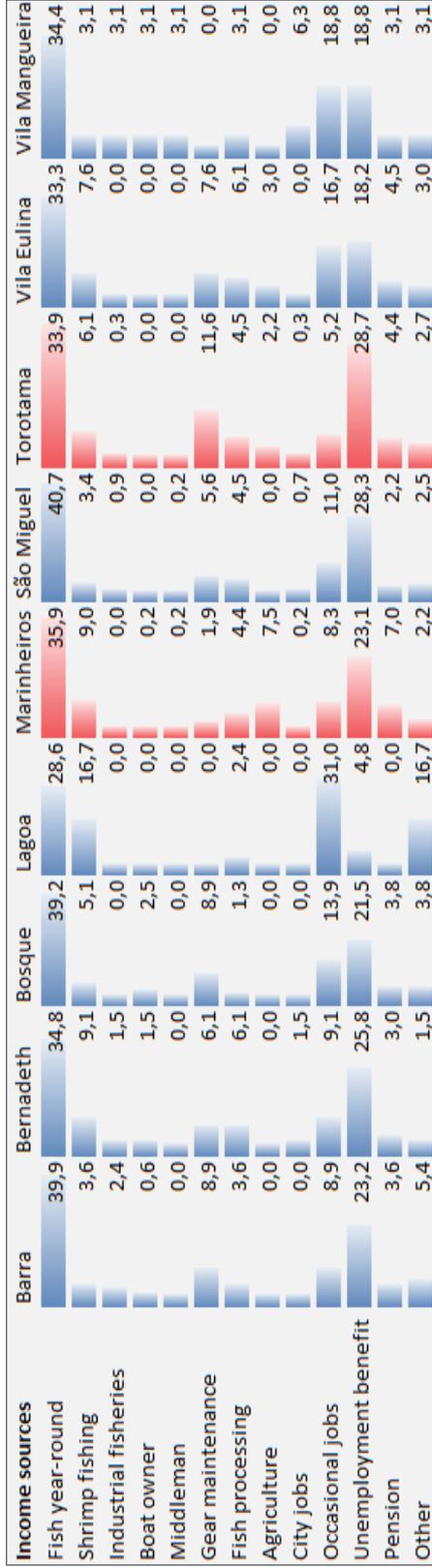


Figure 73: Frequency of responses (in percentage) reported by fishers of Rio Grande as their main activities and/or sources of income

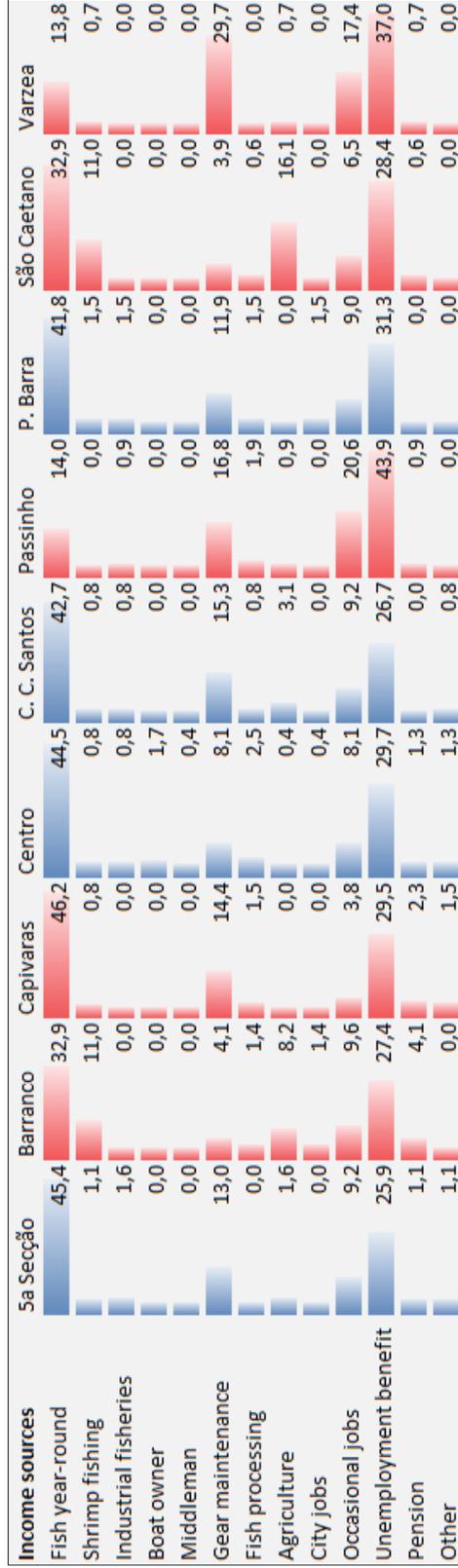


Figure 74: Frequency of responses (in percentage) reported by fishers of São José do Norte as their main activities and/or sources of income

Income sources	Barrinha	Navegantes	Income sources	Balsa	Pontal da Barra	Z3
Fish year-round	16,9	13,1	Fish year-round	48,0	41,4	37,8
Shrimp fishing	0,0	0,0	Shrimp fishing	1,0	0,0	3,2
Industrial fisheries	0,0	0,0	Industrial fisheries	0,0	0,9	0,8
Boat owner	1,7	2,6	Boat owner	0,0	0,0	0,1
Middleman	0,0	0,4	Middleman	1,0	0,0	0,1
Gear maintenance	28,8	32,6	Gear maintenance	3,9	10,3	14,4
Fish processing	7,6	4,1	Fish processing	1,0	1,7	3,1
Agriculture	0,0	0,0	Agriculture	0,0	4,3	0,0
City jobs	0,0	0,0	City jobs	0,0	0,9	0,1
Occasional jobs	11,9	13,1	Occasional jobs	11,8	11,2	7,2
Unemployment benefit	32,2	33,0	Unemployment benefit	20,6	24,1	28,2
Pension	0,8	1,1	Pension	2,9	1,7	3,5
Other	0,0	0,0	Other	9,8	3,4	1,4

Figure 75: Frequency of responses (in percentage) reported by fishers of São Lourenço do Sul (Barrinha and Navegantes) and of Pelotas (Balsa, Pontal da Barra and Z3) as their main activities and/or sources of income

Income sources	Arambaré	Camaqua	Tapes	Mostardas	Tavares
Fish year-round	31,0	27,3	38,4	59,1	58,3
Shrimp fishing	0,0	0,0	0,0	0,0	1,4
Industrial fisheries	0,0	0,0	0,0	0,0	0,7
Boat owner	2,4	3,0	7,1	0,0	0,0
Middleman	2,4	0,0	1,0	0,0	0,7
Gear maintenance	19,0	33,3	14,1	0,0	1,4
Fish processing	11,9	0,0	4,0	0,0	2,9
Agriculture	0,0	3,0	0,0	0,0	2,9
City jobs	0,0	0,0	0,0	0,0	0,0
Occasional jobs	7,1	6,1	7,1	4,5	2,9
Unemployment benefit	19,0	27,3	22,2	22,7	24,5
Pension	4,8	0,0	2,0	4,5	1,4
Other	2,4	0,0	4,0	9,1	2,9

Figure 76: Frequency of responses (in percentage) reported by fishers of Arambaré, Camaquã, Mostardas, Tapes and Tavares as their main activities and/or sources of income

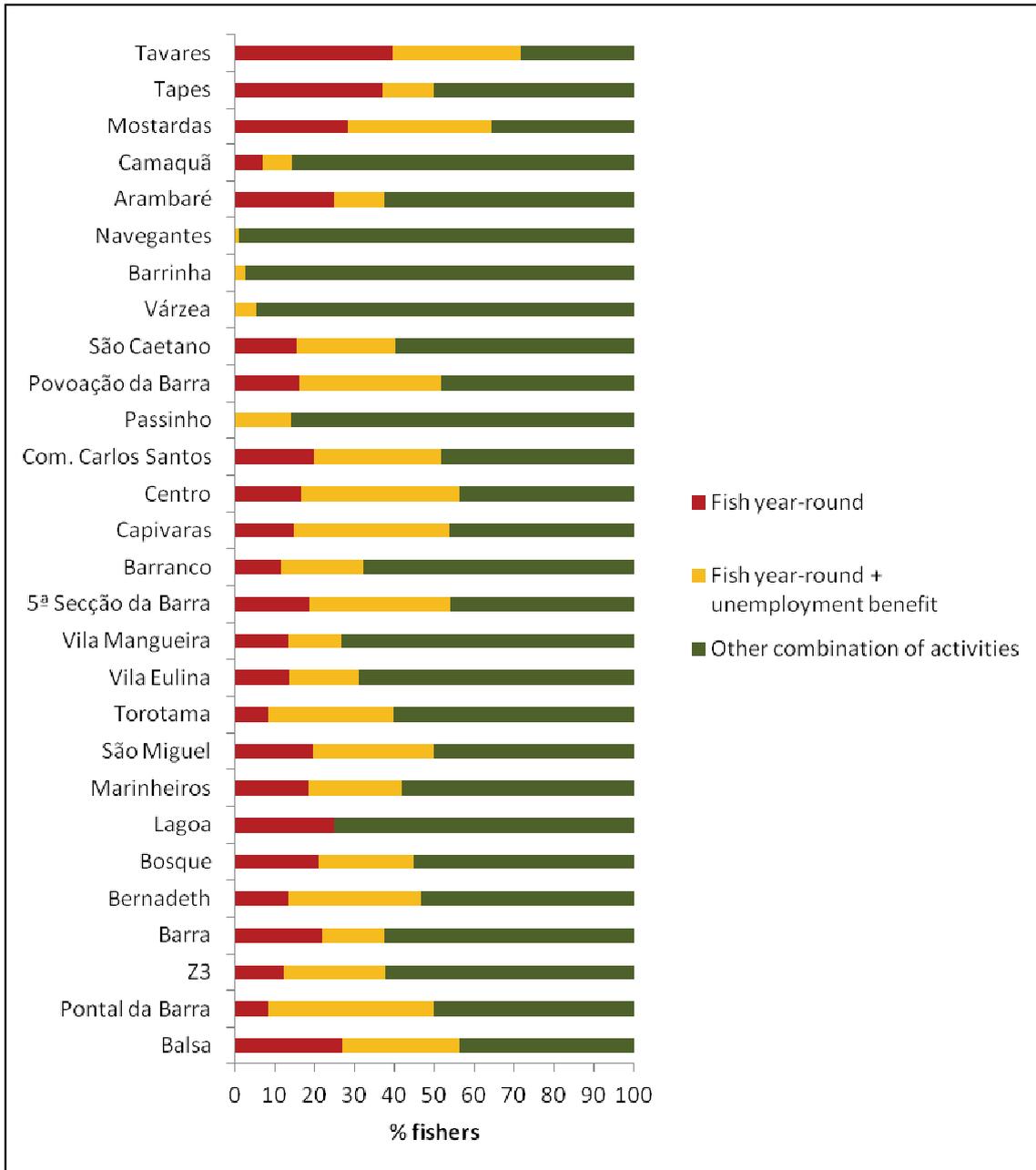


Figure 77: Percentage of fishers adopting three types of strategies as main source of income: (1) fish year-round only; (2) combine fish year-round with unemployment benefit; and (3) employ other combination of activities and/or sources of income, not necessarily including fish year-round and the unemployment benefit

To understand livelihood strategies more fully, fishers were asked to indicate what their main activities were during the winter, when there is a fishing closure in the Patos Lagoon estuary. The options were:

- *Fish controlled species:* continue fishing the forbidden species (shrimp, mullet, croaker and catfish) despite the closure.
- *Fish other species:* continue fishing species not included in the closure, such as blue crab, flatfish and silverside.
- *Fish in other areas of Patos Lagoon:* continue fishing in areas of the lagoon outside the estuary.

- *Fish in other lagoons*: fish in other coastal lagoons, such as the Mirim and Mangueira lagoons in southern Brazil.
- *Fish in coastal waters*: fish for marine species in coastal waters.
- *Industrial fisheries*: work in industrial fisheries, including working as crew on industrial fishing boats operating in coastal waters of southern Brazil and unloading fishing vessels.
- *Gear maintenance*: work repairing and building nets for other fishers, including industrial fisheries.
- *Fish processing*: work in the processing of fish in industrial plants and in artisanal fishers' cooperatives and/or associations.
- *Agriculture*: work on farms, either as landowner or as labour force.
- *Selling fish*: work in commercialization of fish products.
- *City jobs*: have formal jobs in the city.
- *Occasional jobs*: have informal, occasional, jobs including construction work and general services.
- *Do not work*: do not carry any remunerated activity.
- *Other*: other activities not listed above or specified.

According to the fisheries legislation, fishing for shrimp, mullet, croaker and catfish is forbidden during the winter in the Patos Lagoon estuary (see Chapter 5). The four-month fishing closure has been adopted as one of the main conservation measures for these estuarine resources. To compensate for the income losses resulting from the closure, artisanal fishers are entitled to receive an unemployment benefit (one minimum wage for every month of the closure). The labour law that regulates the unemployment benefit practically forbids its beneficiaries from having any other additional source of income, including fishing for species not included in the closure while receiving the benefit (see section on access to credit, subsidies and government aid in Chapter 4). The vast majority of fishers in the estuary are beneficiaries of this policy (Chapter 3). In spite of this, data presented in Figures 78 to 81 show that only a small percentage of fishers declared not working during the closure. Many continue fishing species regulated and not regulated by the closure. Gear maintenance is a common activity and takes particular importance in localities in Camaquã, São Lourenço and São José do Norte. A high percentage of fishers in some communities engage in occasional jobs, while in rural communities agriculture is a strategy frequently used.

These results raise the question of whether the unemployment benefit is sufficient to sustain fishing households, especially in years with bad fishing seasons when income drops significantly, as demonstrated in the assessment of technical-economic performance of fishers in this chapter. It also questions the effectiveness of the coupled conservation-compensatory policies to resource sustainability and livelihood security, given the current socio-economic vulnerability of fishers, their diversified livelihoods and the practice of illegal fishing in the estuary. These results are important benchmarks to support the revision of these policies in the near future. In the figures below, rural localities are in red and urban localities in blue.

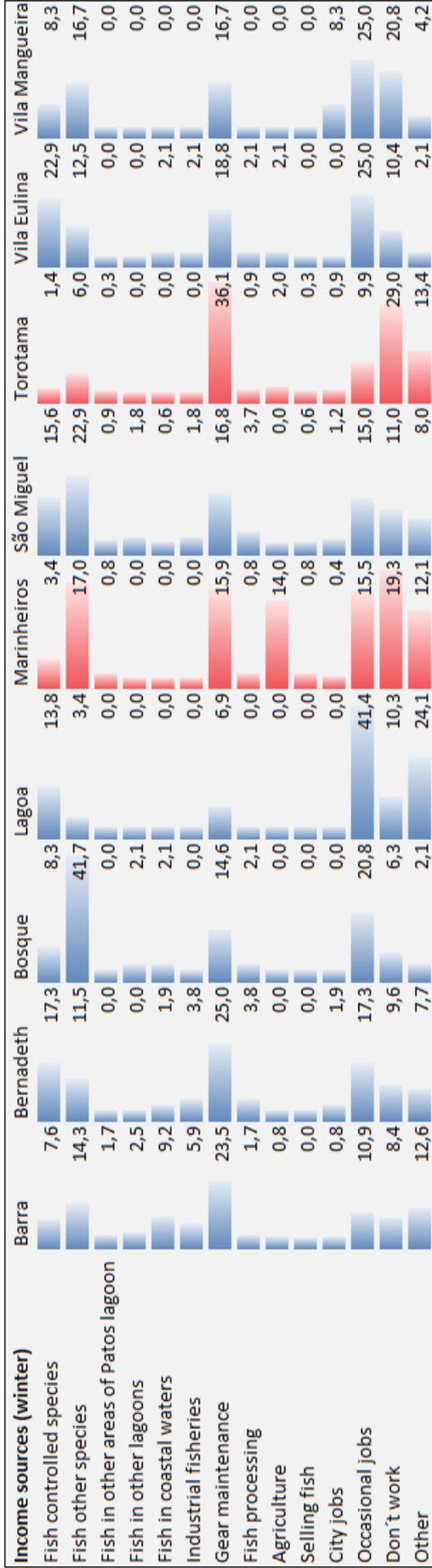


Figure 78: Frequency of responses (in percentage) reported by fishers of Rio Grande as their main activities and/or sources of income during the winter fishing closure

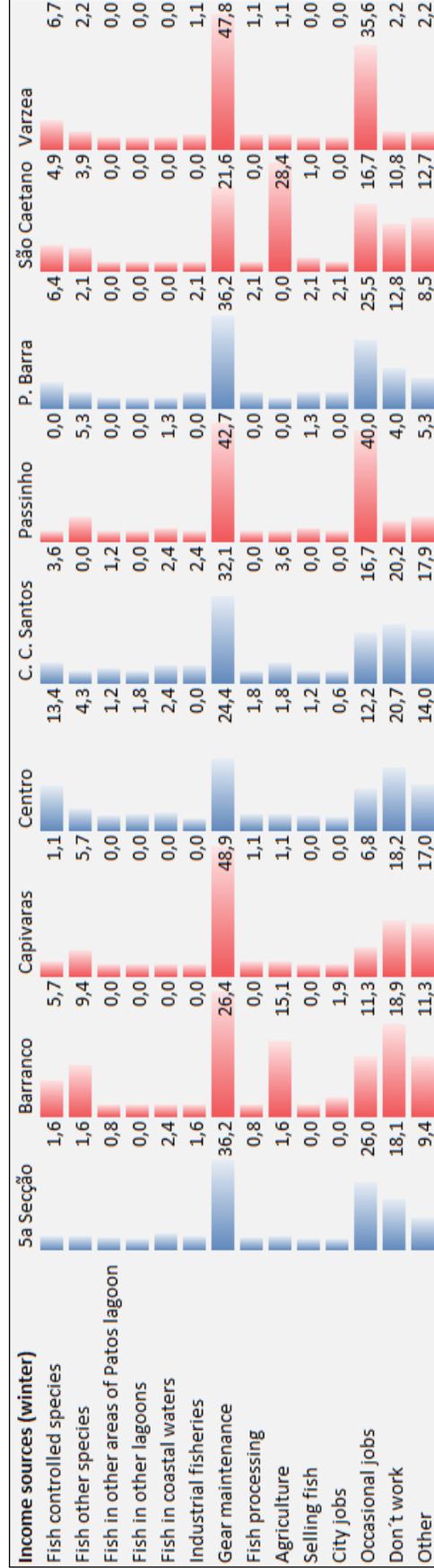


Figure 79: Frequency of responses (in percentage) reported by fishers of São José do Norte as their main activities and/or sources of income during the winter fishing closure

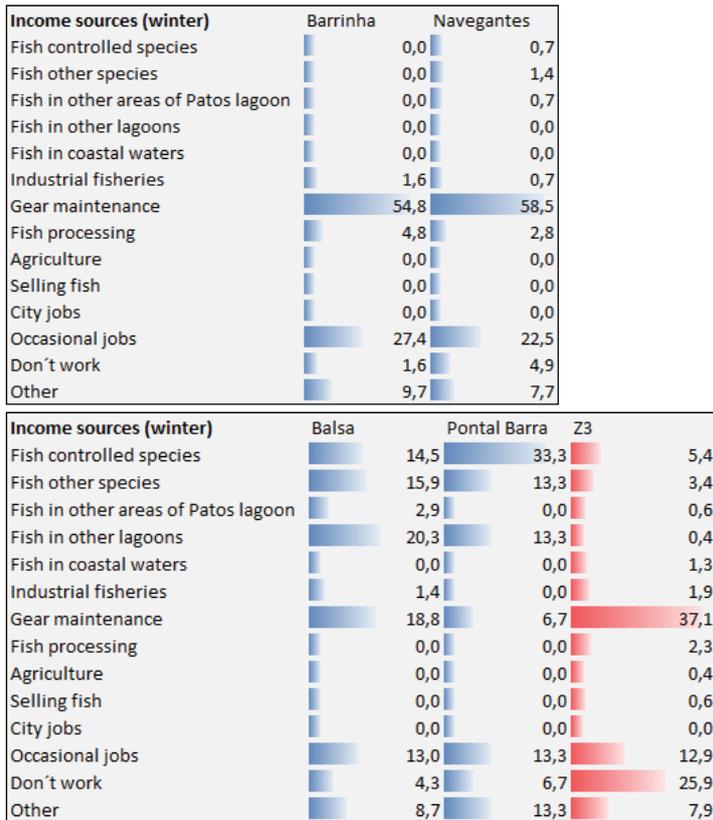


Figure 80: Frequency of responses (in percentage) reported by fishers of São Lourenço do Sul (Barrinha and Navegantes) and Pelotas (Balsa, Pontal da Barra and Z3) as their main activities and/or sources of income during the winter fishing closure

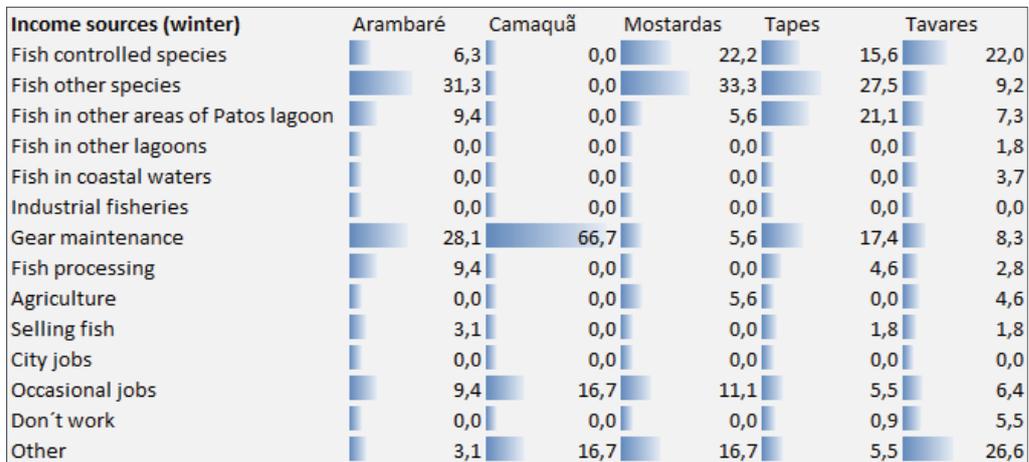


Figure 81: Frequency of responses (in percentage) reported by fishers of Arambaré, Camaquã, Mostardas, Tapes and Tavares as their main activities and/or sources of income during the winter fishing closure

Recognizing the importance of shrimp to the income of fishers in many localities (Chapter 3), fishers were also asked to indicate what they do in the years of a failed shrimp season. The options included changes in fishing strategies and fishing gear, alternative activities and sources of money, which are:

- *Fish other species*: fish for species other than shrimp during the shrimp season.
- *Fish other species (other periods)*: fish for other species in other periods to compensate for the low shrimp catches.
- *Fish in other places*: fish in areas outside the estuary, including other lagoons and coastal areas.
- *Otter trawl*: opt to fish shrimp with otter trawls.
- *Beach seine*: opt to fish shrimp with beach seine (*rede de coca*).
- *Berimbau*: opt to fish shrimp with the *berimbau* gear.
- *Occasional jobs*: have informal, occasional jobs, including construction work and general services.
- *Industrial fisheries*: work in industrial fisheries, including working as crew on industrial fishing boats operating in coastal waters of southern Brazil and unloading fishing vessels.
- *Agriculture*: work on farms, either as landowner or as labour force.
- *Aquaculture*: work in fish and/or shrimp culture.
- *Rely on intermediaries*: borrow money from intermediaries.
- *Rely on friends*: borrow money from friends.
- *Rely on family*: borrow money from family.
- *Bank loans*: borrow money from bank.
- *Buy on credit*: maintained by buying goods on credit.
- *Other*: other activities not listed above or specified.

When the shrimp fishing season fails, fishing other species becomes a necessity and is frequently adopted by fishers throughout the estuary (Figures 82 to 85). The alternative target species vary across the region. Mullet was reported to be important to all communities. Blue crab is an alternative pointed out by communities of Rio Grande and Tavares. Croaker and catfish become important in communities of São José do Norte, while freshwater species appear as an alternative in communities in the upper estuary (Arambaré, Pelotas and São Lourenço). It is also noticeable that where shrimp is not an important source of income (Arambaré, Camaquã and São Lourenço), other strategies outside the fishery activity are less frequent. This may indicate, perhaps, that a bad shrimp season does not strongly affect the communities from the upper estuary as it affects the communities from the lower estuary. The strategy adopted by fishers from the localities at the mouth of the lagoon (Barra and Mangueira) include to fish in adjacent coastal waters. These fishers, as demonstrated in Chapter 3, have more autonomy to fish in coastal marine waters because they have larger and more powerful boats. This strategy of fishing in coastal marine areas is also used by fishers from Tavares.

The reliance on sources of income outside fisheries when a bad shrimp season happens increases in the localities of Pelotas, Rio Grande and São José do Norte. Fishers from these localities frequently perform occasional jobs as an alternative livelihood. Agriculture again appears to be an option adopted in some rural localities of Rio Grande and São José do Norte.

Other strategies verified with more frequency in rural localities of Rio Grande and São José do Norte were to borrow money from family members and buying goods and services on credit. These communities have some of the lowest levels of income from fishing, a stronger dependence on shrimp fishing as source of income, and are less capitalized and with smaller boats. This set of conditions probably limits their ability to diversify fishing strategies, and borrowing money or buying on credit becomes a strategy to overcome the difficulties created when the shrimp season fails.

Taken together, these data indicate that small-scale fisheries are actually maintained by diversified sources of income and also are highly dependent on government benefits for securing their livelihoods.

These findings have serious policy implications, given that the current view of artisanal fishers adopted by government institutions, when it comes to the calculation of social security and unemployment benefits and towards better fisheries management, is based on the paradigm that artisanal fishers rely on fisheries as their only source of income. As demonstrated here, with some exceptions, this is no longer a reality in the region, where fishers have other sources of income in addition to fishing to maintain their fishing livelihood.

Figures 82 to 85 show the frequency of responses (in percentage) reported by fishers of Rio Grande, São José do Norte, São Lourenço do Sul (Barrinha and Navegantes), Pelotas (Balsa, Pontal da Barra and Z3), and Arambaré, Camaquã, Mostardas and Tavares, when asked what their main activities and/or sources of income were when the shrimp season fails. The rural localities are shown in red and urban localities in blue. Alternative target species are listed in order of importance. Tapes was excluded from the analysis because of the low importance of shrimp to fishers.

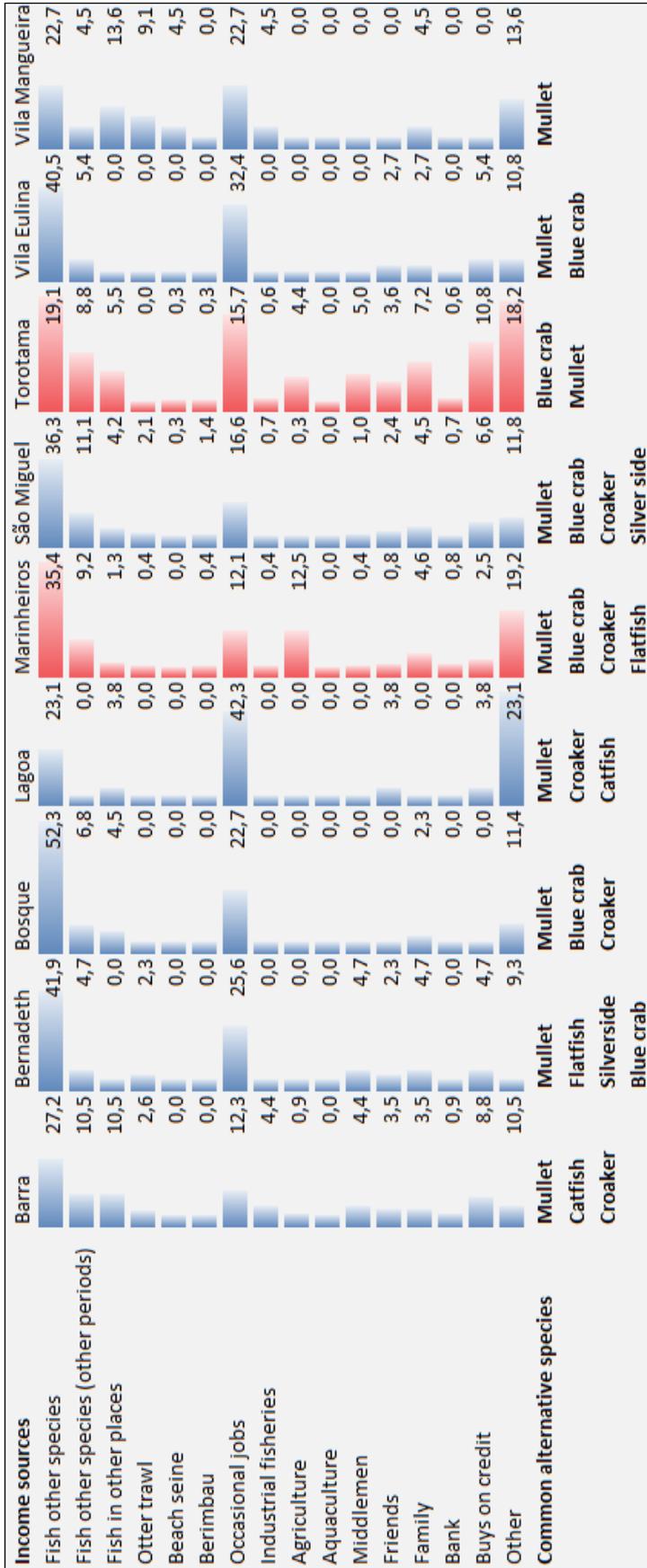


Figure 82: Frequency of responses (in percentage) reported by fishers of Rio Grande

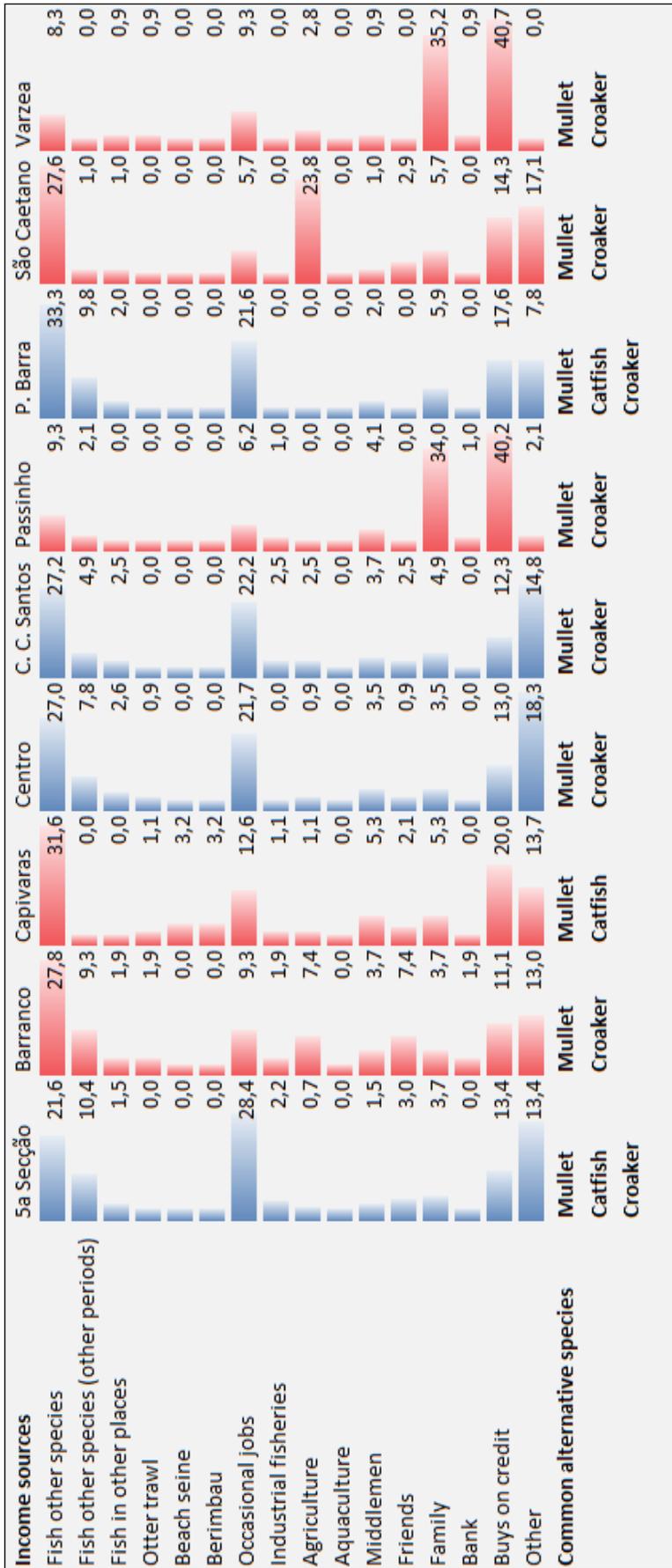


Figure 83: Frequency of responses (in percentage) reported by fishers of São José do Norte

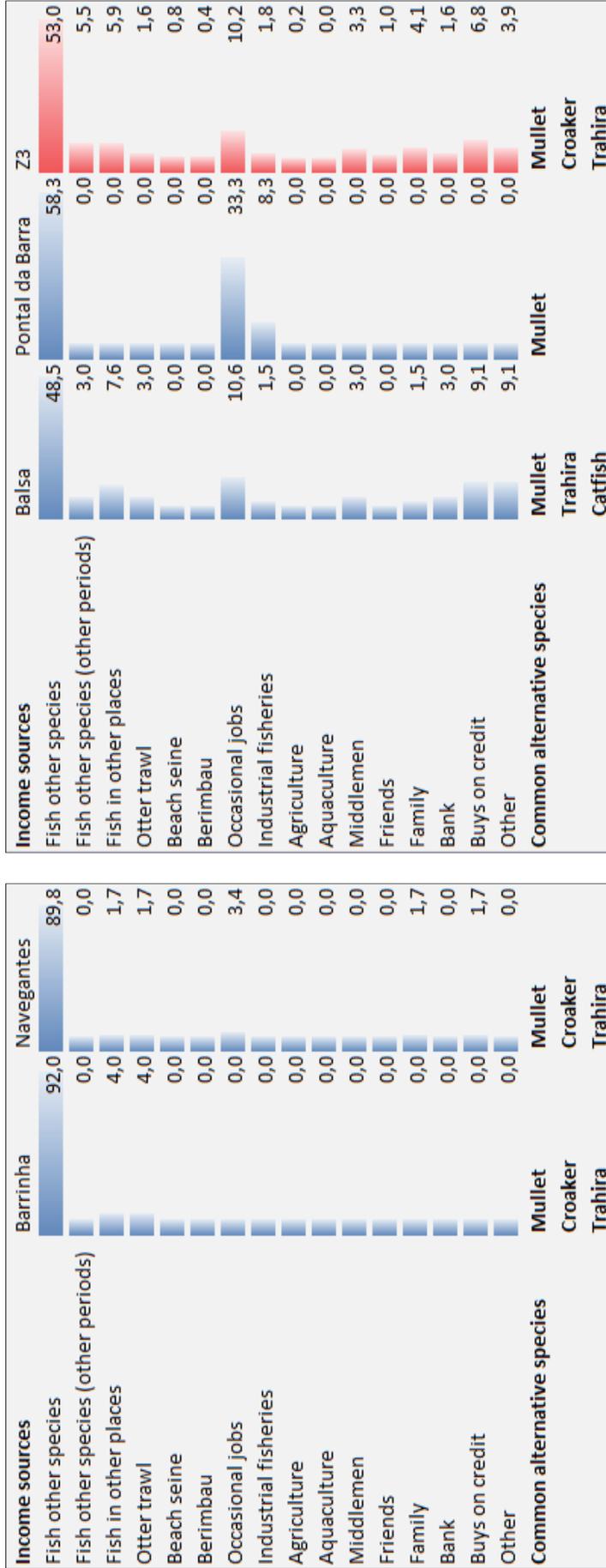


Figure 84: Frequency of responses (in percentage) reported by fishers of São Lourenço do Sul (Barrinha and Navegantes) and Pelotas (Balsa, Pontal da Barra and Z3)

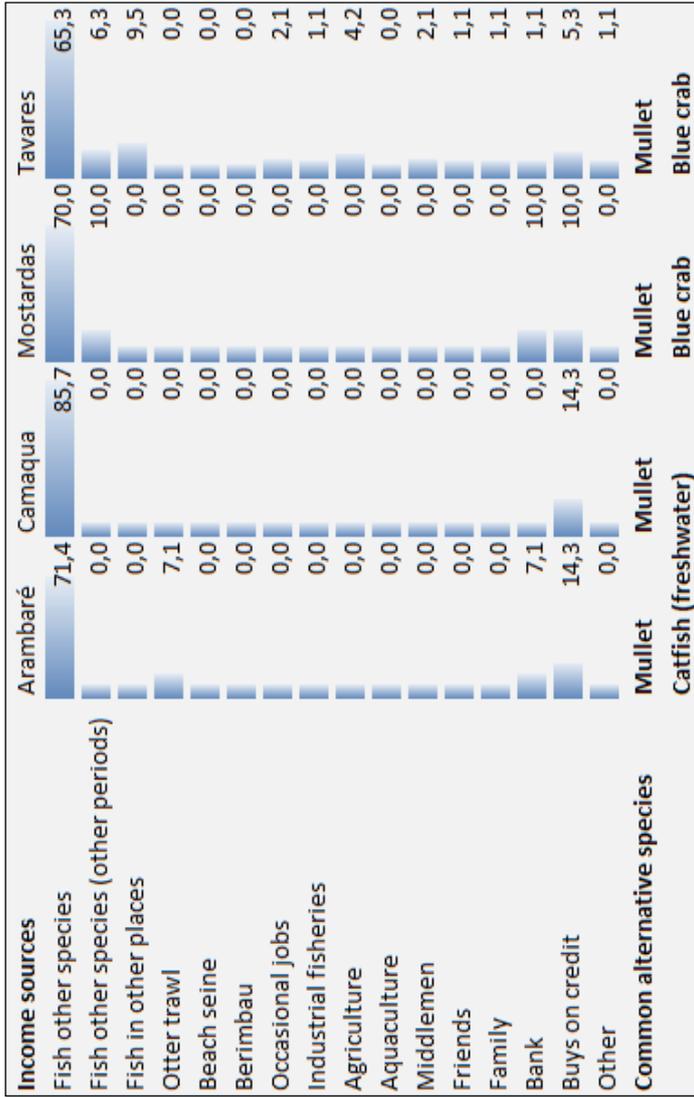


Figure 85: Frequency of responses (in percentage) reported by fishers of Arambaré, Camaquã, Mostardas and Tavares

Techno-economic performance of selected artisanal fishing units

The assessment of the techno-economic performance of artisanal fisheries was designed to demonstrate the differences in cost structure, income, and the financial and economic performance of fishers in selected communities of the estuary. Ten fishers were selected for this assessment based on the characteristics of their fishing enterprises and similarity of their enterprises and fishing strategies to other fishers in the community.

Table 9 and Figure 86 describe the technical and operational characteristics of the fishing units. Table 10 shows the investment costs and estimated depreciation of fishing units.

Table 9: Technical and operational characteristics of fishing units

Locality	Boat length (m)	Engine (hp)	Additional boat, on board equipment/facilities	Fishing gear	Crew size	Average duration of fishing trips (days)	Sharing system
Rio Grande, São Miguel	8.4	60	Canoe 5.2 m; ice for flatfish	Fyke nets; gillnets	2	1–4	Equal sharing of costs
Rio Grande, São Miguel	4.8	9	Boat 7.7 m with used car engine; no ice	Fyke nets; gillnets; longline for blue crabs	3	1	Profit divided in equal parts
São José do Norte, Várzea	9	24	3 canoes 5 m; no ice	Fyke nets; gillnets	2–3	1	Shrimp: 1/2 profit to owner and 1/2 for the crew; Mullet/croaker: 3/4 owner and 1/4 crew
São José do Norte, Várzea	7.5	18	3 canoes 5 m; no ice	Fyke nets; gillnets	2–3	1	Shrimp: 1/2 profit to owner and 1/2 for the crew; Mullet: 60% to owner and 40% crew; Croaker: 2/3 owner and 1/3 crew
São José do Norte, Capivaras	9	22	Echosounder; radio Px; ice for croaker and shrimp	Fyke nets; stow nets; otter trawl; gillnets	3	–	4/6 of profit to owner and 2/6 to crew
São José do Norte, Capivaras	10.3	74	Echosounder; GPS; radio Px; ice	gillnets	5	–	5/9 of profit to owner and 4/9 to crew
Pelotas, Z3	8	11	Canoe 6 m; ice	Stow nets; gillnets	2–3	1–5	Shrimp: equal sharing of costs; Mullet: 3/5 of profit to owner and 2/5 to crew; Flatfish: 1/2 to owner 1/2 to crew
Pelotas, Z3	9.2	55	Echosounder; radio VHF; ice	Trawling gillnets	2–3	1–10	Mullet: 6/9 to owner and 3/9 to crew; Others: 1/3 to each fisher
São Lourenço do Sul, Navegantes	11.7	45	Echosounder; radio Px; compass; ice	Stow nets; trawling gillnets	4	1–20	5/9 of profit to owner and 4/9 to crew
São Lourenço do Sul, Navegantes	10.8	55	Echosounder; radio Px; ice	Trawling gillnets	4	1–20	Cost covered by owner; crew retain revenue from their own nets

Figure 87 describes the cost structure of the fishing units. Cost components are related to the total costs, which include depreciation and interest. An important difference among the units studied relates to the labour cost. Labour cost is usually the most important cost element in units adopting profit-sharing systems. For these units, labour costs range from 27 percent to 82 percent of the total costs. Labour costs are zero in units adopting systems of partnership, where crew members share operating costs⁴ and fish with their own material. In such cases, running costs become the most important cost element, ranging from 49 percent to 64 percent of the total costs. Fuel and gear expenses, including butane gas used in the fyke net fishing, account for a considerable part of the running costs. The least important cost component in all units studied is the vessel costs⁵, amounting from 3 percent to 8 percent of the total costs. However, when adding the costs of investment (depreciation and interest) to vessel costs, the situation changes significantly. The combined costs range from 10 percent to 51 percent of the total costs.

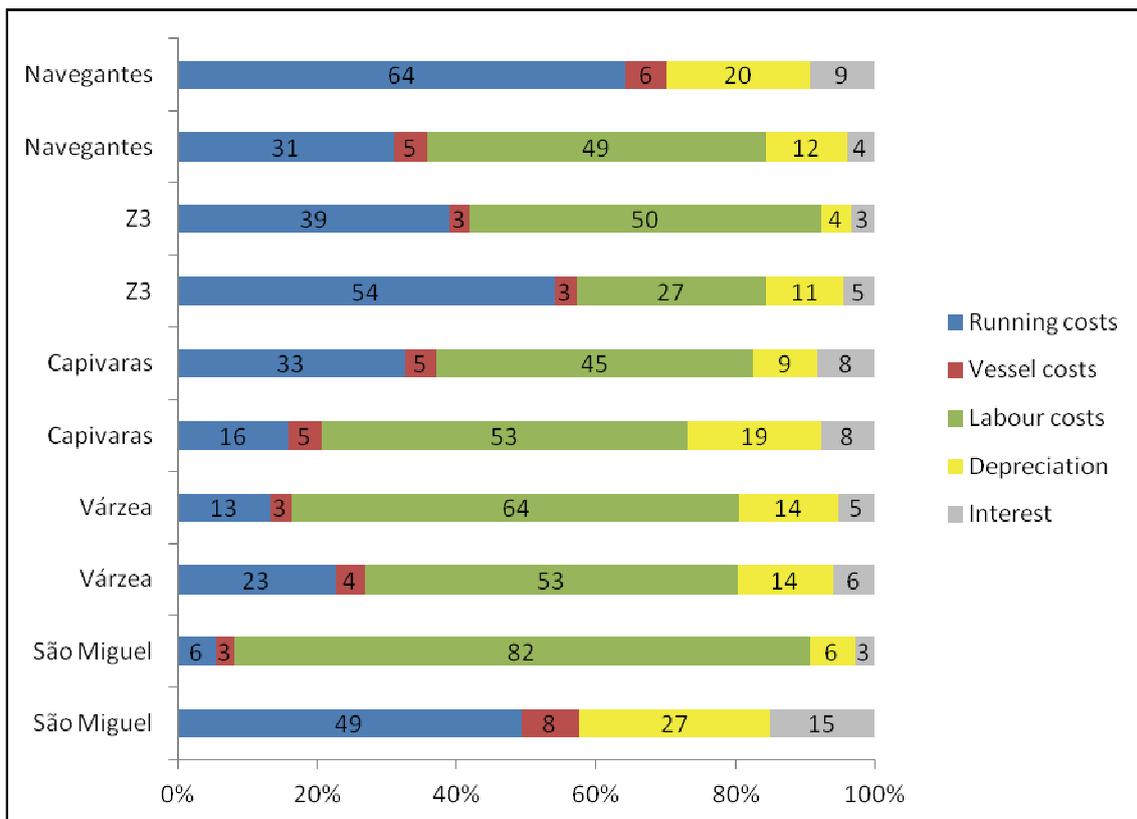


Figure 87: Cost structure of small-scale fishing units in selected communities of the estuary of Patos Lagoon

The relative contribution of each species to the total earnings is shown in Figure 88. Shrimp, mullet and croaker account for most of the earnings. The relative importance of each of the three species varies across the units studied, with shrimp being the most important in São Miguel and in one unit of Z3, and croaker important to units in Capivaras and Várzea. The general tendency of the decrease in importance of croaker is noticeable from the communities in the lower estuary (Capivaras, São Miguel) to the communities in the upper estuary (Navegantes). The opposite trend is observed with mullet, which become the most important resource in the upper estuary. In this regard, an interesting finding of the study was the identification of fishers who rely almost exclusively on mullet fishing and who do not take part in shrimp fishing (one unit in Capivaras and one in Z3). Such a strategy seems to be a common

⁴ Running costs include fuel, food and gear expenses.

⁵ Vessel costs include the costs of repair and maintenance and documentation.

adaptation of fishers to avoid the high costs involved with shrimp fishing. These results are corroborated by the data on relative importance of the main fisheries resources to fishers' income (Figure 53).

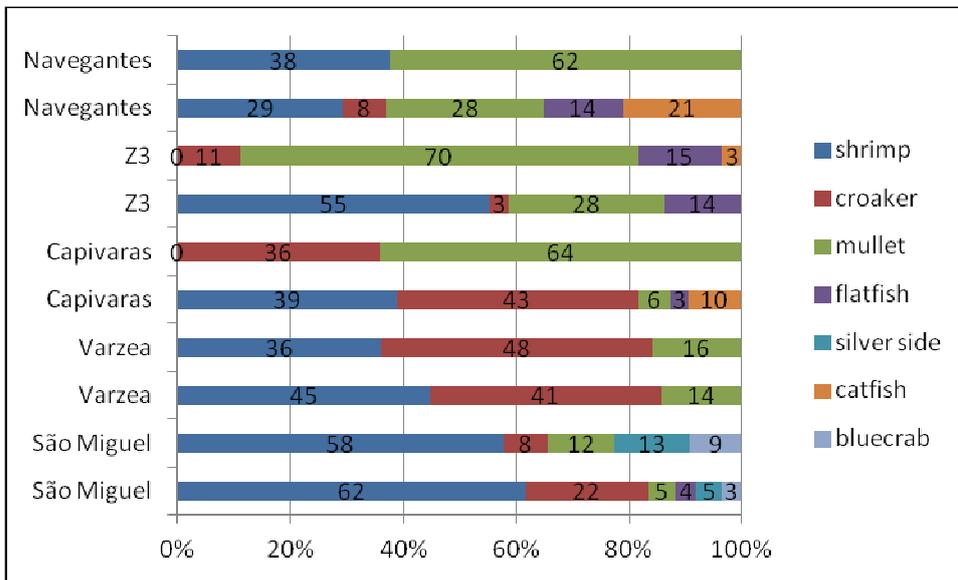


Figure 88: Relative importance of each species to the total earnings of fishing units

Table 11 quantifies the costs and earnings from fishing of each fishing unit in a scenario considered by fishers as representative of a good fishing season for all resources. The net profit was calculated in this table. In the assessment of the net profit, the depreciation and the interest paid on the total investment of a fishing unit, an interest rate of 4 percent per year was used. This is the interest rate for rural credit obtained with the National Program to Strengthen Family-based Agriculture (PRONAF) for credit of up to R\$50 000. However, in the majority of cases, the investment cost per fishing unit is below this amount.

In Table 12, the earnings from fishing are compared with the total household earnings, including remunerated work by family members, unemployment benefit and other government aid. The total annual household earnings vary from R\$14 123 to R\$79 528.

Table 11: Cost structure and earnings from fishing during good fishing seasons (values in R\$, 2010)

	São Miguel	São Miguel	Várzea	Várzea	Capivaras	Capivaras	Z3	Z3	Navegantes	Navegantes
Total earnings	34 057	41 575	45 162	40 462	63 100	85 600	64 750	59 650	142 667	106 000
Labour	0	26 006	11 597	15 145	19 165	30 428	8 628	1 9767	50 707	0
Food	1 440	0	360	200	225	6 400	4 700	5 000	8 800	3 840
Fuel	1 813	620	2 410	1 060	4 140	9 890	4 668	9 080	12 160	12 480
Gear expenses	3 878	350	2 037	1 743	339	945	5 967	65	3 700	1 650
Other running costs	160	682	0	0	942	4 500	1 650	1 070	7 616	4 273
Colony/association fees	0	108	128	128	132	132	96	96	50	50
Documentation (vessel insurance, licensing)	37	80	37	0	37	37	0	15	0	37
Repairs and maintenance	1 200	725	880	750	1 700	3 000	1 000	1 114	5 000	2 000
Total costs	8 528	28 571	17 449	19 026	26 680	55 332	26 709	36 207	88 033	24 330
Gross cash flow	25 529	13 004	27 713	21 436	36 420	30 268	38 041	23 443	54 634	81 670
Depreciation	4 043	2 049	2 966	3 333	6 960	6 236	3 483	1 676	12 172	7 100
Interest ¹	2 226	920	1 317	1 246	2 820	5 521	1 430	1 366	4 217	3 218
Net profit	19 260	10 035	23 430	16 857	26 640	18 511	33 128	20 401	38 245	71 352

¹. Amount of debt repayment at an annual interest rate of 4 percent of investment (PRONAF).

Table 12: Household earnings from fisheries (good season) and other activities (values in R\$, 2010).

Household earnings	São Miguel	São Miguel	Várzea	Várzea	Várzea	Capivaras	Capivaras	Z3	Z3	Navegantes	Navegantes
Income from fishing	19 260	10 035	23 430	16 857	26 640	18 511	33 128	20 401	38 245	71 352	
Family	6 000	0	12 264	0	6 620	0	6 132	0		6 132	
Unemployment benefit	4 088	4 088	0	4 088	2 044	4 088	8 176	2 044	4 088	2 044	
Other government aid	264	0	0	264		1 120	264	0	264	0	
Total	29 612	14 123	35 694	21 209	35 304	23 719	47 700	22 445	42 597	79 528	

Tables 13 and 14 compare the economic performance between the “good and bad fishing seasons”, respectively. The dependence of the fisher on fisheries and on other household incomes, including government aid and contributions from other household members, is also compared during good and bad fishing seasons.

The economic performance of fishing units in a good fishing season scenario varied from 21.6 percent to 67.3 percent. The units with highest economic performance (Navegantes, 67.3 percent and São Miguel, 56.6 percent) are those that eliminated labour costs by operating in a partnership system. The financial performance (measured by the return on investment [ROI]) varied from 16.7 percent to 92.7 percent, reaching the highest values in the communities of Navegantes and Z3.

The household economic dependence on fishing is high among the units assessed, representing at least 65 percent of the total household income in such conditions. The importance of government aid varied from 0 percent (in a family where nobody receives unemployment benefit) to 28.9 percent of the total household income. The contribution of income from family members working outside the fishery varied from 0 percent to 34.4 percent of the total household income. Based on this result, it can be said that government aid and additional family income have a complementary role in the household income during good fishing seasons, when fishing is highly profitable and makes the bulk of family earnings.

A bad fishing season has a drastic impact on income and performance indicators (Table 14). Comparing the results in Tables 13 and 14, it is estimated that the total earnings is reduced between 65 percent and 90 percent during bad fishing seasons. Five out of ten fishers interviewed have a positive cash flow in this scenario, but only two fishers have a positive net profit (after discounting depreciation and interest). For these fishers, the net profit/total earnings (NP/TE) ratio decreased to 3.6 percent and 14.4 percent, from 24.1 percent and 51.9 percent, respectively. In turn, the ROI decreased from 43.6 percent and 71.2 percent to 2 percent and 7 percent, respectively. Despite the positive results of these two fishers, fisheries account for only a small part of their household income. Government aid, especially the unemployment benefit, plays a fundamental role in the household income in this situation, representing all the household income in families who do not have other alternative income sources. In households that have other alternative income sources, the contribution of earnings from family members working outside the fishery varied from 42.1 percent to 84.1 percent of the total household income (Table 14).

It can be inferred from the census data that the above household income situations are common among artisanal fishers in the estuary of Patos Lagoon. Data from Table 24 show that about 80 percent of fishery-dependent people have accessed the unemployment benefit and a considerable number of fishers recognize the benefit as one of the main sources of income (Figure 77). The census data also show that approximately 19 percent of households have some level of dependency on income obtained from outside the fishery by family members (in half of these cases it is the wives who have remunerated work outside the fishery). In addition, the data show that a significant number of fishers have diversified their sources of income in fishery-related or unrelated activities, as can be seen in Figures 73 to 76. These livelihood strategies are important coping strategies to compensate for the poor economic returns from fishing in the last decade.

Table 13: Economic and financial performance indicators of fishing units in a good fishing season. The percentage contribution of fishing, government aid and family earnings to household income is shown

Description	São Miguel	São Miguel	Várzea	Várzea	Capivaras	Capivaras	Z3	Z3	Navegantes	Navegantes
NP/TE (%)	56.6	24.1	51.9	41.7	42.2	21.6	51.2	34.2	26.8	67.3
ROI (%)	34.6	43.6	71.2	54.1	37.8	16.7	92.7	59.7	36.3	88.7
Economic dependence on fishing (%)	65.0	71.1	65.6	79.5	75.5	78.0	69.5	90.9	89.8	89.7
Government aid (%)	14.7	28.9	0.0	20.5	5.8	22.0	17.7	9.1	10.2	2.6
Family (%)	20.3	0.0	34.4	0.0	18.7	0.0	12.8	0.0	0.0	7.7

Table 14: Economic and financial performance indicators of fishing units in a bad fishing season. The percentage contribution of fishing, government aid and family earnings to household income is shown (values in R\$, 2010)

Description	São Miguel	São Miguel	Várzea	Várzea	Capivaras	Capivaras	Z3	Z3	Navegantes	Navegantes
Total earnings	11 640	12 850	16 075	10 137	6 800	14 600	5 275	11 350	49 500	10 600
Gross cash flow	4 155	3 429	6 593	3 000	-1 113	-10 304	-12 806	-5 090	2 874	-13 730
Net profit	-2 114.16	460.24	2 310	-1 578.6	-10 893	-22 061.2	-17 718.6	-8 132	-13 515.2	-24 047.8
NP/TE (%)	-	3.6	14.4	-	-	-	-	-	-	-
ROI (%)	-	2.0	7.0	-	-	-	-	-	-	-
Economic dependence on fishing (%)	0	10.1	15.9	0	0	0	0	0	0	0
Government aid (%)	42.0	89.9	0.0	100.0	23.6	100.0	57.9	100.0	100.0	25.0
Family (%)	58.0	0	84.1	0	76.4	0	42.1	0	0	75.0

One assumption made in this assessment was that all main resources follow the same pattern of change in production, i.e. years with favourable conditions lead to good seasons for all resources and vice versa. This assumption finds strong support in scientific studies (Vieira, Garcia and Grimm, 2008; Möller, Castello and Vaz, 2009) and fishers' knowledge. For instance, when asked what influences yearly income, most fishers stated: "climate and salt water; when the water gets salty, fisheries is good in all seasons". This is a common perception among artisanal fishers of Patos Lagoon (Kalikoski and Vasconcellos, 2007). Available landings data also support this assumption, as shown by the positive correlation among landings of the main resources (Figure 89). The correlation between the strength of fishing seasons is stronger in the more recent period (1976–2008) for shrimp and mullet ($R^2 = 0.29$) and for mullet and croaker ($R^2 = 0.23$).

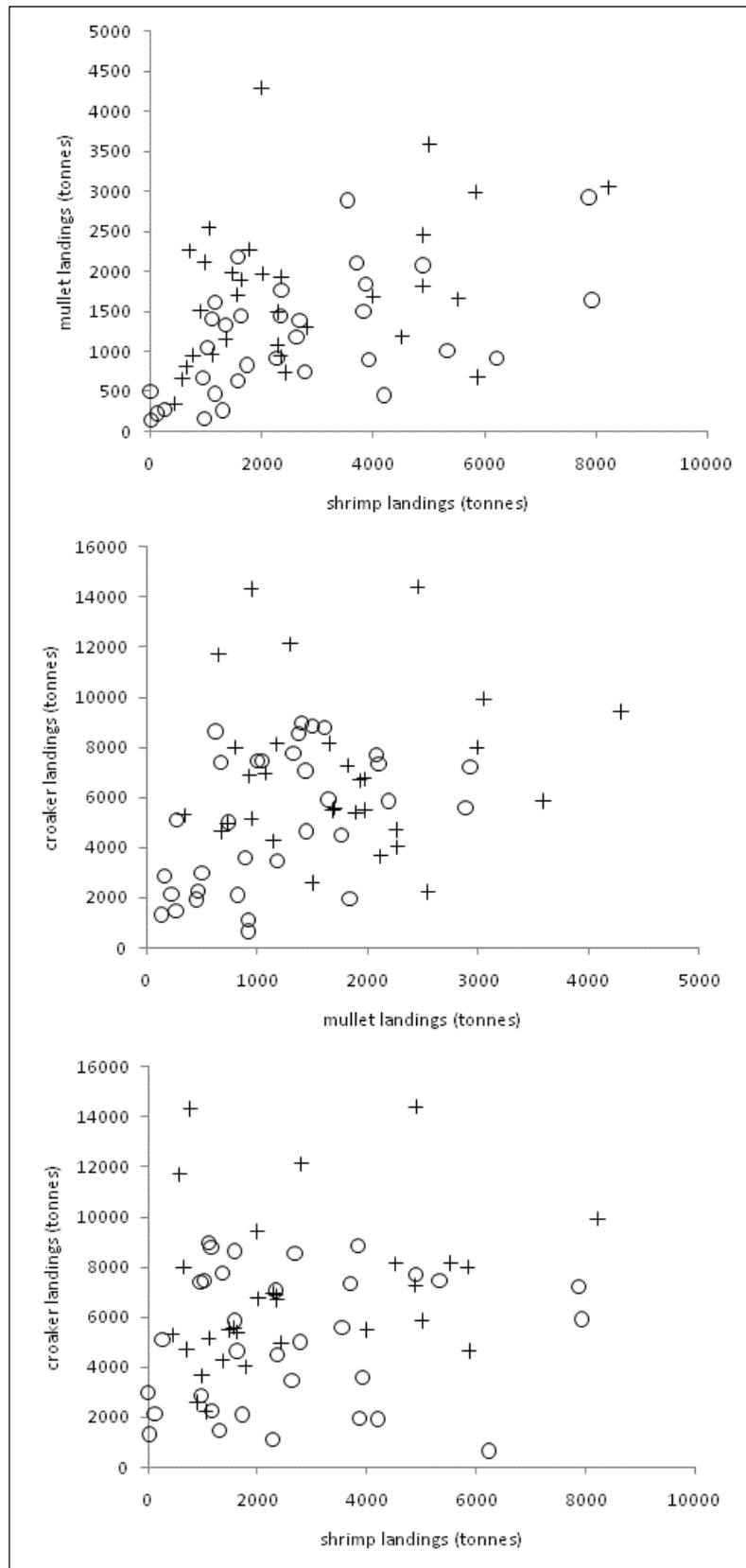


Figure 89: Correlation between landings of shrimp, croaker and mullet in the Patos Lagoon estuary. Data for croaker refers to the previous year of the data for mullet and shrimp. Crosses are data for the period 1945–1975, circles for 1976–2008.

Another important point to observe is the frequency with which good and bad seasons occur and how this has changed over the years. Studying the time series of shrimp landings in the estuary of Patos Lagoon and its relationship to meteorological data, Pereira (2010) proposed threshold levels of landings to classify the strength of shrimp fishing seasons. According to the author, a bad fishing season normally occurs when total landings are below 1 081 tonnes, and a good fishing season when landings are above 4 087 tonnes. It is worth noting that this level of catches is consistent with the total catches of shrimp during good fishing seasons, as calculated based on the census assessment (4 198 tonnes; Figure 54). The study also demonstrated that bad seasons are strongly correlated to wet springs of the preceding year and that good seasons are strongly correlated to dry springs, as was also shown by Möller, Castello and Vaz (2009). If the threshold levels are superimposed in the shrimp landings time series, it is possible to evaluate the frequency of occurrence of good and bad seasons in the last 60 years (Figure 90). For instance, in the period 1998–2008, there were two good seasons (2000 and 2005) and four bad seasons (1998, 2001, 2002 and 2003). This is contrastingly different from the previous decades, when the frequency of good seasons was higher than the bad seasons. More specifically, there were nine good seasons in the period (1965, 1968, 1970, 1971, 1972, 1974, 1979, 1985 and 1986) and seven bad seasons (1966, 1967, 1973, 1983, 1984, 1987 and 1994). This pattern of variation in the strength of shrimp fishing seasons can be the result of the combined effect of stock overfishing and changes in climatic conditions that affect the hydrological regime in the estuary.

In the last 60 years, there has been an upward trend in the runoff of the major rivers contributing to the Patos Lagoon, associated with rising rates of rainfall in the drainage areas of these rivers (Costa, Seelinger and Bemvenuti, 2010). As discussed earlier and validated by the fishers during the interviews and the census data, increased amount of freshwater reaching the estuary has negative effects on the productivity and availability of the most important artisanal fisheries resources. In turn, the overfishing of the stock has a direct effect on the recruitment strength and production. For instance, D’Incao, Valentini and Rodrigues (2002) demonstrated that one effect of the overfishing of the pink shrimp stock was the decrease in the strength of correlation between good seasons and pluviosity. When the stock was abundant, up to 90 percent of the good seasons were explained by pluviosity. With the decrease in the stock observed in the last two decades, pluviosity, although still important, does not influence as much the strength of shrimp seasons. According to the author, this occurs because the amount of shrimp postlarvae available to enter the estuary has decreased in response to recruitment overfishing.

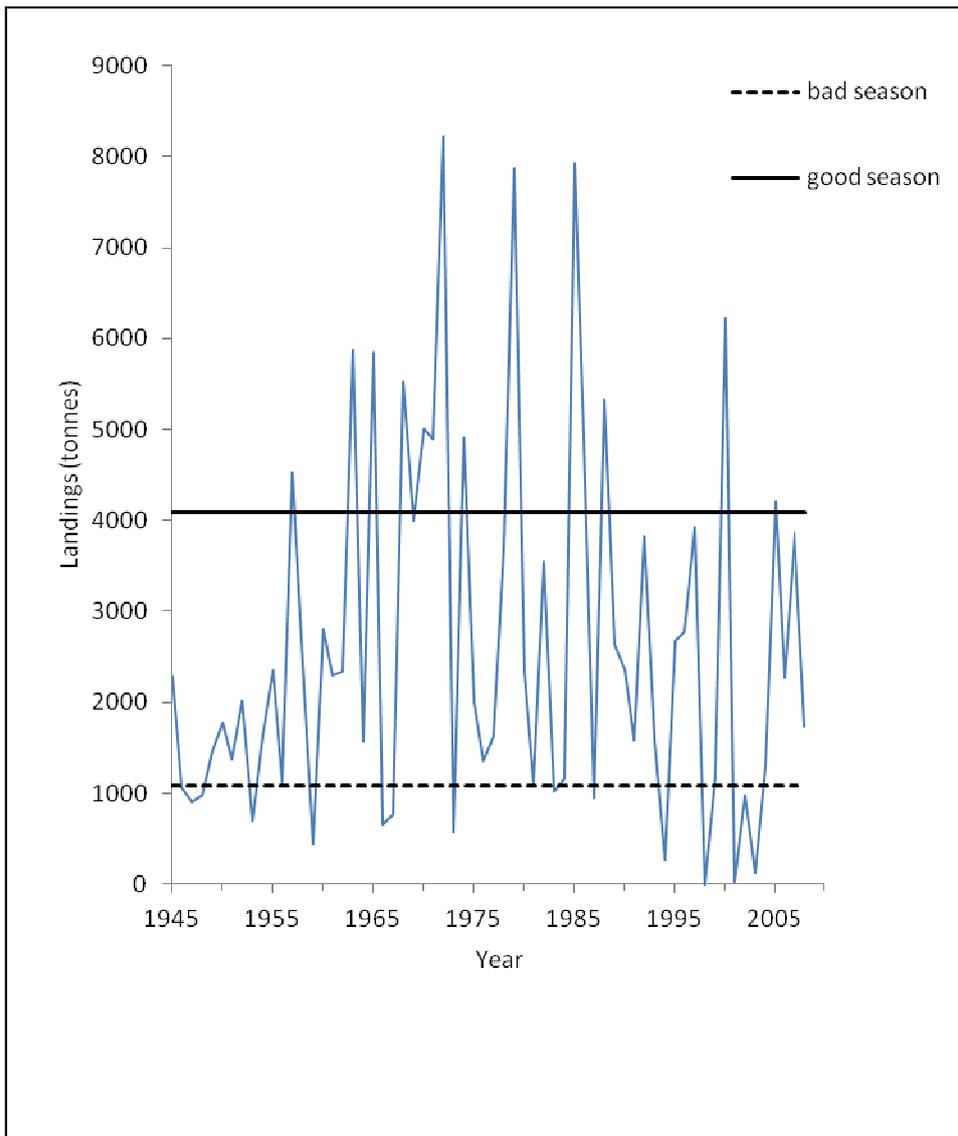


Figure 90: Shrimp landings in the estuary of Patos Lagoon and threshold levels for good and bad seasons, as defined by Pereira (2010)

Considering the importance of shrimp to fishers' earnings, and that the strength of the shrimp season is also correlated with that of the other resources, it can be concluded that the prevalence of unfavourable conditions during the last decade has placed fishers in a vulnerable situation of low income and low profitability. In such situations, the importance of additional sources of income in the household becomes crucial (e.g. family income outside of fishing and government aid). The results of the assessment of livelihood strategies (in this section) corroborates this finding by demonstrating, among other things, the low percentage of fishers who declared that they rely exclusively on fishing as their main source of income. It also shows the high importance of the unemployment benefit scheme.

Income and productivity

If one considers the range of economic performances calculated in the previous section as representative of the performance of fishers in the estuary of Patos Lagoon, it is then possible to estimate the net profit of fishers in each locality using the total earnings calculated based on declared catches and first sale prices. To express uncertainties on the actual net profit of fishers, results are presented for two extreme scenarios: a worst-case scenario that combines the lowest economic performance (21.6 percent) and the lowest prices at first sale; and a best-case scenario

that combines the best economic performance (67.3 percent) and the highest prices received at first sale.

Figure 91 shows the cumulative distribution of fishers according to the estimated net profit during a good fishing season. Graphs on the left side are the net profit estimated using the lowest prices at first sale and the lowest economic performance. Graphs on the right side use the highest prices and the best economic performance. The upper row lists the localities of Rio Grande, the middle row São José do Norte, and lower row Pelotas, São Lourenço do Sul, Tapes and Tavares. Only localities with more than ten respondents are represented. The vertical line represents the annual income based on the national minimum wage (R\$510/month, 2010).

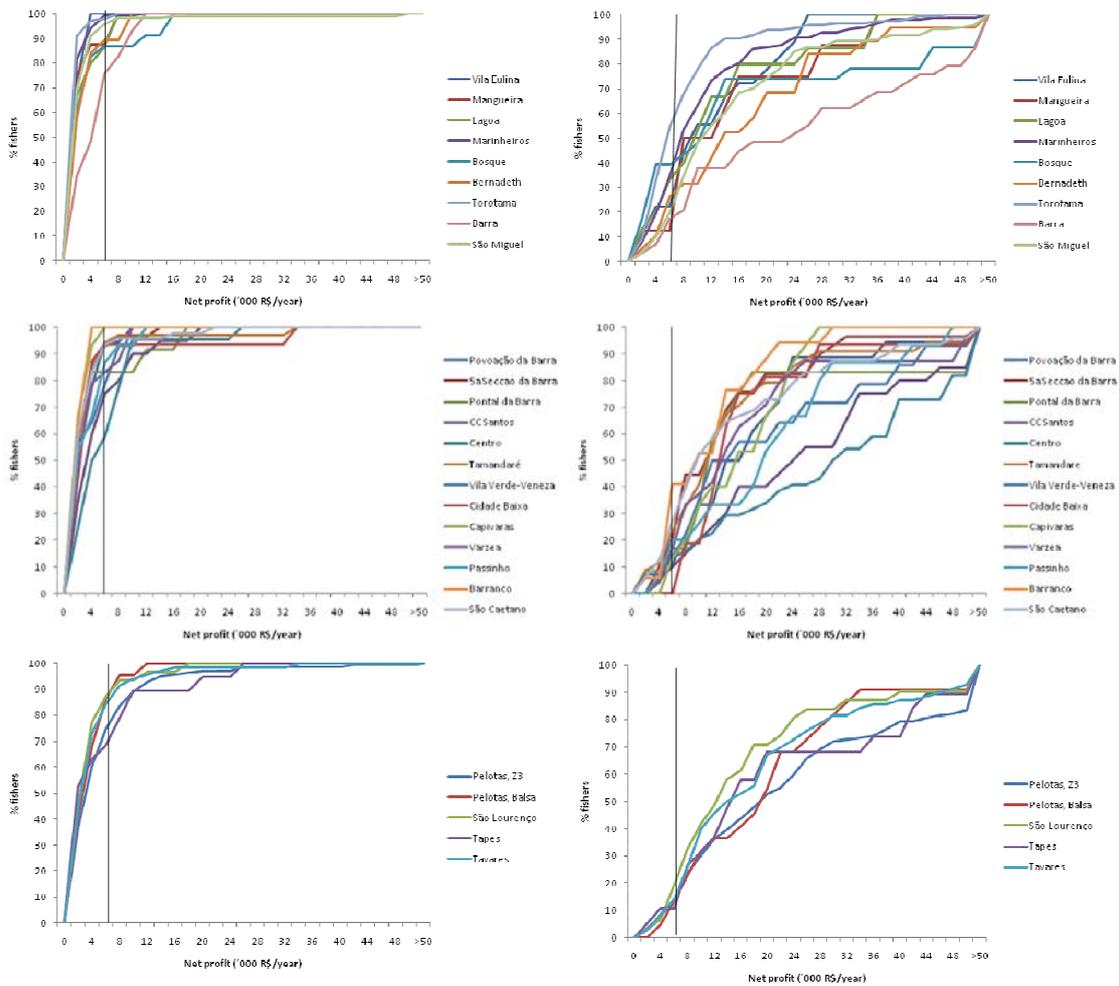


Figure 91: Cumulative distribution of fishers according to the estimated net profit during bad and good fishing seasons

In the municipality of Rio Grande, the average net profit varies from R\$1 975/year (worst case) to R\$13 735/year (best case). Under a best-case scenario, the percentage of fishers in the main fishing villages earning a net profit below the minimum national wage (R\$510 per month or

R\$6 120 per year)⁶ varies between 12.5 percent and 54.7 percent. Between 75 percent and 100 percent of fishers would fall in this net profit level in a worst-case scenario. The localities with the highest individual profits are Barra, Bernadeth and Bosque and the ones with lowest profit are the rural localities of Marinheiros and Torotama.

In the municipality of São José do Norte, the average net profit varies from R\$3 084 per year (worst case) to R\$19 104/year (best case). Under a best-case scenario, between 0 percent and 41.7 percent of fishers in the main fishing villages would have a net profit below the minimum national wage. Between 59 percent and 100 percent of fishers would fall in the net profit level in a worst-case scenario. The localities of Centro and Comendador Carlos Santos figure among the ones with the highest individual profits, while fishers of the locality of Barranco (in the rural area) have the lowest net profit levels.

Two localities were analysed in the municipality of Pelotas: Z3 and Balsa. The average net profit in the locality of Z3 varies from R\$4 956 (worst case) to R\$28 854 per year (best case). In the locality of Balsa, the average net profit varies from R\$3 685 per year (worst case) to R\$23 115 per year (best case). The percentage of fishers earning up to one minimum national wage varies from 13.6 percent to 74.5 percent in Z3, and from 13.6 percent to 86.4 percent in Balsa.

Results for the remaining localities are presented for the municipalities as a whole given the low number of respondents per locality. The municipalities of Camaquã, Arambaré and Mostardas were not included for the same reason. The average net profit of fishers varies from R\$3 122 per year to R\$19 244 per year in São Lourenço do Sul, from R\$5 055 per year to R\$26 788 per year in Tapes, and from R\$3 580 per year to R\$20 525 per year in Tavares. The percentage of fishers earning up to one minimum wage varies from 19.3 percent and 87.1 percent in São Lourenço do Sul, from 10.5 percent and 68.4 percent in Tapes, and from 14.3 percent and 84.3 percent in Tavares.

Much of the regional variation in income can be explained by differences in fishers' productivity (Figures 92 and 93). For instance, Figure 93 shows that the total productivity of fishers in the locality of Barra, the one with the highest estimated income in Rio Grande, is on average five times higher than that of the fishers from Torotama, the one with the lowest estimated income. Similarly, the average productivity of fishers from Barranco, in São José do Norte, is nearly two times lower than that of fishers from Centro, the two localities being at the opposite extremes of the income distribution in the municipality. Price plays a secondary role in the estimated income owing to the relatively small variation in price at first sale for the dominant forms of commercialization across the estuary, as demonstrated for shrimp and mullet in the section on commercialization. One evident outlier in the relationship between productivity and income is the municipality of Tavares (Figure 92), where prices at first sale are consistently higher than of the other localities in the estuary.

Productivity is, in turn, a complex issue related to the level of capitalization of fishing units, fishing effort, target species, fishing strategies (including variations in technologies, practices, areas and periods), and variations in productivity of fishing grounds. Taking, for instance, two localities – Torotama (average productivity of 3 119 kg/fisher per year) and Z3 (15 171 kg/fisher per year) – with extreme opposite levels of productivity: fishers in Torotama rely

⁶ Although the national minimum wage is meant to guarantee a minimum standard of living to an average family, in reality it has been well below the needed minimum earnings to attend to the basic needs of food, housing, education, health, leisure, clothing, transportation and pension. A study by the Ministry of Labour and Employment reports, for instance, that the minimum wage in 2005 represented on average five times less than the needed salary of a family of four people (www.mte.gov.br; accessed on 3 January 2011).

mostly on shrimp as the main source of cash (see section on shrimp and blue crab fisheries in Chapter 3). Catches of the species represent, on average, 60 percent of the total gross income of individual fishers. Croaker, mullet and blue crab play secondary roles as sources of income. Motorized boats are, on average, 6.8 m with 11.9 hp. The Torotama fishers use mostly passive gears (fyke and stow nets) in shrimp fisheries and normally fish closer to their homes.

On the other hand, fishers of Z3 have, on average, a more diversified fishing strategy, relying on shrimp and mullet as the main sources of cash income, with shrimp representing, on average, 46 percent and mullet 30 percent of fishers' gross incomes. Croaker is the third species in importance, accounting, on average, for 15 percent of the income. Motorized boats are larger (average 8.1 m) and more powerful (average engine 24.9 hp) than those of Torotama, and some carry echosounders on board that are used in croaker and mullet fishing. The higher fishing capacity of boats is correlated with the more frequent use of active gear, such as otter trawling for shrimp and surrounding gillnets for mullet. The strategy of diversifying the target resources and increasing fishing capacity gives an advantage in terms of productivity of fishers of Z3 compared with fishers of Torotama.

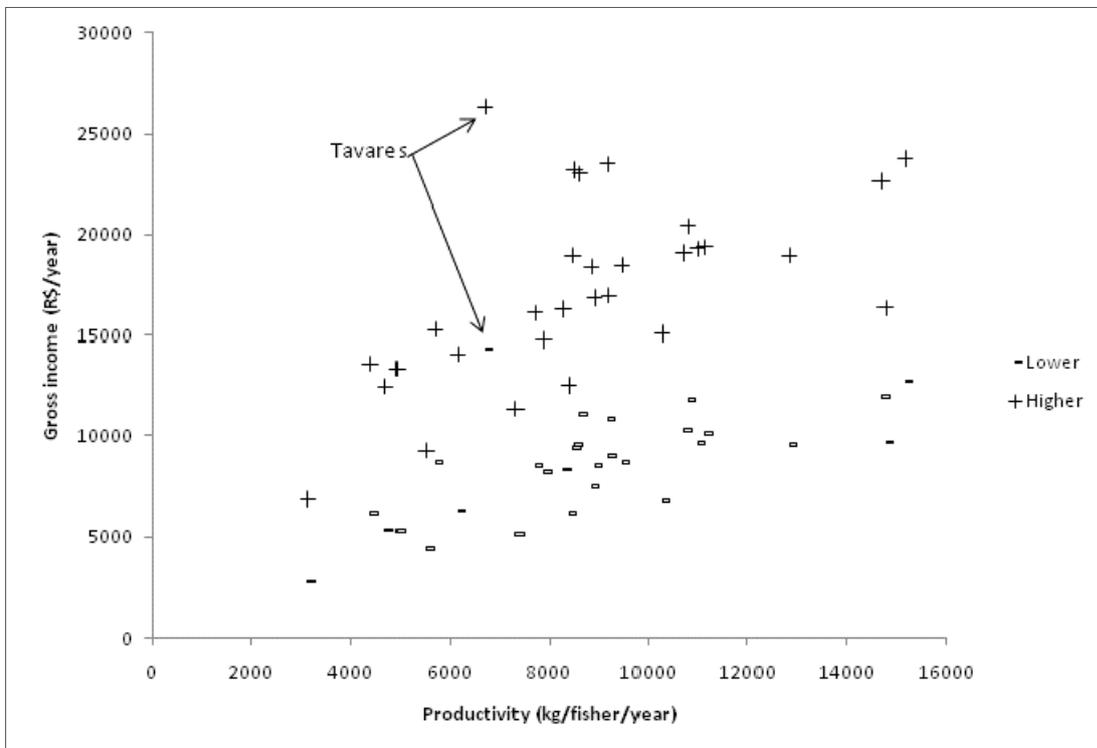


Figure 92: Relationship between average productivity and gross income from fishing calculated based on catches and prices at first sale. The lower and higher gross incomes refer to incomes, calculated using the lowest and highest prices at the first sale.

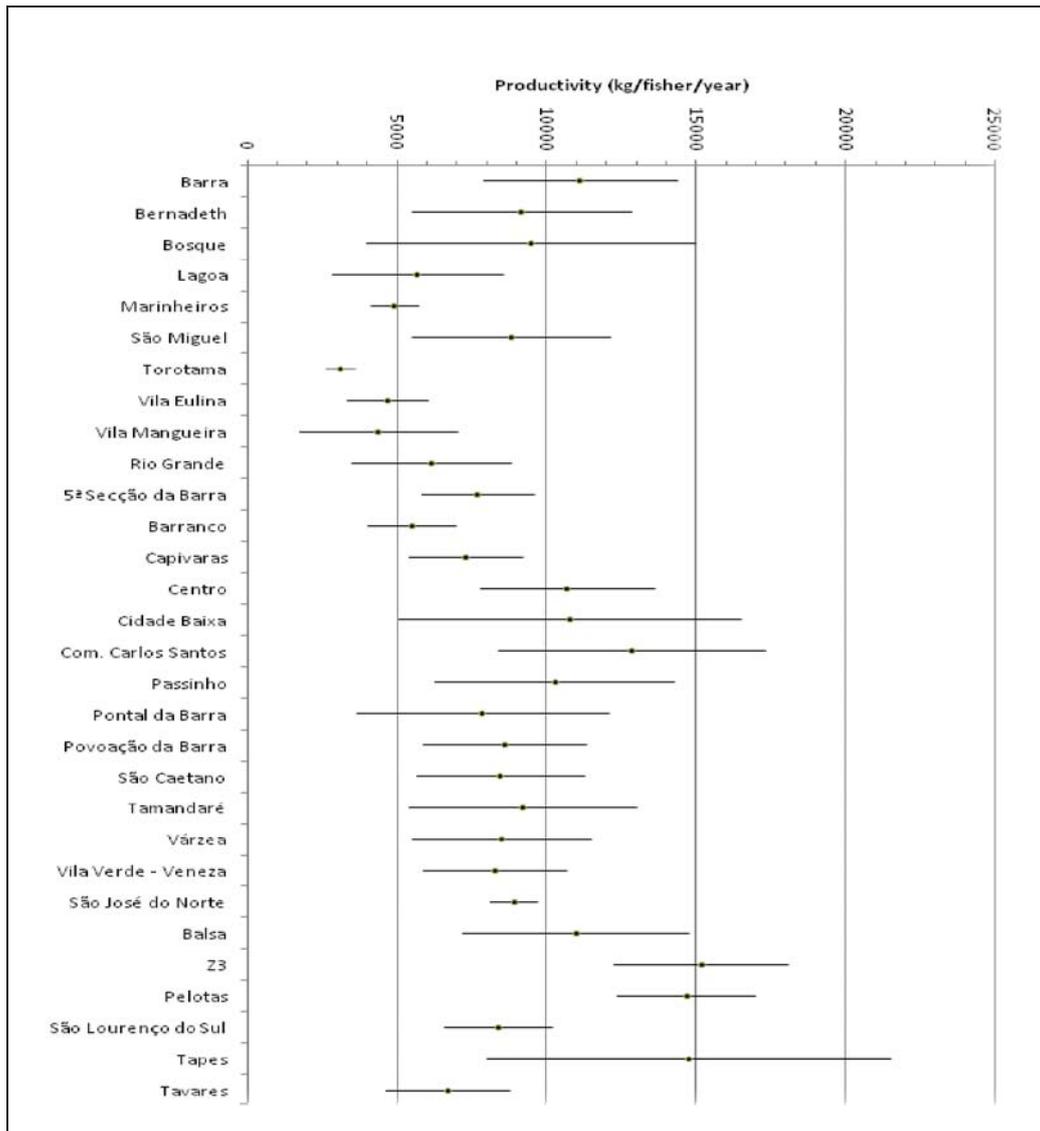


Figure 93: Productivity (kg/fisher/year) of fishers during a good fishing season in the main localities and municipalities in the Patos Lagoon estuary. Lines link the minimum and maximum values and dots are the average productivity.

The above results indicate that a considerable contingent of estuary fishers in Patos Lagoon have an income level from fishing below the minimum national wage. It should be noted that the values calculated in this study refer to the expected income during good fishing seasons and therefore represent an optimistic income scenario. As demonstrated in the previous section, during bad fishing seasons net profits from fishing can become negative and households become more dependent on income from non-fishery-related activities and government aid.

These findings corroborate previous localized studies in the region. Garcez and Sanchez-Botero (2005) estimated that the average monthly income of artisanal fishers in the State of Rio Grande do Sul reaches a maximum of four times the minimum wage, with 37 percent of fishers receiving up to one minimum wage. In the municipality of Pelotas, Itepa (2002, *apud* Dias Neto and Vasconcellos, 2006) estimated that 40 percent of fishers received up to one minimum wage, 29 percent between one and two wages, 11.6 percent between two and three wages, 19 percent between three and five wages, and 1.3 percent more than ten wages. In the municipality of São Lourenço do Sul, Pasquotto and Miguel (2005) estimated that the annual average income from fisheries varied between R\$1 507 and R\$6 646, or between one-half and two minimum wages (2004 values). Among the fishers with the lowest income are those that do not have the

wages (2004 values). Among the fishers with the lowest income are those that do not have the means of production (boats and nets) and work as crew members in fishing units of other fishers or boat owners (Pasquoto and Miguel, 2005).

There are common strategies adopted by fishers to deal with the low levels of income from fishing, including remunerated work in non-extractive activities (e.g. gear maintenance) and non-fishery-related activities, such as agriculture in rural areas and occasional jobs around urban areas. The percentage of households dependent on alternative sources of income is more or less constant in each municipality and independent of the level of income. Figure 94 presents data only for the four municipalities with the highest number of fishers. Accordingly, the percentage of households depending exclusively on fishing as their source of income varies from 58 percent to 69 percent in Pelotas, from 57 percent to 64 percent in Rio Grande, from 54 percent to 64 percent in São José do Norte, and from 76 percent to 88 percent in São Lourenço do Sul.

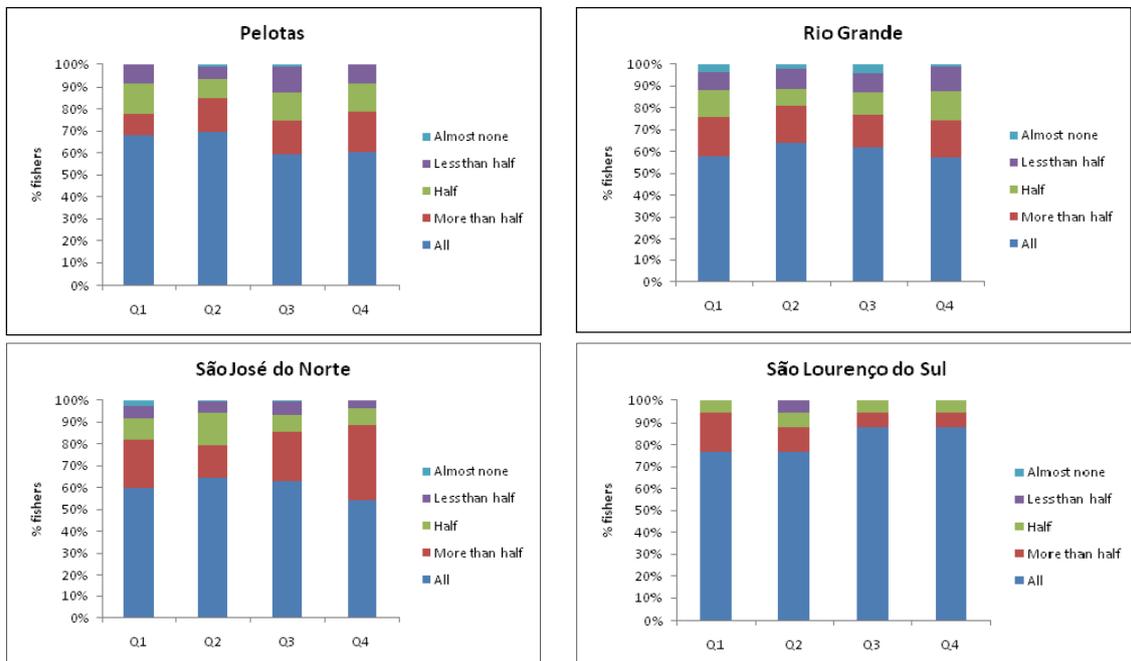


Figure 94: Relationship between level of income from fishing (Q1: lowest income quartile; Q4: highest income quartile) and household dependence on fisheries as source of income. All: all income from the household comes from fisheries; Almost none: income from fisheries has an insignificant contribution to the household income. Data shown only for the municipalities with highest concentration of fishers.

Government aid, especially in the form of the unemployment benefit, figures high among the income options for fishers across the region, as shown in previous sections. The relevance of this type of government aid can be easily demonstrated if one compares the estimated earnings from fishing against the value of the unemployment benefit. Assuming that, on average, in a household two people (husband and wife) receive the benefit during the four months of fishing closure (in reality the average number of beneficiaries per family is lower than that, as demonstrated below), the total income from government aid would amount to R\$4 088 per year. Taking the average net profit from fishing under a best-case scenario as a basis for comparison, this amount of government aid would represent at least 23 percent of the household income in the communities of Rio Grande, 17 percent in São José do Norte and São Lourenço do Sul, 16 percent in Tavares and 12 percent in Pelotas. Because Tapes is not legally bordering the estuary, the benefit is paid only for the three months of spring closure in the upper lagoon, and, therefore, accounting, on average, to at least 8 percent of the household income. Similar levels

of dependence on government aid were estimated in the assessment of the economic performance of fishing units during good fishing seasons reported in the previous section.

Pasquoto and Miguel (2005) estimated that fisheries account, on average, to 62 percent of the total family income of fishers who own the means of production in the municipality of São Lourenço do Sul. The income from non-fishery-related activities accounts for 10 percent of the family income and from government aid to 28 percent. The authors also demonstrated that the share of the household income coming from these different sources varies according to the level of capitalization of fishers. For instance, in the case of fishers who do not have the means of production and work as crew members (*proeiros*), the income from fisheries, non-fisheries-related activities and government aid represents 54 percent, 40 percent and 6 percent of the household income, respectively. According to Pasquoto and Miguel (2005), the low dependence on government aid is explained by the difficulties of this group of fishers in documenting themselves to be able to apply for the benefit.

Fish consumption

Fish plays an important role in the diet of fishers of the Patos Lagoon estuary, as can be seen in Figure 95, which reports the frequency of fish consumption by fishers from each municipality. On average, fish is consumed at least three days per week, with higher frequencies in Camaquã and slightly lower frequencies in Arambaré. There were minor differences in fish consumption among communities of each municipality. It is estimated that 78 percent of all fishers consume fish between three and seven days a week.

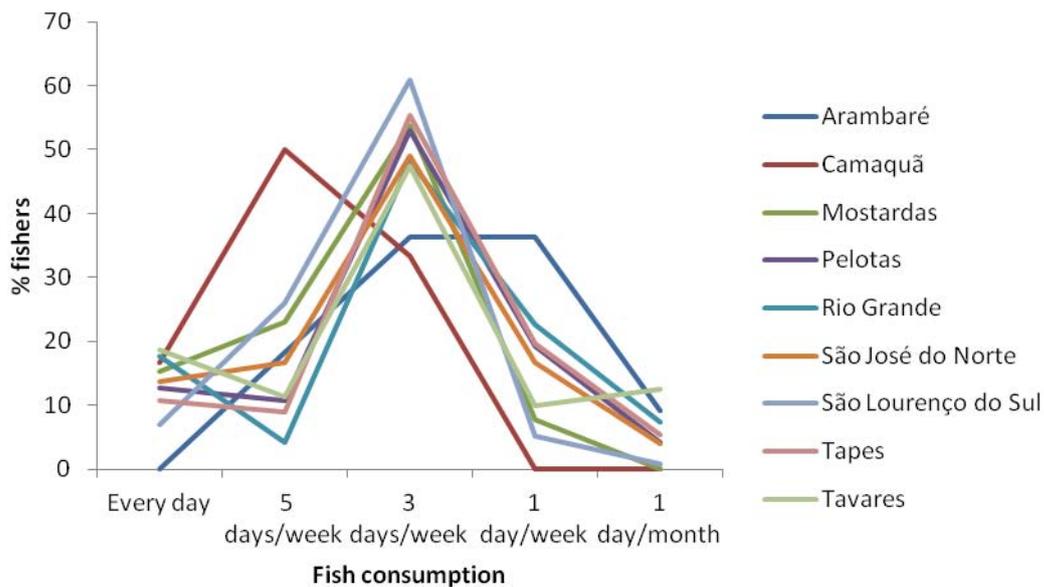


Figure 95: Frequency of fish consumption per fisher by municipality in the Patos Lagoon estuary

Assuming an average daily intake of fish of 366.5 g by an adult (Garcez and Sanchez-Botero, 2005), it is estimated that the average fish consumption per capita in fishing communities of the estuary is about 52.8 kg/person per year. This value is well above the national average consumption of 9 kg/person per year, and in the same order of magnitude of fish consumption of the Amazon region (where it varies from 194 g/person per day to 500 g/person per day (Freitas and Batista, 1999), or from 61 kg/person per year to 182 kg/person per year), one of the highest in the country.

Socio-economic aspects and indicators

Artisanal fishing communities are found in both rural and urban areas of the Patos Lagoon estuary. Although the degree of urbanization of communities is thought to have increased since the 1970s, following the widespread phenomenon of rural-urban emigration in Brazil, the presence of communities in rural areas is still significant in the region. The percentage of fishers living in rural areas in the municipalities of Pelotas, Rio Grande and São José do Norte (the most important areas of concentration of fishers in the estuary) are 78 percent, 50 percent and 39 percent, respectively.

Fish capture activities are mostly developed by men. As shown in Table 15, 85.5 percent of the total number of fishers are men. The participation of women is more important in fish processing activities, where they represent approximately half of the total workforce. Women process fish for the household and also for local industries. Fish processing can also involve women that are not artisanal fishers. Costa (2004), for instance, estimated that a good shrimp season could employ up to 2 000 women in the processing of catches for the industry of Rio Grande.

There is little variation in this situation in communities throughout the estuary. In different regions of Brazil, mainly in the northeast and the north, women have traditionally participated in fishing activities by harvesting shellfish (*marisqueiras*) or by fishing along the seashore (*pescadeiras*). Women have also been the main labour force in the processing of fish in artisanal and industrial fisheries. Until the 1988 Constitution, women were not legally permitted to work in fisheries, which were considered a male activity (Vasconcellos, Diegues and Kalikoski, 2011). It was only in 1988 that a Presidential act abolished the prohibition on female labour in fisheries. In spite of the legislation controlling their role, women rarely participate in offshore fishing (Vasconcellos, Diegues and Kalikoski, 2011).

Table 15: Gender participation in fishery-related activities in the Patos Lagoon estuary

Description	Men (%)	Women (%)
Fish capture	85.5	14.5
Commercialization	87.4	12.6
Processing	51.8	48.2
Gear maintenance	76.9	23.1
Other	70.5	29.5

The distribution of fishers by age groups (Table 16) points to the poor recruitment of young people to artisanal fisheries, a phenomenon also demonstrated for other regions of Brazil (Vasconcellos, Diegues and Sales, 2007). In the Patos Lagoon estuary, 12.8 percent of fishers are less than 30 years old and 32.4 percent are more than 50 years old. Data for Brazil in the year 2002 indicated that 13.1 percent of fishers were less than 30 years old and 27.1 percent more than 50 years old. This phenomenon, found in both rural and urban communities, can be explained, among other things, by the poor prospects of making a living as an artisanal fisher and the availability of other job opportunities in urban centres in the region. The poor recruitment of individuals represents a threat to the continuity of the activity in the estuary in the medium-long term.

Table 16: Distribution of fishers by age groups in the Patos Lagoon estuary and Brazil

Age (years)	Estuary (%)	Brazil (%)
14–17	0.1	0.2
18–24	4.8	4.3
25–29	7.9	8.6
30–39	21.4	27.9
40–49	33.4	32.1
50–64	29.5	26.5
65 or more	2.9	0.6

Source: Vasconcellos, Diegues and Sales, 2007.

The illiteracy rate is 12.6 percent among men and 6.6 percent among women (Table 17). Only 5.7 percent of men completed elementary school and 3.2 percent high school. Among women, 10.2 percent completed elementary school and 5.9 percent completed high school. Illiteracy is slightly higher in urban communities than rural communities for both men and women. These figures indicate that the educational level of fishers is low, as compared with the illiteracy rates in the State of Rio Grande do Sul (3.1 percent in 2009; IPEA, 2010). However, fishers of the Patos Lagoon estuary have a relatively higher education level than the national average. As demonstrated by Vasconcellos, Diegues and Sales (2007), in Brazil, the illiteracy rate in artisanal fishing communities is 44.6 percent among men and 53.5 percent among women. This difference is nonetheless consistent with the higher educational level of the population in the State of Rio Grande do Sul compared with the national average (9.7 percent in 2009; IPEA, 2010). It must be considered, however, that a large proportion of fishers have incomplete elementary school (75.3 percent of the total) and may be considered functionally illiterate.⁷

⁷ Functional illiteracy is a term used to describe reading, writing and mathematical skills that are inadequate to manage daily living and employment tasks that require skills beyond a basic level. As it is not easy to measure functional illiteracy, Brazil and other Latin American countries have been using as parameter a minimum of four years of study (IPEA, 2010).

Table 17: Gender-based percentages related to education

Urban/rural	Total			Rural			Urban		
	M	W	T	M	W	T	M	W	T
Illiterate	12.6	6.6	10.9	11.8	5.8	10.0	13.4	10.3	12.7
Incomplete elementary school	76.2	73.1	75.3	76.5	69.6	74.3	77.8	74.1	77.0
Complete elementary school	5.7	10.2	6.9	6.3	13.9	8.7	4.6	6.6	5.1
Incomplete high school	1.9	3.6	2.4	1.9	3.5	2.4	1.4	2.9	1.8
Complete high school	3.2	5.9	3.9	3.3	6.9	4.4	2.3	5.8	3.1
Incomplete university degree	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.0	0.2
Complete university degree	–	0.2	0.1	–	–	–	0.1	0.4	0.2

Note: M = men; W = women; T = Total.

In Brazil, fishers' access to infrastructure and to social services is normally precarious in coastal communities as well as in urban zones (Vasconcellos, Diegues and Kalikoski, 2011). Table 18 compares some statistics that characterize the living conditions in communities of the estuary of Patos Lagoon and in certain artisanal fishing communities of selected coastal states. Data for the estuary indicate that 63.9 percent of the households have access to potable water, with access per municipality varying from 0 percent in Camaquã to 76.6 percent in Rio Grande. A total of 82.2 percent of the households have some type of treatment of domestic sewage (varying from 70.5 percent in Pelotas to 100 percent in Arambaré), and 85.4 percent are served with regular collection of domestic waste (varying from 7.1 percent in Camaquã to 100 percent in Arambaré and Tapes). With few exceptions, the access of households to these basic infrastructures and services are reasonably good compared with other areas in Brazil. The poor access to potable water in communities of São José do Norte and Tavares is probably the most important issue at this moment, considering that both municipalities concentrate a substantial number of fishers' households.

Table 18: Percentage of households with access to basic services in the municipalities in the Patos Lagoon estuary and in fishing communities in selected areas of coastal states

Locality	Access to treated water	Sewage system	Regular collection of domestic waste
Ceará	7.0	7.0	24.0
Maranhão	< 5.0	7.0	0.5
Rio de Janeiro	62.0	3.0	No data
Santa Catarina	52.0	3.5	No data
São Paulo	71.0	<5.0	No data
Estuary Patos Lagoon			
Total	63.9	82.2	85.4
Pelotas	57.8	70.5	92.8
Rio Grande	76.6	81.8	95.9
São José do Norte	25.4	84.7	71.2
São Lourenço do Sul	73.6	94.8	94.8
Camaquã	0.0	71.4	7.1
Arambaré	65.0	100.0	100.0
Tapes	58.7	92.9	100.0
Tavares	7.5	93.7	83.5
Mostardas	11.1	78.6	78.6

Source: Diegues, 1999.

Table 19 shows the fishers' households access to public health services, primary schools and public transport. Access to health services is more precarious in localities of Camaquã, São José do Norte and Tavares. With the exception of São José do Norte and Tavares, where access to these services is generally poorer, the other localities are relatively well served by public services.

Table 19: Percentage of households in localities with access to health services (units), public schools and public transportation

Locality	Health services	Public school	Public transportation
Rio Grande	91.8	96.4	96.5
São José do Norte	40.3	74.3	65.4
Pelotas	93.4	93.9	94.6
São Lourenço do Sul	96.1	97.7	100.0
Camaquã	7.1	92.9	85.7
Arambaré	100.0	100.0	61.5
Tapes	94.6	94.6	41.1
Tavares	43.0	73.4	69.6
Mostardas	85.7	85.7	78.6
Total	71.5	87.1	82.7

Access to credit (formal and informal), subsidies and government aid

Among the governmental policies of credit to fisheries, two directly benefited the artisanal fisheries sector in the estuary of Patos Lagoon: the “National Program to Strengthen Family-based Agriculture” (PRONAF) of the federal government and the “RS State Programme for Strengthening Family-based Agriculture” (RS Rural) of the government of Rio Grande do Sul State.

The PRONAF was created in 1996 with the main goal of strengthening family-based farming through the provision of credit to increase food production and income generation. Artisanal fishers became beneficiaries of PRONAF in 1997 with the promulgation of resolution BANCEN No. 2409. The programme finances individual and collective projects, and has the lowest interest rates among the governmental programmes of rural credit (varying from 0.5 percent/year for individual credits of up to R\$4 000; 1.1 percent/year for credits of up to R\$10 000; to 4 percent/year for credits of up to R\$50 000). Credit for maintenance and investment is provided under two main lines of credit⁸: one for individuals who have an annual gross income between R\$6 000 and R\$110 000, and one line of microcredit for individuals who have a total annual gross income of less than R\$6 000 (*Pronafinho*).

More recently, a special line of credit (“PRONAF Mais Alimentos”) destined to increase food production has raised the level of individual credit to R\$130 000 at an annual interest rate of 2 percent. Among the items financed by the “PRONAF Mais Alimentos” are the acquisition of fishing gear, infrastructure for maintenance of equipment, modernization, reform and substitution of fishing boats.

Of the total credit accessed between 1997 and 1999, the artisanal fisheries sector received less than 0.5 percent, with the remaining invested mainly in the agriculture sector (Souza, 2001). Close to 1 000 fishers from the municipalities of the Patos Lagoon estuary accessed credits of PRONAF from 1998 to 2001 (Haimovici *et al.*, 2006). In the 2010/2011 fishing season, only

⁸ Ministério do Desenvolvimento Agrário – Ministry of Agrarian Development (<http://portal.mda.gov.br/portal/saf/programas/pronaf/>; accessed on 5 January 2011).

163 fishers accessed the programme (Banco Central do Brasil⁹ – Central Bank of Brazil). The drop in the number of contracts reflects the fact that, despite the facilitated conditions for borrowing money and the low interest rates of PRONAF, the level of default is substantial among artisanal fishers of the estuary (Table 20). In total, 697 fishers, or 20.9 percent of the total number of fishers interviewed, declared having accessed credit of PRONAF in the past. Of those, 457 (or 66 percent of the total) are indebted, and 94 (or 13.4 percent) are in default. Approximately the same number of fishers accessed the line of microcredit of PRONAF (*Pronafinho*), but in this case the debt situation is slightly better (Table 21). Of the 702 fishers who accessed the programme, 375 (or 53 percent of the total) are indebted. Nonetheless, 95 (or 13.5 percent) of the total are also in default.

Table 20: Number of fishers who accessed credit of PRONAF and actual debt situation

Municipality	Access to PRONAF	Still paying	Paid	Default
Arambaré	5 (27.8%)	3	1	1
Camaquã	0 (0.0%)	–	–	–
Mostardas	3 (17.6%)	2	1	–
Pelotas	184 (29.3%)	89	78	17
Rio Grande	234 (20.4%)	139	54	41
São José do Norte	197 (16.9%)	83	94	20
São Lourenço do Sul	35 (23.2%)	16	8	11
Tapes	35 (44.9%)	29	3	3
Tavares	4 (3.6%)	2	1	1
Total	697 (20.9%)	363	240	94

Note: In brackets, the number that accessed PRONAF is expressed as a percentage of the total number of fishers in the municipality.

Table 21: Number of fishers who accessed microcredit of PRONAF (*Pronafinho*) and actual debt situation

Municipality	Accessed <i>Pronafinho</i>	Still paying	Paid	Default
Arambaré	4 (22.2%)	2	1	1
Camaquã	1 (8.3%)	–	1	–
Mostardas	0 (0.0%)	–	–	–
Pelotas	86 (13.7%)	27	46	13
Rio Grande	314 (27.4%)	171	87	56
São José do Norte	273 (23.4%)	72	180	21
São Lourenço do Sul	16 (10.6%)	3	9	4
Tapes	2 (2.6%)	2	–	–
Tavares	6 (5.4%)	3	3	–
Total	702 (21.1%)	280	327	95

Note: In brackets, the number that accessed the *Pronafinho* is expressed as a percentage of the total number of fishers in the municipality.

⁹ See www.bcb.gov.br; accessed on 15 September 2011.

The State of Rio Grande do Sul began a line of credit to fisheries in the period 1991–94 using resources from the State Fund to Support the Development of Small Rural Enterprises – *Fundo Estadual de Apoio ao Desenvolvimento de Pequenos Estabelecimentos Rurais* (FEAPER). Investments in this period reached very few fishers and led to a situation of debt among fishers that persisted for many years (Dias Neto and Vasconcellos, 2006). In 2001, with resources borrowed from the World Bank, the state government implemented the programme RS Rural. The main objectives of RS Rural were to improve the quality of living and strengthen the productive capacity of the rural population of the State of Rio Grande do Sul. Its ultimate goal was to combat poverty, environmental degradation and the migration of people from rural areas. The programme financed rural infrastructure, actions for income generation, natural resources management, and conservation and institutional strengthening. To be eligible to receive credit from the programme, fishers needed to present group proposals of at least five families and provide proof that fisheries was their main livelihood, that they were actively fishing during the last three years, and that none possessed boats with more than 10 gross registered tonnage (at that time that was the threshold level of capacity to consider a boat artisanal or industrial). Funds were used mainly in the acquisition of equipment for improving the infrastructure of fish conservation and marketing such as ice factories, fishing gear, boats and engines (Pasquoto, 2007). The total amount invested in artisanal fisheries of the Patos Lagoon estuary in 2002 was about R\$1 540 000 (Secretaria de Agricultura do RS, *apud* Vasconcellos *et al.*, 2005). According to Pasquoto (2007), the total amount invested in artisanal fisheries in the State of Rio Grande do Sul in 2004 was R\$4 581 000. The programme RS Rural ended in 2005 and since then credit support from the state has been insignificant. Table 22 shows that a total of 343 fishers declared having accessed credit from RS Rural, representing 10.3 percent of the total number of fishers in the region. Of this total, 244 (or 71 percent) are still in debt and 84 (or 24 percent) are in default.

Table 22: Number of fishers who accessed credit of RS Rural and their current debt situation

Municipality	Accessed RS Rural	Still paying	Paid	Default
Arambaré	0 (0.0%)	–	–	–
Camaquã	2 (16.7%)	1	1	0
Mostardas	1 (5.9%)	0	1	0
Pelotas	59 (9.4%)	23	27	9
Rio Grande	175 (15.2%)	89	39	47
Sao José do Norte	89 (7.6%)	40	24	25
São Lourenço do Sul	10 (6.6%)	3	4	3
Tapes	4 (5.1%)	2	2	0
Tavares	3 (2.7%)	2	1	0
Total	343 (10.3)	160	99	84

Note: In brackets, the number that accessed the RS Rural is expressed as a percentage of the total number of fishers in the municipality.

It can be concluded from this analysis that the national and state programmes of rural credit to family-based agriculture have created conditions for access to financial resources otherwise inaccessible to artisanal fishers because of the low income of families and the lack of means to access bank loans. In fact, only 117 of the fishers interviewed (or 3.5 percent of the total) declared having accessed bank loans. About 67 percent of them are either in debt or in default.¹⁰

¹⁰ With the recent enactment of the State of Rio Grande do Sul Decree 13.695 of January 2011, the debts with the programme RS Rural were pardoned.

Until the 1990s, the governmental policies for fisheries development had as their main goal to increase industrial fisheries production, with very little attention given to the artisanal fisheries sector. The policies of fiscal incentives and rural credit applied between the 1960s and 1980s led to an uncontrolled increase in industrial fishing capacity that culminated with the overexploitation of some of the main national marine stocks (Abdallah and Sumaila, 2007). Artisanal fishers, who were marginalized from these governmental development policies, started to become the target of public policies during the 1990s at the federal and state level with programmes such as PRONAF, FEAPER and RS Rural. The effect of such programmes on the sustainability of artisanal fisheries is a matter of debate. One view is that by making available to artisanal fishers resources to improve the means of production, these programmes worsened the problem of excess fishing capacity in the region. An opposite view is that by facilitating access to credit to fishers who have been historically marginalized from public policies, these programmes can positively address inequalities in the access and use of fisheries resources and improve the infrastructure for fish conservation, processing and commercialization. This, in turn, creates the conditions for improving income without putting more pressure on resources. While evidence of the first effect (providing means of production to fishers) has been observed in communities of the estuary (Figure 96 shows, for instance, the use of credit for the acquisition of motorized boats), the effect of the credit policies on infrastructure has been minor if not insignificant. Most of the resources accessed from PRONAF were used for buying boats and fishing gear (Haimovici *et al.*, 2006; Dias Neto and Vasconcellos, 2006). Pasquoto and Miguel (2005) showed, for instance, that in São Lourenço do Sul the access to the credit policies led to a multiplication of small fishing units constituted of former crew members who accessed resources of PRONAF to buy small boats and engines. Although some have obtained good return on the investment, it is clear from the number of credit defaults that the investment in means of production is not paying off because of the low fishing yields.

Figure 96 shows the percentage of fishers relying on different sources of cash to buy motorized boats. Formal credit includes governmental credit policies such as PRONAF and RS Rural and bank loans. Informal credit refers to the borrowing of money from other people, including intermediaries. Other includes donations and inheritance from family

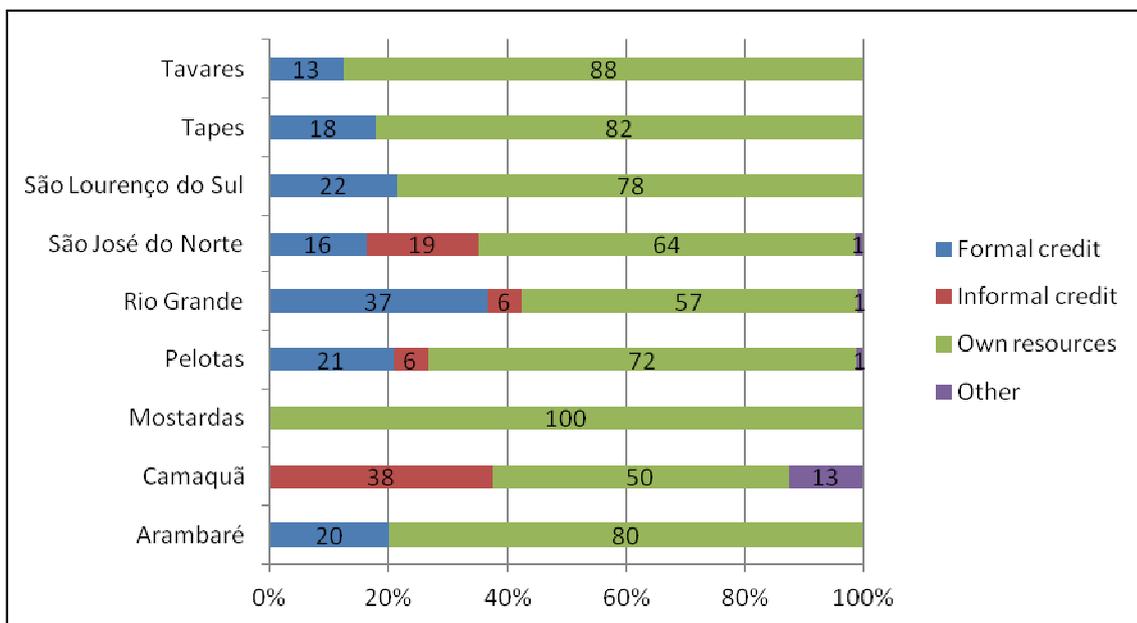


Figure 96: Percentage of fishers relying on different sources of cash to buy motorized boats

Different actions have been proposed to make the credit policies more congruent with the sustainability of fisheries in the region, such as improving the dissemination of information on credit options for aspects of commercialization and organization of associations and cooperatives, forbidding the investment in fishing gear to fish species that are currently overexploited, and creating lines of credit specific to fish commercialization and alternative livelihoods such as family-based aquaculture (Dias Neto and Vasconcellos, 2006). Another demand in the region is for a line of credit that could be accessed in situations of emergency and used to substitute damaged gear, boats and engines during the fishing season. As no such form of credit presently exists, fishers are often forced to borrow money from intermediaries when such emergency repairs are needed during the season. According to fishers, this is one of the main mechanisms that make them more dependent on intermediaries for commercialization.

The importance of intermediaries as a source of informal credit can be seen in two aspects, analysed in Figures 97 and 98. The reliance on intermediaries for credit to repair gear, boats and engines during the fishing season appeared as an option for fishers in eight of the nine municipalities covered in the study, being particularly high in the communities of São José do Norte, where 47 percent of fishers declared relying on intermediaries during these emergency situations. Borrowing money from other fishers and family members is a more important option in Arambaré and São Lourenço do Sul, where this type of informal credit is employed by about one-third of the fishers interviewed. Also noticeable is the small percentage of fishers who rely on formal credit to this end (less than 2 percent overall).

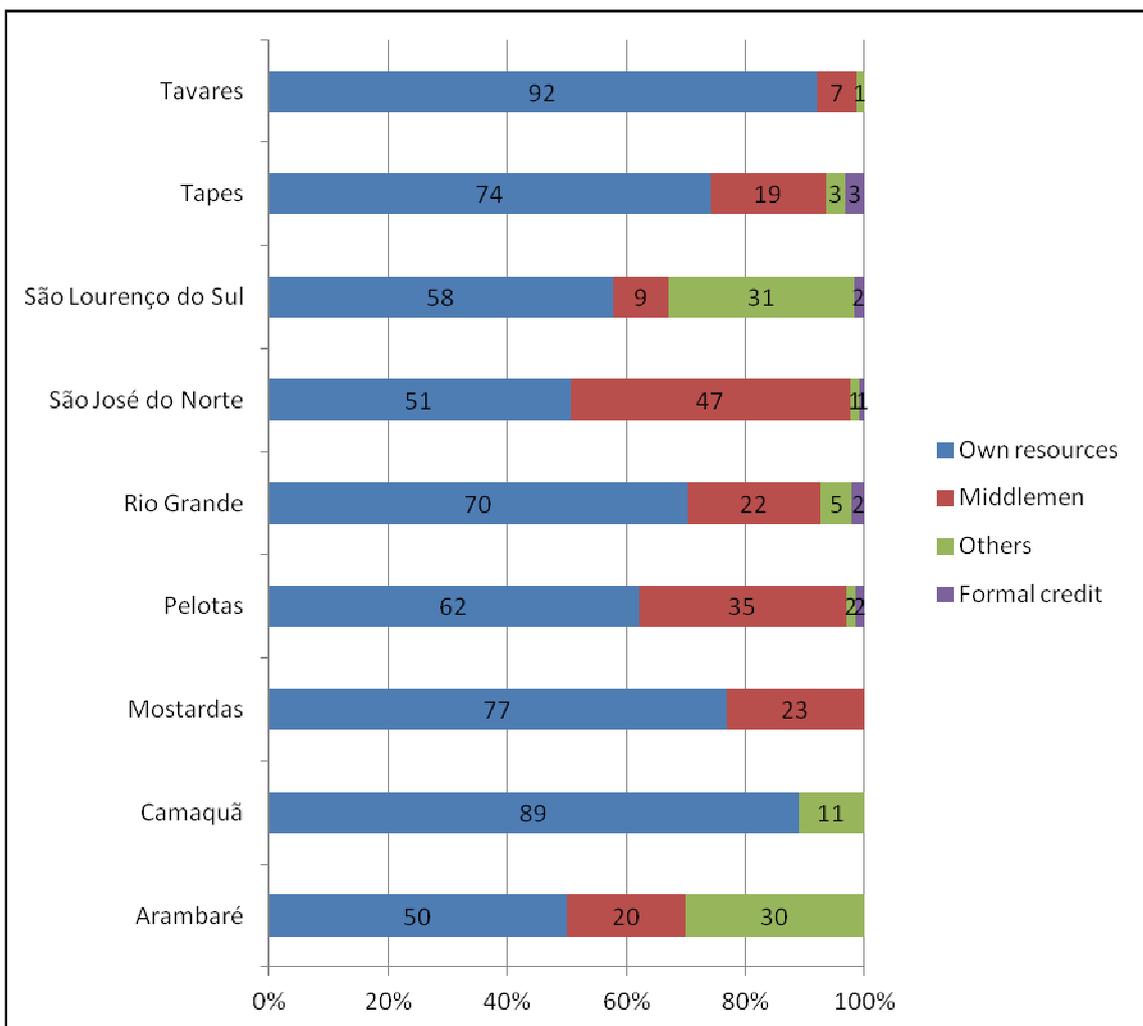


Figure 97: Percentage of fishers relying on different sources of cash to repair gear, boats and engines during the fishing season

The other aspect analysed was the source of the cash employed by fishers before the beginning of the fishing season to prepare boats and gear to fish (Figure 98). Borrowing money from intermediaries is a common strategy in seven out of nine municipalities. The percentage of fishers who declared relying on intermediaries for cash during the pre-season in these seven municipalities varied from 25 percent to 63 percent. Borrowing from other fishers and family members is less frequently adopted and accessing formal credit is only an option for 1 percent of fishers in some of the municipalities.

The picture arising from the above analysis is that formal and informal credit options have complementary roles in the financing of fisheries activities. While formal credit has been instrumental in the acquisition of means of production (such as motorized boats), it is the informal credit that provides the cash flow needed to run the fishing units. Further analysis of the data showed that there is no relationship between the reliance on informal credit and the income level of fishers.

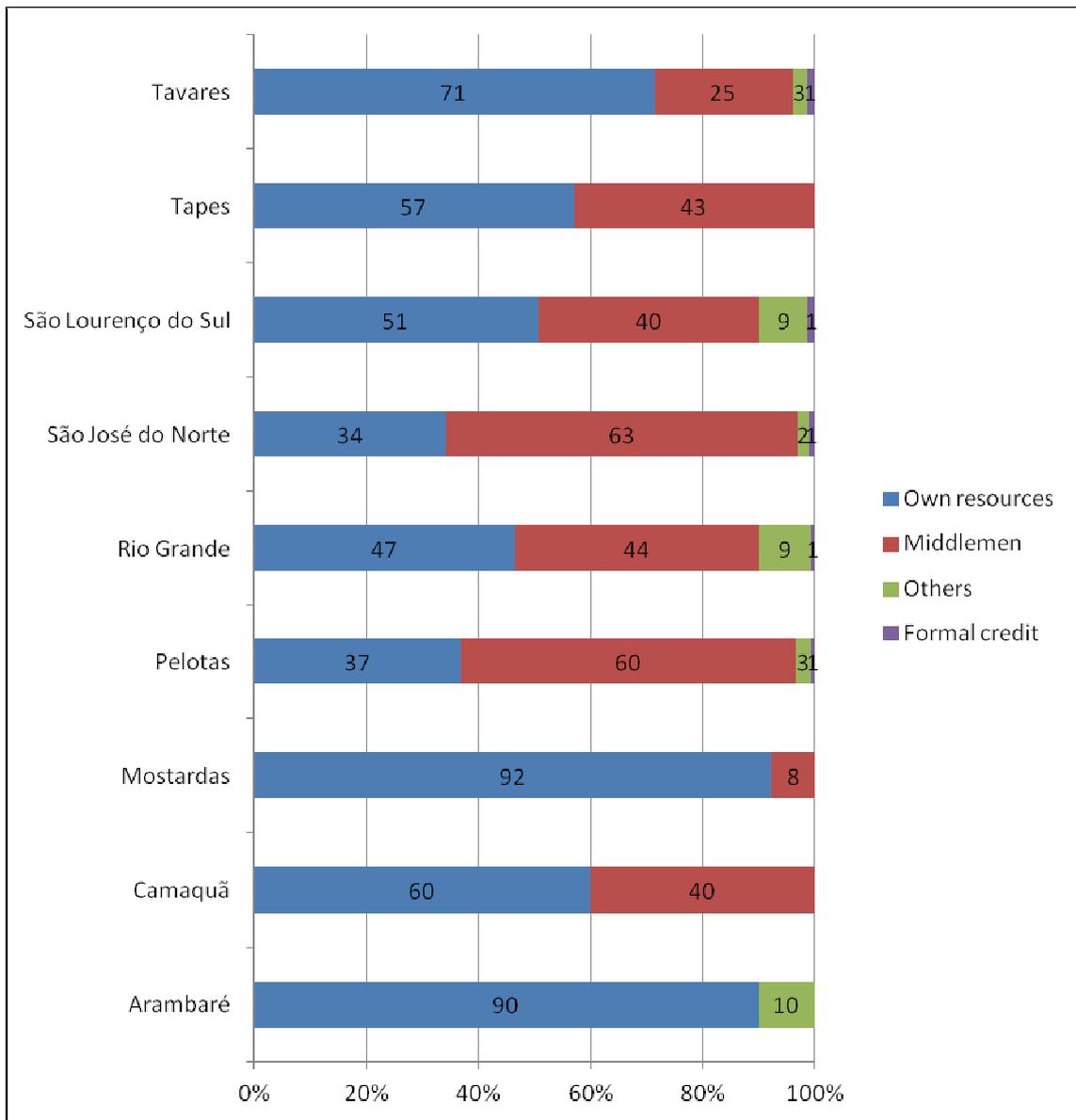


Figure 98: Percentage of fishers relying on different sources of cash to prepare fishing gear and boats before the beginning of the fishing season

Fuel subsidies

A subsidy policy that was frequently adopted by the federal government to reduce costs and increase profitability of fishing units was the subvention of fuel prices. Souza (2001) described three periods in which this policy was employed. From 1967 to 1986, in parallel to the policy of fiscal incentives, fuel subsidies were applied to industrial fleets targeting resources for export, reducing the price of diesel by 30 percent. In 1996, a policy of subvention of the diesel price was applied nationwide to all industrial fishing fleets. Finally, from 1997, the federal government established a national policy of equalization of the fuel price (*Programa de Equalização Econômica do Oleo Diesel*; Law No. 9.445 of 1997) applied to states that agreed to reduce taxes on fuel. One of the main objectives of these policies was to reduce costs of fishing to make the national fishery products more competitive in international markets. Although the artisanal fisheries sector could also benefit from fuel subsidies, the practical implementation of this policy in the region has been hampered by bureaucratic bottlenecks created by the legislation.

Government aid

Two forms of government aid are analysed: the conditional cash transfer programme *Bolsa Família* and the unemployment insurance (or benefit).

The *Bolsa Família* (family grant) is the most important conditional cash transfer programme of Brazil (Soares and Silva, 2010), created in 2003 through the merger of four programmes: the *Bolsa Escola* (school grant) from the Ministry of Education; *Bolsa alimentação* (food grant) from the Ministry of Health; the *Auxílio Gás* (gas aid) from the Ministry of Mines and Energy; and the *Cartão Alimentação* (food card) from the Ministry of Food Security. With the merger of these programmes, *Bolsa Família* became the responsibility, and the main flagship, of the newly created Ministry of Social Development and Fight Against Hunger.

The programme objectives are to:

- promote access to the network of public services, especially health, education and social assistance;
- fight hunger and promote food and nutritional security;
- stimulate the sustained emancipation of families who live in poverty or extreme poverty;
- fight poverty; and
- promote intersectoral, complementarity and synergies among policies at different government levels.

Since its implementation, there was a gradual increase in coverage from 5.1 million families in December 2002 to more than 12 million beneficiary families in 2010. The government target was to reach 12.9 million families by December 2010, a target that was established based on estimates of the number of families who were in poverty and vulnerable to poverty owing to fluctuations in income (www.mds.gov.br; accessed on 8 December 2010).

Criteria for eligibility include families with (self-reported) per capita income lower than R\$70 per month (extreme poor) and families with children under 17 years old and whose per capita income is lower than R\$140. For the extreme poor families, there is a benefit of R\$68 per month regardless of the number of children. For families with children under 15 years old and a per capita income lower than R\$140, there is a benefit of R\$22 per child 0–15 years (up to three children), and R\$33 for teenagers 16–17 years (up to a maximum of two teenagers). Thus, the maximum amount a family can receive from *Bolsa Família* is R\$200 (extreme poor with three children 0–15 years of age and two teenagers 16–17 years of age) and the minimum is R\$22 (poor family with just one child younger than 15 years of age).

Bolsa Família conditionalities are related mainly to education and health. A minimum school attendance rate of 85 percent for beneficiary children aged 6–15 and 75 percent for those aged 16–17 is required. Also, immunizations and growth and weight monitoring are necessary for children under the age of seven, and prenatal care and postnatal care for women between 14 and 44 years of age. Conditionality monitoring occurs at the school and health unit levels and the information is transmitted from the municipality to the Ministry of Social Development.

Of the 2 566 families enumerated in the Patos Lagoon estuary, 605 (or 23.6 percent) are currently receiving *Bolsa Família* and 28 (1.1 percent) applied for the benefit but could not receive it (Table 23). The families who benefited the most from the programme are in São José do Norte (245), followed by Rio Grande (194), Pelotas (98), Tavares (29), and São Lourenço do Sul (25). Among these municipalities, Tavares is the one with the highest proportion of families receiving the benefit (about 34 percent of the total). The locality with the highest proportion of beneficiary families is the community of Várzea, in São José do Norte, where 58 percent of the families receive *Bolsa Família*. In Rio Grande, the community of Torotama is the one with highest proportion of beneficiary families (25 percent).

Table 23: *Bolsa Família* beneficiaries in the estuary by locality

Municipality	Number of families	Families receiving <i>Bolsa Família</i>	Families who tried but did not receive	Localities
Arambaré	13	1	–	Santa Rita
Camaquã	11	–	–	–
Mostardas	14	1	–	Vila Norte
Pelotas	458	98	3	Z3 (80), Balsa (8)
Rio Grande	869	194	15	Torotama (53), Marinheiros (38), São Miguel (39), Barra (12), Bosque (11)
São José do Norte	929	245	10	Várzea (31), Tamandaré (24), São Caetano (21), Vila Verde (19), Passinho (16), Centro (17), Com. Carlos Santos (16), 5ª S. Barra (16), Capivaras (14)
São Lourenço do Sul	135	25	–	Navegantes (15), Barrinha (9)
Tapes	56	12	–	Balneário (8), Vila dos Pescadores (3)
Tavares	81	29	–	Capão Comprido (6)
Total	2 566	605	28	–

The other important type of government aid to artisanal fishers is the unemployment benefit. The benefit consists of the payment of a minimal national wage (R\$510) per month for each fisher during the months of a fishing closure established for conservation purposes. The benefit is also commonly known in the region as *seguro-defeso* (fishing closure insurance). The benefit was first implemented nationally in 1991 with Decree No. 8287, which was later replaced by Law No. 10779 of 2003 and rectified by Resolution No. 657 of 2010. The objective of the benefit is to provide security to artisanal fishers who depend on fisheries as the only source of income during closures when fishing is forbidden for resource conservation. Fishers from the Patos Lagoon estuary became eligible to access the benefit only after 1998, when a three-month fishing closure was first established in the estuary (Decree No. 171 of 1998). Later, in 2004, the fishing closure was expanded to four months (Decree MMA/SEAP No. 03/2004), and fishers became eligible to receive four minimal wages per year. Despite current debate on who in a family should receive the benefit, the interpretation applied until 2010 has been that a person in the family who performs any indirect activity in support of the fishing activity (e.g. processing, gear maintenance, cleaning, etc.) is considered part of the family-based economy regime of artisanal fisheries and therefore is eligible to receive the benefit.

The requirements to access the benefit are:

- be registered as a professional artisanal fisher and documented with the RGP issued by the Ministry of Fisheries and Aquaculture;
- be enrolled in the National Institute of Social Security (INSS) in the appropriate category of artisanal fishers (*segurado especial*);
- possess fish sale receipts for the period between fishing closures or proof of contribution to the INSS referent to the commercialization of fish products between fishing closures;
- not receiving continuous pension or benefits from social assistance (with some exceptions); and
- not formally employed or have other sources of income besides fishing.

An additional requirement in the region is the licence to fish in the Patos Lagoon estuary issued by IBAMA.

The unemployment benefit can be cancelled in the following situations:

- existence of a formal job contract or other employment relationship that is not related to fisheries;
- illegal fishing of any kind, including fishing during the fishing closure;
- generation of income from fishing alternative species not included in the norm that established the fishing closure;
- fishing closure is revoked;
- death of the beneficiary, with the exception of past due payments;
- receipt of pension or other continuous social assistance benefit (with some exceptions); and
- proof of fraudulent activity and false declaration.

The number of fishers receiving the benefit increased steadily since its enactment, beginning with 2 686 fishers in 1992, 181 896 fishers in 2005, and reaching 403 351 fishers in 2008, the last year with available data.¹¹ Of the total number of beneficiaries in 2008, 2.9 percent were from Rio Grande do Sul State, representing about 11 697 fishers. In the same period, the total amount paid by the government to cover the benefit increased from US\$511 292.52 in 1992 to US\$83 705 812.74 in 2005 (Abdallah, in preparation).

In this study, it is estimated that a total of 3 149 fishers receive the benefit in the Patos Lagoon estuary, including fishery-dependent family members (Table 24). This represents about 80 percent of the total number of fishery-dependent people enumerated in the municipalities of the estuary. The average number of people receiving per family is 1.4, which reflects the fact that in many families both husband and wife receive the benefit. In some rare cases, up to six family members receive the unemployment benefit.

¹¹ Ministry of Labour and Employment (www.mte.gov.br).

Table 24: Number of fishers and family members receiving the unemployment benefit, number who applied and did not receive, and average number of people receiving the benefit per family

Municipality	Number receiving	Number who applied and did not receive	Number receiving per family
Arambaré	15	0	1.4 (1–3)
Camaquã	7	0	1
Mostardas	14	0	1.3 (1–2)
Rio Grande	1 031	14	1.4 (1–4)
Pelotas	598	13	1.5 (1–4)
São José do Norte	1 144	10	1.4 (1–4)
São Lourenço do Sul	148	0	1.2 (1–4)
Tapes	78	0	1.5 (1–5)
Tavares	114	0	1.5 (1–6)
Total	3 149	36	

Note: In brackets, the minimum and maximum number per family.

The high proportion of fishers receiving the unemployment benefit (about 80 percent of the total number of fishery-dependent people interviewed, Table 24) and the small number of fishers who have not been able to access it yet (36 fishers) are proof of the importance and inclusiveness of the programme. In spite of this, there has been a lot of debate about the exact role of the unemployment benefit, whether it is a form of subsidy to the artisanal fisheries sector, or a compensatory measure that is part of a fisheries management strategy, or even if it is another conditional cash transfer programme directed to a vulnerable sector. One of the weak points of the programme is the lack of control on the part of the beneficiaries. As the amount of cash involved is substantial, it has stimulated fraudulent application by non-fishers who are able to obtain the needed documentation and access the benefit. If on the one hand the requirements to access the benefit can be obtained by non-fishers, on the other hand the strict application and enforcement of the requirements in the law would penalize a large number of fishers who do not fit criteria, such as the exclusive dependence on fishing as a source of income and fishing for alternative species during closure periods. As demonstrated in previous chapters, these are common strategies adopted by artisanal fishers in the estuary, strategies that are essential today for livelihood security in the face of poor economic returns from fishing.

Fishers' organizations

The majority of artisanal fishers are organized into Fishers' Colonies (*Colônias de Pescadores*) that the Brazilian Navy created at the beginning of the twentieth century. The objective for the creation of these colonies was to organize the fishing communities spread out along the coast into reserves for the Navy. Fishers who are legal members of the colonies elect the directors of the colonies, and the directors, in turn, elect the president of the Provincial Federation of Colonies. The president of the National Confederation of Colonies was personally nominated by the Ministry of Agriculture, to which the fishing sector was institutionally attached until 1989 (Vasconcellos, Diegues and Kalikoski, 2011).

Before the 1988 Constitution, the majority of the directors of the colonies were representatives of other social and professional sectors, such as fish traders and lawyers, who utilized the fishers' organizations for political purposes. In 1973, a new statute was established for the colonies, but no substantial changes occurred as this new law was promulgated during the military regime and there was no consultation whatsoever with artisanal fishers. At the beginning of the 1980s, for the first time, artisanal fishers from the State of Pernambuco (northeast Brazil) organized mass meetings against the environmental degradation of the rivers and estuaries, which were caused by large sugarcane mills. The movement to redemocratize the country towards the end of the military dictatorial regime had an important influence on the democratization of the overall electoral process. This process was stronger in the northeast, where the *Pastoral dos Pescadores* (Fishers' Pastoral), created by the National Conference of Bishops of Brazil, played an important role. The work of the Fishers' Pastoral since then has

been also instrumental in securing artisanal fishers' rights to social security services of other workers (e.g. retirement benefits, health benefits, maternity allowances and unemployment benefit to compensate for periods of fishing closures).

Moreover, before the Constitution of 1988, fishers were only allowed to organize themselves into traditional colonies whose role was mainly related to social services. The new Constitution allowed fishers to create their own trade unions; however, few of these unions were established effectively. In the Patos Lagoon estuary, fishers are organized into four colonies (Z1 covering the municipality of Rio Grande; Z2 São José do Norte; Z8 São Lourenço do Sul, Camaquã, Arambaré and Tapes; and Z11 Tavares and Mostardas) and one syndicate (Z3 in Pelotas).

During the last decade, a number of associations and cooperatives have been created in the region, which originated from community initiatives and supported by governmental programmes at municipal, state and federal levels (Table 25). The origin, achievements and current obstacles faced by some of the pioneering organizations are described below.

- **Cooperative of Artisanal Professionals Lagoa Viva (*Cooperativa dos Profissionais Artesanais Lagoa Viva, Pelotas*)**. Founded in 2003, this cooperative originated from the initiative of a group of fishers from the community of Z3, Pelotas, who participated in a project of artisanal fishers' fairs funded by the municipality of Pelotas. The goals of the cooperative are to bring together artisanal fishers and fish farmers in their area, promoting socio-economic development, encouraging the collective work, integration, solidarity, and social and cultural growth of its members, and seeking to develop its activities while preserving the environment. With more than 300 members (including not only artisanal fishers), the cooperative maintains the administration of an ice factory, a truck purchased by the city through federal resources, and an agribusiness that has a processing capacity of 800–1 000 kg of fish per day, which was partially built with resources from the state rural credit programme RS Rural. For the first time in the region, a fisher cooperative accessed funding from the Federal Government Agency of Food Supply (CONAB) through the national Food Acquisition Program (PAA). The cooperative created conditions for improved economic returns of its members. Furthermore, by increasing the first sale price of some fish products, such as blue crab, the cooperative also had a positive community-wide effect because it also forced local intermediaries to increase the price paid to fishers for these products. Among the limitations are the weak technical capacity of fishers for business administration, the small scale of production that made it difficult for the cooperative to compete with traditional industries for a share of the market, and the bundling and debts of cooperative members with intermediaries. The accumulation of debts led to the bankruptcy of the cooperative in 2010. A re-opening is currently being negotiated with creditors, including the federal government.
- **Cooperative of Fishers of São José do Norte – *Cooperativa dos Pescadores de São José do Norte (COOPANORTE)***. The cooperative originated from the work of extensionists of the Organization for Technical Assistance and Rural Extension (EMATER) in the municipality of São José do Norte, which triggered fishers to work collectively for improving the infrastructure for adding value to fisheries products. A total of 190 fishers were founding members of the cooperative. With funds accessed from the state programme RS Rural, and financial contributions from the municipality of São José do Norte and the federal Special Secretariat of Aquaculture and Fisheries (SEAP, now the Ministry of Fisheries and Aquaculture), a processing plant was built. However, the most recent information available indicated that the cooperative was still not legally constituted and therefore unable to operate.

- **Community Centre of Fishers and Farmers of Várzea Village – *Centro Comunitário de Pescadores e de Agricultores da Localidade da Várzea (CECOV)*.** CECOV is a non-profit organization located at the community of Várzea, São José do Norte. According to its statutes, CECOV aims at grouping artisanal fishers and farmers in the area, promoting socio-economic security, fostering collective work, integration, solidarity and social and cultural growth of its members and of the community while preserving the environment. More than 80 families are associated with CECOV. Among the important achievements of the organization to members and to the community of Várzea was the facilitation of access to electric power and the acquisition of an ice factory with production capacity of 5 tonnes per day (Figure 99), supported by the federal electric company (Eletrobras). At the time of writing, the organization was attempting to participate in the PAA by supplying fish to the implementation of the national programme for hunger eradication (*Programa Fome Zero*) in the municipality of São José do Norte.
- **Cooperative of Artisanal Fishers of the Pérola da Lagoa – *Cooperativa de Pescadores Artesanais Pérola da Lagoa (COOPESCA)*.** The idea of organizing COOPESCA started from the experience of a group of fishers (men and women) who, challenged by the Secretary of Rural Development of the municipality of São Lourenço do Sul, organized the sale of meals made with fish during a music festival in 2005. This experience stimulated the organization of the first fish fair in the municipality and triggered a series of meetings coordinated by City Hall to find alternative ways to strengthen fishers' organizations. During this process, the City Hall obtained resources from the federal Special Secretariat of Aquaculture and Fisheries (SEAP, now the Ministry of Fisheries and Aquaculture) to build a filleting room. With the possibility of acquiring the filleting room, fishers sought support to form the COOPESCA cooperative. According to the most recent information available, COOPESCA has 30 members and is in the process of legalizing its operation.
- **Association of Fishers of São Miguel Village – *Associação dos Pescadores da Vila São Miguel (APESMI)*:** the association was legally constituted in 2003 with the objective to support the organization of fishers from the São Miguel village, Rio Grande. APESMI's goals are to improve fish processing and commercialization, to defend fishers' interests, and to work collaboratively with governmental and non-governmental organizations in the fisheries governance of Patos Lagoon. The association was formed by the initiative of 21 fishers who decided to work collectively to deal with some of the major threats to their livelihoods, including fishers' dependence on intermediaries. One of the first actions of the association was to access credit from the programme RS Rural to improve infrastructure for fish processing and commercialization. With time, the association gained recognition among official bodies and institutions dealing with artisanal fisheries in the estuary. APESMI became one the members of the Forum of Patos Lagoon co-management arrangement (together with other associations, such as CECOV and COOPANORTE).

Since its foundation, important achievements have been made, including the acquisition of land (on loan) for construction of a warehouse, the construction of a plant for fish storage and processing, the participation in various forums, networks and fairs of solidarity economy in the State of Rio Grande do Sul, and the supply of fish products to institutional markets such as the federal PAA. Despite these achievements, the association still faces many limitations that preclude it from becoming operational and self-sustained. The weak technical capacity for business administration is an important limiting factor that recently led to an unsustainable debt situation. Also, the limited infrastructure for operating the fish processing plant in accordance with legislation impedes advancements in this area. In this regard, the association has recently acquired equipment and materials that will enable the necessary improvement

in fish processing. The collaboration and support of the Federal University of Rio Grande has been instrumental in the ongoing improvements in infrastructure and technical capacity of the association.

Data gathered in Table 25 indicate that there are a significant number of fishers organized in alternative forms of association and/or cooperatives in the region (469 fishers, representing about 18 percent of the total number of fishers participating in different types of organizations). However, the majority are associated with traditional Fishers' Colonies and syndicates. According to the commercialization data presented in previous sections, the role of the associations and cooperatives in the supply chain has been important in some localities but small or absent in some of the most important centres of artisanal fisheries in the estuary, including the municipalities of Rio Grande and São José do Norte.

Table 25: Breakdown of number of fishers by type of association

Municipality	Colonies/associations/cooperatives	Numbers associated
Rio Grande	Fishers' Colony Z1	825
	Other Fishers' Colonies	13
	Associations/cooperatives	46
	Associação de Pescadores da Ilha da Torotama	
	Associação de Pescadores Artesanais da Coréia	
	Associação de Pescadores da São Miguel (APESMI)	
	Cooperativa de Pescadores Artesanais do Parque Coelho (COOPEPAC)	
	Associação dos Pescadores e Aquicultores do Cassino (APAAC)	
São José do Norte	Fishers' Colony Z2	739
	Other Fishers' Colonies	160
	Associations/cooperatives	157
	Associação de Agricultores, Pescadores e Moradores de São Caetano	
	Centro Comunitário da Várzea (CECOV)	
	Centro Comunitário de Agricultores e Pescadores das Capivaras (CENTROCAP)	
	Cooperativa de Pescadores Artesanais de São José do Norte (COOPANORTE)	
	Grupo Comunitário do Barranco	
Pelotas	Fishers' syndicate Z3	444
	Other Fishers' Colonies	2
	Associations/cooperatives	180
	Cooperativa dos Pescadores Profissionais Artesanais Lagoa Viva	
São Lourenço do Sul	Fishers' Colony Z8	116
	Other Fishers' Colonies	11
	Associations/cooperatives	35
	Cooperativa de Pescadores de São Lourenço do Sul (COPESCA)	
Camaquã	Fishers' Colony Z8	12
Arambaré	Fishers' Colony Z8	13
Tapes	Fishers' Colony Z8	46
	Other colonies	1
	Associations/cooperatives	48
	Associação dos Pescadores de Tapes	
Tavares	Fishers' Colony Z11	80
	Associations/cooperatives	3
Mostardas	Fishers' Colony Z11	13

Despite the challenges faced at the moment by associations and cooperatives, they do represent a seed for transforming social relationships within communities, with the potential to address some of the major socio-economic threats to artisanal fisheries livelihoods. Some key lessons learned from the experiences described above need to be considered for improving the role of these organizations in the region, including:

- the importance of strengthening community leaderships considering their key role in fishers' organization and empowerment;
- the need for building technical capacity of fishers to run cooperatives and associations;
- the need to improve and strengthen formal credit policies for associativism and cooperativism. Fisher's access to credit was key to the development of infrastructure for fish processing and for consolidating fishers' organizations;
- institutional markets, such as the PAA and fish fairs, are viable alternatives to address common problems faced by fishers in the commercialization of fish products (e.g. long supply chains, low prices); and
- finally, finding ways to regulate the dominant mode of commercialization in the region, which is highly informal and centred on the intermediaries, is key for associations and cooperatives to thrive. While associations and cooperatives have to meet strict sanitary requirements and fiscal obligations to operate, the same does not happen with intermediaries. This situation puts associations and/or cooperatives at a disadvantage to compete for the market and to succeed as a viable, better and fairer alternative for artisanal fishers.



Figure 99: Ice factory acquired by CECOV in the community of Várzea, São José do Norte

5. ENVIRONMENTAL ASPECTS AND FISHERIES GOVERNANCE

Institutions that mediate the use of fisheries resources and ecosystem

The institution with the highest authority for coastal zone management in Brazil is the Ministry of the Environment. The National Programme for Coastal Management (GERCO) is administered by this Ministry. The conditions set forth in the programme have to be implemented by each coastal state and municipality. The programme defines the legal aspects for the management of the Brazilian coastal zone and establishes the basis for the development of regional and local policies, programmes and management plans. Estuarine areas, such as the estuary of the Patos Lagoon, were defined as areas of high management priority by GERCO because of their high level of environment risk and actual impacts (MMA, 1996). Although fisheries are important coastal resources, GERCO has no mandate over them.

The management of fisheries in Brazil is mainly the responsibility of the federal government, which is responsible for assessing the status of the stocks and for setting and enforcing regulations on the use of aquatic living resources. However, governmental institutional arrangements for regulating fisheries activities have been evolving over the years. The role of the federal government in marine fisheries management became particularly influential in the mid-1960s with the creation of SUDEPE, an agency of the Ministry of Agriculture with sole responsibility for the development and management of fisheries. Later, in 1989, fisheries became one of the agendas of IBAMA, a subsidiary of the Ministry of Environment. The shift of management responsibilities from SUDEPE to IBAMA was not favourable to artisanal fisheries. Because IBAMA focuses its attention mostly on environmental issues, legislation and law enforcement, there has been little attention given to the sustained development of artisanal fishing communities. In 1998, the government shifted a large part of the responsibilities of the fisheries sector from IBAMA back to the Ministry of Agriculture, thereby constituting the Department of Fisheries and Aquaculture (DPA). The main responsibility of DPA was to promote and execute programmes and projects to support the development of the industrial fisheries. The DPA's main objective then was to promote the development of this sector and to manage unexploited fisheries resources. On the other hand, IBAMA was responsible for executing the national policies to protect the environment, and particularly for managing endangered and overexploited species, and encouraging the sharing and decentralization of decisions through co-management and community-based management initiatives.

The development policies put forth by these two agencies were not only diverse but opposite and conflictive in their approach to resource management. According to Dias Neto (1999), such a change represented "one of the most anarchical moments in fisheries management in Brazilian history". Dias Neto and Marrul-Filho (2003) highlighted the three main institutional conflicts created with the division of responsibilities between IBAMA and DPA. The first one was of legal nature, related to the division of competencies in fisheries management, and in the organization and maintenance of the national system of control and licensing of fishing activities. The second one was conceptual, because stocks are intrinsically linked in the marine environment through ecological and/or technological interactions, and in multispecific fisheries the same fishing activity often targets stocks with different exploitation levels. Besides, a stock that is considered unexploited at a given moment could eventually be overfished, and hence, the same species could be under the responsibility of two different agencies at different moments in time. As stated by Dias Neto and Marrul-Filho (2003) "IBAMA and DPA were trying to divide the indivisible". The third conflict was related to the transfer of responsibility from IBAMA to DPA for the management and control of foreign fleets fishing under joint-venture arrangements and the consequent changes in the rules and norms.

In 2003, a new fisheries agency was created at ministerial level: the Special Secretariat for Aquaculture and Fisheries (SEAP). SEAP had a broader authority than the previous agencies. Its priority is the development of the aquaculture sector, particularly of shrimp cultivation for

export, freshwater aquaculture and industrial fisheries. In spite of official speeches, the artisanal sector is not a top priority for this new agency.

With the enactment of Law 11.958 of June 2009, SEAP was transformed into the Ministry of Fisheries and Aquaculture. The same law put an end to the division of responsibilities in the management of fish stocks stated above, making mandatory the joint work of the Ministry of Fisheries and Aquaculture and IBAMA/Ministry of Environment in the design of regulations and of governance for sustainable use of resources. This work is to be carried out under the general coordination of the Ministry of Fisheries and Aquaculture. However, this new institutional arrangement has not yet contributed to the implementation of policies and measures to revert the critical situation of the main fish stocks.

In terms of property rights, according to the Brazilian Constitution, the fisheries resources in the coastal zone and in the exclusive economic zone are considered open access under a State property regime (Dias Neto and Marrul-Filho, 2003). The Constitution also asserts that state and society should construct the means to collaborate and participate in the process of decision-making for the sustainable use of environmental resources and in the formulation of norms and rules to that effect (Dias Neto and Marrul-Filho, 2003), which leaves ample scope for the sharing of responsibilities between government and society in the management of fisheries.

The weakening role of the state in fostering the development of artisanal fisheries during the last two decades, mainly after the termination of SUDEPE, contributed to the general lack of organization of the sector. On the other hand, the institutional void favoured action to social movements and non-governmental organizations in developing projects and management initiatives for the sustainable management of fisheries. Many of these initiatives were born out of a crisis that required solutions and from a process of increasing participation of fishers as new protagonists in decision-making. The initiatives were developed around five main processes that are currently legitimized, some of which are promoted by the government (all of them could be placed within a spectrum of co-management).

1. Within the National System of Conservation Units (regulated by Law 9985/2000):

- Areas of permanent preservation (APA) – defined as “large areas with a certain degree of human occupation and characterized by physical, biological, aesthetical or cultural elements of crucial importance for the quality of life and well-being of human populations, having as main goals to protect the biological diversity, to regulate the process of human occupation and to ensure the sustainable use of natural resources”. APAs are managed by a council constituted by representatives of governmental bodies, non-governmental organizations, community organizations, and the local population through specific management plans. Example in fisheries: “APA dos Corais”, Pernambuco, northeastern Brazil.
- Marine extractive reserve (RESEX): defined as “an area used by traditional extractive activity populations, whose livelihood is based on extractive activities but also complemented by subsistence agriculture and animal production, having as its main goals the protection the livelihoods and culture of these populations and to ensure the sustainable use of natural resources”. RESEXs are managed by a deliberative council of organizations and community representatives through specific management plans. At the time of writing this paper, there were 19 RESEXs operational or in the process of becoming operational along the Brazilian coast (Kalikoski and Vasconcellos, 2011).
- Sustainable development reserves (RDSs): defined as “areas used by traditional populations, whose existence is based on systems of sustainable exploitation of natural resources, developed through generations and adapted to the local

ecological conditions, and that have played a key role in nature conservation and in the maintenance of biological diversity”. The objectives of the RDSs are “to preserve nature and at the same time to ensure the necessary conditions and means to sustain and improve the living conditions and the use of natural resources by traditional populations, as well as to appreciate and conserve the traditional knowledge-practice systems of environmental management of these populations”. RDSs are also managed by a deliberative council of organizations and representatives of communities, which is responsible for developing and implementing a management plan that defines, *inter alia*, no-take protected areas, buffer zones and corridors, and areas for sustainable use. The Mamirauá RDSs in the Amazon region are the first and most well-known example.

2. Other processes

- Fishing accords: regulated by Decree No. 29/03 of IBAMA, this instrument aims to define and legitimize access rules and norms elaborated by the fishing community to regulate the use of fisheries resources in a given region. This type of instrument does not involve the expropriation of land (as the conservation units above), but only some aspects for regulating the exploitation of resources. There are examples of fishing accords in fisheries in the Amazon floodplain.
- Fishing forums: this is an instrument that is not regulated by the government; it is rather an instrument that has been created as a result of communities’ initiatives in order to organize themselves, and to discuss their problems and seek solutions in partnership with governmental and non-governmental organizations. Because it is not regulated, this instrument can be developed in different ways, with various types of arrangements involving individual stakeholders and institutions. Some examples are the Forum of Patos Lagoon in southern Brazil, the Forum Agenda 21 in Ibiraquera, Santa Catarina, and the Forum Terramar in Ceará, among others.

Given the failure of the above institutional arrangements to sustain artisanal fisheries over time, and benefiting from the policy of mainstreaming co-management initiated in the 1990s, an alternative institutional arrangement was formed to co-manage the local resources in the Patos Lagoon estuary (Kalikoski, Vasconcellos and Lavkulich, 2002; Kalikoski and Satterfield, 2004). The local co-management arrangement referred to as the Forum of Patos Lagoon was set up to: (i) organize the artisanal fisheries sector in relation to fisheries administration policies; (ii) prompt partnerships within the sector in order to implement action plans to rebuild the productive capacity of the fisheries resources in the Patos Lagoon; (iii) establish criteria that control fishing effort as one mechanism for rebuilding fisheries resources; and (iv) encourage the collective organization for the support of local sustainable artisanal fishing communities (Forum of Patos Lagoon Mission Statement, 1998). Since the establishment of the Forum in 1998, fisheries regulation has been debated, redefining rules and rights to local resource use in the estuary of Patos Lagoon. Measures such as fishing effort limit, minimum mesh size, closed season, among others, have been exhaustively discussed and agreed as a first initiative of this co-management arrangement (Decree MMA/SEAP No. 03/2004; Table 26).

Table 26 presents a summary of the laws and decrees that control the use of local resources in the different aquatic environments and their location. It describes the established rules regarding how much, when and what different resources can be harvested, involving management functions such as licensing, timing, location, and vessel or gear restriction to prevent overexploitation, as well as rules to protect critical habitats and water quality from damage to preserve health of the resource. From Table 26, one concludes that access to the majority of artisanal fisheries resources is being limited by licence control in all areas. The exceptions are the semi-industrial fisheries based on gillnets and industrial purse seine fisheries, which are still open access fisheries. The most common rules on paper are those determining fishing seasons,

size limits and the characteristics of fishing gear. The regions differ, however, in the number of restricting rules – the fisheries in the estuary of Patos Lagoon present the largest number of rules controlling fishing seasons and gear characteristics. Another notable feature shown in Table 26 is the absence of management quotas in practically all regions (the exception is a bycatch quota established for deep-water species caught by foreign trawlers) and the absence of fisheries management rules defining marine habitat protection. Habitat protection rules for terrestrial ecosystems that are relevant for fisheries are defined by state and federal environmental agencies. They set the standards for water quality, rules to prevent water pollution, and regulate the types of use in estuarine and freshwater systems for protecting critical habitats such as marshes and riparian ecosystems. There are no similar rules for habitat protection in inshore and offshore marine areas.

Table 26: Summary of norms controlling the use of fisheries in different areas of the Patos Lagoon estuary and surrounding environment

	Freshwater	Estuary Decree 03/2004	Inshore	Offshore
Limited areas	<ul style="list-style-type: none"> • In the convergence of river and lagoons 	None	<ul style="list-style-type: none"> • Industrial purse seining around the mouth of the lagoon • Trawling inside 3 miles (4.8 km) • Fishing blue crabs 6 km around the mouth of Patos Lagoon • Fishing bluefish inside 3 miles (4.8 km) 	<ul style="list-style-type: none"> • Trawling by foreign fleets inside the 200 m isobaths
Limited access	<ul style="list-style-type: none"> • Fishing in the Mirim Lagoon to fishers who live in the area 	<ul style="list-style-type: none"> • Licences restricted to full-time fishers who live around the estuary 	<ul style="list-style-type: none"> • Licence control for demersal fish trawling • Licence control for shrimp trawling 	
Seasonal limits restrictions	<ul style="list-style-type: none"> • During spawning migrations (only allowed with hook-and-line fisheries) 	<ul style="list-style-type: none"> • Pink shrimp: 1/6–31/1 • Mullet: 1/6–30/9 • Croaker: 1/3–30/9 • Catfish: 1/6–30/9 and 1/12–30/3 • Fishing closure 1/6–30/9 	<ul style="list-style-type: none"> • Shrimps: 1/3–31/5 • Bluefish: 1/11–31/3 (or 1/12–31/3 for vessels <10 m inside 10 nm) • Catfish: 1/1–31/3 	
Size limit	<ul style="list-style-type: none"> • Pink shrimp (90 mm); mullet (35 cm); croaker (25 cm); catfish (40 cm); silverside (20 cm); flatfish (35 cm); blue crab (12 cm) 		<ul style="list-style-type: none"> • Pink shrimp (90 mm); bluefish (40 cm); Argentine croaker (25 cm); croaker (25 cm); flatfish (30 cm); black drum (50 cm); silverside (20 cm); royal weakfish (25 cm); weakfish (30 cm); mullet (35 cm); catfish (30 cm) 	
Fishing gear restrictions	<ul style="list-style-type: none"> • Bottom gillnet • Trawling, seine nets and electric fishing • Minimum mesh sizes (50–70 mm) • Maximum 1 830 m of nets per fisher in the Mirim Lagoon 	<ul style="list-style-type: none"> • Trawling of any kind • Maximum of 10 shrimp nets/fisher • Maximum length (1 830 m) and height (100 meshes) of gillnets/fisher • Minimum mesh size (mm opposite knots): shrimp 24, gillnet 100, catfish 140, silverside 40 • Maximum length shrimp nets (15 m) 	<ul style="list-style-type: none"> • Minimum mesh size pink shrimp trawl (30 mm) • Minimum mesh size marine shrimp trawl (24 mm) and maximum length of nets (12 m) 	<ul style="list-style-type: none"> • Minimum mesh size fish trawl (90 mm) • Use of Turtle Excluder Device (TED) in shrimp trawlers >11 m
Quota	None	None	None	<ul style="list-style-type: none"> • Maximum 5% incidental catch of rockfish in foreign trawlers
Habitat protection	<ul style="list-style-type: none"> • Protection of creeks and lakes; standards for water quality/use • Protection of riparian habitats 	<ul style="list-style-type: none"> • Protection of estuarine shoals; standards for water quality/use • Protection of salt marshes 	<ul style="list-style-type: none"> • Federal laws to prevent pollution by oil spills and other contaminants (MMA, 1998) 	<ul style="list-style-type: none"> • Federal laws to prevent pollution by oil spills and other contaminants (MMA, 1998)

Modified from Kalikoski, Vasconcellos and Lavkulich, 2002.

Fishers' perception about the legislation

Fishers' perception about the legislation was evaluated based on the level of agreement with some of the rules controlling artisanal fisheries in the estuary (Table 27). The following general consensus was found among fishers from different municipalities:

- the majority disagree with the current rule of a fixed date for the opening of the shrimp season;
- the majority agree with the prohibition of otter trawling in shallow waters of the estuary;
- the majority agree with the prohibition of the operation of boats larger than 12 m in the estuary;
- the majority agree that access to the estuary should be forbidden to fishers from outside the region; and
- the majority agree with the receipt of unemployment benefit during the fishing closure.

These consensual perceptions among fishers reflect a common understanding about some key points for the sustainability of estuarine fisheries. Closing access and limiting fishing capacity of individual boats are two important standing blocks for fisheries sustainability generally supported by fishers.

The control of destructive fishing practices, such as trawling in shallow waters, is also perceived as a necessity because of the role of shallow waters as nursery areas for shrimp and fish resources.

The adoption of an adaptable calendar for shrimp is also supported by fishers because of the variability in environmental conditions that control shrimp recruitment and growth in the estuary. Such strategy has been successfully applied in other coastal lagoons (Almudi and Kalikoski, 2010), where the opening of the fishing season is based on the monitoring of shrimp size. The fixed date rule currently in use was established considering the month of peak historical production of shrimp in the estuary (D'Incao, 1985). It is based on the assumption that the opening in February will allow the escapement of some individuals to recruit back to the adult stock in the sea. In addition, this rule is easier and less costly to enforce and monitor. However, the current regulation brings also problems for the sustainability of the fishery. For instance, in years when conditions are unfavourable for growth, the season opens when shrimp are too small, resulting in a situation of growth overfishing and loss of yield. On the other hand, in years when shrimp are ready before the official opening, there is an intensification of illegal trawling because trawlers, unlike the fixed fyke nets, are less likely to be caught by enforcement officers.

Finally, another perceived general agreement is the receipt of government aid through the unemployment benefit during the months of fishing closure. As demonstrated in this study, the benefit is a necessity for maintaining fishing livelihoods given the low income and high vulnerability of fishers in the region.

On the other hand, there was no general agreement with the following rules:

- *Limit of 10 fyke nets per fisher.* While fishers of Camaquã, Pelotas, Rio Grande and São Lourenço do Sul agree with the rule, fishers from Arambaré and São José do Norte disagree. There was no consensus about this rule in the other municipalities.

- *Limit of 1 000 fathoms (1 829 m) of gillnets per boat.* Fishers from Tapes disagreed with the rule and there was no consensus in Camaquã and São Lourenço. Fisheries in the remaining municipalities agreed with the rule.
- *Prohibition of trawling fisheries.* While there was a general agreement about the rule of banning trawling in shallow waters, fishers from Camaquã and São Lourenço do Sul believed that trawling should be allowed in channel waters of the estuary.
- *Prohibition of beach seines.* Fishers from Rio Grande and São Lourenço do Sul generally disagree with the prohibition of beach seines. In the remaining municipalities, there was a general agreement with the prohibition, with the exception of Tapes where there was no consensus.
- *Prohibition of berimbau.* Fishers from Arambaré and São Lourenço do Sul disagree with the prohibition. There was no consensus in Tapes and an agreement with the rule in all other municipalities.

The consensus found at municipality level for some of these rules hides sometimes disagreement between localities of the same municipalities. For instance, on the limit of 10 fyke nets per fisher, there was a disagreement between fishers from Pontal da Barra (mainly against the limit) and those from Z3 (mainly in favour) in the municipality of Pelotas. The same divergence was found in São José do Norte, where fishers from 5^a Secção da Barra and Povoação da Barra were generally in favour of the limit while fishers in the remaining communities were against it.

One of the most controversial issues is the prohibition of otter trawling in channel waters. In the municipality of Pelotas, fishers from Balsa and Pontal da Barra were generally against the prohibition and those from Z3 were in favour. In Rio Grande, the majority of fishers from Barra and Mangueira (two localities known to operate otter trawling fisheries, see Chapter 3) were against the prohibition, while the majority of fishers in the remaining communities favoured the banning of trawling. In São José do Norte, the community of Povoação da Barra was against the ban. And, finally, in São Lourenço do Sul, there was no consensus among fishers from the community of Barrinha.

Regarding the ban of beach seines, there was disagreement among communities of Rio Grande (Barra, Bosque, Marinheiros, São Miguel and Torotama against the ban) and of São José do Norte (Passinho and Povoação da Barra against the ban). On the banning of *berimbau*, there was disagreement in Pelotas (Balsa against the ban), Rio Grande (Barra and Bosque against) and São José do Norte (Povoação da Barra against).

Table 27: Responses to questions of how fishers agree with the rules defined for artisanal fisheries in the estuary and other proposed rules

Rules	Pelotas (n = 495)		Rio Grande (n = 846)		S. J. do Norte (n = 708)		S. L. do Sul (n = 134)		Camaquã (n = 12)		Arambaré (n = 16)		Tapes (n = 53)		Tavares (n = 81)		Mostardas (n = 16)	
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
Fishing closure (June–September)	82	18	66	34	89	11	64	36	100	0	56	44	47	53	88	12	77	23
Fixed date shrimp season	15	85	19	81	14	86	33	67	25	75	33	67	39	61	11	89	10	90
Max. 10 fyke nets	57	43	65	35	45	55	70	30	80	20	31	69	46	54	48	52	50	50
Max. 1 000 fathoms (1 829 m)	75	25	77	23	67	33	47	53	46	54	63	38	39	61	74	26	57	43
Allow trawling in channel	42	58	34	66	23	77	63	37	58	42	33	67	40	60	4	96	27	73
Allow trawling in shallow water	25	75	11	89	10	90	44	56	25	75	36	64	40	60	4	96	0	100
Allow beach seines	41	59	61	39	38	62	73	27	36	64	44	56	52	48	4	96	15	85
Allow <i>berimbau</i>	44	56	36	64	35	65	76	24	13	88	67	33	48	52	10	90	20	80
Allow boats >12m	13	87	14	86	5	95	2	98	0	100	0	100	20	80	15	85	36	64
Open access to lagoon	30	70	23	77	11	89	13	87	0	100	19	81	33	67	27	73	14	86
Receive unemployment benefit	98	2	97	3	97	3	91	9	92	8	94	6	96	4	96	4	100	0

Note: Numbers presented as percentage of total number of responses (n). Y = yes; N = No. Boxes in green are where the majority of the respondents agree with the proposed rule; in red where the majority disagree; and in grey where there is no consensus (difference between yes and no less than 10 percent).

Figures 100 to 103 show the results of the question in which fishers were asked to define for themselves the period they think would be more appropriate for fishing each of the resources. For mullet, the majority believes that the fishing season should encompass the months from January to May, with the highest number of respondents indicating the period from April to May. This is the period when, according to fishers, the largest schools of mullet leave the estuary to reproduce; therefore, it is the most important period for the fishery. The responses differ markedly with the current mullet calendar, defined from October to May (Decree MMA/SEAP No. 03/2004). It is important to note that the mullet calendar was originally from February to May (Decree No. 171 of 1998) and was later revised in response to fishers' complaints that it was impossible to have different calendars for mullet and croaker because both resources are fished with similar gear and are present in the estuary during the same period. Fishers' requests were taken into account in the first revision of the rules for artisanal fisheries in the estuary (Decree No. 144 of 2001) and were later incorporated in the current legislation. Therefore, while a shorter season (February to May) would have obvious conservation benefits, it has proven unpractical to enforce it because of the technological interactions between the croaker and mullet fisheries.

As for the croaker fishing season, there is an apparent disagreement between the opinion of the majority of fishers who believe the season should last from October to January and the current legislation that defines the calendar from October to February. In fact, the original calendar in Decree No. 171 of 1998 was from October to January and was later revised in Decree No. 144 of 2001 based on requests made especially by fishers from the communities of Z3 in Pelotas and São Lourenço do Sul (Kalikoski, Vasconcellos and Lavkulich, 2002). According to the authors, while many fishers from Rio Grande and São José do Norte defend the possibility of ending the croaker season as early as December, practically all fishers from Pelotas and São Lourenço do Sul agree on a calendar extending to February, and some defend also the possibility of leaving the fishery open all year round. These differences reflect distinct fishing strategies of artisanal fishers, and to accommodate these differences the legislation became less restrictive. As for the mullet fishery, it can also be argued here that the fishing calendar for croaker, as currently defined in the legislation, has little conservation value and rather serves to minimize conflicts between fishers.

The calendar for catfish has some peculiarities compared with the other finfish resources. First, there is a general agreement that the fishing seasons should be short, as can be seen from the placement of responses in the diagonal axis of Figure 102. On the other hand, there is no agreement on a single period for the catfish season. While a group of fishers indicated the summer months from January to March, another group of fishers considered the winter months from June to August as ideal seasons for the catfish calendar. The current calendar in the legislation misses both periods. In fact, in contrast to the rules defined for mullet and croaker, the calendar for catfish is largely opposed by fishers in all communities (Kalikoski, 2002). The revision of the catfish calendar is currently on demand by fishers, especially fishers from communities in the upper estuary (such as São Lourenço do Sul) who fish catfish during the winter months of the fishing closure in the estuary. The fishing season for catfish has shown some marked changes since the fishery collapsed in the 1980s (before the collapse, most catches occurred during spring months), which are presently being investigated to support the revision of the legislation.

As for the shrimp calendar, in spite of the general agreement between fishers' knowledge about the season and the current legislation (February to May), as demonstrated in Table 26, the majority of fishers agree that the shrimp calendar should be adapted each year according to the resource conditions, which is in contrast to Decree MMA/SEAP No. 03/2004 that fixes the opening of the season annually on 1 February.

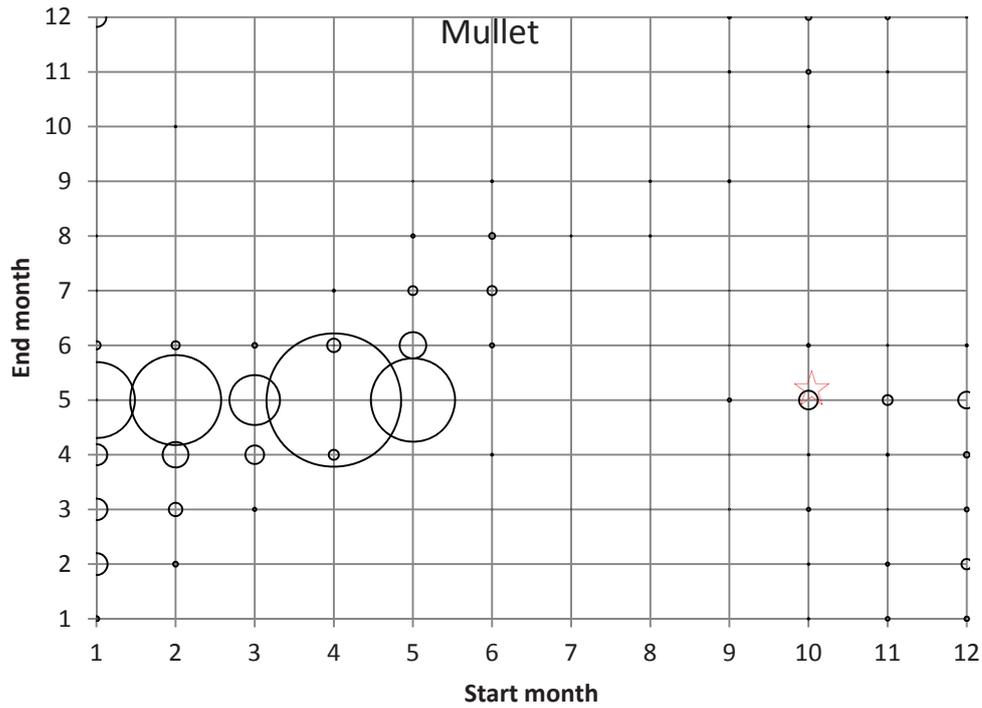


Figure 100: Fishers' perception about the length of the fishing season for mullet

The size of the circles is proportional to the number of respondents (smaller circle [n = 1]; larger circle [n = 360]). The red star indicates the length of the fishing calendar according to Decree MMA/SEAP No. 03/2004.

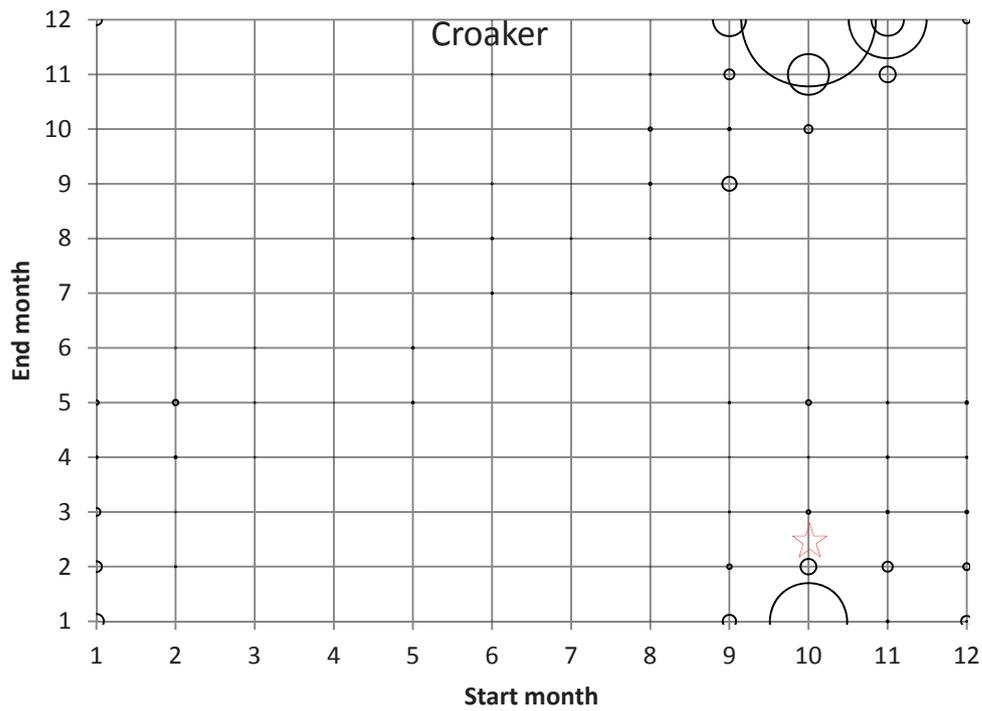


Figure 101: Fishers' perception about the length of the fishing season for croaker

The size of the circles is proportional to the number of respondents (smaller circle [n = 1]; larger circle [n = 464]). The red star indicates the length of the fishing calendar according to Decree MMA/SEAP No. 03/2004.

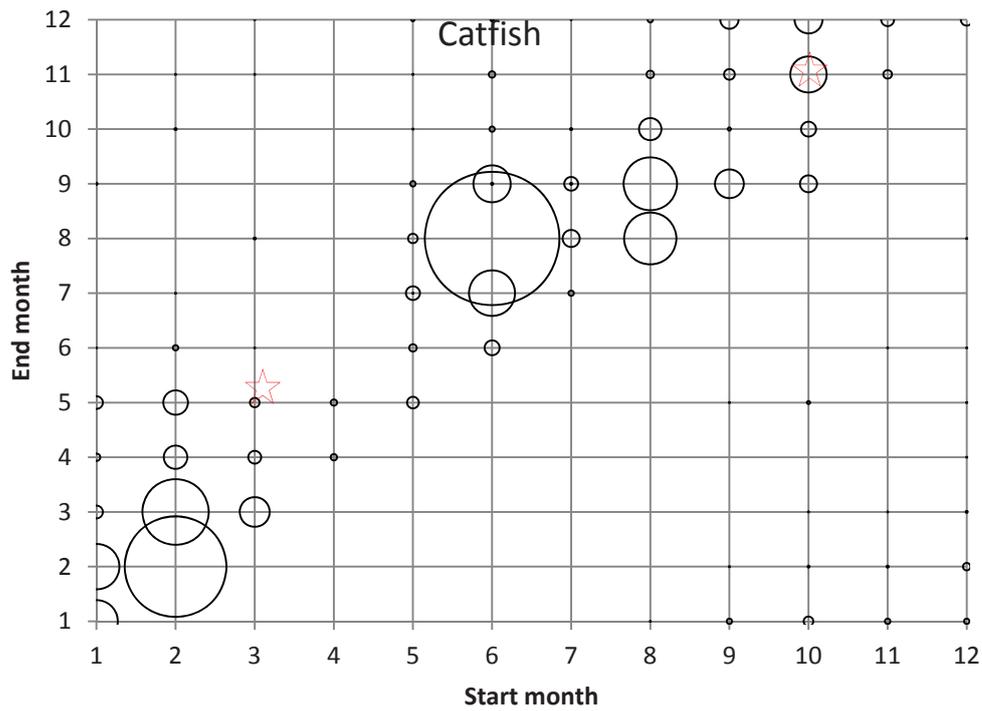


Figure 102: Fishers' perception about the length of the fishing season for catfish

The size of the circles is proportional to the number of respondents (smaller circle [n= 1]; larger circle [n = 126]). The red stars indicate the length of the fishing calendar according to Decree MMA/SEAP No. 03/2004.

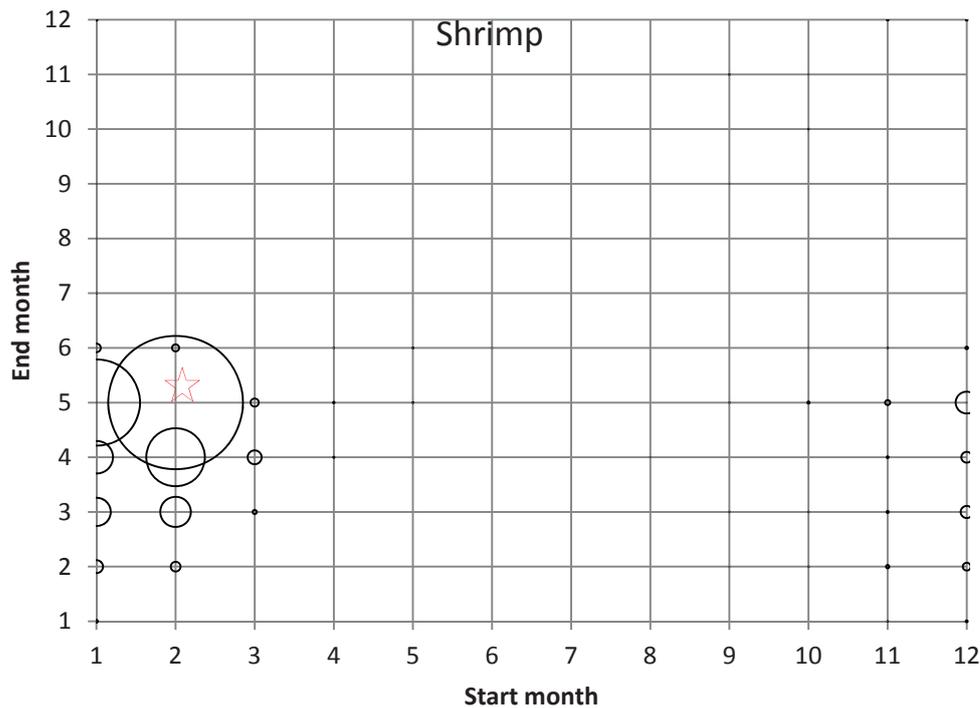


Figure 103: Fishers' perception about the length of the fishing season for shrimp

The size of the circles is proportional to the number of respondents (smaller circle [n = 1]; larger circle [n = 606]). The red star indicates the length of the fishing calendar according to Decree MMA/SEAP No. 03/2004.

The congruence between management rules and resource sustainability

This section describes some mismatches that were identified in the management of fisheries that can potentially affect resources sustainability in the Patos Lagoon estuary.

Harvest technologies and environmental characteristics

Fishing impacts ecosystems in many different ways; for example, by exploiting resources beyond their carrying capacity, by damaging habitats that are important for nursery and production, and by capturing species that are not the main target of the fishery (bycatch) (Hall, 1999). Bycatch is an important issue in the management of shrimp fisheries and as such it has evoked rules that restrict the use of certain fishing methods. In the Patos Lagoon estuary, the gear allowed to catch shrimp (fyke nets and stow nets) are considered adequate by the legislation because they produce relatively low bycatch rates per net compared with what is known about other types of gear such as trawling. Vieira *et al.* (1996) estimated that on average only 6 percent of the total catch in fyke nets is composed of juvenile fish (mostly croaker and catfish), which are discarded. However, the total amount of juvenile fish discarded at the end of shrimp season can be significantly high, in the order of 600 tonnes (Vieira *et al.*, 1996), because of the high number of nets used (see Chapter 3). The reality is, therefore, that the shrimp fishery with fixed nets can produce harmful levels of bycatch. The decision-making process that by law established this as the technology to be used was narrowly defined because it considered only the characteristics of the fishing gear and failed to account for the difficult problem of limiting the right of entry and use of resources. The opening of access and the lack of monitoring and enforcement contributed to increase the pressure on the resource over the years.

The bycatch produced by trawling, which is still used by many fishers, can also be high, although no formal evaluation has been conducted since it was prohibited in the estuary of Patos Lagoon in the 1970s. Bycatch is not only an issue in artisanal shrimp fisheries. It is particularly important in industrial trawling fisheries that operate along the coast. Haimovici (1997) estimated that the total discarded bycatch of pair trawlers and otter trawlers fishing in the region during the early 1980s summed up to 46 percent of the total catch in weight, most of it composed of juvenile weakfish, royal weakfish and *castanha*. The discarded bycatch in double-rig trawlers is about 50 percent of the total catch and is composed of small sharks and fish. A rule limiting the minimum mesh size of fish trawling nets to 90 mm was later adopted to remedy the bycatch of juvenile fish (Vooren, 1983) (Table 26).

Therefore, both artisanal and industrial fisheries use harvest technologies that can affect resource sustainability. The shrimp fishery with fyke nets provides an example of incongruence between rules and the local characteristics of the ecosystems. The case of artisanal trawling in estuarine waters is an example of a rule that is apparently congruent with the resource conditions; however, trawling is still done. A combination of factors seems responsible for the lack of compliance with the trawling ban (Kalikoski, 2002). First, because fishers believe that trawling in the channel waters is less damaging than fishing with fixed nets in shallow waters. Second, because the shallow waters are already occupied by thousands of fixed nets; therefore, for many fishers, there is no other available way to catch shrimp. The third is due to the poor level of involvement of fishers in policy and regulation formulation. Finally, fishers seem to be trapped in the rationale that “if I don’t do it, others will do it”, which, when combined with the lack of enforcement, leads to non-compliance with the rules. Industrial trawling provides an example of a fishing technology that is incongruent with the sustainability of resources. Rules have been devised to alleviate the damaging effects of this fishery, such as the three-mile exclusion zone and the mesh size limits (Table 26), but in fact there has been little compliance with these rules and low level of enforcement.

Fishing calendars

One of the most widely used rules to control fisheries in the Patos Lagoon estuary is the fishing calendars, which define the timing of fisheries for each of the main resources (Table 26). The shrimp fishery calendar is tied to a fixed opening that occurs every year on 1 February, even though fishers, scientists and managers acknowledge the fact that the cycle of shrimp growth and production varies between years and areas. Although the fishery occurs mostly after February, in reality some fishers follow their own traditional calendar and start catching shrimp earlier in the year depending on environmental and/or resource conditions. The lack of feedback mechanisms to adapt rules to the characteristics of the resource and to the climatic conditions often generates conflicts between fishers and officials. Fishers ask for annual revisions of the rules and for distinct openings by areas, as shrimp production varies along the estuarine shallows and is closely related to the hydrological conditions (Forum of Patos Lagoon minutes). Changing the status quo to an adaptive calendar would require a more complex system of monitoring, which is viewed as unfeasible by the official agency (Forum of Patos Lagoon minutes). On the other hand, attempts to adapt rules to resource conditions have failed because of fierce discussions between scientists and fishers about when the stock would achieve the adequate fishing size (Reis and D’Incao, 2000). There is still a perceived institutional barrier to be broken to allow the sharing of responsibilities between officials and resource users in the monitoring of shrimp stocks and in the management of the activity (Forum of Patos Lagoon minutes).

Another identified incongruence in the law relates to the calendar for catfish. The established rule is that the fishing season is restricted to the period from October to November and from March to May. The fishery traditionally started in August and lasted until December, the period when the species enters the estuary to mature and reproduce (Reis, 1986). Fishers consider the

current calendar inadequate because it makes them catch catfish in a critical period in the species life cycle, when adults are incubating the young in their mouths. After spawning in estuarine and coastal waters in late spring, male catfish incubate the eggs and the fry for up to two months in their buccal cavity (Reis, 1986). The incongruence in the catfish calendar is particularly threatening to the maintenance of this long-lived resource, which suffered from intense overfishing in the last decades and requires strong conservation measures to recover (Reis and D’Incao, 2000).

Limiting excessive exploitation of resources

Most of the fisheries resources traditionally targeted by artisanal fisheries are currently classified as either fully exploited, overexploited or collapsed (D’Incao, 1991; IBAMA, 1995; Haimovici, 1997; Vasconcellos, Diegues and Sales, 2007). The abundance of croaker has been decreasing steadily in the last two decades and current exploitation rates are considered unsustainable (Vasconcellos and Haimovici, 2006). Resources such as black drum and catfish were overexploited in the 1970s, and the fishery in the estuary of Patos Lagoon collapsed in the early 1980s (Reis, Vieira and Duarte, 1994). The stock of pink shrimp also shows signs of overfishing. Despite the high natural variability in catches, the average landings have declined since the 1970s (Reis and D’Incao 2000). Individual fishers catch rates have been also declining in the last three decades (Chapter 3) confirming concerns of resource overfishing. Not much is known about the status of the mullet stock in southern Brazil; landings are highly variable but show a clear declining trend since the peak in reported landings in 1975 (Figure 90). Catch volumes in good seasons during the last two decades have remained relatively constant, as demonstrated by official statistics and fishers’ knowledge (see Chapter 3). The species is, however, considered threatened with overfishing owing to the high fishing intensity from artisanal and industrial fishing fleets operating in southern Brazil (Vasconcellos, Diegues and Sales, 2007).

Recognizing the need to recover the productivity of estuarine fisheries, the Decree MMA/SEAP No. 03/2004 defined measures to control the excess resource exploitation in the estuary (e.g. licence control, effort control, closed seasons; Table 26). The expected effect of these rules in alleviating the excess exploitation and allowing the recovery of depleted stocks is highly uncertain. At best, the rules in place are expected to maintain the status quo conditions, which are worrisome for their potential impact on some resources such as catfish and black drum. There is no action plan defined with specific strategies to recover the depleted resources. More importantly is the fact that all species exploited by the artisanal fishery in the estuary migrate to shelf waters of southern and southeastern Brazil (some to Uruguayan and Argentine waters), where they are also exploited and subjected to other less-restrictive management rules (Table 26). A complicating factor to the effectiveness of management rules is the overall limited enforcement.

Deficient monitoring and enforcement

Institutional behaviour is not only defined by its intentions, political rhetoric and the policies that it enacts, but it is also largely defined by the extent to which these policies are implemented and monitored. Monitoring constitutes a vital source of feedback in the management process. Many contend that Brazil has one of the most advanced bodies of environmental laws in the world, yet implementation and enforcement of these laws are exceptionally weak and ineffective (Domask, 1997). As it can be observed in Table 26, a number of rules exist for regulating fisheries activities in southern Brazil, but enforcing these rules has been ineffective.

Considering the technological characterization of artisanal fisheries described in Chapter 3, it can be concluded that compliance can be low for some rules, such as: the rules limiting the maximum number of fyke nets per fisher (average number in use is 15 per fisher while the rule is 10 nets per fisher); the use of trawling gear (at least 170 fishers declared using otter trawls);

and the use of forbidden gear for blue crab (254 fishers declared using fyke nets and 49 otter trawls). Another set of rules with low compliance is the rules establishing fishing closures and calendars for the main resources. As demonstrated in previous sections, in some localities of the estuary, it is common for fishers to continue fishing controlled species during the closure as a means of guaranteeing some cash income. Likewise, the fishers' disagreements with established calendars for catfish (Figure 102) and also with the fixed calendar for shrimp (Table 26) are indicative of poor compliance with these rules.

Another way of evaluating the level of compliance is to investigate the number of fishers that have been caught or received sanctions for not following rules. Data presented in Figure 104 indicate that 17 percent of artisanal fishers in the estuary have been caught at least once. The highest rate of sanctions was in Tapes, where 42 percent of fishers declared receiving sanctions at least once. These levels of sanctions should be considered minimal estimates of non-compliance considering the deficient enforcement in the region (Dias Neto and Vasconcellos, 2006; Kalikoski, Vasconcellos and Lavkulich, 2002).

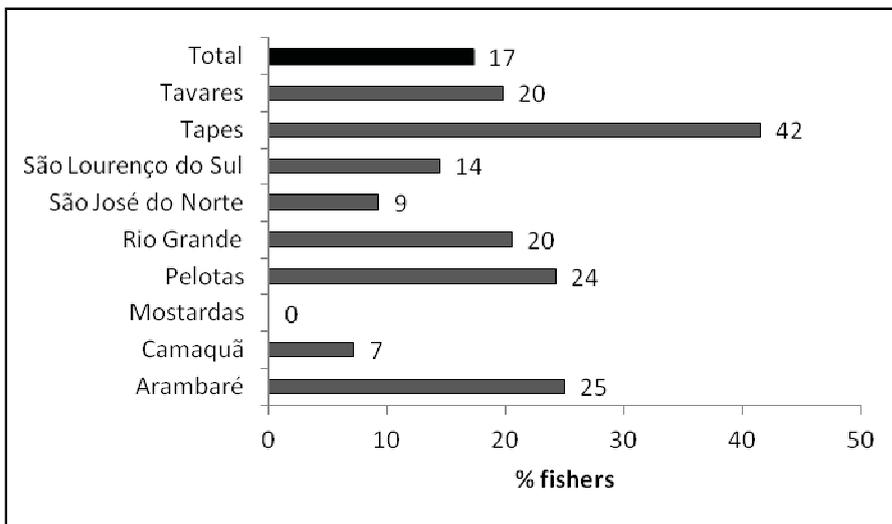


Figure 104: Percentage of fishers who were caught by enforcement officers and/or applied sanctions for not following rules at least once

Many factors contribute to the deficient monitoring of resource conditions and the enforcement of regulations in the estuary of Patos Lagoon and coastal areas. Beginning with the fact that with the centralization of fisheries management both monitoring and enforcement became the responsibility of a single federal agency (SUDEPE and later IBAMA), which has always lacked structure and human resources to carry out the functions effectively. It is known that contravention is usually tolerated by officials, who are often unwilling to enforce rules impartially (Kalikoski, 2002). It has been proposed that the efficiency of this source of feedback (who monitors resource conditions and how) is increased with the inclusiveness and accountability of the resource users (Pinkerton, 1989; Ostrom, 1990). This sharing of responsibilities between government and fishers over enforcement has not been considered yet by the local institutions. On the other hand, efforts to overcome the problem of infrastructure and the monitoring of illegal fishing in estuarine and coastal areas were addressed by concerted action between IBAMA and the Navy and more recently between IBAMA and the Ministry of Fisheries and Aquaculture. The results of these initiatives, which are to be analysed in the future, will serve as an important mechanism to evaluate how these management functions could be better performed over time by the different institutions.

The poor compliance with the established norms should be also evaluated from the perspective of fisheries co-management. The rules in place were exhaustively discussed and agreed in the

Forum of Patos Lagoon as a first step for community-based management. In spite of a consensus reached by the Forum representatives at the time of elaborating these management instruments, few fishers were consulted and gave inputs on the rules launched (Kalikoski, 2002). Measures for fisheries management in place in the estuary seem not to meet fishers' purposes fully; therefore, they are not supported by a large number of Patos Lagoon fishers. This indicates that the Forum does not genuinely represent the interests of the fishers. This challenge illustrates the difficulties in implementing co-management arrangements when only a consultative co-management is in place, i.e. government consults with fishers about decisions but does not share decision-making responsibility with fishers.

Wider environmental impacts

Fisheries management in Brazil is still sectoral, and does not include in its structure the possible interference from other activities and institutions. There are multiple sources of human impacts that can alter the carrying capacity of the estuary of Patos Lagoon and that can potentially impact artisanal fisheries. These include:

- *Destruction of vital habitats:* estuaries provide vital habitats for nursery of aquatic organisms. Seagrass beds, for instance, are a nursery ground in which postlarval stages of many invertebrates and fish species concentrate and develop. Salt marshes are important producers of organic matter that is either transported to the estuary and coastal area or recycled in the marshes by herbivore and detritivore organisms that are important food sources for juvenile fish and birds that rest in the estuary (Costa, 1997). Although legally protected, seagrass and salt marsh habitats (Table 26) have been destroyed by the filling of intertidal and shallow-water flats in the lower estuary for port, residential and industrial development. It is estimated that filling along estuarine margins and around small islands has destroyed as much as 10 percent of the total salt marsh area of the estuary (Seeliger and Costa, 1997). Other important man-induced impacts to salt marshes, which have not yet been quantified, are the large-scale grazing by livestock on marginal marshes. Estuarine habitats are also lost due to sedimentation processes, which could be natural or man-induced, the latter related to the misuse of agricultural land in the watersheds. Over the last two centuries, it is estimated that the water area of the estuary has decreased by about 11 percent owing to the deposition of fine sediments from the Patos Lagoon in shallow estuarine shoals (Seeliger and Costa, 1997).
- *Changes in primary production:* the main primary producers in the estuary of Patos Lagoon are salt marshes, seagrasses, benthic and floating macroalgae, cyanobacteria and microalgae (including phytoplankton). Conservative estimates of net primary production indicate that salt marsh plants, macroalgae and cyanobacteria are responsible for as much as 86 percent of the total addition of carbon to the estuary (Seeliger, Odobrecht and Castello, 1997). There is no direct evidence of changes in primary production in the estuary of Patos Lagoon. On the one hand, a decrease in primary production may have occurred owing to the destruction of salt marshes and seagrass habitats during the last century. On the other hand, excess nutrient loads from domestic and industrial effluents and agricultural runoff are responsible for the eutrophication of the estuary with the development of blooms and changes in phytoplankton composition (Seeliger and Costa, 1997). Eutrophication has as a side effect led to the decline of seagrass biomass in estuarine embayments owing to the attenuation of light penetration, which can also decrease the overall primary productivity (Okey *et al.*, 2004).
- *Pollution and contamination of estuarine waters:* the estuary presents high risks of contamination by chemical substances owing to the large number of petrochemical and fertilizer industries installed on its margins, the trade and transportation of toxic substances in the port of Rio Grande, landfills, and the excessive use of agricultural

pesticides in the farmlands around the lagoon (Seeliger, Odebrecht and Castello, 1997). One of the most recent and important incidents in the port of Rio Grande was the acid spill from the Maltese freighter *MV Bahamas*. The ship entered the port of Rio Grande in August 1998 carrying 22 000 tonnes of sulphuric acid to supply the local fertilizer industries. A hole in the *MV Bahamas* caused water from the estuary to enter the freighter and react with the acid to produce a highly explosive gas. Considering the risks of explosion and the economic costs to take alternative measures, local authorities (port and governmental organizations, Port Authority, municipality and the university) decided to release about 9 000 tonnes of acid in the estuarine environment. The consequences to fisheries activities were extremely grave. Artisanal fisheries activities were prohibited in the estuary, compromising part of the fishing season for croaker and shrimp. The accident revealed the lack of contingency plans in port activities and the absence of care of local authorities for the environment and the population that depend on the resources. Seeliger and Costa (1997) also cite as important pollution sources in port activities the washing of vessel tanks, which release into the estuary different types of toxic hydrocarbon forms. Yet another source of contaminants to the estuary is the landfill of the city of Rio Grande. The municipal district of Rio Grande produces 110 000 tonnes of waste per year, which has been deposited on salt marshes at the margins of the estuary during the last 20 years. There are no prospects of waste treatment in the near future, which poses serious threats for the health of the local people and the environment.

One important environmental stressor to estuarine fisheries relates to the impacts of climate change on the productivity of estuarine resources. Costa, Seelinger and Bemvenuti (2010) demonstrated that the outflow of major tributaries to the Patos Lagoon increased since the first half of the twentieth century mainly in response to an increase in precipitation in the watersheds. Other concurrent processes contributed to the increase in freshwater runoff in the period, such as the decrease in soil permeability resulting from the expansion of urban areas, and the decrease in water infiltration and increase in near-surface runoff caused by deforestation and intensification of agriculture (Castello, in press). The process of turning the estuary into a more limnic state, observed in the last half century, is expected to continue in the next decades. Model projections point to a rise in precipitation and river runoff in the order of 10 percent to 60 percent in the next 50 years associated to an increase in temperature (Costa, Seelinger and Bemvenuti, 2010). According to the authors, the resulting increase in the outflow of the Patos Lagoon could extend the estuarine limits (or the area of brackish water) towards the sea and decrease the productivity of the area currently occupied by the estuary.

The intensification of the lagoon outflow and the decrease in salinity of estuarine waters will have grave consequences to the dynamics of artisanal fisheries resources. The exchange of larvae and juveniles of fish and crustaceans between the coastal waters and the estuary is strongly influenced by the intensity of the outflow currents. Vieira, Garcia and Grimm (2008) showed, for instance, that the increase in precipitation associated to El Niño events reduces the recruitment of juvenile mullet into the estuary and affects the reproductive migration. As a result, there is an inverse relationship between rainfall and mullet catches in the estuary (Vieira, Garcia and Grimm, 2008). Möller, Castello and Vaz (2009) demonstrated the same effect for shrimp, i.e. rainfall anomalies increase the lagoon outflow and negatively affect the passive entry of shrimp postlarvae into estuarine nursery areas, resulting in poor shrimp seasons with low catches. These effects are well known by fishers who frequently associate the success of their fisheries to the prevailing climatic conditions (Kalikoski and Vasconcellos, 2007).

The above examples illustrate the complex reality of the estuary of Patos Lagoon, where artisanal fisheries are subjected to the cascading impacts of other human activities in the watershed and estuarine areas as well as from environmental changes such as those associated to climate.

To be effective, the co-management regime established in the Patos Lagoon has to find ways to protect not only the fish stocks as it has been the issue of concern but also their habitats. There is little point in planning the enhancement of stocks if in the process the community cannot protect its environment and the habitats on which the stocks depend for spawning and nursery (Pinkerton, 1989; Young, 1999). Existing fisheries management institutions pay little attention to this aspect when defining rules for the conservation of fisheries resources (Table 26). On the other hand, efforts for the management and conservation of coastal habitats through their federal and state institutions have narrowly defined goals and indicators that disregard the impacts of coastal activities on the living resources, such as fisheries. This demonstrates the need for an integrated ecosystem-based management plan for fisheries and coastal zones.

6. CONCLUSIONS AND RECOMMENDATIONS

Final considerations on the study methodology

This study was carried out in response to a proposal made by FAO to elaborate a methodology that could be employed to assess the condition of small-scale fisheries in coastal lagoons. Challenged by this task, and motivated by the necessity for improving the knowledge base of artisanal fisheries in the Patos Lagoon estuary, a methodological approach was devised to assess the technical, environmental and socio-economic conditions of local artisanal fisheries.

A preliminary evaluation of the information needs for the governance of local artisanal fisheries, done in consultation with main stakeholders, revealed main deficiencies in basic information, such as the number of fishers, fishing effort and practices, fisheries production, as well as the need to unfold the complexity of livelihoods, vulnerabilities and adaptive capacity of fishers. It became clear that a sample-based approach alone would not suffice to respond to these needs. Therefore, a census methodology was adopted as the main instrument of research. Complementary information was sourced from a literature review, secondary data and in-depth semi-structured interviews.

The authors of this study believe that the census methodology was successful in meeting the demands for improving the knowledge base about local artisanal fisheries. The following strengths and weaknesses of the methodology adopted in the present study can be highlighted:

Strengths:

- The census method provided a complete picture of the fishery in terms of its technical, economic, social and environmental conditions.
- Data obtained can be readily converted into indicators that could be used to monitor these conditions over time and evaluate the performance of fisheries governance against sustainability and human development benchmarks.
- The method provided basic information that is normally lacking to support fisheries governance, such as the number of fishers, fishing effort, socio-economic conditions and access to policies.
- The design of the survey methodology was participatory and responded to stakeholders' priorities and demands. As a consequence, results of the study are being rapidly appropriated and applied to address governance issues by local institutions (e.g. in the 2010/2011 licensing of artisanal fishers by IBAMA, in the monitoring of fisheries statistics by the Ministry of Fisheries and Aquaculture, and in diligences of the Public Ministry).
- The capture of local knowledge in a systematic way provided information about fisheries dynamics and trends until now inexistent, contributing to the assessment of these data-poor fisheries.
- The method provided information on illegal, unreported and unregulated fisheries.

Weaknesses:

- The census method is time consuming and needs to take into account fishers' time availability, which is seasonal and often does not follow regular working hours. Carrying out fieldwork during fishing closure, on weekends and holidays, and having the help of

fishing community members were strategies used to conduct the study and overcome this problem.

- The high cost of conducting a census in large areas may be a limiting factor in some situations. Obtaining additional in-kind contributions from interested parties, especially for field support, has shown to be a viable option to attenuate this problem.
- Difficulty in finding adequately trained people with technical capacity to carry out fieldwork and data entry. A considerable amount of time was spent on training people to guarantee the quality of the study.

Censuses studies have been historically used in the agriculture sector to monitor the status and trends of food production and living conditions of rural people worldwide (FAO, 1995). Similarly, considering the data-poor status of artisanal fisheries globally, we conclude that censuses have the potential to be used by fishing states to monitor the status and trends in small-scale fisheries and improve the availability of information about these fisheries. The authors of this study believe that the Fisheries and Aquaculture Department of FAO has a strong role to play to this end, providing guidance to apply fisheries censuses globally.

To apply and adapt the method described in the present study to assess small-scale fisheries in other locations, the following general steps and recommendations are considered important:

1. Rapid assessment of data needs and priorities with all key fisheries stakeholders through meetings, interviews and focus groups. This initial step should aim to respond to questions such as those proposed by Garcia *et al.* (2008): Why is an assessment needed? Who asked for it? Who else should be invited to participate? What sort of assessment is needed? What sort of advice is expected? When is the response needed? What is the management context and/or capacity? The results of the study should always lead to further actions that secure livelihoods and sustainability of the fisheries.
2. Draft of the census survey questionnaire based on the data needs and priorities previously identified. When organizations draft the survey instrument, particular consideration should be given as to how the data collected can be merged and analysed in order to draw important conclusions. Do not collect data just to have it, but consider how the data can be triangulated to confirm certain hypotheses. Another important step to be taken at this stage is to evaluate the sensitivity of the information requested based on the cultural context, fishing practices and legislation. Finding ways to deal with the most sensitive information is key to obtaining reliable data. In this study, for instance, sensitive questions that could put respondents at risk were included in a separate anonymous questionnaire.
3. Validation of the census survey questionnaire through key stakeholders meetings. Once the survey instrument is drafted, it is important to check with key stakeholders if the instrument is adequately addressing all the needed information. The instrument should be revised until the questions are considered satisfactory.
4. Pre-test the census survey questionnaire with fishers for both content and language. It is important to pre-test the instrument with fishers' representatives of the whole diversity of fishing livelihoods and cultural backgrounds. The pre-test should be used to revise and prepare the final instrument to be applied in the fieldwork. At this stage, questions are reformulated to be clearer and to avoid ambiguity.
5. Announce the objectives of the study and the procedure to be adopted (including why, how, when, where and who will carry out the survey) before beginning fieldwork. Strategies such as radio interviews and distribution of pamphlets in fishing villages are

useful to make the study widely known. Inception workshops, such as the one conducted in this study, are also useful to discuss survey procedures with a wide range of main stakeholders. In situations where participation is voluntary, this step is particularly important to promote fishers buying into the study.

6. Make sure that all the logistics are in place to run fieldwork and data storage. The success of the study depends not only on the quality of the survey instrument but also on the technical capacity of the team running the project, including coordinators, enumerators and people responsible for data storage and processing. To this end, providing basic training in fisheries census surveys for enumerators is an important preparatory step. Good planning at this stage involves knowing the communities and mapping the fishing villages to be visited beforehand, establishing a calendar of visits per village and checking the best time to conduct the survey, having reliable contact people in the villages, having contingency plans for unexpected situations (e.g. bad weather, transportation problems, changes in team composition, etc.) that will require adaptations in the fieldwork. Customized databases are probably the best option for data storage, but in the lack of them commonly available spreadsheets and databases (Microsoft Excel and Access) can provide the needed tools for storage and analysis. Keep backups of the data.
7. Existing censuses and surveys from other non-fisheries authorities should be analysed to identify synergies and data gaps, and thereby providing important data for fisheries' managers. In this context, fisheries' managers and authorities should insist on the inclusion of fisheries pertinent data in national censuses and surveys for future use. Data such as the World Bank "Living Standards Measurement Study" can provide important sources of information to enrich the studies on fisheries. The World Bank database can be accessed at <http://microdata.worldbank.org/lsms/index.php/catalog>, and then can be searched for the country of interest.

Final considerations on the status and trends of artisanal fisheries in the Patos Lagoon estuary

This study has provided important contributions for the understanding of the current status and the challenges for the future of artisanal fisheries in the estuary of Patos Lagoon. Some of the key findings of the study, summarized below, can serve as benchmarks for guiding and evaluating future governance strategies to secure fishing livelihood and for sustainable use of resources.

- The number of artisanal fishers dependent on fishing as main livelihood in the Patos Lagoon estuary is smaller than expected from previously available information. It should be noted, however, that the number of people exploiting fisheries resources in the area is probably higher if occasional fishers are taken into account. In the future, a specific study will be required to adequately evaluate the magnitude and impact on the resources by occasional fishers.
- A better system of registration and documentation of artisanal fishers is a necessity to control access into the fishery and to guarantee participation in formulation of governmental policies by those who have fisheries as their main livelihood. The findings that a significant number of fishers are not fully documented and that a large contingent of non-fishers have been accessing governmental benefits are symptomatic of the failures of the current system. The institutions regulating the fisheries of the estuary should take into consideration the following aspects when revising the regulations and documentation required for the registration and licensing: differences between occasional and professional fishers, sale, transfer, rental and expiration of licences and registration, new

fishers, licence of boat and/or fisher, crews and owners, inheritance, invoices, and history in the fishery.

- The artisanal fishery has diverse technological characteristics, expressed in terms of differences in boat sizes, engines, equipment and fishing gear, affecting distinct levels of fishing capacity, territories and both fishing and non-fishing livelihood strategies.
- The shrimp fishery is an important source of income for the majority of the fishing localities, but not in all. There are many instances where other fisheries play a more important economic role, such as the mullet and croaker fisheries. Other species such as blue crab and silverside represent an important auxiliary source of income, especially in fishing seasons where there is a failure in abundance of the main resources.
- Shrimp catch volumes estimated in this study matched reasonably well the official statistics of production in recent good seasons. The same finding was not verified for the other main resources, which appear to be grossly underestimated by official statistics. The reasons for discrepancies need to be better evaluated in future studies. Declining trends in catches and CPUE of shrimp and croaker, inferred on the basis of fishers' knowledge, corroborate scientific assessments of the overexploited status of these resources. On the other hand, there is no clear indication of decline in mullet catches that would characterize overfishing. Instead, individual catches in good seasons seem to have changed little in the last two decades; a finding that is consistent with the official statistics. Further analysis of the changes in artisanal fishing effort and the changes in the frequency of occurrence of good seasons (another indicator of resource overfishing), as well as of other biological indicators, should be made in the future to better evaluate the status of this important resource for artisanal fishers.
- Artisanal fisheries make a significant contribution to local economies, as inferred from the first sale value of production. It is estimated that between R\$23 million and R\$46 million worth of fisheries resources enter the local economies in good seasons. Fisheries can account for up to 25 percent of the agriculture GDP of municipalities in the estuary of Patos Lagoon. This represents an underestimate of the real economic importance of the sector if other use and non-use values of fisheries are considered.
- Artisanal fisheries are characterized by minimal infrastructure for fish landing and conservation. Although this situation is well suited to the dominant type of commercialization, it is an important impediment to the development of alternative market strategies, which would increase economic returns for fishers and allow them to break away from the economic dependence on intermediaries and processors.
- The bulk of fisheries production is marketed fresh. Fishers sell their catches to a different array of buyers, including intermediaries, local processors, associations and/or cooperatives and directly to consumers. Selling to local buyers and/or intermediaries is the dominant way of commercialization in the main fishing localities. The highest prices are fetched when selling directly to consumers, while little variation in prices was found among the other identified buyers. In recent years, efforts have been made to stimulate the organization of fishers' associations and cooperatives as a way of promoting better and fairer options for fish commercialization. Although this mode of commercialization has a potential role to play in the future, it was found to have a minor importance at the moment in the region.
- Improving the role of fishers associations and cooperatives in the region will require strengthening community leaderships, building technical capacity, improving and strengthening formal credit policies for local community-based organizations,

strengthening alternative markets for artisanal fisheries production (e.g. institutional markets and fish fairs), and finding ways to regulate the dominant mode of commercialization in the region centred on the intermediaries.

- The income level of fishers is generally low in good seasons and can drop below the poverty line in bad seasons. Given the deteriorating status of resources and the unfavourable climatic conditions that prevailed in the last decades, it can be concluded that artisanal fishers' livelihoods are currently in a vulnerable situation.
- Fishing livelihoods in the Patos Lagoon estuary are diverse and generally not exclusively dependent on capture fisheries activities. Fishers often rely on other sources of income in addition to fishing as a strategy for subsistence, including both fisheries and non-fisheries-related activities. Gear maintenance, fish processing, agriculture in rural areas and occasional jobs in urban areas are common alternatives of cash income for fishers. This situation is both a reflection of traditional practices and an adaptation strategy to current poor economic returns from fishing.
- Fishers also employ distinct fishing strategies to cope with failed seasons, such as directing effort to alternative species – blue crab and mullet are important alternatives in communities of the lower estuary and freshwater species in the upper estuary.
- Government aid in the form of an unemployment benefit paid during the fishing closure is one of the main sources of fishers' income at the moment. This policy, which was shown to reach 80 percent of fishers interviewed, has an important role to livelihood maintenance because it guarantees a minimal level of income to households in the face of the current poor economic returns from fishing. If on the one hand it provides an important social "safety net" that precludes fishers from entering in a situation of poverty, on the other hand it is unclear the effect that high dependence on this policy will have on the adaptive capacity of communities to cope with such situations of crisis and to secure their livelihoods in a changing environment.
- Qualitative and quantitative data indicate that a large number of artisanal fishers of the estuary of Patos Lagoon receive a significant part of their livelihood from sources other than capture fishing. Numerous factors have contributed to this situation, including failures in fisheries governance and environmental changes, which led to a series of adaptation strategies at the community and government levels for securing fishing livelihoods. These findings have serious policy implications, if it is considered that the current view of artisanal fishers adopted by government institutions that artisanal fishers work exclusively on fishing. As demonstrated here, with some exceptions, this is no longer a reality in the region, where fishers were forced to find income sources in addition to fishing to maintain their fishing livelihood.
- Fish is an important source of animal protein to artisanal fishers and plays a crucial role for their food security. The estimated average fish consumption per capita (52.8 kg/person per year) in artisanal fishing communities of the estuary of Patos Lagoon is among the highest in the country.
- Fish capture activities are mostly developed by men, while women participate more intensively in fish processing activities. In addition, in some communities, the income obtained by women in activities outside the fishery plays an important role in the maintenance of fishers' households. The importance of this source of family income becomes particularly important during failed fishing seasons.

- There are very few young fishers engaged in artisanal fisheries (12.8 percent are less than 30 years old). The low recruitment of individuals to the fishery, associated with the overexploitation of resources, represents a threat to the continuity of the activity in the estuary of Patos Lagoon in the medium-long term.
- The illiteracy rate among fishers is high (10.9 percent) and well above the state (3.1 percent) average. Still, about 75 percent of fishers may be considered functionally illiterate for not having completed elementary school.
- With few exceptions, the access of households to basic infrastructure and social services, including access to potable water, sewage systems, collection of domestic waste, health, school and transport, are reasonably good compared with other areas in Brazil.
- Both formal and informal credit mechanisms play a role in the financing of artisanal fisheries activities at the moment. While federal and state programmes of rural credit have been instrumental to the acquisition of means of production by fishers, informal credit options, sourced for instance from intermediaries, have been providing the needed cash flow to run individual fishing units. The absence of formal credit options to cover the latter aspect, contributes to maintaining the relationship of dependence of fishers on intermediaries – a dependence that permeates the whole fishery system from production to commercialization. Governmental policies of rural credit have enabled artisanal fishers to access financial resources previously inaccessible, and therefore created the conditions for the independence of fishers who lacked the means of production. However, concerns exist that without appropriate criteria for accessing credit, these policies will have the unintended effect of exacerbating the pernicious cycle of increase in fishing capacity, intensification of resource overfishing and worsening of the economic situation of fishers.
- An important institutional change that influenced positively the governance of artisanal fisheries in the Patos Lagoon estuary was the creation of the Forum of Patos Lagoon, a multi-institutional co-management arrangement. Through the Forum, a venue exists where institutions and fishers can discuss and take actions on different issues affecting the artisanal fishery. One of the merits of the Forum was the establishment of norms for resource exploitation based on a participatory process. An evaluation of fishers' perception about the norms in place revealed, however, incongruence and lack of consensus about the control of fishing gear and fishing calendars of some species. It has also shown that compliance with the norms is generally low. Other factors contributing to this situation are the diversified fishing livelihoods in the estuary, the lack of community organization and leadership able to influence decisions and improve governance, and the condition of open access to fisheries outside the estuarine limits. This situation encourages competition that leads to overexploitation of resources instead of cooperation for sustainable use.
- Artisanal fisheries in the Patos Lagoon estuary are inserted in a coastal ecosystem with multiple activities, which can alter the carrying capacity and resilience of the estuary. The information available also indicates that the estuarine ecosystem is shifting to a more limnic condition in response to environmental changes and may become less productive and consequently less favourable to artisanal fisheries in the next decades. This scenario points to a continuous increase in the vulnerability of fishers. The need for an ecosystem-based fisheries management is certain under this scenario to improve the adaptive capacity of institutions and communities to find optimal solutions, within and outside the sector, to deal with these threats.

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ANNEX 1

SURVEY QUESTIONNAIRES USED IN THE CENSUS OF ARTISANAL FISHERIES
IN THE PATOS LAGOON ESTUARY

Interviewer: _____ Date: __/__/__

BASIC QUESTIONNAIRE		
1-Name: _____ Nickname: _____		
Gender: () M () F Date of birth: __/__/__ CPF: _____		
Street: _____ # _____		
City: _____ District/area _____		
2-Marital status: () Single () Married () Separated () Live-in () Widower	3-Children? () yes How many? _____ () no	
4- Other family members in the community? () yes () no	5- Were you born and raised in the community? () yes () no Where? _____	
6- How long have you live in the current house? _____ years	7- How long have you lived in the community? _____ years	
8- Home situation: () own () rented () family () squatted () other		
PHYSICAL CONDITIONS OF HOME		
9-Type of construction material: () Brick, with plaster covering () Brick, with partial or no plaster covering () Wood () Mixed	10-Bathroom? () yes, within the house () yes, outside () no	11-Type of flooring: () covered () concrete base () dirt () mixed(covered/concrete base) () other _____
12-Which of the following appliances do you own? () TV () DVD () Radio () Fridge () Stove () Freezer () Telephone () Mobile phone () Computer () Other(s): _____		
VULNERABILITY OF HOME		
13- Has your home ever been affected by floods? () often () a few times () once () never		
14- Is your home located at an unstable area (affected by erosion)? () yes () no		
15- Is your home near any of the following: () industrial area () open sewer () waste disposal area () fish processing disposal area () another unhealthy place _____ () no		
HUMAN SERVICES AVAILABLE		
16-Do you have electric power supply at home? () yes () no	17- How is the water supply to your home? () pipe () pipe within lot () cistern () ground well () artesian well, with pump () none	
18- Where does your home's sewer drain to? () tank () tank with overflow pipe () septic tank () public sewage system () directly to lagoon () open () other		
19- Your solid waste is: () collected () collected and separated () recycled () burnt () buried () thrown into lagoon () others		
20- Is there public transportation in the community? () no () yes, access less than 2 km from home	21- Is there a community health center available in the community? () yes () no	22- Is there a public school available in the community? () yes () no
23- Who do you look to during a medical emergency in the family? () no one, go directly to the local health center or hospital () family members () friends () colony/union () middleman () association () cooperative () politicians		

FISHERY ACTIVITIES AND TRADITION	
24- How old were you when you started fishing? _____ years old	26- How old were you when you started fishing with your own nets and boat? _____ years old
27- If you had a choice, would you have chosen the profession of fisherman? () yes () no Which one? ___	28- If you could have the same income at another occupation, would you change activity? () yes () no
29- If you have underage children or grandchildren, would you like them to keep fishing? () yes, children () yes, children () no	
30- How many people in your home work at fishing?	
Self	
Schooling: () 1-illiterate () 2- Incomplete Elementary () 3- Complete Elementary () 4- Incomplete High School () 5- Complete High School () 6- Incomplete College () 7- Complete College	
Fishery-related activities : <input type="checkbox"/> 1-fishing <input type="checkbox"/> 2-direct sale to consumer <input type="checkbox"/> 3-direct sale to middleman <input type="checkbox"/> 4-direct sale to associations/cooperatives <input type="checkbox"/> 5-processing <input type="checkbox"/> 6-equipment maintenance and cleaning <input type="checkbox"/> 7-other: _____	Do you also perform those activities outside your household? <input type="checkbox"/> yes () no <input type="checkbox"/> yes () no
Name: _____ CPF: _____	
Kinship: _____ Gender: () M () F	
Schooling: () 1-illiterate () 2- Incomplete Elementary () 3- Complete Elementary () 4- Incomplete High School () 5- Complete High School () 6- Incomplete College () 7- Complete College	
Fishery-related activities: (1) (2) (3) (4) (5) (6) (7)	Which one is also performed outside the family (home)? _____
Name: _____ CPF: _____	
Kinship: _____ Gender: () M () F	
Schooling: () 1-illiterate () 2- Incomplete Elementary () 3- Complete Elementary () 4- Incomplete High School () 5- Complete High School () 6- Incomplete College () 7- Complete College	
Fishery-related activities: (1) (2) (3) (4) (5) (6) (7)	Which one is also performed outside the family (home)? _____
Name: _____ CPF: _____	
Kinship: _____ Gender: () M () F	
Schooling: () 1-illiterate () 2- Incomplete Elementary () 3- Complete Elementary () 4- Incomplete High School () 5- Complete High School () 6- Incomplete College () 7- Complete College	
Fishery-related activities: (1) (2) (3) (4) (5) (6) (7)	Which one is also performed outside the family (home)? _____

ORGANIZATIONS AND REPRESENTATION			
31- Are you affiliated to any fisherman's colony/union? ()21()22()23()28()other __ ()no		32- Are you affiliated to any fisherman's association or cooperative? () no () yes, which one? _____	
33- Have you taken any course or training for associativism or cooperativism? () yes, which one? _____ () no			
DOCUMENTATION AND BENEFITS			
34- Among the people in your home who work at fishing, who has the fisherman's registry card (SEAP)?			
Self:		Kinship:	
Type:	Do not have NFR. Reasons:	Type:	Do not have NFR. Reasons:
() professional artisanal () professional industrial () does not have	() never applied () applied, but never received () lack of documentation () other _____	() professional artisanal () professional industrial () does not have	() never applied () applied, but never received () lack of documentation () other _____
Kinship:		Kinship:	
Type:	Do not have NFR. Reasons:	Type:	Do not have NFR. Reasons:
() professional artisanal () professional industrial () does not have	() never applied () applied, but never received () lack of documentation () other _____	() professional artisanal () professional industrial () does not have	() never applied () applied, but never received () lack of documentation () other _____
35- Among the people in your home who work at fishing, who has IBAMA's license permit?			
() yes, self:		() yes, kinship:	
Does not have permit reasons:	If asked, but never got reasons?	Does not have permit Reasons:	If asked, but never got reasons?
() never applied () applied, but never received (has protocol)	() IBAMA's limit reached () applied after deadline () lack of documentation Which one? _____ () other (s) _____	() never applied () applied, but never received (has protocol)	() IBAMA's limit reached () applied after deadline () lack of documentation Which one? _____ () other (s) _____
() yes, kinship:		() yes, kinship:	
Does not have permit reasons:	If asked, but never got reasons?	Does not have permit Reasons:	If asked, but never got reasons?
() never applied () applied, but never received (has protocol)	() IBAMA's limit reached () applied after deadline () lack of documentation Which one? _____ () other (s) _____	() never applied () applied, but never received (has protocol)	() IBAMA's limit reached () applied after deadline () lack of documentation Which one? _____ () other (s) _____
36- Among the people in your home who work at fishing, who is registered at the Navy Port State Control?			
() yes, self:		() yes, kinship:	
Not registered. Reasons: () not minimum schooling (4th grade) () cannot swim () does not have NFR () never applied for () has no identification document () course always full () other(s) _____		Not registered. Reasons: () not minimum schooling (4th grade) () cannot swim () does not have NFR () never applied for () has no identification document () course always full () other(s) _____	

<input type="checkbox"/> yes, kinship:		<input type="checkbox"/> yes, kinship:	
Not registered. Reasons: <input type="checkbox"/> not minimum schooling (4th grade) <input type="checkbox"/> cannot swim <input type="checkbox"/> does not have NFR <input type="checkbox"/> never applied for <input type="checkbox"/> has no identification document <input type="checkbox"/> course always full <input type="checkbox"/> other(s) _____		Not registered. Reasons: <input type="checkbox"/> not minimum schooling (4th grade) <input type="checkbox"/> cannot swim <input type="checkbox"/> does not have NFR <input type="checkbox"/> never applied for <input type="checkbox"/> has no identification document <input type="checkbox"/> course always full <input type="checkbox"/> other(s) _____	
37- Do you or anyone else in your household have a producer receipt of invoices?			
Self:		Kinship:	
<input type="checkbox"/> yes, self <input type="checkbox"/> yes, with someone else <input type="checkbox"/> no		<input type="checkbox"/> yes, self <input type="checkbox"/> yes, with someone else <input type="checkbox"/> no	
Kinship:		Kinship:	
<input type="checkbox"/> yes, self <input type="checkbox"/> yes, with someone else <input type="checkbox"/> no		<input type="checkbox"/> yes, self <input type="checkbox"/> yes, with someone else <input type="checkbox"/> no	
38- If you have the producer receipt of invoices, do you give out the invoice?			
Self:		Kinship:	
<input type="checkbox"/> yes, for costumers <input type="checkbox"/> yes, for buyers/middlemen <input type="checkbox"/> yes, for industries <input type="checkbox"/> yes, for association or cooperative <input type="checkbox"/> no		<input type="checkbox"/> yes, for costumers <input type="checkbox"/> yes, for buyers/middlemen <input type="checkbox"/> yes, for industries <input type="checkbox"/> yes, for association or cooperative <input type="checkbox"/> no	
<input type="checkbox"/> yes, for costumers <input type="checkbox"/> yes, for buyers/middlemen <input type="checkbox"/> yes, for industries <input type="checkbox"/> yes, for association or cooperative <input type="checkbox"/> no		<input type="checkbox"/> yes, for costumers <input type="checkbox"/> yes, for buyers/middlemen <input type="checkbox"/> yes, for industries <input type="checkbox"/> yes, for association or cooperative <input type="checkbox"/> no	
39- Out of the people who work at fishing in your home, which ones own boats?			
Self:			
Powerless boats.			
Name of boat:			
Is it registered at the Navy Port State Control? <input type="checkbox"/> yes <input type="checkbox"/> no			
If not registered. Reason: <input type="checkbox"/> financial issues <input type="checkbox"/> travel to the Navy <input type="checkbox"/> didn't know <input type="checkbox"/> others _____			
Name of boat:			
Is it registered at the Navy Port State Control? <input type="checkbox"/> yes <input type="checkbox"/> no			
If not registered. Reason: <input type="checkbox"/> financial issues <input type="checkbox"/> travel to the Navy <input type="checkbox"/> didn't know <input type="checkbox"/> others _____			
Powered boats.			
Name of boat:			
Is it registered at the Navy Port State ? <input type="checkbox"/> yes <input type="checkbox"/> no		If not registered. Reason: <input type="checkbox"/> financial issues <input type="checkbox"/> travel to the captancy <input type="checkbox"/> didn't know <input type="checkbox"/> others _____	
Year: _____ Size: _____ GRT: _____		Engine: (Hp) _____ <input type="checkbox"/> diesel <input type="checkbox"/> gas	
Cabin? <input type="checkbox"/> yes <input type="checkbox"/> no		Brand _____ Switchgear <input type="checkbox"/> yes <input type="checkbox"/> no	
Equipment: <input type="checkbox"/> VHF radio <input type="checkbox"/> mobile phone <input type="checkbox"/> TV <input type="checkbox"/> AM/FM radio <input type="checkbox"/> PXradio (amateur) <input type="checkbox"/> sound <input type="checkbox"/> sonar <input type="checkbox"/> GPS <input type="checkbox"/> other _____			
Name of boat:			
Is it registered at the Navy Port State? <input type="checkbox"/> yes <input type="checkbox"/> no		If not registered. Reason: <input type="checkbox"/> financial issues <input type="checkbox"/> travel to the captancy <input type="checkbox"/> didn't know <input type="checkbox"/> others _____	
Year: _____ Size: _____ GRT: _____		Engine: (Hp) _____ <input type="checkbox"/> diesel <input type="checkbox"/> gas	
Cabin? <input type="checkbox"/> yes <input type="checkbox"/> no		Brand _____ Switchgear <input type="checkbox"/> yes <input type="checkbox"/> no	
Equipment: <input type="checkbox"/> VHF radio <input type="checkbox"/> mobile phone <input type="checkbox"/> TV <input type="checkbox"/> AM/FM radio <input type="checkbox"/> PXradio (amateur) <input type="checkbox"/> sound <input type="checkbox"/> sonar <input type="checkbox"/> GPS <input type="checkbox"/> other _____			

Kinship:			
Powerless boats.			
Name of boat: _____			
Is it registered at the Navy Port State Control? <input type="checkbox"/> yes <input type="checkbox"/> no			
If not registered. Reason: <input type="checkbox"/> financial issues <input type="checkbox"/> travel to the captancy <input type="checkbox"/> didn't know <input type="checkbox"/> others _____			
Powered boats.			
Name of boat: _____			
Is it registered at the Navy Port State? <input type="checkbox"/> yes <input type="checkbox"/> no		If not registered. Reason: <input type="checkbox"/> financial issues <input type="checkbox"/> travel to the captancy <input type="checkbox"/> didn't know <input type="checkbox"/> others _____	
Year _____	Size _____	GRT _____	Engine: (Hp) _____ <input type="checkbox"/> diesel <input type="checkbox"/> gas
Cabin? <input type="checkbox"/> yes <input type="checkbox"/> no			Brand _____ Switchgear <input type="checkbox"/> yes <input type="checkbox"/> no
Equipment: <input type="checkbox"/> VHF radio <input type="checkbox"/> mobile phone <input type="checkbox"/> TV <input type="checkbox"/> AM/FM radio <input type="checkbox"/> PX radio (amateur) <input type="checkbox"/> sound <input type="checkbox"/> sonar <input type="checkbox"/> GPS <input type="checkbox"/> other _____			
40- If takes part in capture fishing but has no boat, what function?			
Kinship	Function	Owner name	Fish on land?
	<input type="checkbox"/> crew <input type="checkbox"/> skipper		<input type="checkbox"/> yes <input type="checkbox"/> no
	<input type="checkbox"/> crew <input type="checkbox"/> skipper		<input type="checkbox"/> yes <input type="checkbox"/> no
	<input type="checkbox"/> crew <input type="checkbox"/> skipper		<input type="checkbox"/> yes <input type="checkbox"/> no
	<input type="checkbox"/> crew <input type="checkbox"/> skipper		<input type="checkbox"/> yes <input type="checkbox"/> no
	<input type="checkbox"/> crew <input type="checkbox"/> skipper		<input type="checkbox"/> yes <input type="checkbox"/> no
	<input type="checkbox"/> crew <input type="checkbox"/> skipper		<input type="checkbox"/> yes <input type="checkbox"/> no
BENEFITS			
41- Do you or anyone in your home receive or have received any of the following benefits?			
Self:			
Unemployment benefit <input type="checkbox"/> Yes <input type="checkbox"/> Yes, but no longer gets <input type="checkbox"/> No <input type="checkbox"/> Tried, but didn't get	Others <input type="checkbox"/> School grant <input type="checkbox"/> Maternity bonus <input type="checkbox"/> Family grant <input type="checkbox"/> Illness bonus, work accident <input type="checkbox"/> Death pension <input type="checkbox"/> Reclusion bonus <input type="checkbox"/> Gas bonus <input type="checkbox"/> Tried, but didn't get. Which one _____	Retirement <input type="checkbox"/> Tried, but didn't get <input type="checkbox"/> Yes Type: <input type="checkbox"/> Disability <input type="checkbox"/> Age <input type="checkbox"/> Time in fishery	
Kinship:			
Unemployment benefit <input type="checkbox"/> Yes <input type="checkbox"/> Yes, but no longer gets <input type="checkbox"/> No <input type="checkbox"/> Tried, but couldn't	Others <input type="checkbox"/> School grant <input type="checkbox"/> Maternity bonus <input type="checkbox"/> Family grant <input type="checkbox"/> Illness bonus, work accident <input type="checkbox"/> Death pension <input type="checkbox"/> Reclusion bonus <input type="checkbox"/> Gas bonus <input type="checkbox"/> Tried, but didn't get. Which one _____	Retirement <input type="checkbox"/> Tried, but didn't get <input type="checkbox"/> Yes Type: <input type="checkbox"/> Disability <input type="checkbox"/> Age <input type="checkbox"/> Time in fishery	
Kinship:			
Unemployment benefit <input type="checkbox"/> Yes <input type="checkbox"/> Yes, but no longer gets <input type="checkbox"/> No <input type="checkbox"/> Tried, but couldn't	Others <input type="checkbox"/> School grant <input type="checkbox"/> Maternity bonus <input type="checkbox"/> Family grant <input type="checkbox"/> Illness bonus, work accident <input type="checkbox"/> Death pension <input type="checkbox"/> Reclusion bonus <input type="checkbox"/> Gas bonus <input type="checkbox"/> Tried, but didn't get. Which one _____	Retirement <input type="checkbox"/> Tried, but didn't get <input type="checkbox"/> Yes Type: <input type="checkbox"/> Disability <input type="checkbox"/> Age <input type="checkbox"/> Time in fishery	
Kinship:			
Unemployment benefit <input type="checkbox"/> Yes <input type="checkbox"/> Yes, but no longer gets <input type="checkbox"/> No <input type="checkbox"/> Tried, but couldn't	Others <input type="checkbox"/> School grant <input type="checkbox"/> Maternity bonus <input type="checkbox"/> Family grant <input type="checkbox"/> Illness bonus, work accident <input type="checkbox"/> Death pension <input type="checkbox"/> Reclusion bonus <input type="checkbox"/> Gas bonus <input type="checkbox"/> Tried, but didn't get. Which one _____	Retirement <input type="checkbox"/> Tried, but didn't get <input type="checkbox"/> Yes Type: <input type="checkbox"/> Disability <input type="checkbox"/> Age <input type="checkbox"/> Time in fishery	

42- How do you make your retirement payments (IN \$)?		
Self:		
How? <input type="checkbox"/> Own producer receipt of invoices <input type="checkbox"/> Husband's/wife's producer receipt of invoices <input type="checkbox"/> Social security payment <input type="checkbox"/> No payment	How long? <input type="checkbox"/> Less than 1 year <input type="checkbox"/> 1-5 years <input type="checkbox"/> 5-10 years <input type="checkbox"/> 10-20 years <input type="checkbox"/> More than 20 years	Still paying? <input type="checkbox"/> Yes <input type="checkbox"/> No
Kinship:		
How? <input type="checkbox"/> Own producer receipt of invoices <input type="checkbox"/> Husband's/wife's producer receipt of invoices <input type="checkbox"/> Social security payment <input type="checkbox"/> No payment	How long? <input type="checkbox"/> Less than 1 year <input type="checkbox"/> 1-5 years <input type="checkbox"/> 5-10 years <input type="checkbox"/> 10-20 years <input type="checkbox"/> More than 20 years	Still paying? <input type="checkbox"/> Yes <input type="checkbox"/> No
Kinship:		
How? <input type="checkbox"/> Own producer receipt of invoices <input type="checkbox"/> Husband's/wife's producer receipt of invoices <input type="checkbox"/> Social security payment <input type="checkbox"/> No payment	How long? <input type="checkbox"/> Less than 1 year <input type="checkbox"/> 1-5 years <input type="checkbox"/> 5-10 years <input type="checkbox"/> 10-20 years <input type="checkbox"/> More than 20 years	Still paying? <input type="checkbox"/> Yes <input type="checkbox"/> No
Kinship:		
How? <input type="checkbox"/> Own producer receipt of invoices <input type="checkbox"/> Husband's/wife's producer receipt of invoices <input type="checkbox"/> Social security payment <input type="checkbox"/> No payment	How long? <input type="checkbox"/> Less than 1 year <input type="checkbox"/> 1-5 years <input type="checkbox"/> 5-10 years <input type="checkbox"/> 10-20 years <input type="checkbox"/> More than 20 years	Still paying? <input type="checkbox"/> Yes <input type="checkbox"/> No
43- Have you or anyone from your household ever accessed a fishery financing program?		
Self:		
Financing and debt situation		
<input type="checkbox"/> PRONAF: <input type="checkbox"/> still paying <input type="checkbox"/> paid for <input type="checkbox"/> stopped paying <input type="checkbox"/> PRONAFINHO: <input type="checkbox"/> still paying <input type="checkbox"/> paid for <input type="checkbox"/> stopped paying <input type="checkbox"/> R.S./RURAL/PESCA: <input type="checkbox"/> still paying <input type="checkbox"/> paid for <input type="checkbox"/> stopped paying <input type="checkbox"/> Bank loan <input type="checkbox"/> still paying <input type="checkbox"/> paid for <input type="checkbox"/> stopped paying		
Kinship:		
Financing and debt situation		
<input type="checkbox"/> PRONAF: <input type="checkbox"/> still paying <input type="checkbox"/> paid for <input type="checkbox"/> stopped paying <input type="checkbox"/> PRONAFINHO: <input type="checkbox"/> still paying <input type="checkbox"/> paid for <input type="checkbox"/> stopped paying <input type="checkbox"/> R.S./RURAL/PESCA: <input type="checkbox"/> still paying <input type="checkbox"/> paid for <input type="checkbox"/> stopped paying <input type="checkbox"/> Bank loan <input type="checkbox"/> still paying <input type="checkbox"/> paid for <input type="checkbox"/> stopped paying		
Kinship:		
Financing and debt situation		
<input type="checkbox"/> PRONAF: <input type="checkbox"/> still paying <input type="checkbox"/> paid for <input type="checkbox"/> stopped paying <input type="checkbox"/> PRONAFINHO: <input type="checkbox"/> still paying <input type="checkbox"/> paid for <input type="checkbox"/> stopped paying <input type="checkbox"/> R.S./RURAL/PESCA: <input type="checkbox"/> still paying <input type="checkbox"/> paid for <input type="checkbox"/> stopped paying <input type="checkbox"/> Bank loan <input type="checkbox"/> still paying <input type="checkbox"/> paid for <input type="checkbox"/> stopped paying		
44- What is the average monthly fish consumption in your household?		
<input type="checkbox"/> Everyday <input type="checkbox"/> At least 5 days a week <input type="checkbox"/> At least 3 days a week <input type="checkbox"/> At least 1 day a week <input type="checkbox"/> Occasional, at least 1 day a month <input type="checkbox"/> None		

Interviewer: _____ Date: / / _____

1- Gender: () M () F 2- Year of birth: _____

3- City: _____ 4- District/Area: _____

5- How old were you when you started fishing? _____ With whom? _____

6- How old were you when you started fishing with your own gear? _____

7- Do you own fishing gear/nets? () yes () no **MOVE TO PART B**

8- Are the fishing nets you use your own, or are they leased (borrowed)?
 () own
 () leased (borrowed)

9- Do you fish or just own gear? () yes, I do () I don't fish **MOVE TO THE TABLE**

10- If you own gear but do not fish, answer the following table and move to part B.

Gear types	Size	How many
Fyke net		
Slow net		
Other trawl		
Gillnet		
Trawl		
Berimou		
Beach seine		
Other		

PART A: EFFORT AND FISHING SEASONS YOU FISH

Select the species you catch and specify the fishing gear and effort used for each one. Indicate how many nets you own (n) in each case.

11- () Pink shrimp

Currently						
Gear	Size (fathom)	How many	Mesh (mm)	Engine power (Hp)	Where? (see map)	Yield in a good day
Fyke net						
Slow net						
Other trawl						
Beach seine						
Pull trawl						
Berimou						
Other:						

When you started fishing						
Gear	Size (fathom)	How many	Mesh (mm)	Engine power (Hp)	Where? (see map)	Gear
Fyke net						
Slow net						
Other trawl						
Beach seine						
Pull trawl						
Berimou						
Other:						

12- How much do you catch, on average, in a good shrimp season?
 When you started fishing _____ kg
 Currently _____ kg

13- () Croaker

Currently						
Gear	Size (fathom)	Height (mesh)	How many	Mesh (mm)	Where (see map)	Yield in a good day
Drift gillnet						
Drift gillnet in the ocean						
Fixed gillnet						
Surround gillnet						
Trawl						
Caracol (arrastão)						
Other:						

When you started fishing						
Gear	Size (fathom)	Height (mesh)	How many	Mesh (mm)	Where (see map)	Yield in a good day
Drift gillnet						
Drift gillnet in the ocean						
Fixed gillnet						
Surround gillnet						
Trawl						
Caracol (arrastão)						
Other:						

14- How much do you catch, on average, in a good croaker season?

When you started fishing _____ kg

Currently _____ kg

13- () Mullet

Currently						
Gear	Size (fathom)	Height (mesh)	How many	Mesh (mm)	Where (see map)	Yield in a good day
Drift gillnet						
Drift gillnet in the ocean						
Fixed gillnet						
Surround gillnet						
Trawl						
Caracol (arrastão)						
Other:						

When you started fishing						
Gear	Size (fathom)	Height (mesh)	How many	Mesh (mm)	Where (see map)	Yield in a good day
Drift gillnet						
Drift gillnet in the ocean						
Fixed gillnet						
Surround gillnet						
Troina						
Caracor (arrastão)						
Other:						

16- How much do you catch, on average, in a good mullet season?

When you started fishing _____ kg

Currently _____ kg

17- () Catfish

Currently						
Gear	Size (fathom)	Height (mesh)	How many	Mesh (mm)	Where (see map)	Yield in a good day
Drift gillnet						
Drift gillnet in the ocean						
Fixed gillnet						
Surround gillnet						
Troina						
Caracor (arrastão)						
Other:						

When you started fishing						
Gear	Size (fathom)	Height (mesh)	How many	Mesh (mm)	Where (see map)	Yield in a good day
Drift gillnet						
Drift gillnet in the ocean						
Fixed gillnet						
Surround gillnet						
Troina						
Caracor (arrastão)						
Other:						

18- How much do you catch, on average, in a good catfish season?

When you started fishing _____ kg

Currently _____ kg

19- () Silverside

Currently						
Gear	Size (fathoms)	Height (mesh)	How many	Mesh (mm)	Where (see map)	Yield in a good day
Drift gillnet						
Fixed gillnet						
Fixed gillnet'						
Surround gillnet						
Trawl						
Caracol (arrastão)						
Other:						

When you started fishing						
Gear	Size (fathoms)	Height (mesh)	How many	Mesh (mm)	Where (see map)	Yield in a good day
Drift gillnet						
Fixed gillnet						
Fixed gillnet'						
Surround gillnet						
Trawl						
Caracol (arrastão)						
Other:						

20- How much do you catch, on average, in a good silverside season?

When you started fishing _____ kg

Currently _____ kg

21- () Flatfish

Currently						
Gear	Size (fathoms)	Height (mesh)	How many	Mesh (mm)	Where (see map)	Yield in a good day
Drift gillnet						
Fixed gillnet						
Fixed gillnet'						
Surround gillnet						
Trawl						
Caracol (arrastão)						
Other:						

When you started fishing						
Gear	Size (fathom)	Height (mesh)	Number	Mesh (mm)	Where (see map)	Yield in a good day
Drift gillnet						
Fixed gillnet						
Fixed gillnet						
Surround gillnet						
Tromba						
Caraco (arrastão)						
Other:						

22- How much do you catch, on average, in a good flatfish season?

When you started fishing _____ kg

Currently _____ kg

23- () Blue crab

Currently						
Gear	Size (fathom)	Number	Mesh (mm)	Where (see map)	Yield in a good day	
Fyke net						
Longline						
Otter trawl						
Beach seine						
Argola						
Gerere						
Other:						

When you started fishing						
Gear	Size (fathom)	Number	Mesh (mm)	Where (see map)	Yield in a good day	
Fyke net						
Longline						
Otter trawl						
Beach seine						
Argola						
Gerere						
Other:						

24- How much do you catch, on average, in a good blue season?

When you started fishing _____ kg

Currently _____ kg

25- What other species are important for your fishery?

Species	Before	Now	Species	Before	Now	Species	Before	Now
Codling			Garoupa			Flava		
Bluefish			Ouroado			Callin pintoado		
Argentine croaker			streaked prochilod			Tambora		
Callin gun			Callin jundiá			Itaipira		
Callin boca-larga			Flatfish			Menhaden		
biru			black drum			Callin viola		
Angler shark			King croaker			Other(s)		
Guitarfish			Callin pau					
Other sharks			Fresh water silverside					
Seabed shrimp			Weakfish					
Callin cascudo			Royal weakfish					

PART B																	
26- When applying for your IBAMA license permit, what do you inform as your "andaina" location? <input type="checkbox"/> Place: _____		27- Do you fish here? <input type="checkbox"/> yes, during the whole season <input type="checkbox"/> yes, during part of the season <input type="checkbox"/> no, I don't usually fish at a fixed place															
28- Do you think fishermen should always fish with their "andainas" at the same spot? <input type="checkbox"/> yes <input type="checkbox"/> no		30- If you fish at another fisherman's registered spot, what happens when he arrives? <input type="checkbox"/> I take my gears away <input type="checkbox"/> I go on fishing <input type="checkbox"/> we share the space between both andainas <input type="checkbox"/> I wait to leave when he calls enforcement <input type="checkbox"/> other _____															
29- Do you think the andaina's location should be registered? <input type="checkbox"/> yes <input type="checkbox"/> no																	
INCOME AND CONSUMPTION																	
31- What are your means of subsistence? <input type="checkbox"/> work at fishing throughout year <input type="checkbox"/> only fish shrimp <input type="checkbox"/> fish aboard the Industrial fleet in the ocean <input type="checkbox"/> boat owner <input type="checkbox"/> buyer or middleman <input type="checkbox"/> net fixing <input type="checkbox"/> processing (e.g., peeling shrimp, fish filleting) <input type="checkbox"/> agriculture <input type="checkbox"/> work in the city (formal job) <input type="checkbox"/> occasional jobs <input type="checkbox"/> unemployment benefit <input type="checkbox"/> retirement pay <input type="checkbox"/> other: _____		32- Activity you perform during the winter: <input type="checkbox"/> keep fishing in the estuary (mullet, shrimp, croaker or catfish) <input type="checkbox"/> keep fishing in the estuary (other species) <input type="checkbox"/> fish in other areas in Patos Lagoon (outside the closed area) <input type="checkbox"/> fish in other lagoons <input type="checkbox"/> Mirim <input type="checkbox"/> Manguelra <input type="checkbox"/> Canal São Gonçalo <input type="checkbox"/> fish outside the channel's mouth <input type="checkbox"/> fish aboard the Industrial fleet in the ocean <input type="checkbox"/> net fixing <input type="checkbox"/> processing (e.g., fish filleting) <input type="checkbox"/> agriculture <input type="checkbox"/> sell fish <input type="checkbox"/> work in the city (formal job) <input type="checkbox"/> occasional jobs <input type="checkbox"/> don't work <input type="checkbox"/> others _____															
33- Does anyone in your house work with pay? No <input type="checkbox"/> Yes <input type="checkbox"/>		34- How much of your home's income comes from fishing? <input type="checkbox"/> everything <input type="checkbox"/> more than half <input type="checkbox"/> half <input type="checkbox"/> less than half <input type="checkbox"/> almost nothing															
<table border="1"> <thead> <tr> <th>Kinship</th> <th>Activity in fishery. Which?</th> <th>Activity outside fishery. Which?</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>	Kinship	Activity in fishery. Which?	Activity outside fishery. Which?													35- Which fishery provides you with more money? (list) <input type="checkbox"/> pink shrimp <input type="checkbox"/> croaker <input type="checkbox"/> mullet <input type="checkbox"/> catfish <input type="checkbox"/> bluecrab <input type="checkbox"/> flatfish <input type="checkbox"/> silverside <input type="checkbox"/> other _____	
Kinship	Activity in fishery. Which?	Activity outside fishery. Which?															

<p>36- What do you do when the shrimp season is weak? <input type="checkbox"/> fish another species during shrimp season. Which one? _____ <input type="checkbox"/> fish other species at other times of the year. Which ones? _____ <input type="checkbox"/> fish elsewhere <input type="checkbox"/> fish with otter trawl <input type="checkbox"/> fish with beach seine <input type="checkbox"/> fish with berimbau <input type="checkbox"/> find an occasional job. Which one? _____ <input type="checkbox"/> fish aboard industrial fleet <input type="checkbox"/> find agricultural work <input type="checkbox"/> fish and shrimp aquaculture <input type="checkbox"/> borrow money from middleman <input type="checkbox"/> borrow money from friends <input type="checkbox"/> borrow money from family <input type="checkbox"/> borrow money from bank <input type="checkbox"/> shop on credit <input type="checkbox"/> other _____</p>	<p>37- Do you usually have money to start the fishing season? <input type="checkbox"/> yes, have own resource <input type="checkbox"/> no, borrow from middlemen (buyers) <input type="checkbox"/> no, borrow from others <input type="checkbox"/> no, borrow from bank <input type="checkbox"/> do not need (crew)</p> <p>38- If you have a boat, how did you acquire it? <input type="checkbox"/> through financing, already paid for <input type="checkbox"/> through financing, still paying for <input type="checkbox"/> loan from others, paid for <input type="checkbox"/> loan from others, still paying for <input type="checkbox"/> acquired with own resource <input type="checkbox"/> do not own boat</p>
<p>39- If you own a powered boat, how did you acquire its engine? <input type="checkbox"/> through financing, already paid for <input type="checkbox"/> through financing, still paying for <input type="checkbox"/> loan from others, paid for <input type="checkbox"/> loan from others, still paying for <input type="checkbox"/> acquired with own resource <input type="checkbox"/> do not own powered boat</p>	<p>40- Who do you look to when you need to repair your nets, boat, or engine? <input type="checkbox"/> no one, use own resource <input type="checkbox"/> financing <input type="checkbox"/> buyers (middlemen) <input type="checkbox"/> other _____ <input type="checkbox"/> do not own boat, engine, or nets</p>
<p>INFRA-STRUCTURE AND PROCESSING</p>	

<p>41- How do you preserve the catch in the boat? <input type="checkbox"/> ice <input type="checkbox"/> in natura (no ice) <input type="checkbox"/> other: _____</p> <p>43- Do you sell directly upon landing? <input type="checkbox"/> yes <input type="checkbox"/> no: How do you stock/preserve landed catch? <input type="checkbox"/> ice box <input type="checkbox"/> cold room with ice <input type="checkbox"/> refrigeration (freezer) <input type="checkbox"/> in natura (no ice)</p>	<p>42- Where do you land your catch? <input type="checkbox"/> local factory <input type="checkbox"/> factory in other city <input type="checkbox"/> own dock <input type="checkbox"/> community dock <input type="checkbox"/> dock in other community <input type="checkbox"/> beach <input type="checkbox"/> buyer boat</p>																								
<p>44- Do you perform any kind of processing before selling the catch?</p>																									
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;">Shrimp</td> <td style="width: 16.6%;">Croaker</td> <td style="width: 16.6%;">Mullet</td> <td style="width: 16.6%;">Catfish</td> <td style="width: 16.6%;">Crab</td> <td style="width: 16.6%;">Others: _____</td> </tr> <tr> <td><input type="checkbox"/> no</td> </tr> <tr> <td><input type="checkbox"/> yes</td> </tr> <tr> <td>What? () () headless</td> <td>What? () gutted () filleted () other</td> <td>What? () gutted () filleted () other</td> <td>What? () gutted () filleted () other</td> <td>What? () () shell off () other</td> <td>What? () gutted () filleted () other</td> </tr> </table>		Shrimp	Croaker	Mullet	Catfish	Crab	Others: _____	<input type="checkbox"/> no	<input type="checkbox"/> yes	What? () () headless	What? () gutted () filleted () other	What? () gutted () filleted () other	What? () gutted () filleted () other	What? () () shell off () other	What? () gutted () filleted () other										
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<p>45- If you perform any processing, what do you do with the remains (waste)? <input type="checkbox"/> dump in the lagoon <input type="checkbox"/> throw away <input type="checkbox"/> bury <input type="checkbox"/> sell. To whom? _____ <input type="checkbox"/> other: _____</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;">Shrimp</td> <td style="width: 16.6%;">Croaker</td> <td style="width: 16.6%;">Mullet</td> <td style="width: 16.6%;">Catfish</td> <td style="width: 16.6%;">Crab</td> <td style="width: 16.6%;">Others: _____</td> </tr> <tr> <td><input type="checkbox"/> no</td> </tr> <tr> <td><input type="checkbox"/> yes</td> </tr> <tr> <td>What? () () headless</td> <td>What? () gutted () filleted () other</td> <td>What? () gutted () filleted () other</td> <td>What? () gutted () filleted () other</td> <td>What? () () shell off () other</td> <td>What? () gutted () filleted () other</td> </tr> </table>	Shrimp	Croaker	Mullet	Catfish	Crab	Others: _____	<input type="checkbox"/> no	<input type="checkbox"/> yes	What? () () headless	What? () gutted () filleted () other	What? () gutted () filleted () other	What? () gutted () filleted () other	What? () () shell off () other	What? () gutted () filleted () other										
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MARKETING																												
<p>46- Who do you usually sell the catch to? (May choose more than one, mark 1 for most important).</p> <p><input type="checkbox"/> local factory. <input type="checkbox"/> factory in other cities. Which ones? <input type="checkbox"/> local buyer (middleman). <input type="checkbox"/> buyer (middleman) from other cities/towns. Which ones? <input type="checkbox"/> buyer boat. <input type="checkbox"/> buyers (middlemen) from Santa Catarina <input type="checkbox"/> fishermen's association. Name: _____ <input type="checkbox"/> fishermen's cooperative. Name: _____ <input type="checkbox"/> fish shop <input type="checkbox"/> restaurant <input type="checkbox"/> directly to consumers in fairs <input type="checkbox"/> directly to consumers at their homes <input type="checkbox"/> directly to consumers, at fisherman's home <input type="checkbox"/> other(s) _____</p>	<p>47- How much did you sell for, on average, the <u>in natura</u> Kg of the following catch in the latest years?</p> <table border="1"> <thead> <tr> <th></th> <th>Lowest price (R\$/kg)</th> <th>Highest price (R\$/kg)</th> </tr> </thead> <tbody> <tr><td>Pink shrimp</td><td></td><td></td></tr> <tr><td>Croaker</td><td></td><td></td></tr> <tr><td>Mullet</td><td></td><td></td></tr> <tr><td>Catfish</td><td></td><td></td></tr> <tr><td>Flatfish</td><td></td><td></td></tr> <tr><td>Silverside</td><td></td><td></td></tr> <tr><td>Crab</td><td></td><td></td></tr> <tr><td>Other(s)</td><td></td><td></td></tr> </tbody> </table>		Lowest price (R\$/kg)	Highest price (R\$/kg)	Pink shrimp			Croaker			Mullet			Catfish			Flatfish			Silverside			Crab			Other(s)		
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Other(s)																												
<p>49- What affects fish price the most?</p> <p><input type="checkbox"/> quantity (good or bad season) <input type="checkbox"/> middlemen (buyers) <input type="checkbox"/> industry <input type="checkbox"/> cooperative/association <input type="checkbox"/> catch quality <input type="checkbox"/> aquaculture yield <input type="checkbox"/> fish size <input type="checkbox"/> other _____</p>	<p>48- IF YOU PERFORM ANY KIND OF PROCESSING, Indicate the lowest and the highest price obtained in the latest years.</p> <table border="1"> <thead> <tr> <th></th> <th>Lowest price (R\$/kg)</th> <th>Highest price (R\$/kg)</th> </tr> </thead> <tbody> <tr> <td>Pink shrimp <input type="checkbox"/> shell off <input type="checkbox"/> headless</td> <td></td> <td></td> </tr> <tr> <td>Croaker <input type="checkbox"/> gutted <input type="checkbox"/> fillet <input type="checkbox"/> other</td> <td></td> <td></td> </tr> <tr> <td>Mullet <input type="checkbox"/> gutted <input type="checkbox"/> fillet <input type="checkbox"/> other</td> <td></td> <td></td> </tr> <tr> <td>Catfish <input type="checkbox"/> gutted <input type="checkbox"/> fillet <input type="checkbox"/> other</td> <td></td> <td></td> </tr> <tr> <td>Flatfish <input type="checkbox"/> gutted <input type="checkbox"/> fillet <input type="checkbox"/> other</td> <td></td> <td></td> </tr> <tr> <td>Silverside <input type="checkbox"/> gutted <input type="checkbox"/> fillet <input type="checkbox"/> other</td> <td></td> <td></td> </tr> <tr> <td>Blue crab <input type="checkbox"/> shell off <input type="checkbox"/> other</td> <td></td> <td></td> </tr> <tr> <td>Other(s)</td> <td></td> <td></td> </tr> </tbody> </table>		Lowest price (R\$/kg)	Highest price (R\$/kg)	Pink shrimp <input type="checkbox"/> shell off <input type="checkbox"/> headless			Croaker <input type="checkbox"/> gutted <input type="checkbox"/> fillet <input type="checkbox"/> other			Mullet <input type="checkbox"/> gutted <input type="checkbox"/> fillet <input type="checkbox"/> other			Catfish <input type="checkbox"/> gutted <input type="checkbox"/> fillet <input type="checkbox"/> other			Flatfish <input type="checkbox"/> gutted <input type="checkbox"/> fillet <input type="checkbox"/> other			Silverside <input type="checkbox"/> gutted <input type="checkbox"/> fillet <input type="checkbox"/> other			Blue crab <input type="checkbox"/> shell off <input type="checkbox"/> other			Other(s)		
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<p>50- What affects shrimp price the most?</p> <p><input type="checkbox"/> quantity (good or bad season) <input type="checkbox"/> middlemen <input type="checkbox"/> industry <input type="checkbox"/> cooperative/association <input type="checkbox"/> shrimp quality (net kind) <input type="checkbox"/> shrimp size <input type="checkbox"/> aquaculture shrimp <input type="checkbox"/> other _____</p>																												
BOAT																												
<p>51- If you own a boat, who usually fishes with you on your boat?</p> <p><input type="checkbox"/> family members <input type="checkbox"/> friends <input type="checkbox"/> fishermen from the community <input type="checkbox"/> fishermen from other communities <input type="checkbox"/> others _____ <input type="checkbox"/> don't own boat</p>	<p>52- The people who fish with you are listed on your boat roster?</p> <p><input type="checkbox"/> yes <input type="checkbox"/> some <input type="checkbox"/> no</p>																											

SAFETY AT SEA	
53- Can you swim? () yes () no	54- Can you float? () yes () no
55- Have you ever done any kind of safety training (first aid, survival at sea) to work aboard fishing boats? () yes () no Which one? _____	56- Does your boat have any safety equipment? () life vest () fire extinguisher () anchor () circular buoy () none
57- Do you have insurance on your boat (s)? () yes, all of them () yes, some () no	58- Have you ever had a serious accident while fishing (bone fracture, burn, fall into sea)? () yes, once () yes, more than once. How many times? _____ () no
59- If you have suffered an accident, where were you fishing when it occurred? () within Patos Lagoon () outside the channel's mouth	60- Do you know anyone who has suffered a serious accident or died while fishing? () No () Less than 5 () 5-10 () More than 10
LEGISLATION	
<p>61- Do you think:</p> <p>The fishing closure should be between June and September? () yes () no</p> <p>Fishermen must use up to 10 fyke nets? () yes () no</p> <p>Fishermen must use up to 1000 fathoms of net? () yes () no</p> <p>Trawling should be allowed in the channel? () yes () no</p> <p>Trawling should be allowed in bays? () yes () no</p> <p>The beavh seine net should be allowed? () yes () no</p> <p>The berimbau net should be allowed? () yes () no</p> <p>Crab should be only fished with the longline ? () yes () no</p> <p>Boats over 12-m long should be allowed to enter the lagoon? () yes () no</p> <p>Fishermen from other areas should be allowed to fish in the lagoon? () yes () no</p> <p>Fishermen should receive unemployment benefit? () yes () no</p> <p>Do you receive unemployment benefit? () yes () no</p>	

62- When do you think you should fish:

Mullet

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Croaker

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Catfish

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Shrimp

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Crab

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Flatfish

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Silverside

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

63- Have you ever been consulted by IBAMA or SEAP (Ministry of Fishery and Aquaculture) about the fishery rules in Patos Lagoon?
 Yes
 No

64- Should the shrimping season start at a fixed date or according to size?
 fixed date
 according to size

ORGANIZATION S AND REPRESENTATION

65- Who helps the fisherman the most?
 SEAP (Ministry of Fishery and Aquaculture)
 IBAMA
 Fisherman's colony
 EMATER
 City Governments
 Forum of Patos Lagoon
 Pastoral do Pescador
 Fisherman's associations/cooperatives
 Other: _____

66- If you take part of a fisherman's association or cooperative, do you think there have been changes in catch price since you joined the association or cooperative?

Shrimp	Croaker	Mullet	Catfish	Crab	Other
<input type="checkbox"/> much better					
<input type="checkbox"/> better					
<input type="checkbox"/> not changed					
<input type="checkbox"/> worse					
<input type="checkbox"/> much worse					

67- Do you believe in the work of the association/cooperative?
 Yes No

68- Do you know or have ever heard about the Forum of Patos Lagoon?
 Yes No

69- Have you participated of any fishing-related meetings throughout the year?

	Never	1-5 times	More than 5 times	Once a month
Colony	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Union				
Associations				
Pastoral				
Forum of Patos Lagoon				
Other				

70- If you have participated, how do you consider the practical and/or concrete results of those meetings?

	Good	Medium	Bad	There has been none
Colony				
Union				
Associations				
Pastoral				
Forum of Patos Lagoon				
Other				

RULE ENFORCEMENT						
71- Have you ever been caught or fined for not following the rules? <input type="checkbox"/> Never <input type="checkbox"/> Once <input type="checkbox"/> Twice <input type="checkbox"/> More than twice	72- Do you know any fisherman who has been caught or fined for not following the rules? <input type="checkbox"/> None <input type="checkbox"/> One <input type="checkbox"/> 1-10 <input type="checkbox"/> 10-20 <input type="checkbox"/> More than 20	73- Do you think rule enforcement is needed? <input type="checkbox"/> Yes <input type="checkbox"/> No				
FISHERY IMPACTS						
74- What fisheries damage the lagoon's environment the most? (You may choose several options, mark 1 on the most important) <input type="checkbox"/> Fyke net <input type="checkbox"/> Slow net <input type="checkbox"/> Trawling <input type="checkbox"/> Trolha <input type="checkbox"/> Beach seine <input type="checkbox"/> Berimbau <input type="checkbox"/> Gillnet <input type="checkbox"/> Other _____	75- Have you ever lost nets while fishing? <input type="checkbox"/> never <input type="checkbox"/> sometimes <input type="checkbox"/> often (every season) <input type="checkbox"/> very often (more than once every season)	76- Have you ever had nets, boats, or other fishing gear stolen out at sea? <input type="checkbox"/> no <input type="checkbox"/> yes, once <input type="checkbox"/> yes, a few times <input type="checkbox"/> yes, often (every year)				
77- Have you ever –unwittingly – caught any of the following animals? <input type="checkbox"/> sea turtle <input type="checkbox"/> seal (sea lion) <input type="checkbox"/> sea birds (e.g. cormorants, gannets) <input type="checkbox"/> sea otter <input type="checkbox"/> Piata dolphin <input type="checkbox"/> dolphin	78- Have you ever suffer any damage to your fishing gear or catch due to seals (sea lions) and/or sea otters? <table border="1"> <thead> <tr> <th>Seal (sea lion)</th> <th>Otter</th> </tr> </thead> <tbody> <tr> <td> <input type="checkbox"/> never <input type="checkbox"/> sometimes <input type="checkbox"/> often (every season) <input type="checkbox"/> very often (more than once every season) </td> <td> <input type="checkbox"/> never <input type="checkbox"/> sometimes <input type="checkbox"/> often (every season) <input type="checkbox"/> very often (more than once every season) </td> </tr> </tbody> </table>		Seal (sea lion)	Otter	<input type="checkbox"/> never <input type="checkbox"/> sometimes <input type="checkbox"/> often (every season) <input type="checkbox"/> very often (more than once every season)	<input type="checkbox"/> never <input type="checkbox"/> sometimes <input type="checkbox"/> often (every season) <input type="checkbox"/> very often (more than once every season)
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79- In your opinion, what is the future of fishing? <hr/> <hr/> <hr/> <hr/> <hr/>						

ANNEX 2

AGENDA AND LIST OF PARTICIPANTS OF THE STUDY INCEPTION WORKSHOP

Inception workshop on the project “A techno-economic study of the small-scale fishing operations of the estuary of Patos Lagoon, Brazil”

Centro de Convivio dos Meninos do Mar (CCMAR-FURG), Rio Grande, 19 October 2009

Agenda

14:00 Workshop opening

Dr Daniela Kalikoski
Dr Marcelo Vasconcellos
Mr Dirceu Lopes, Executive Director, MPA
Mr Joao Carlos Cousin, Rector, FURG
Ms Darlene Torrada, Dean of Extension, FURG
Ms Adriana Senna, Director Institute of Science and Humanities, FURG
Ms Lucia Nobre, Coordinator of NUDESE-FURG

15:00 Signature of Letter of Intention between FURG and MPA

15:30 Coffee break

15:45 Presentation of the project objectives and methodology

Dr Daniela Kalikoski
Dr Marcelo Vasconcellos

16:30 Plenary discussion

17:30: Workshop closure

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ANNEX 3

AGENDA AND LIST OF PARTICIPANTS OF THE FINAL WORKSHOP

Workshop “Status and perspectives for the artisanal fisheries of the estuary of Patos Lagoon: results from the census of artisanal fisheries”

13 April 2011

CIDEC-Sul, FURG, Rio Grande, Brazil

Agenda

9:00	Workshop opening Daniela Kalikoski (ICHI-FURG) Marcelo Vasconcellos (IO-FURG) Joao Carlos Cousin, Rector (FURG) Ernesto Casares Pinto, Vice-Rector (FURG) Adriana Senna, Director (ICHI-FURG) Adriane Lobo Costa (MPA-RS)
9:30 – 10:00	Current status of artisanal fisheries in the estuary of Patos Lagoon: technical aspects Plenary discussion
10:00 – 10:30	
10:30 – 11:00	<i>Coffee break</i>
11:00 – 11:30	Current status of artisanal fisheries in the estuary of Patos Lagoon: socio-economic aspects Plenary discussion
11:30 – 12:00	
12:00 – 13:30	<i>Lunch</i>
13:30 – 14:00	Current status of artisanal fisheries in the estuary of Patos Lagoon: environmental aspects Plenary discussion
14:00 – 14:30	
14:30 – 15:00	Current status of artisanal fisheries in the estuary of Patos Lagoon: governance aspects Plenary discussion
15:00 – 15:30	
15:30 – 16:00	<i>Coffee break</i>
16:00 – 17:00	Plenary discussion
17:00	Workshop closure

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CASE STUDY OF THE TECHNICAL, SOCIO-ECONOMIC AND ENVIRONMENTAL CONDITIONS OF SMALL-SCALE FISHERIES
IN THE ESTUARY OF PATOS LAGOON, BRAZIL – A METHODOLOGY FOR ASSESSMENT

FAO