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 2008[1] (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 Among these are that data from Fishers' Colonies are particularly unreliable because they are for the most part outdated and that there are no controls or criteria for membership.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

		Fishery-dependent		Fishers	
Municipality	**Localities**	**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.

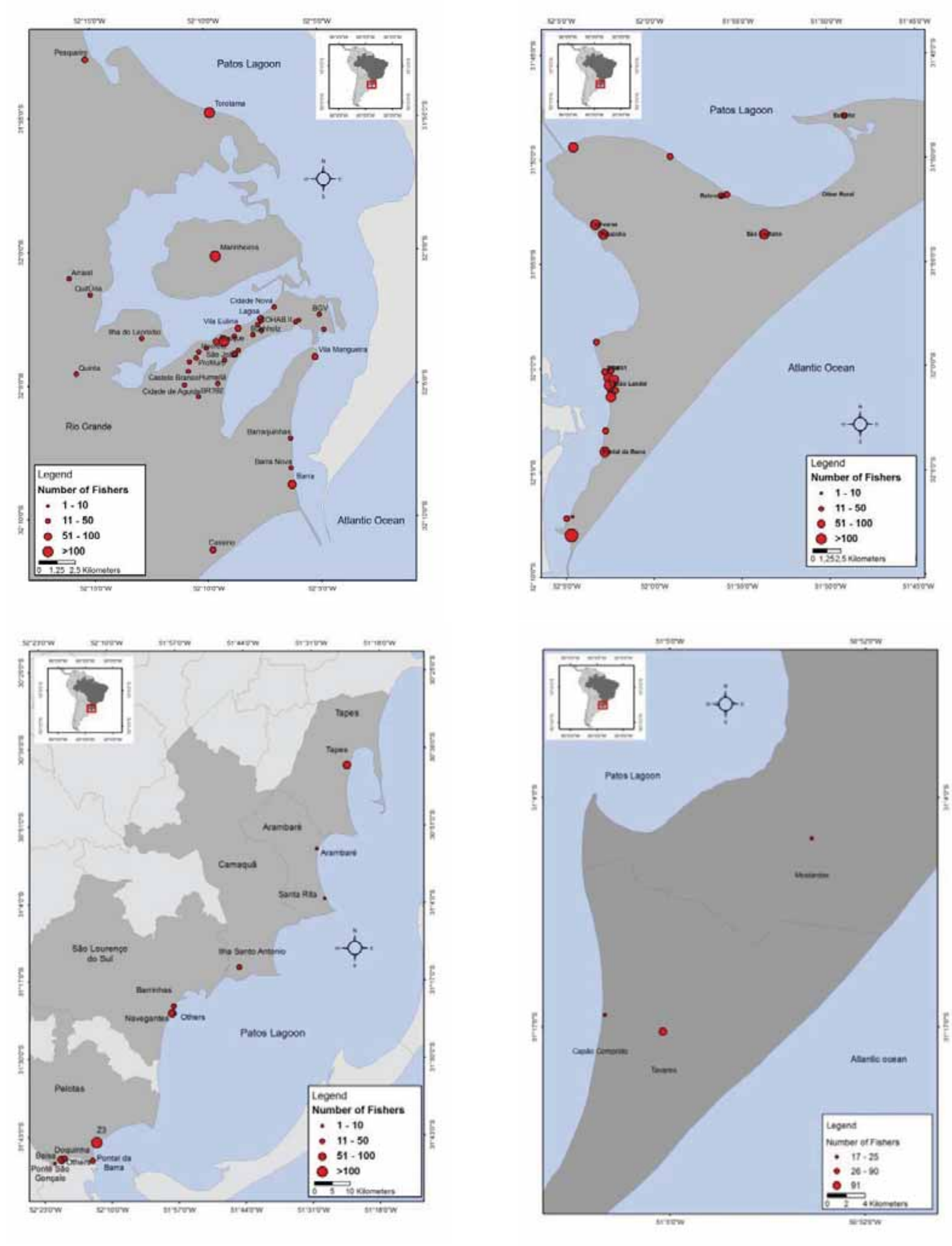


Figure 6: Distribution of artisanal fishers by localities in the Patos Lagoon estuary

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.

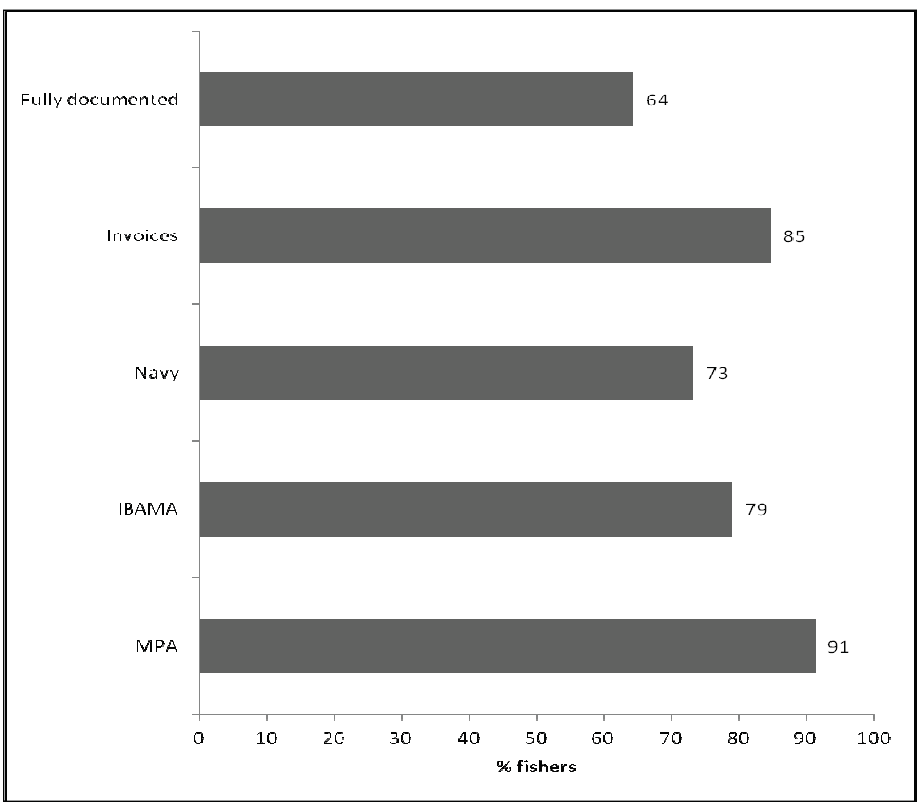


Figure 7: Percentage of fishers with basic required documents for professional artisanal fishers

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 5ª 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 5ª 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.

Motorized boat in Barranco, São José do Norte

Canoe (*caíco*) in Várzea, São José do Norte

Motorized boat in Rio Grande

Motorized boats in Tapes

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).

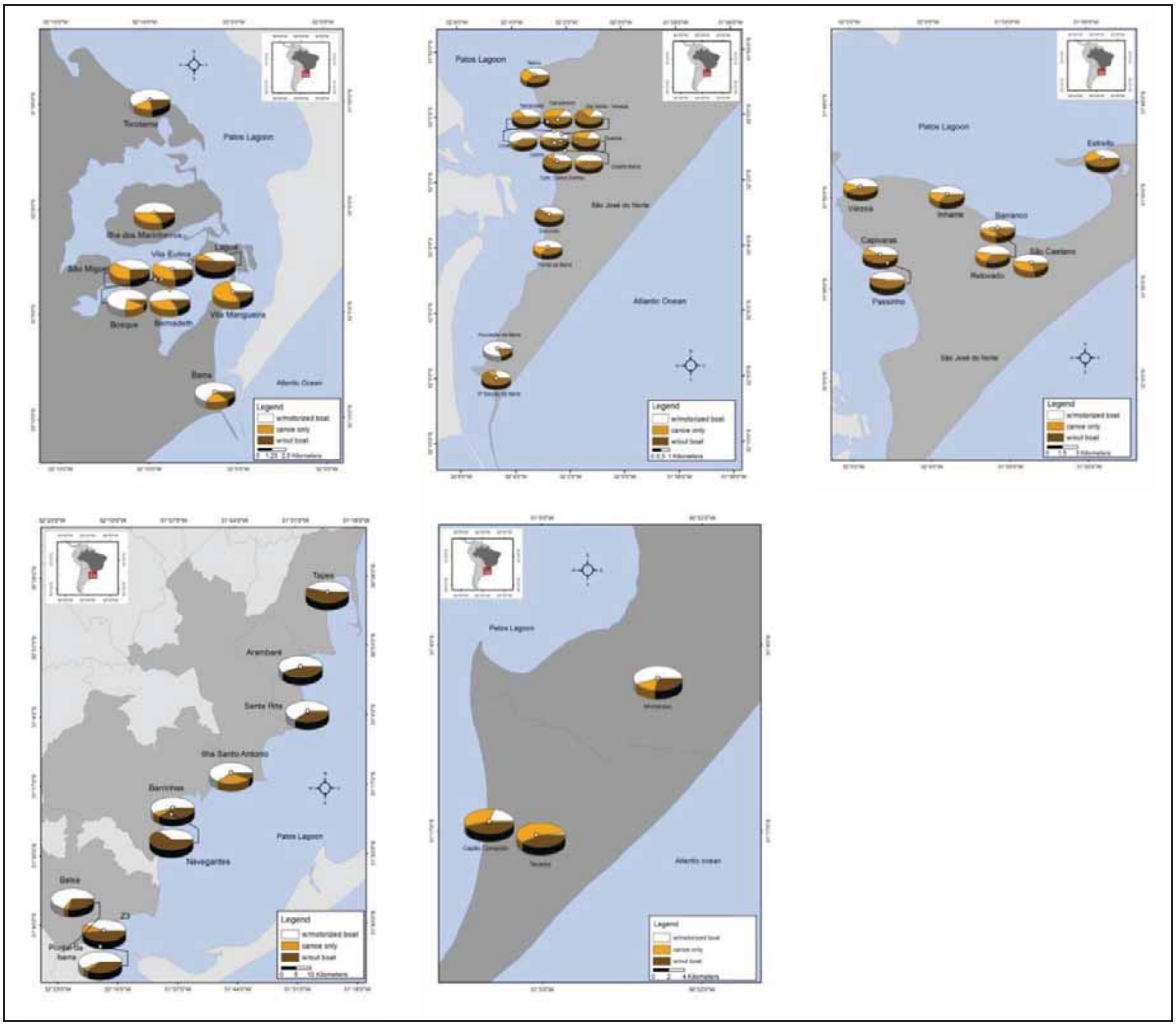


Figure 9: Percent of fishers with motorized boats, canoes and without boats in each of the main artisanal fisheries

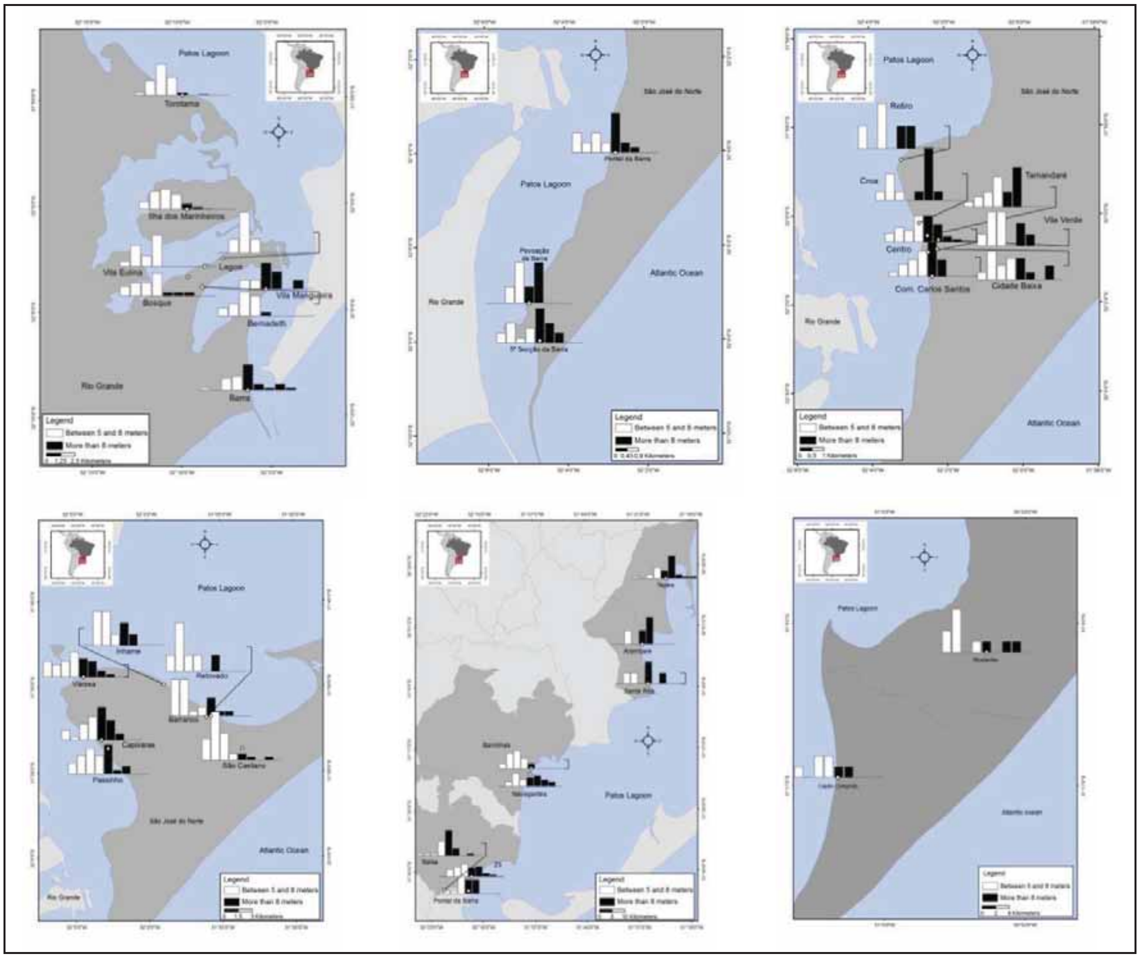


Figure 10: Distribution frequency of sizes of motorized boat in the main artisanal fisheries

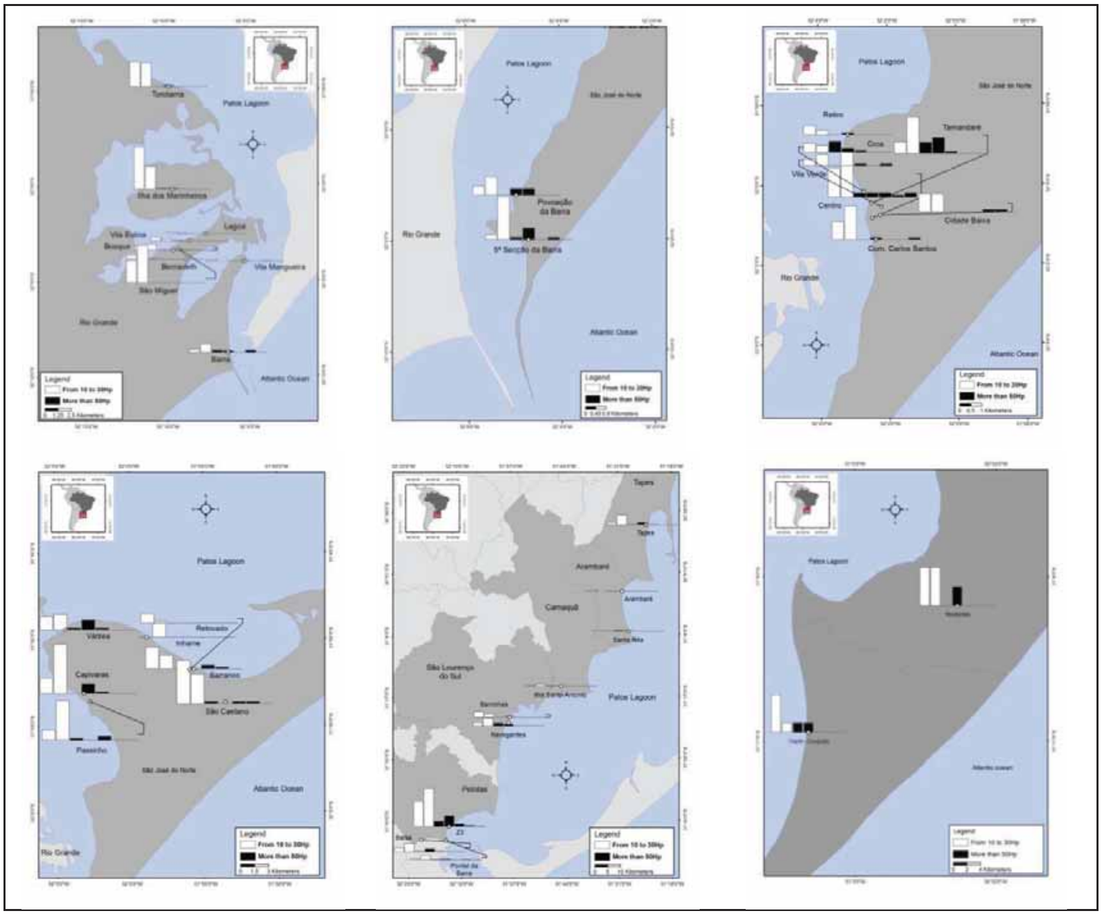


Figure 11: Distribution frequency of engine power (hp) in the main localities

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.

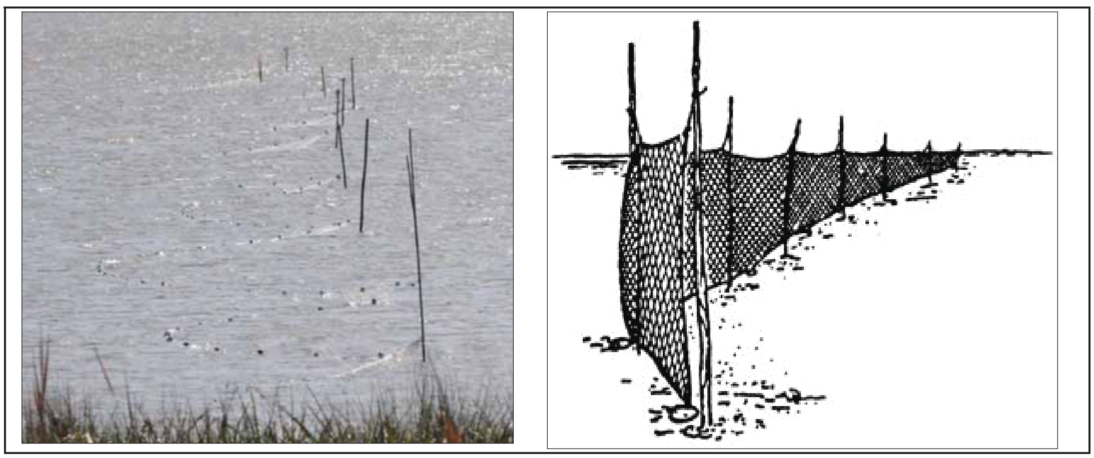


Figure 12: Left: Fixed gillnet. Right: general scheme of a fixed gillnet (*Source*: FAO, 1982)

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. Mullets 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.

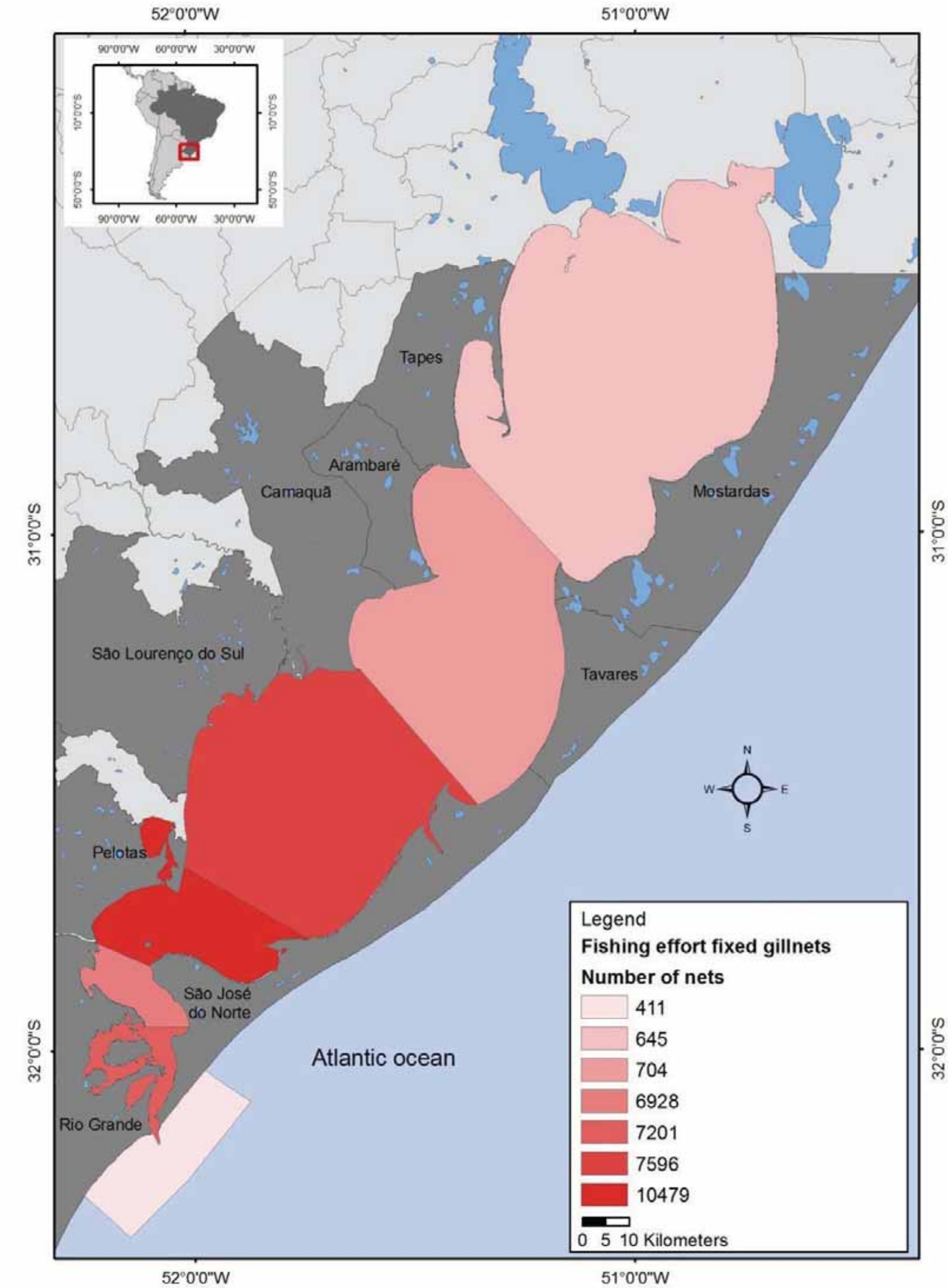


Figure 13: Distribution of total fishing effort with fixed gillnets for croaker

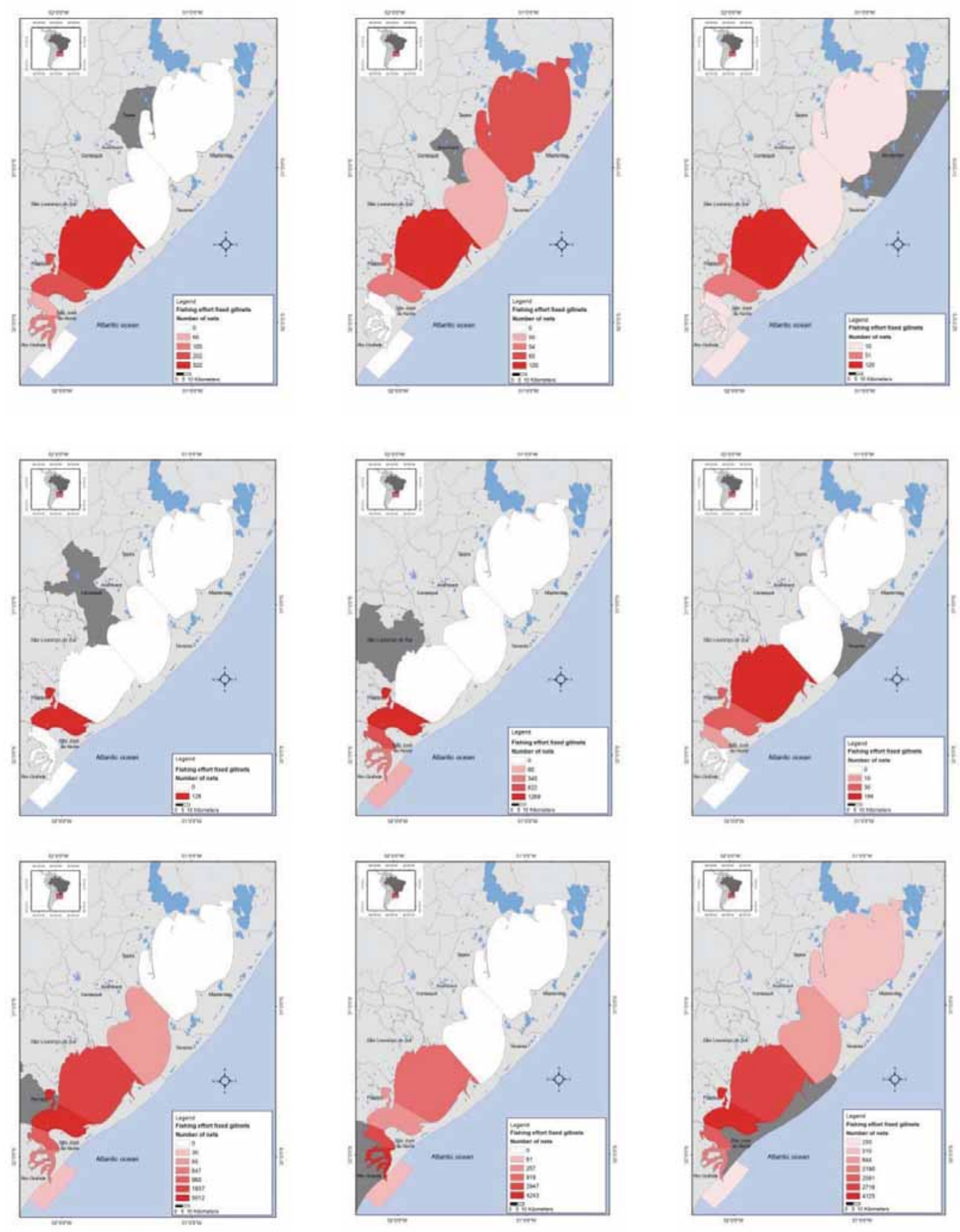


Figure 14: Distribution of fishing effort with fixed gillnets for croaker by municipality (in dark grey)

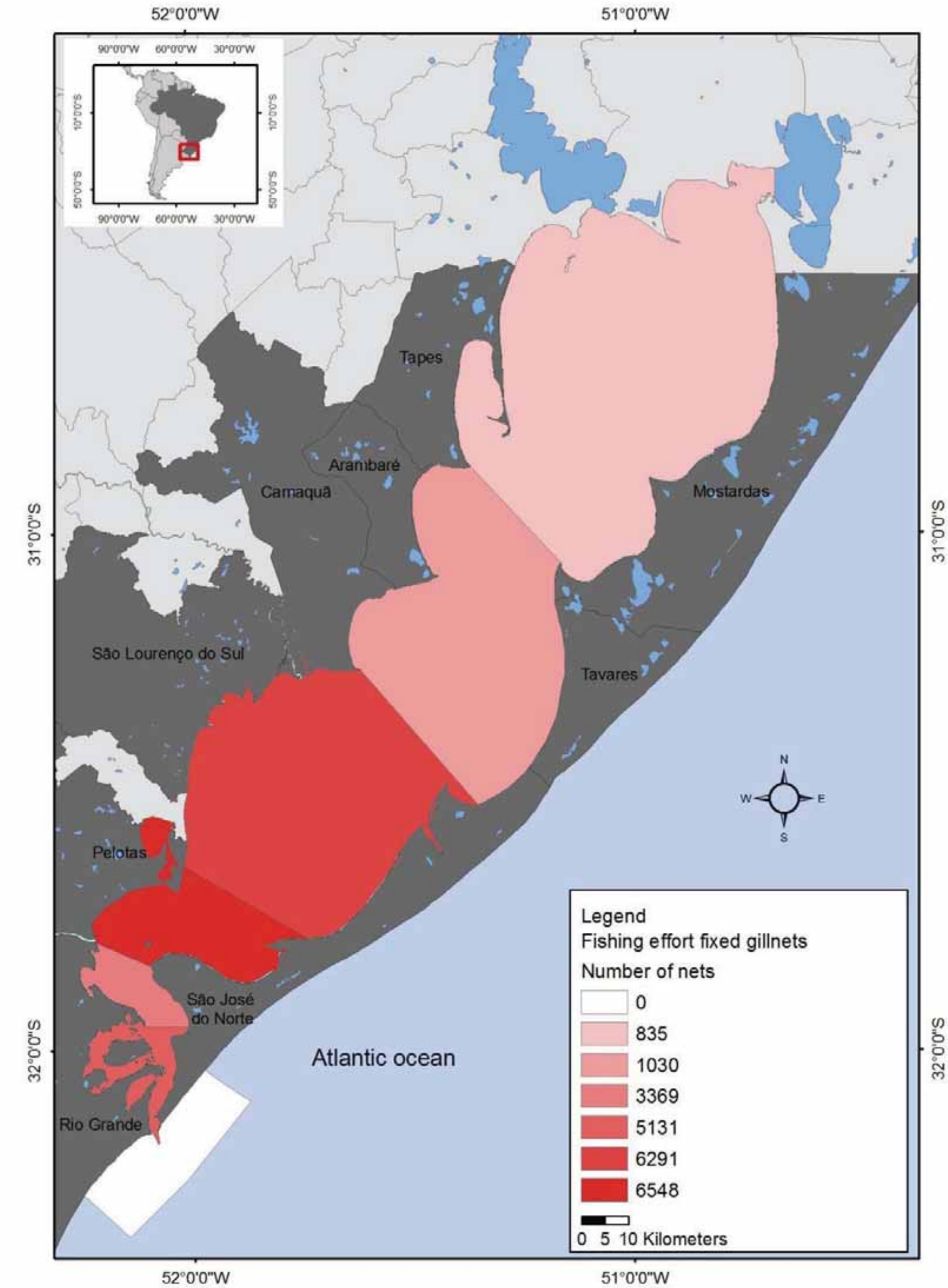


Figure 15: Distribution of total fishing effort with fixed gillnets for mullet

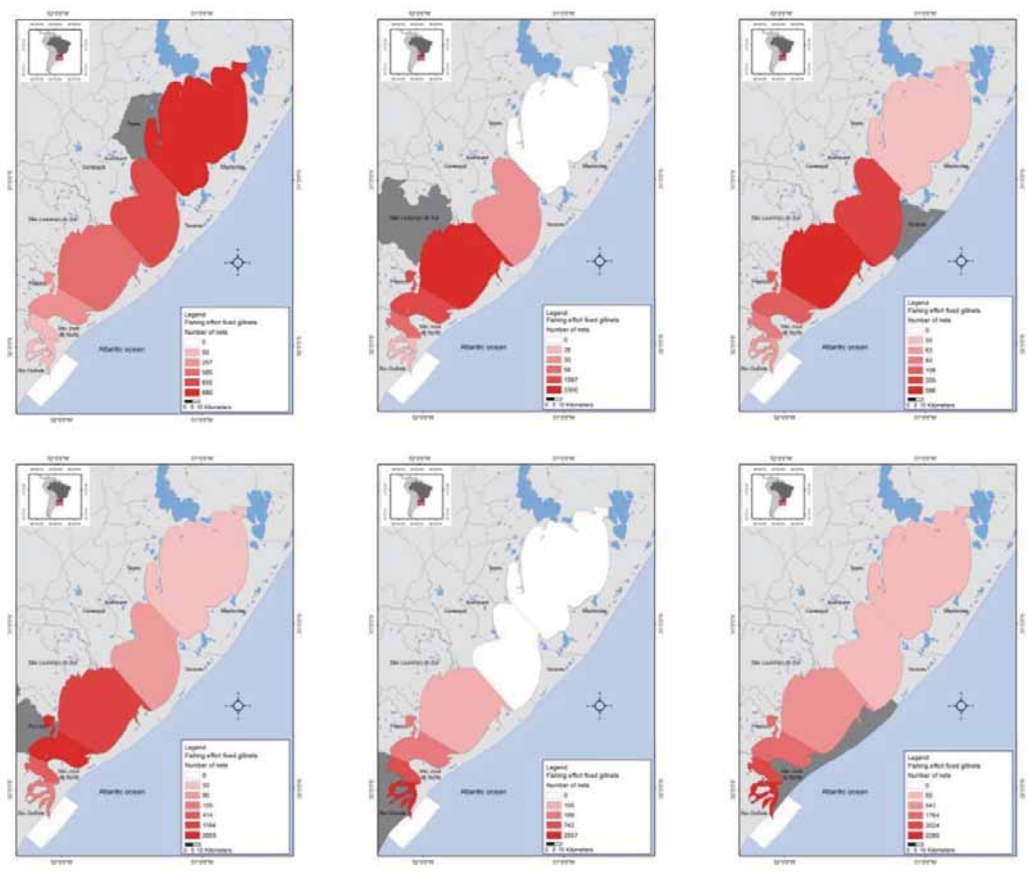


Figure 16: Distribution of fishing effort with fixed gillnets for mullet by municipality (in dark grey)

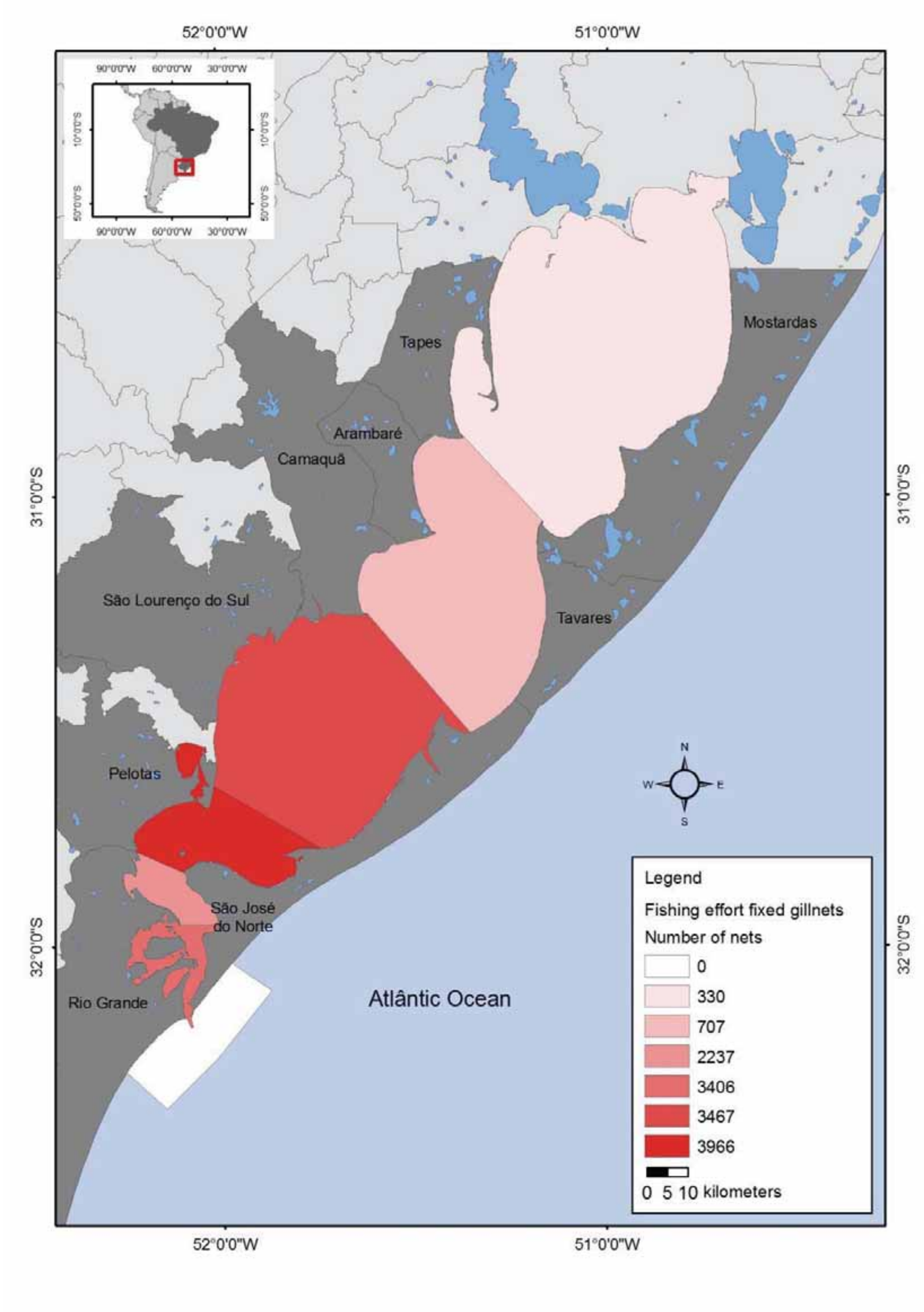


Figure 17: Distribution of total fishing effort with fixed gillnets for flatfish

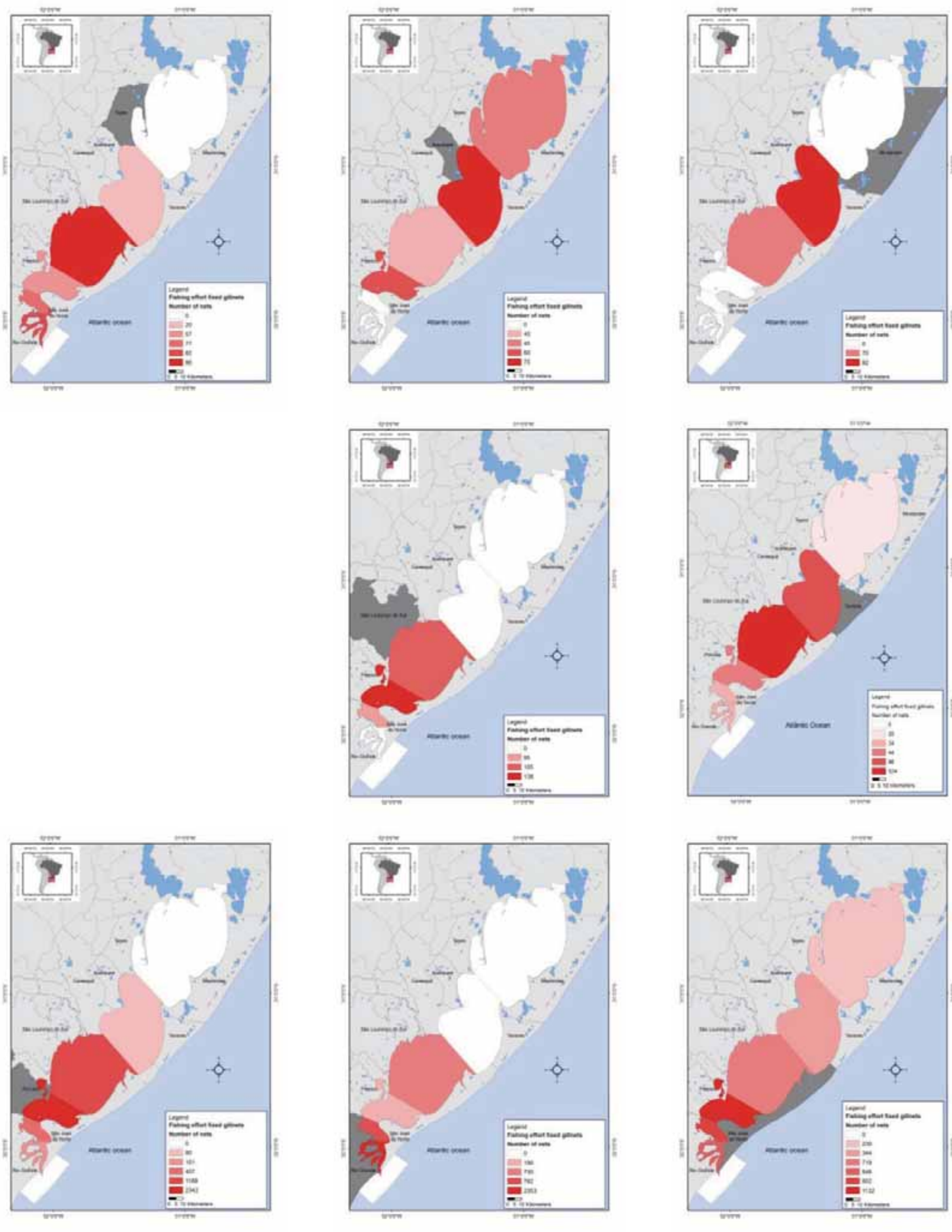


Figure 18: Distribution of fishing effort with fixed gillnets for flatfish by municipality (in dark grey)

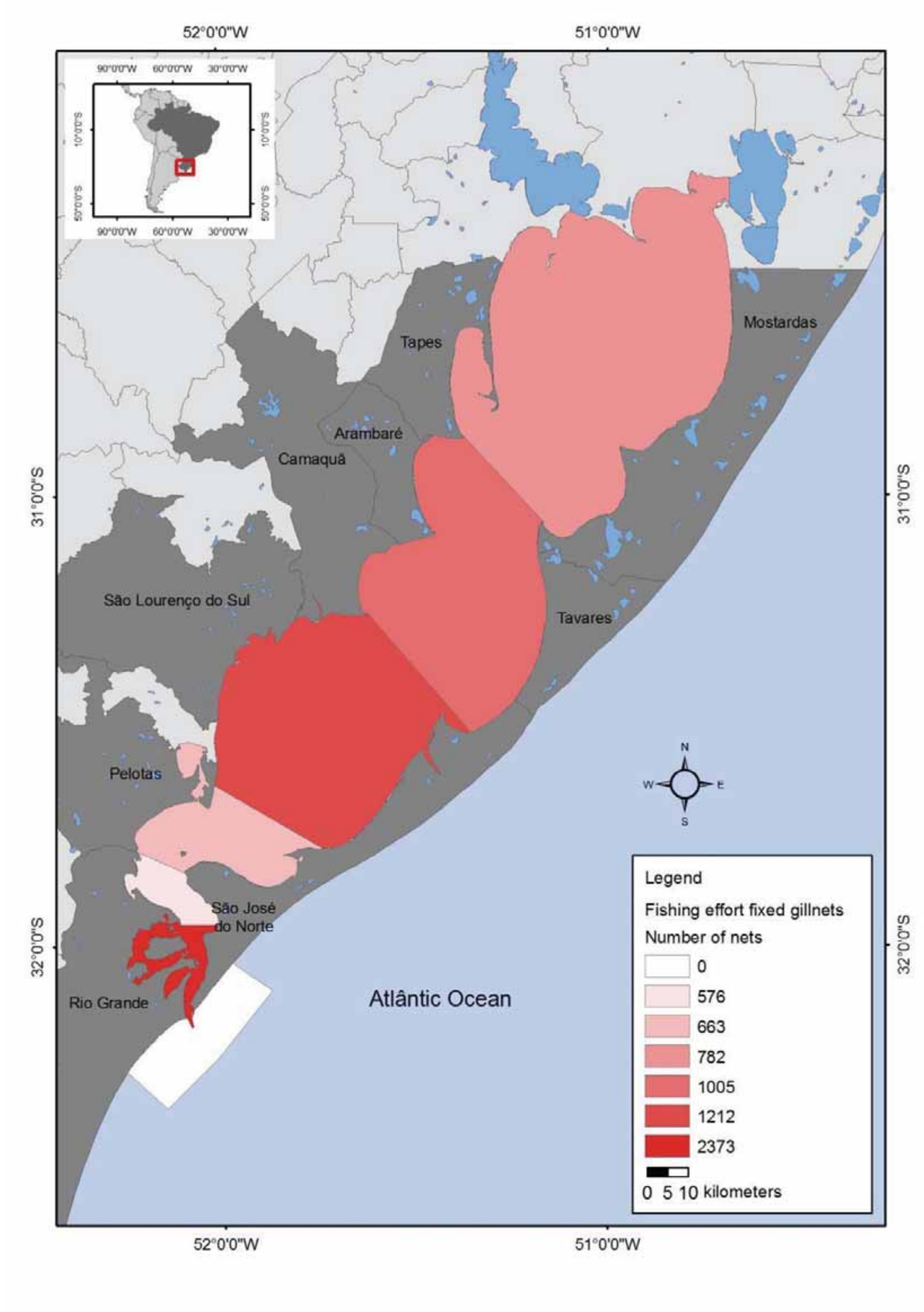


Figure 19: Distribution of total fishing effort with fixed gillnets for silverside

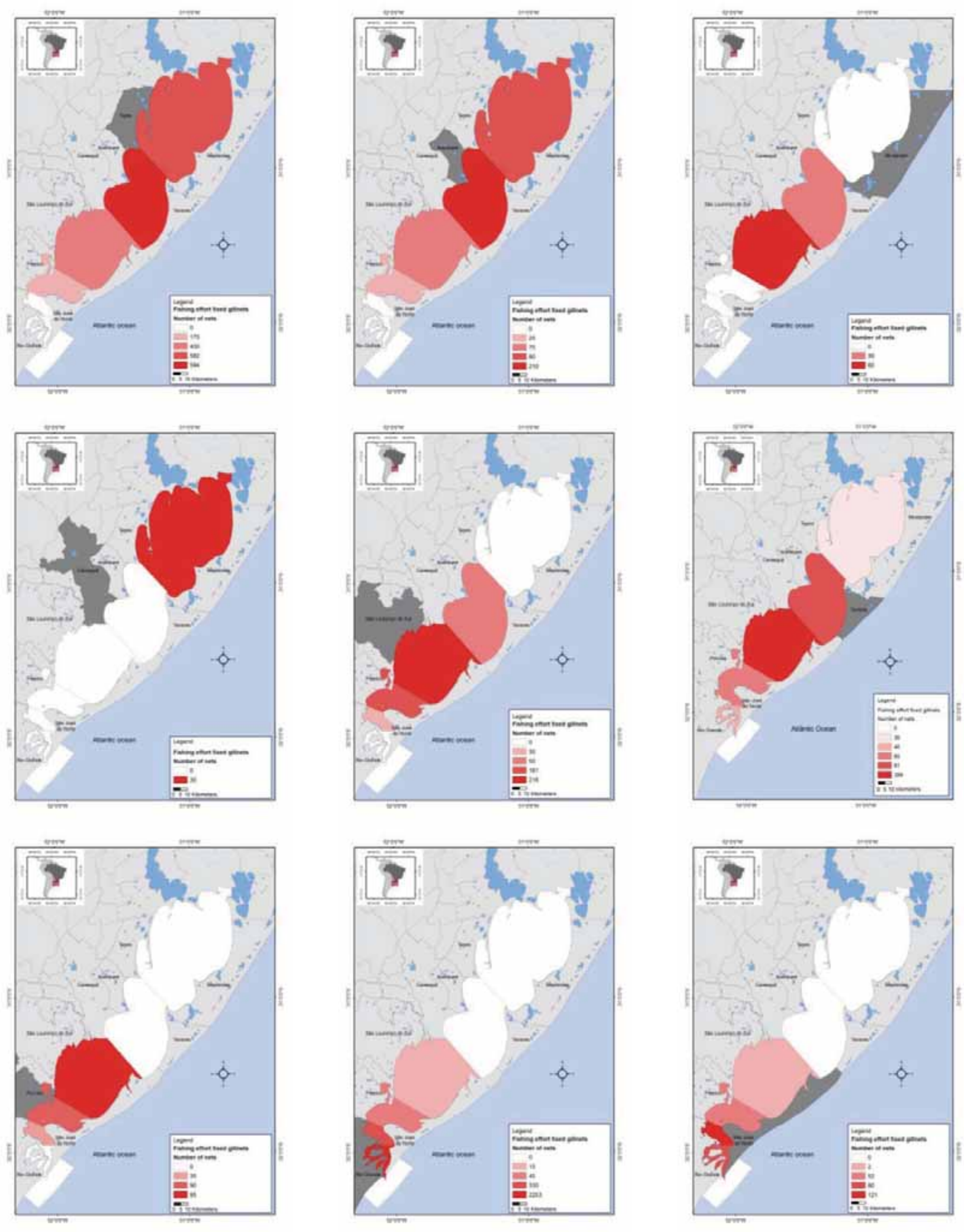


Figure 20: Distribution of fishing effort with fixed gillnets for silverside by municipality (in dark grey) (effort measured in number of fixed gillnets)

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).

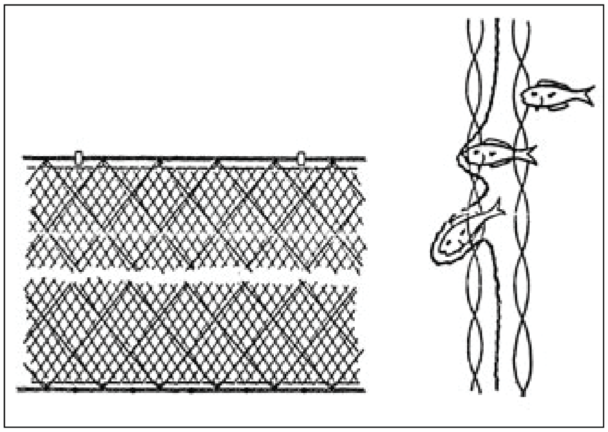


Figure 21: Scheme of operation of a trammel net (*Source*: FAO, 1982)

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.

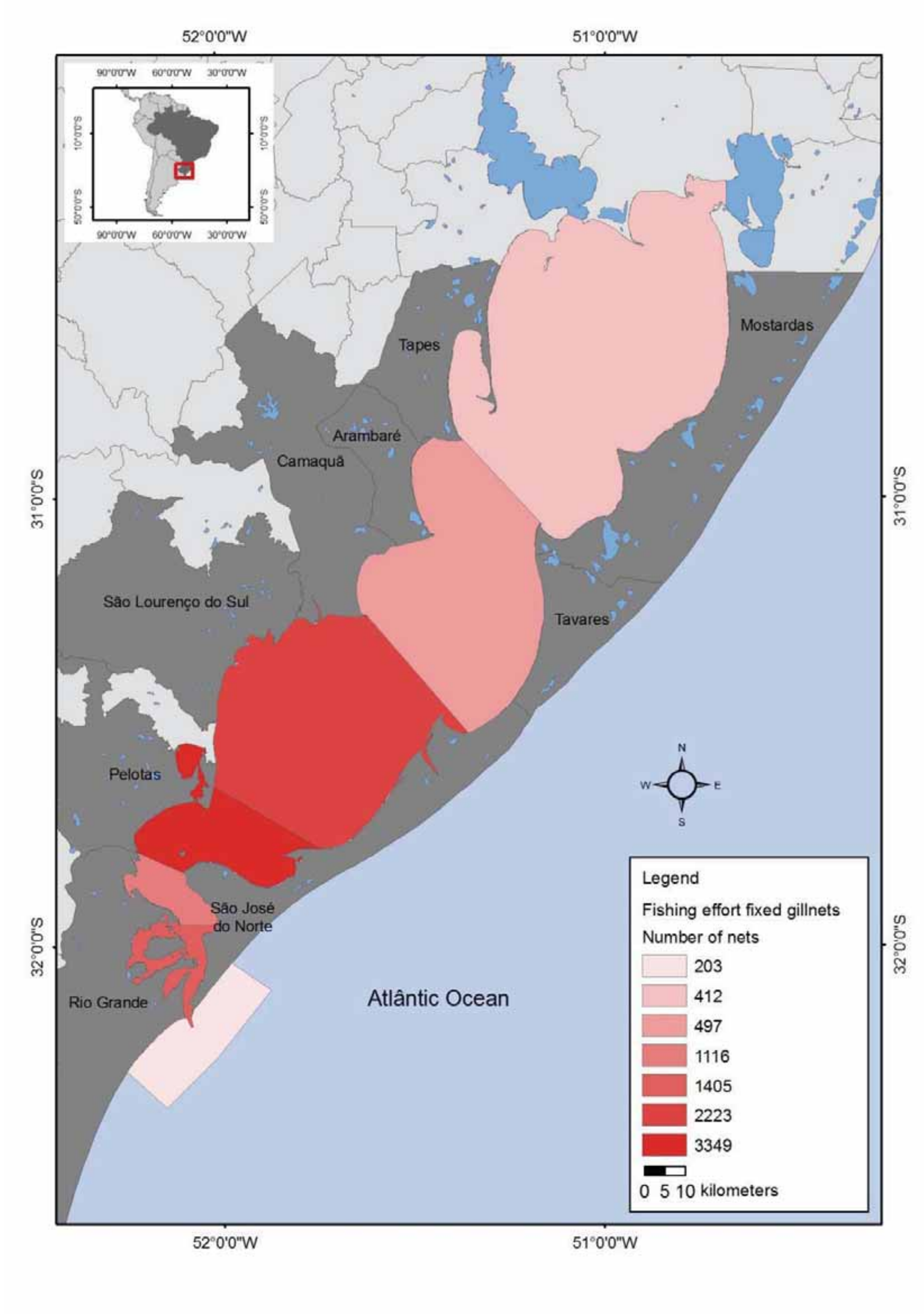


Figure 22: Distribution of total fishing effort with fixed gillnets (trammel nets) for catfish (effort measured in number of fixed trammel nets)

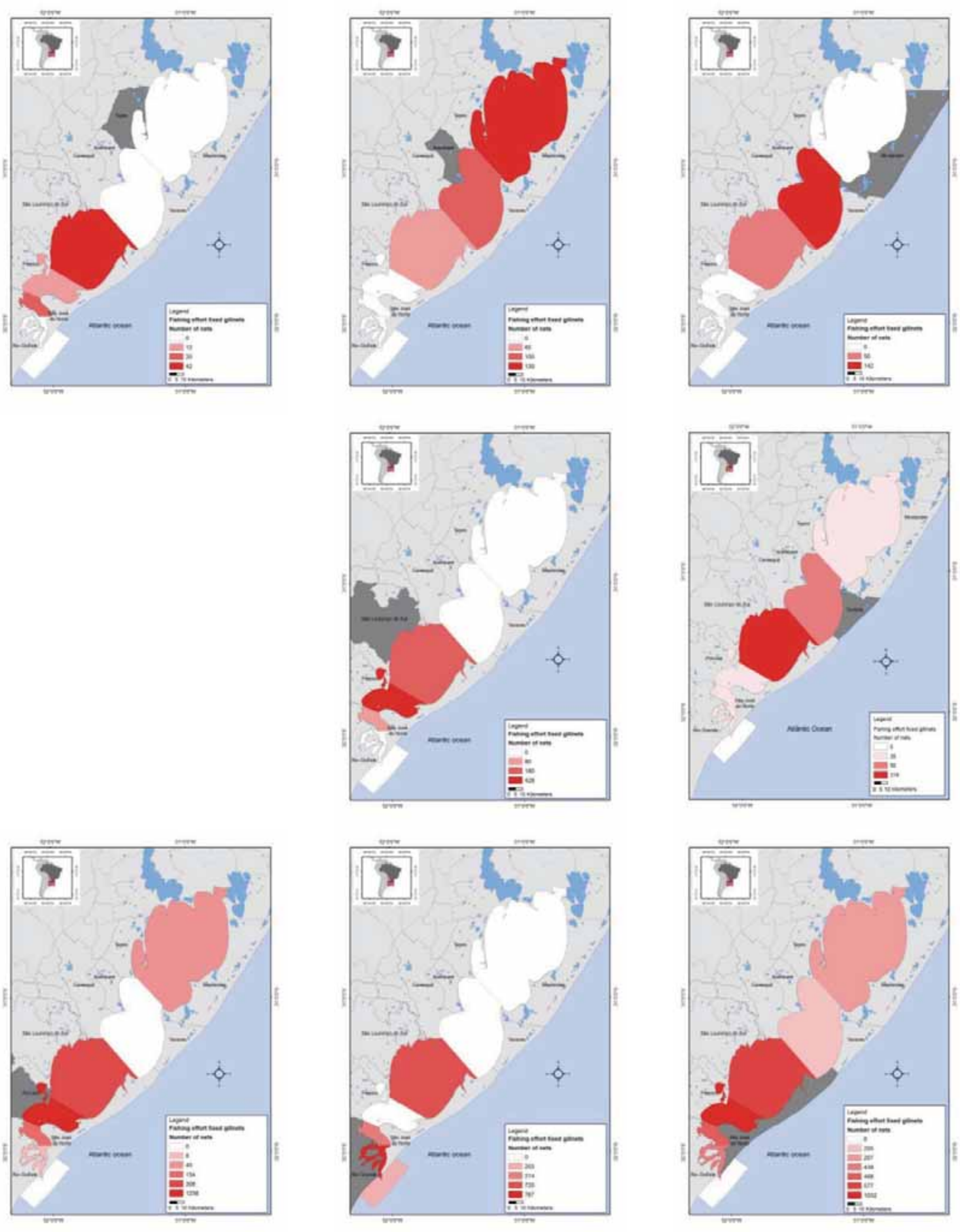


Figure 23: Distribution of fishing effort with fixed gillnets (trammel nets) for catfish by municipality (in dark grey)

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 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.

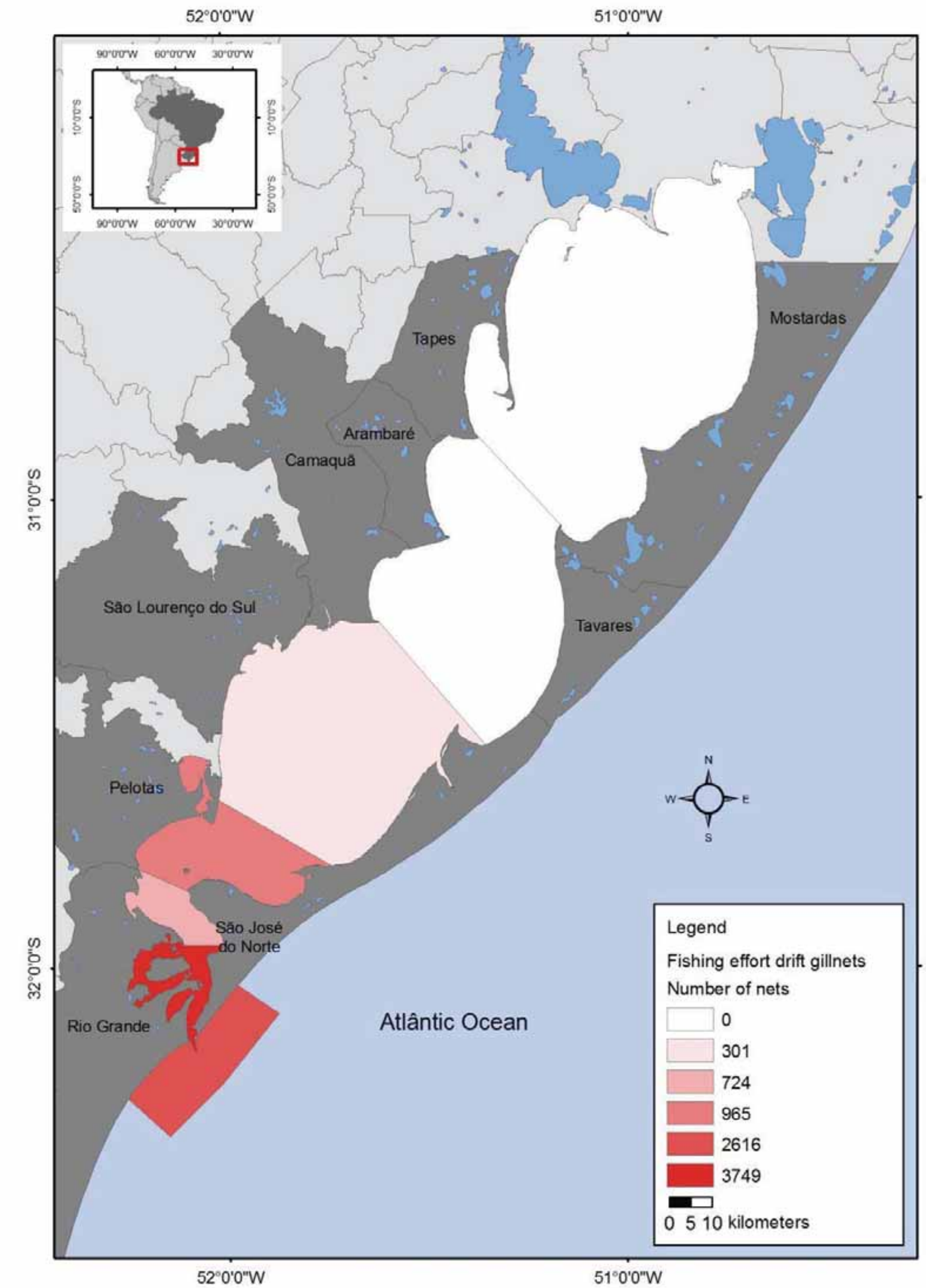


Figure 25: Distribution of total fishing effort with drift gillnets for croaker

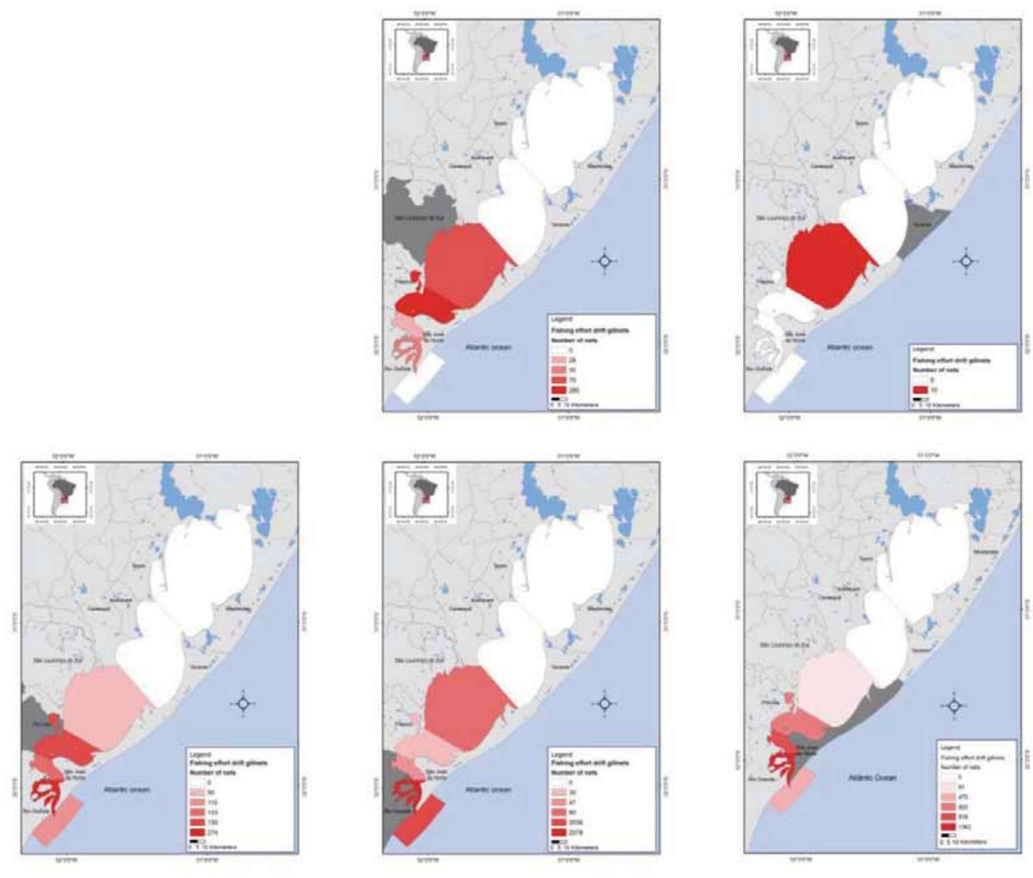


Figure 26: Distribution of fishing effort with drift gillnet for croaker by municipality (in dark grey)

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.

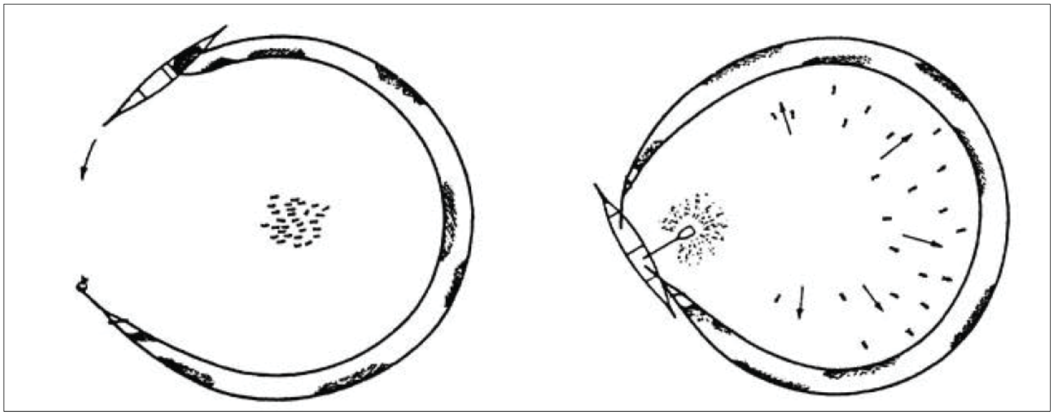


Figure 27: Operation of a surrounding (seine) gillnet (*Source:* FAO, 1982)

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).

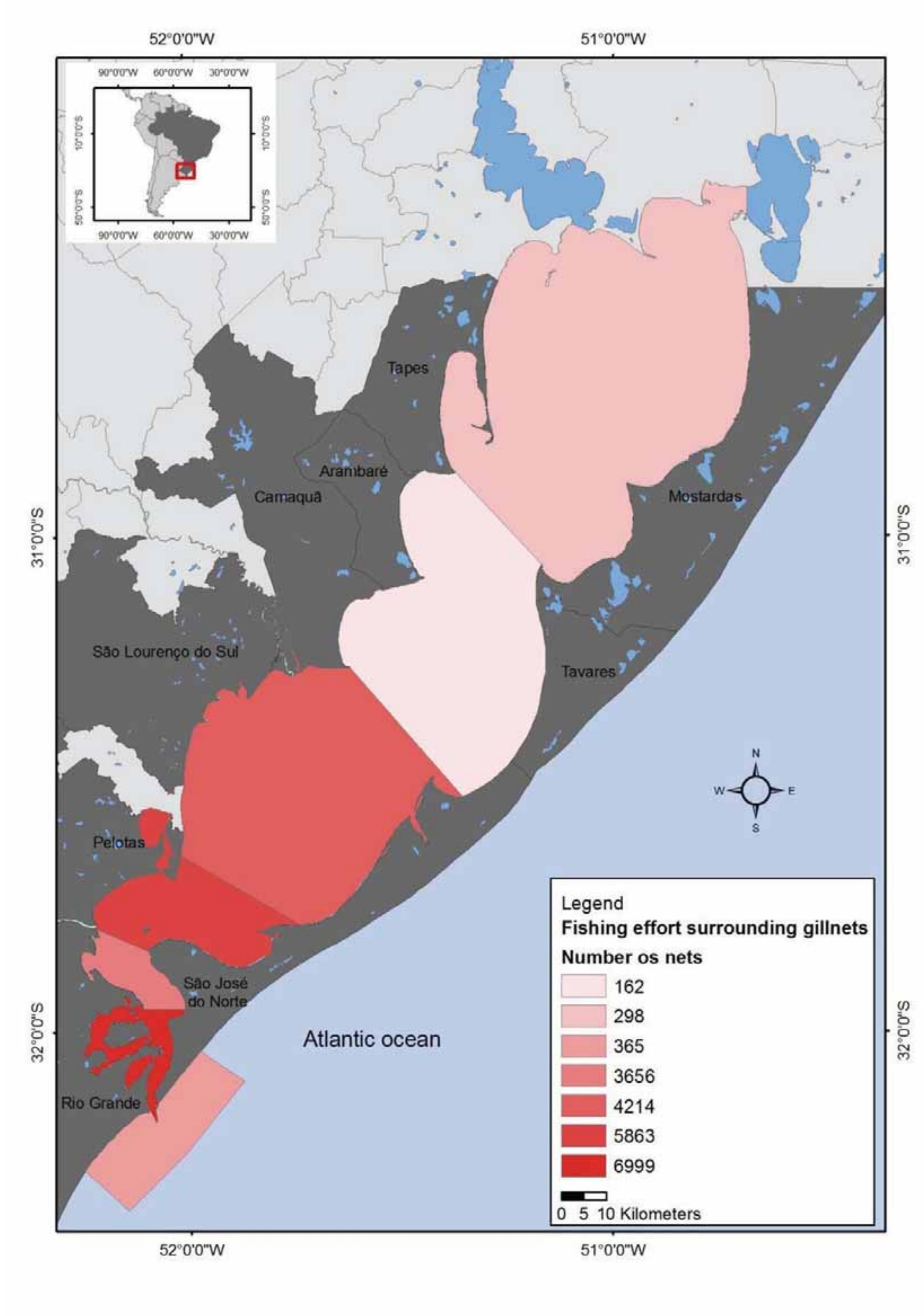


Figure 28: Distribution of total fishing effort with surrounding (seine) gillnets for mullet

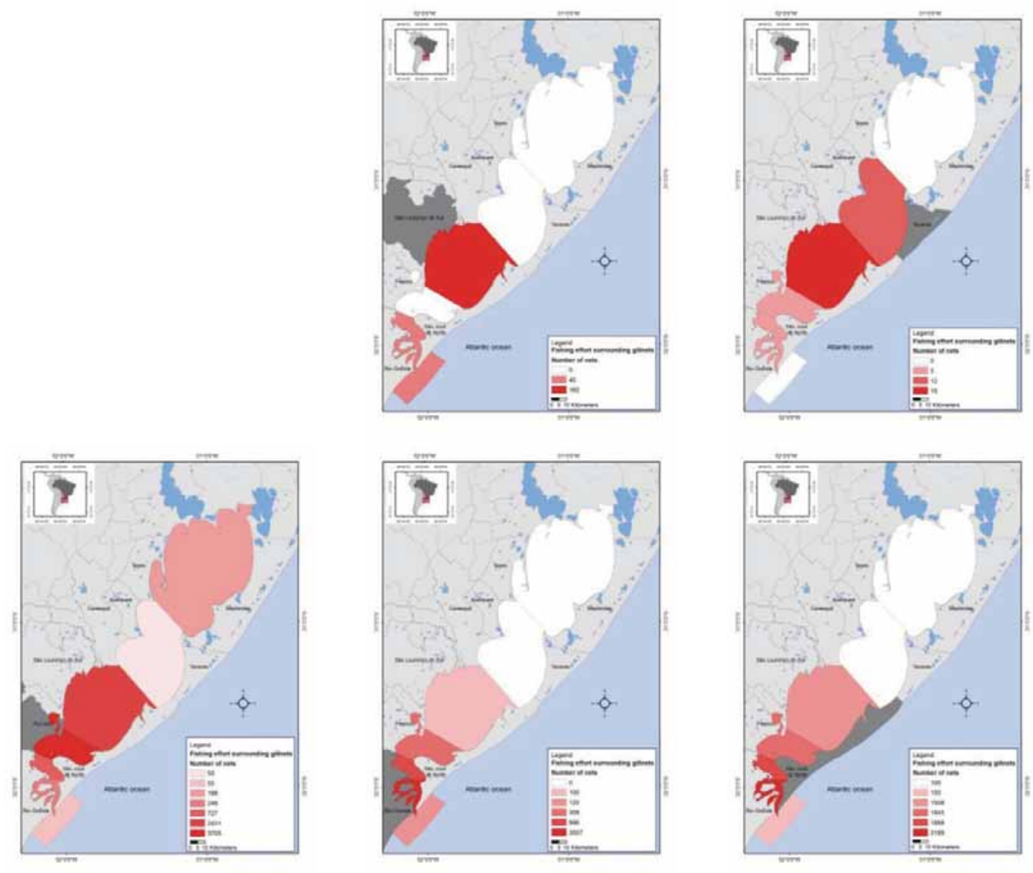


Figure 29: Distribution of fishing effort with surrounding (seine) gillnets for mullet by municipality (in dark grey)

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.

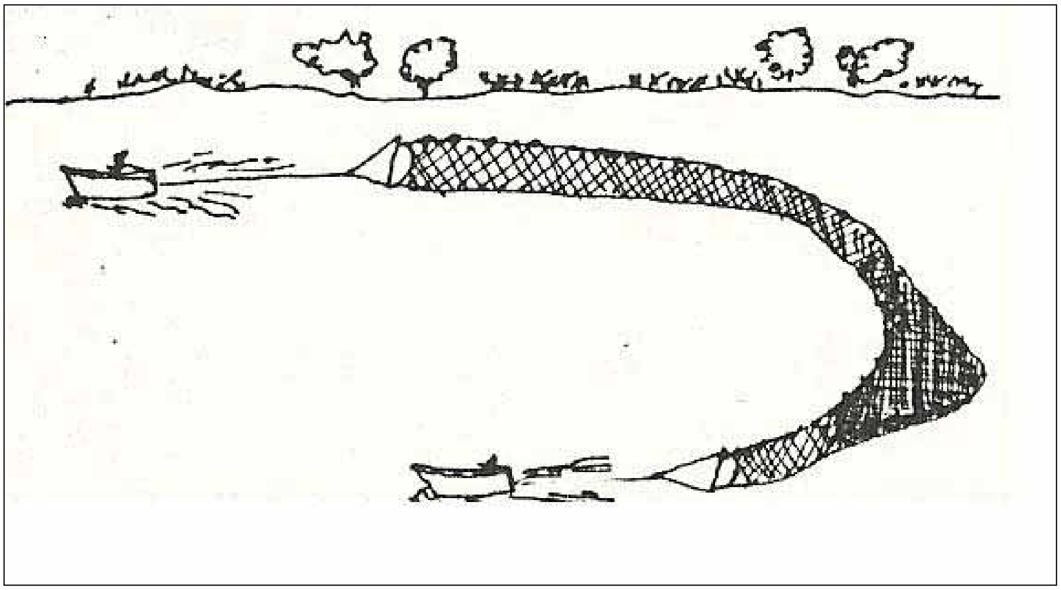


Figure 30: Operation of a *trolha* net used in the capture of demersal fish (*Source:* FURG, 1988)

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
Berimbau	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*.

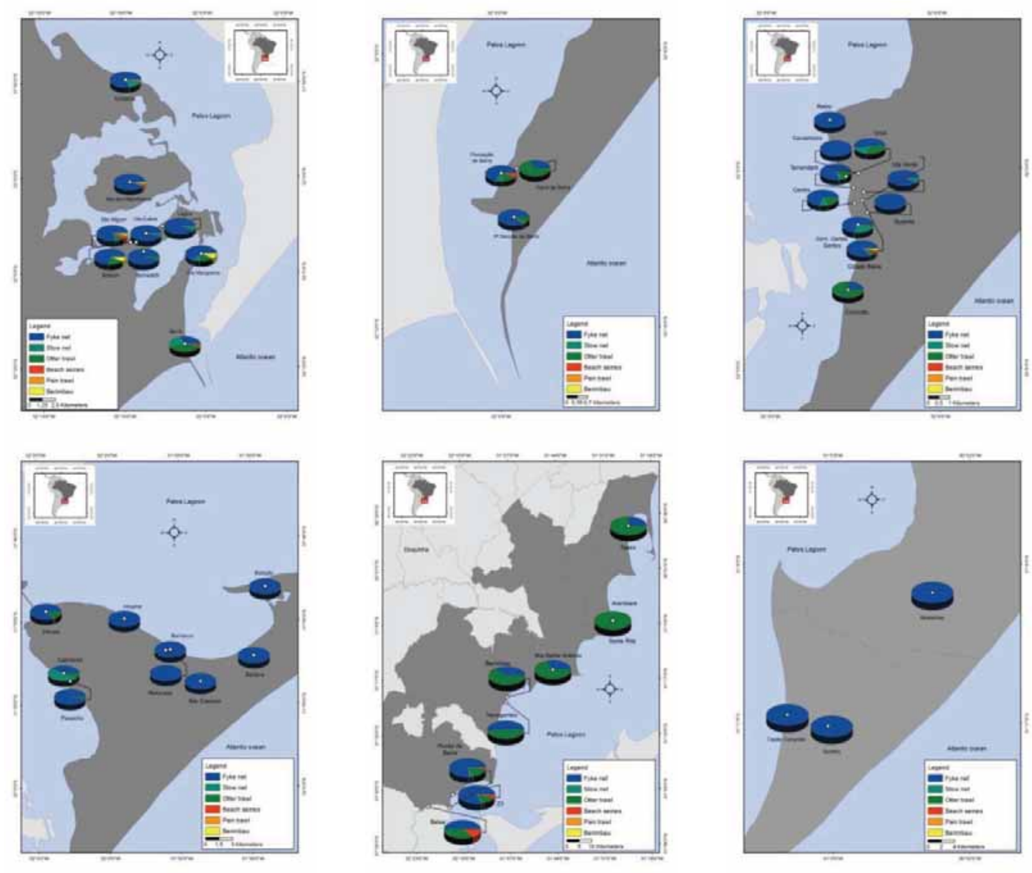


Figure 31: Proportion of fishers using different shrimp fishing gears in each of the main localities

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.

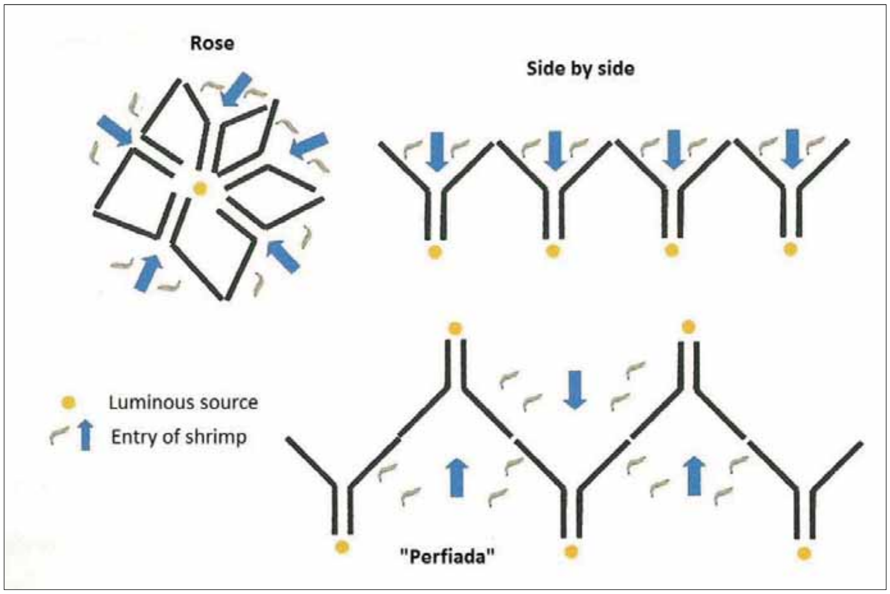


Figure 34: Schematic representation of an *andaina* (*Source:* Benedet, 2006)

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.

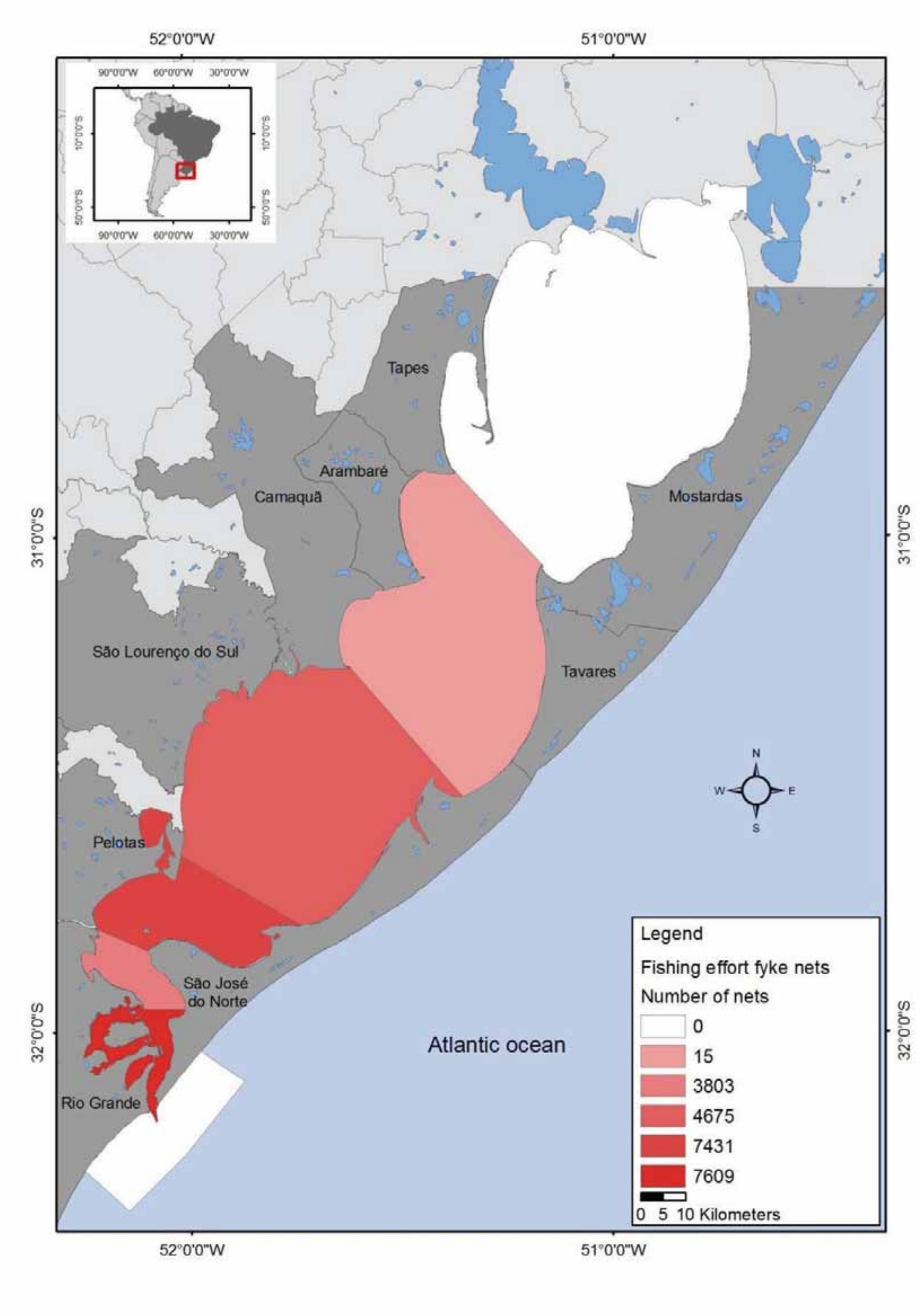


Figure 35: Distribution of total fishing effort with fyke nets for shrimp

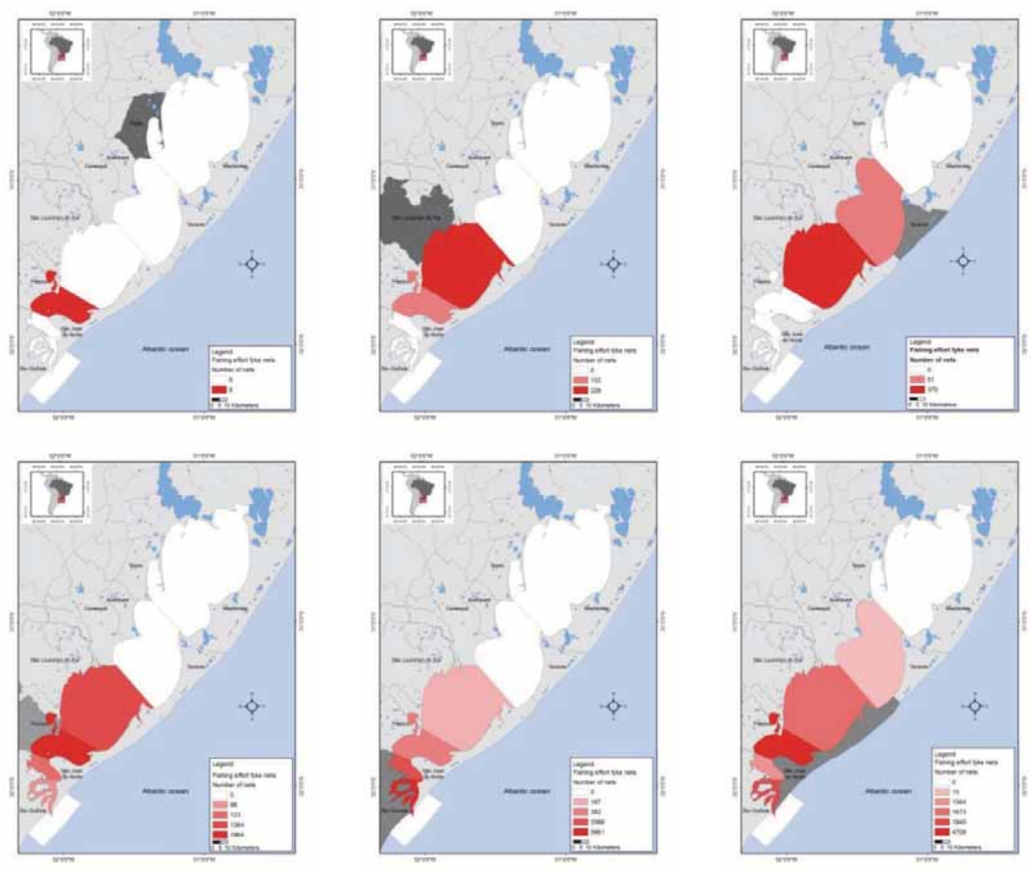


Figure 36: Distribution of fishing effort with fyke nets for shrimp by municipality (in dark grey)

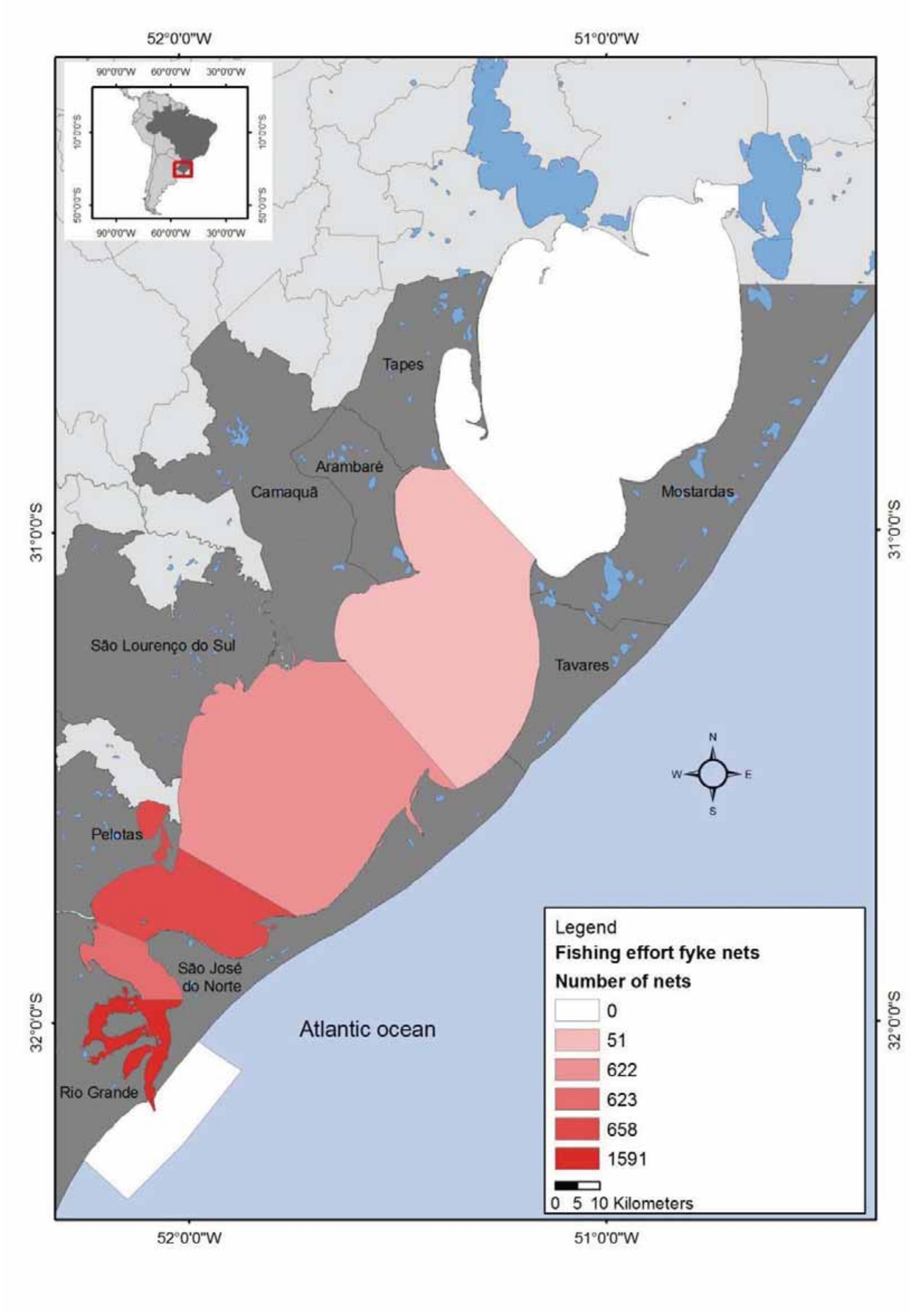


Figure 37: Distribution of total fishing effort with fyke nets for blue crab

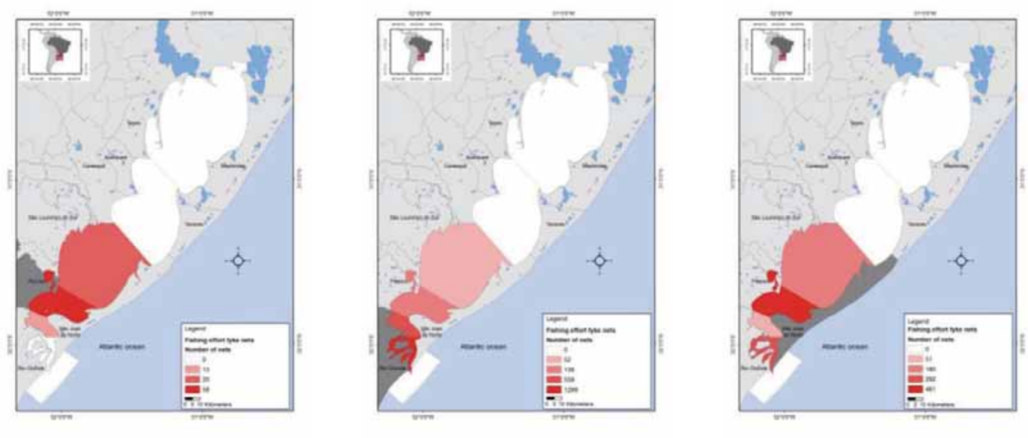


Figure 38: Distribution of fishing effort with fyke nets for blue crab by municipality (in dark grey)

Stow nets

The stow nets (*redes de saco*) 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).

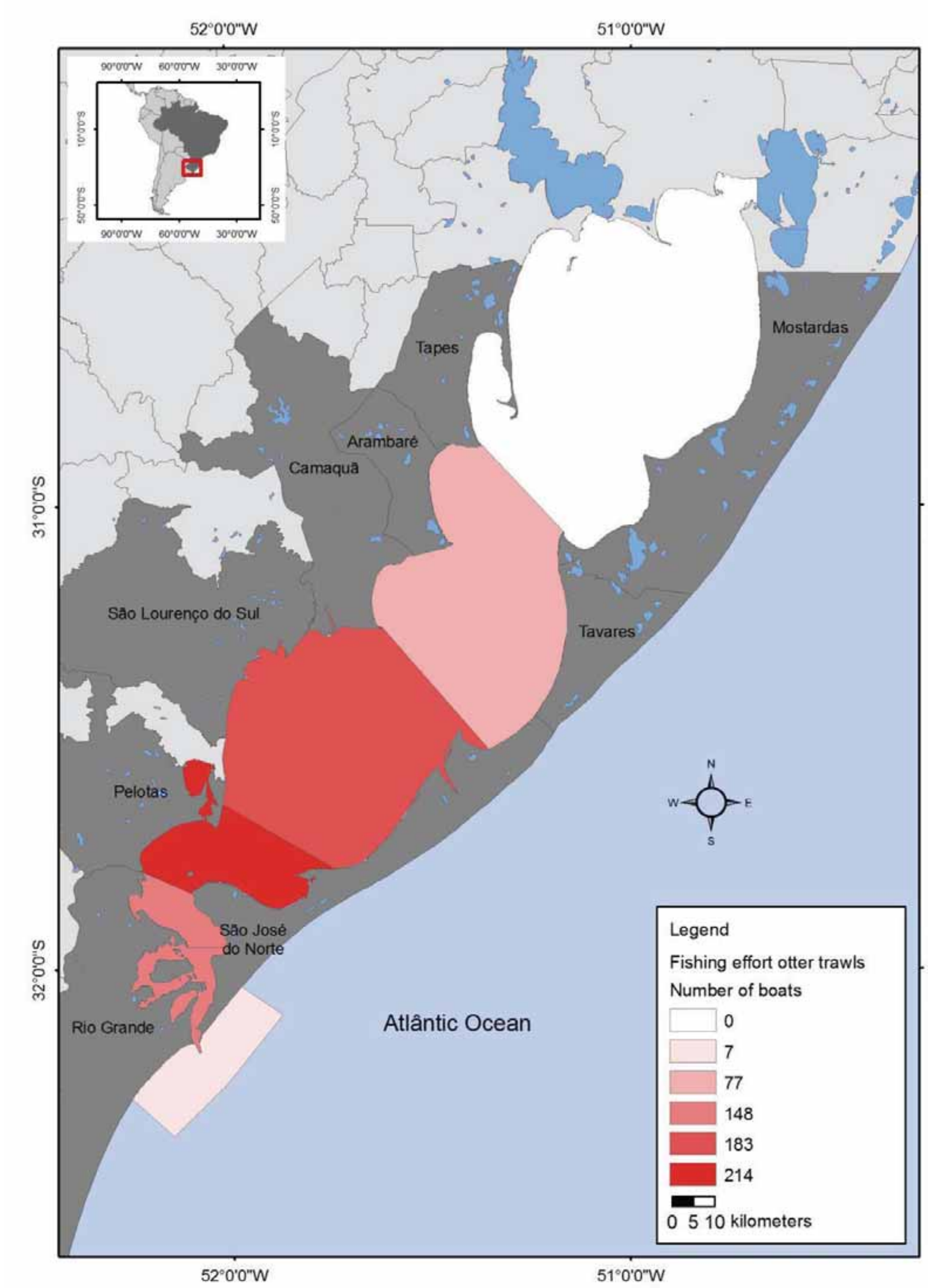


Figure 40: Distribution of total fishing effort with otter trawls for shrimp

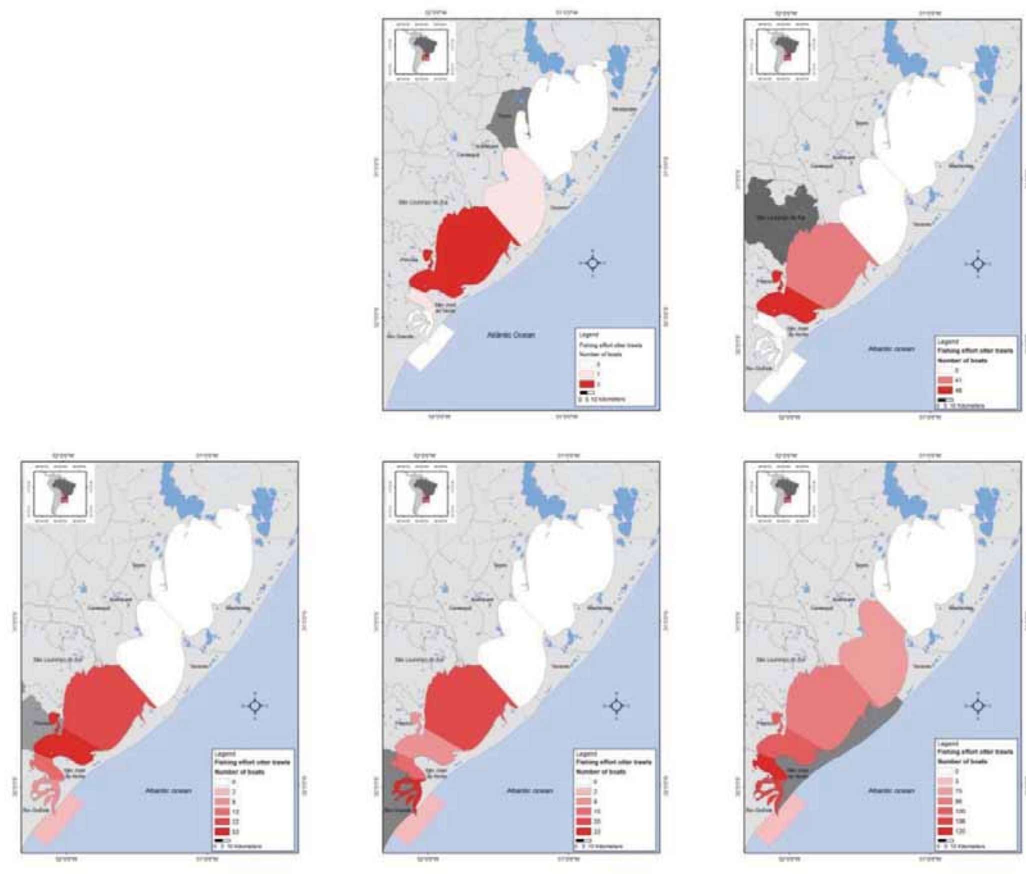


Figure 41: Distribution of fishing effort with otter trawls for shrimp by municipality (in dark grey)

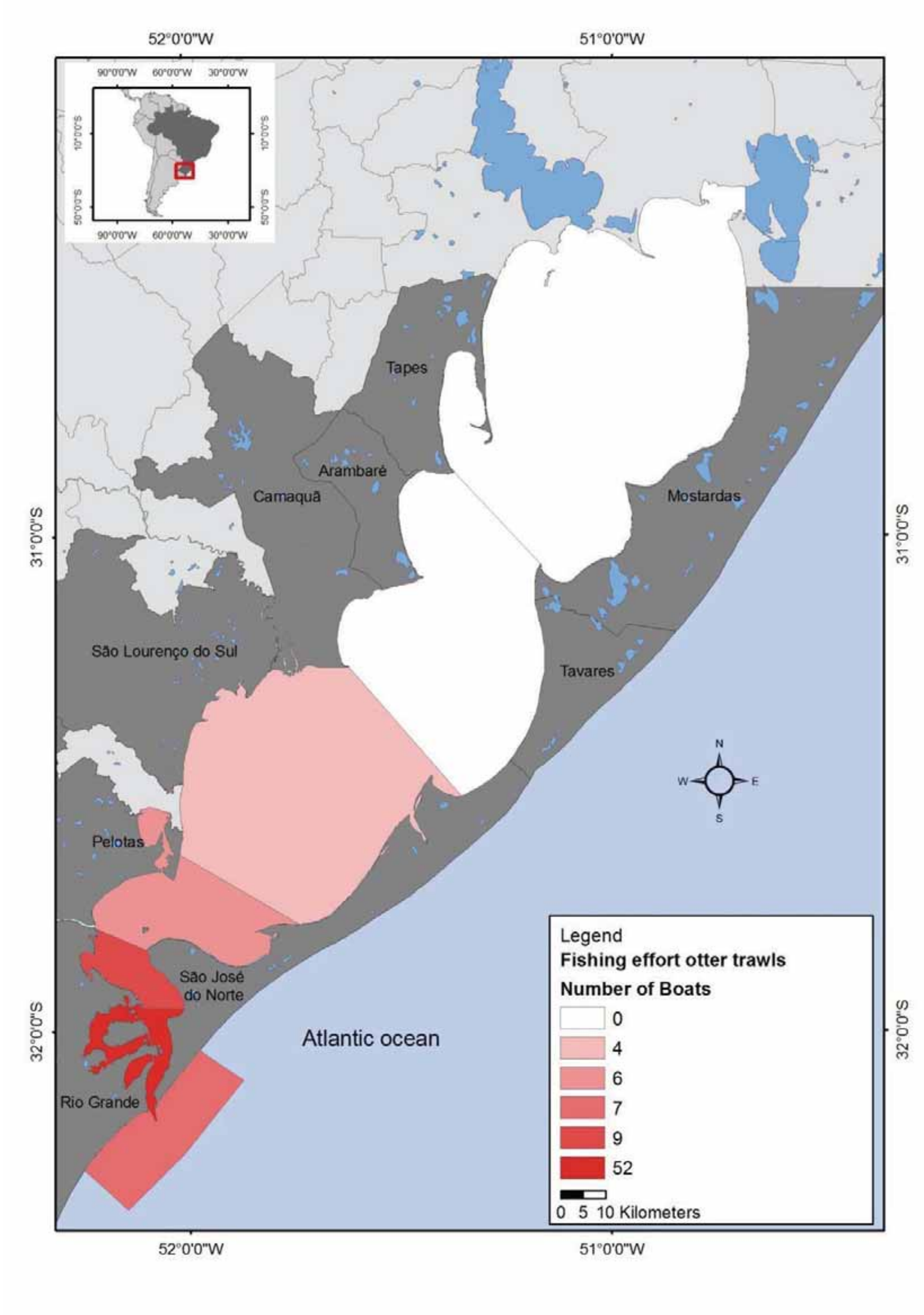


Figure 42: Distribution of total fishing effort with otter trawls for blue crab

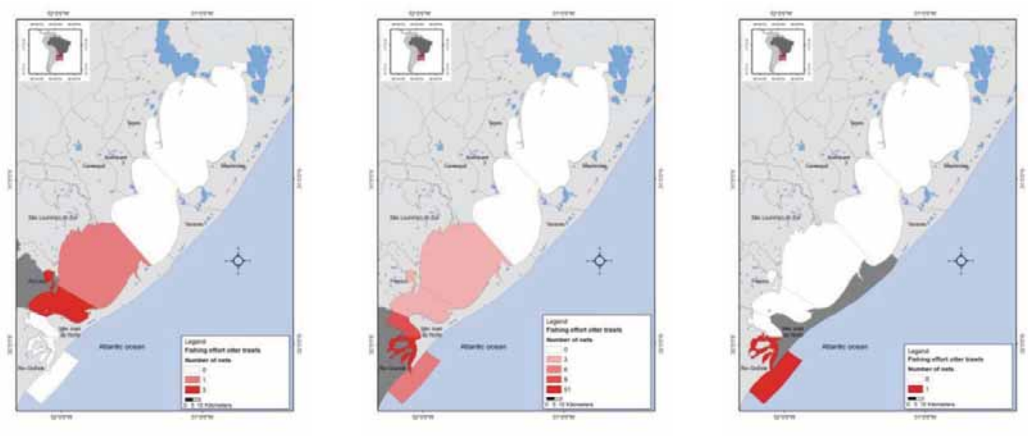


Figure 43: Distribution of fishing effort with otter trawls for blue crab by municipality (in dark grey)

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.

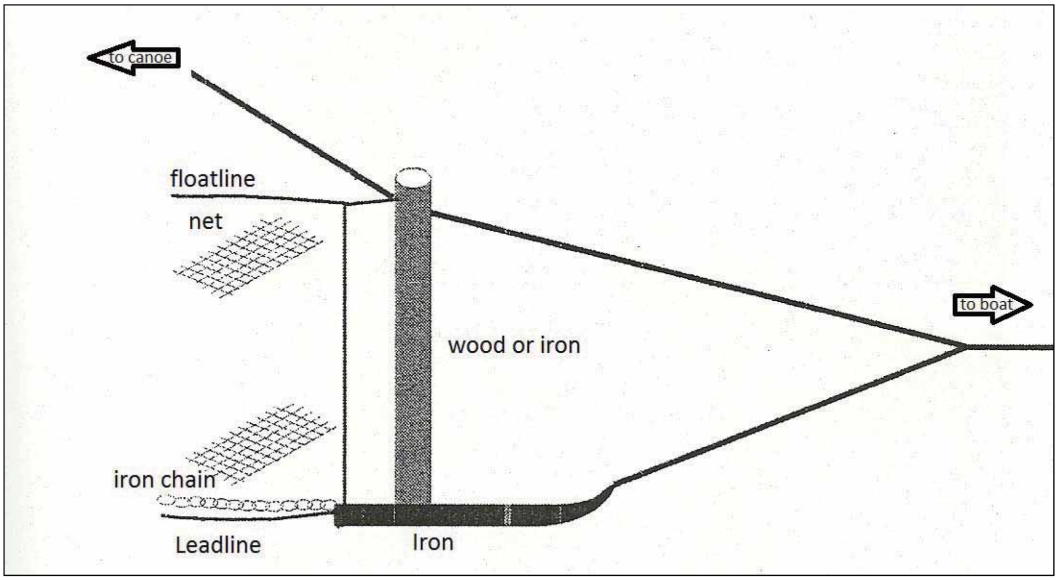


Figure 47: Detail of the mouth of the psin trawl during the tow (*source*: Benedet, 2006)

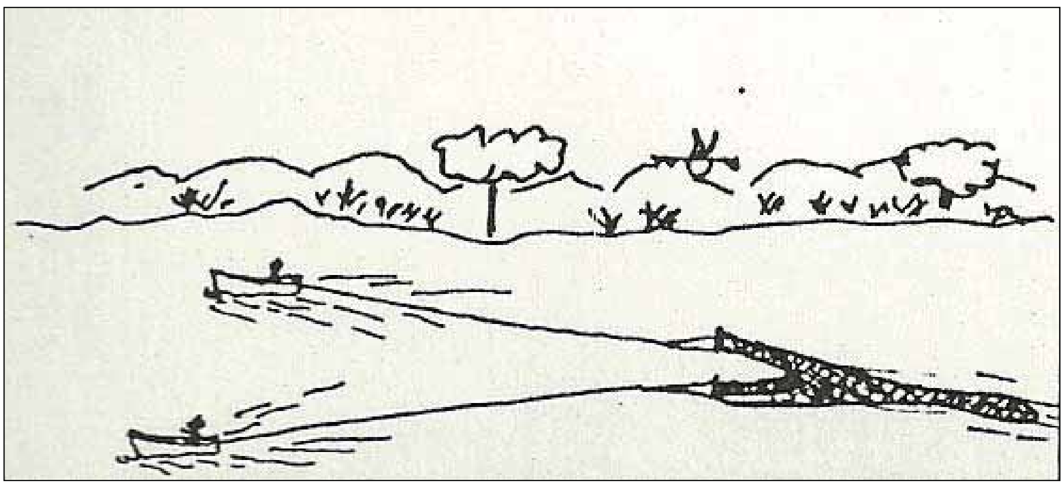
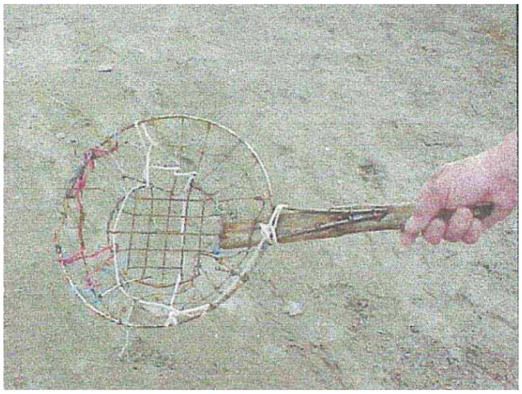


Figure 48: Scheme of operation of a psin trawl (*Source*: FURG, 1988)

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.

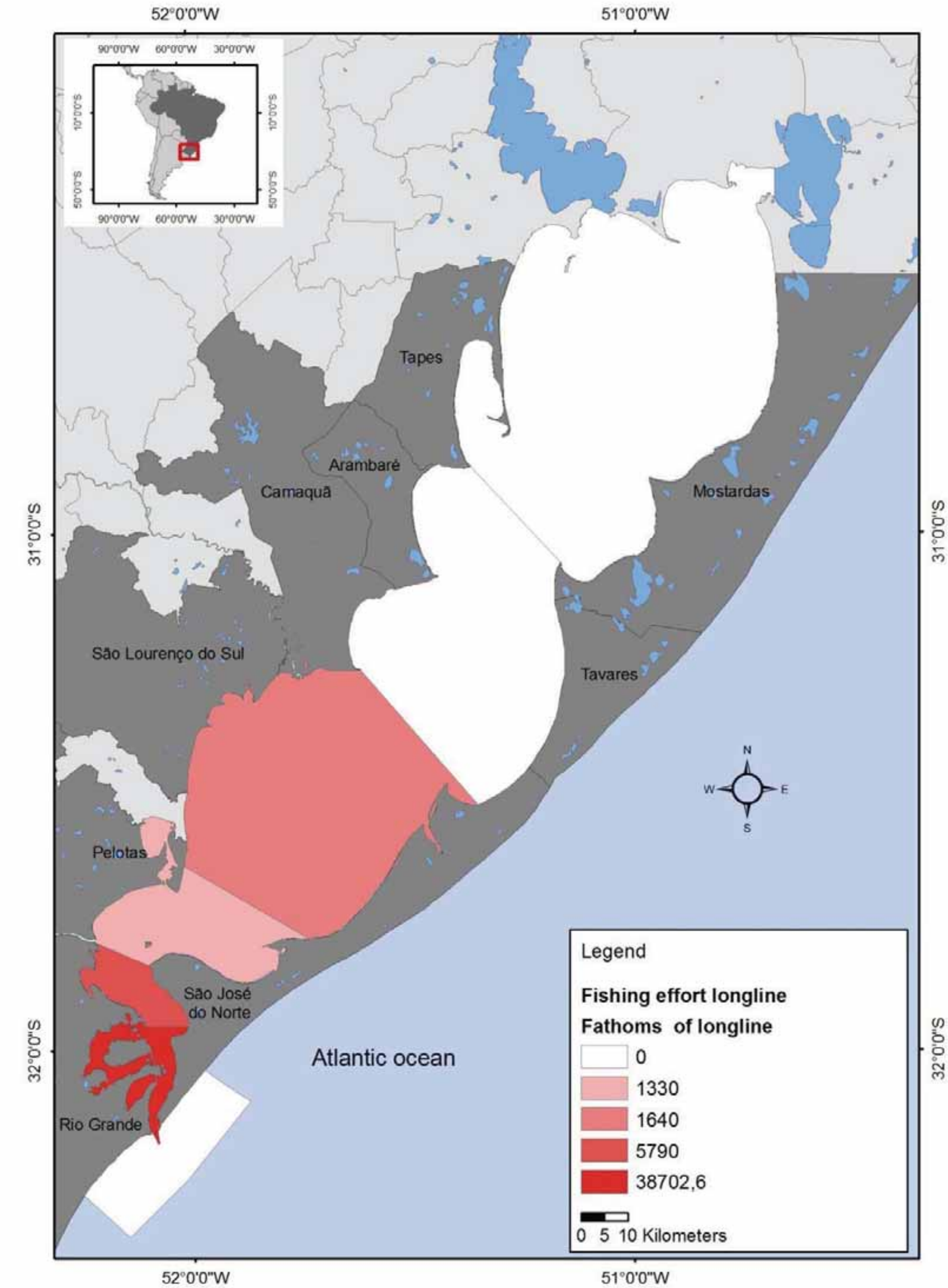


Figure 50: Distribution of total fishing effort with longline for blue crab

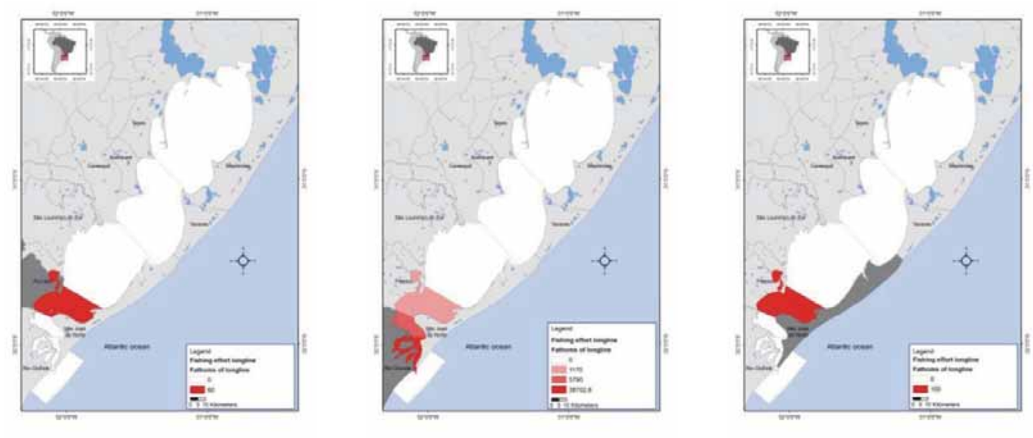
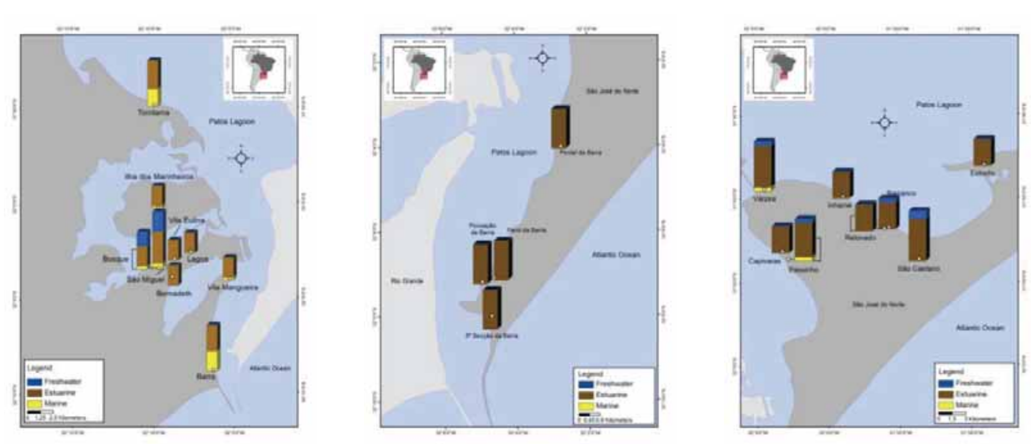


Figure 51: Distribution of fishing effort with longline for blue crab by municipality (in dark grey)

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.



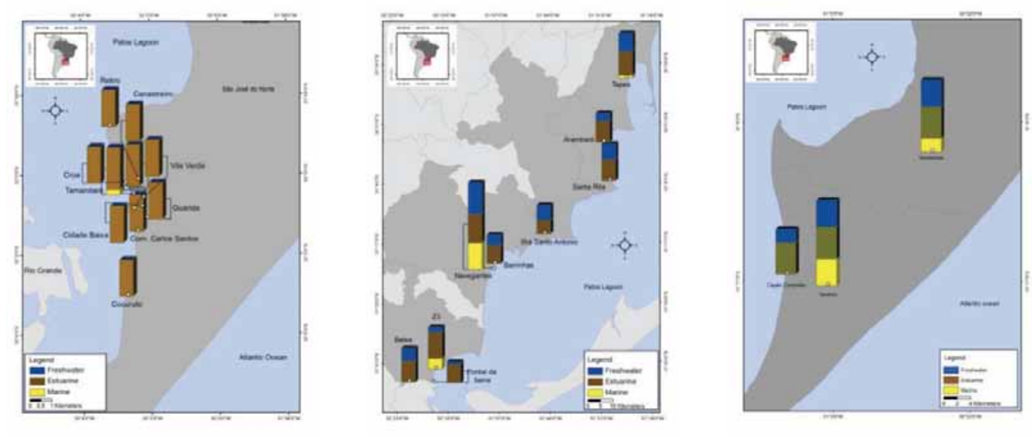


Figure 52: Relative frequency of occurrence of species caught from different environments (the height of the bar is proportional to the number of species)

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.

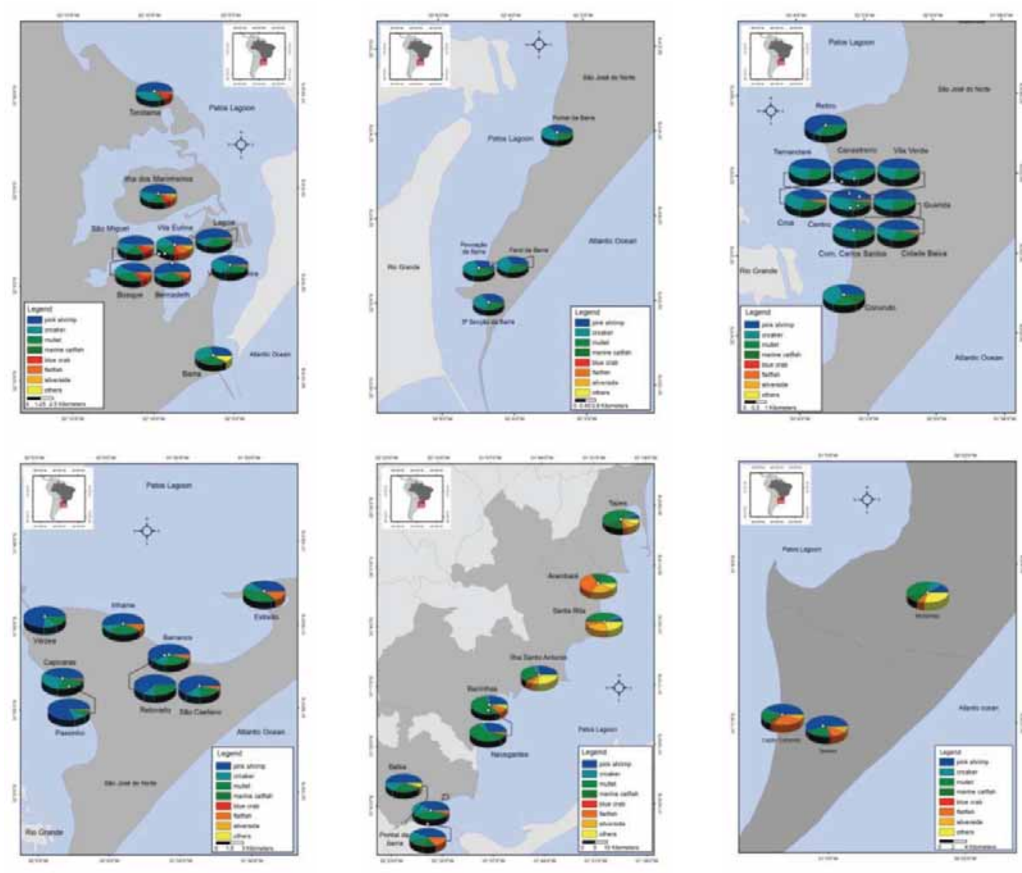


Figure 53: Main commercial fishery resources

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.

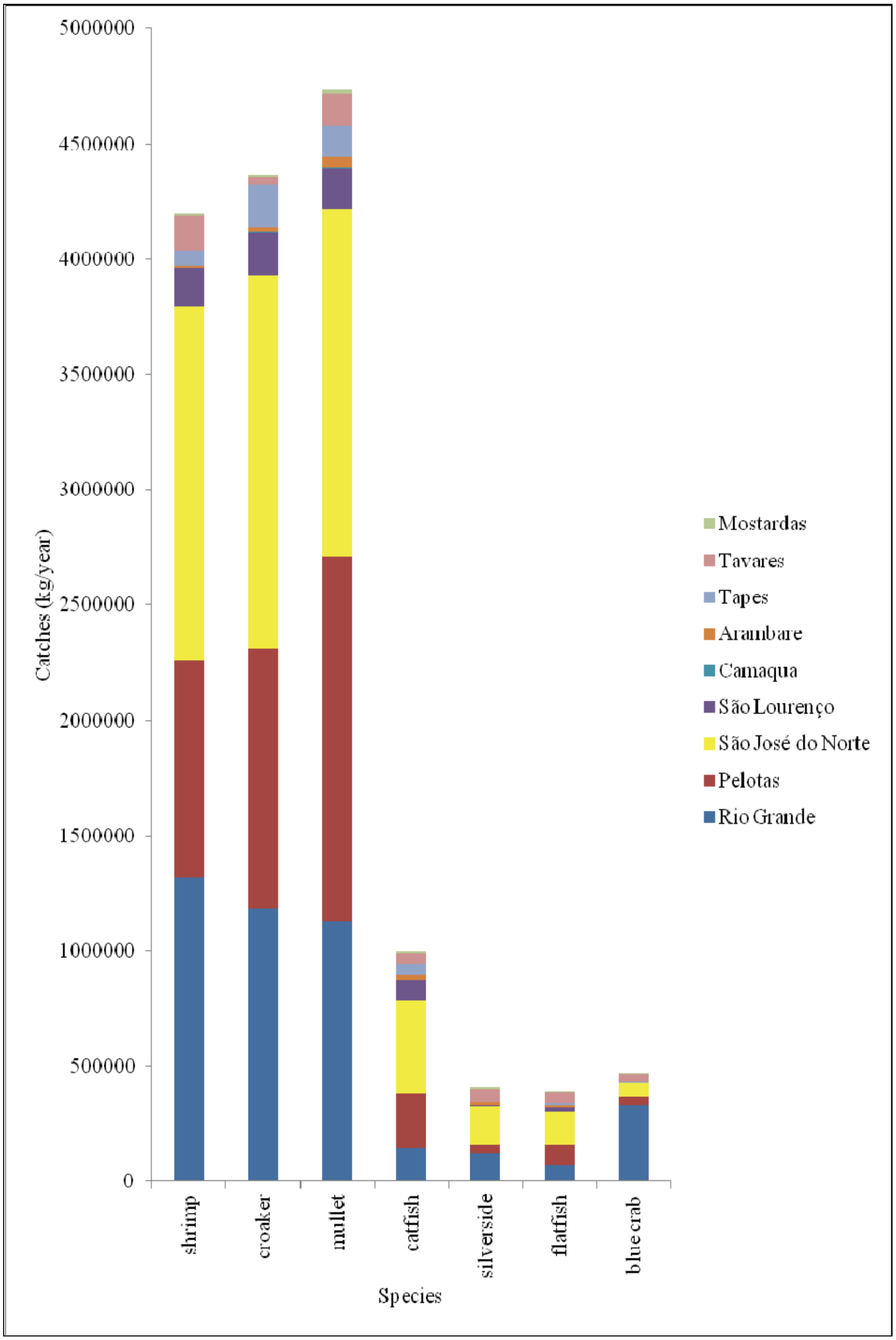


Figure 54: Qualitatively estimated total catch volume of the main fishery resources, as reported by fishers

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 fishers 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.

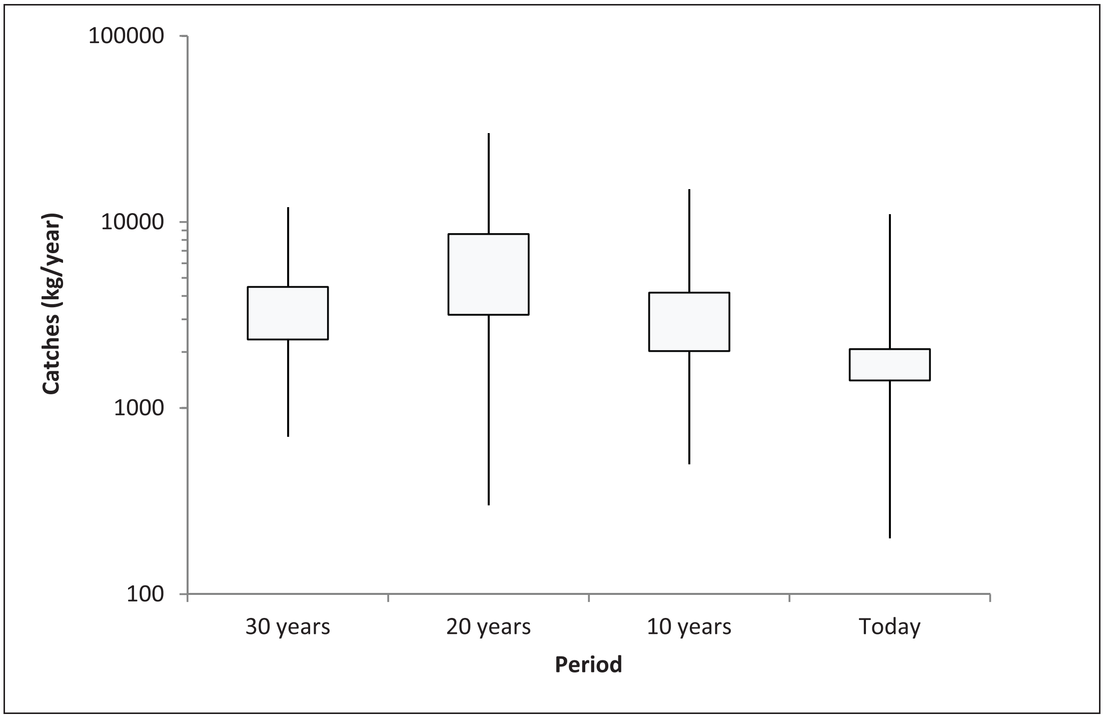


Figure 55: Changes in catches of shrimp by fisher in a good season in the fyke net fishery of Torotama, Rio Grande

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.

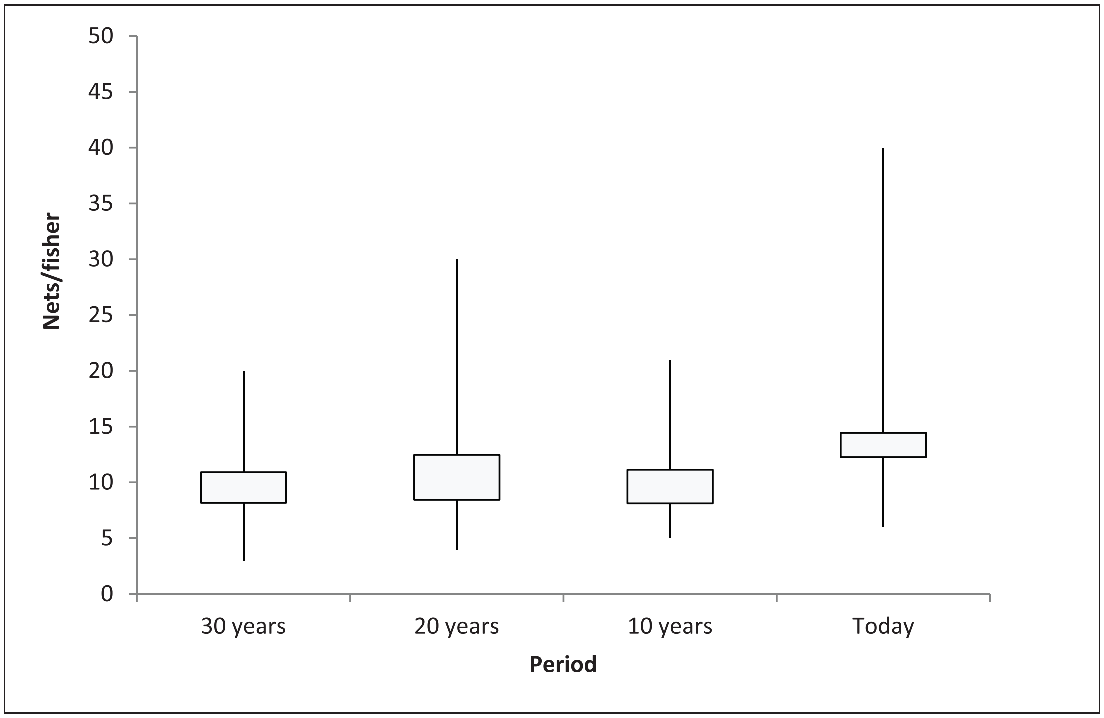


Figure 56: Changes in fishing effort (nets/fisher) in the shrimp fyke net fishery of Torotama, Rio Grande

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.

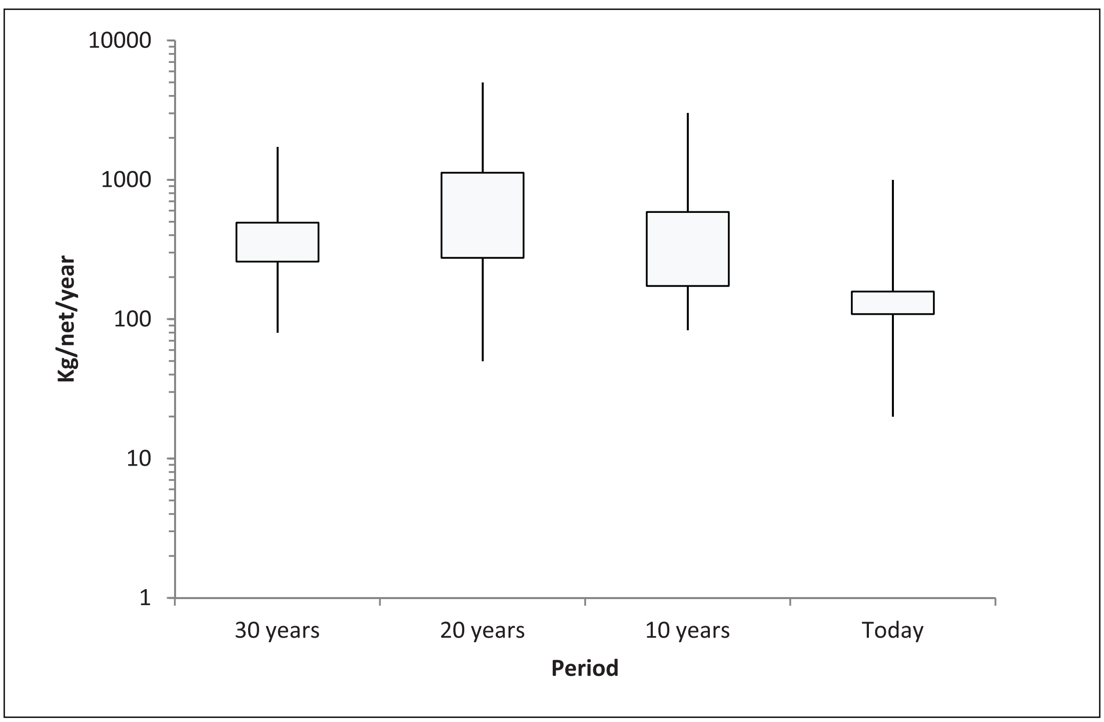


Figure 57: Changes in CPUE (kg/net/year) of the shrimp fyke net fishery of Torotama, Rio Grande

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

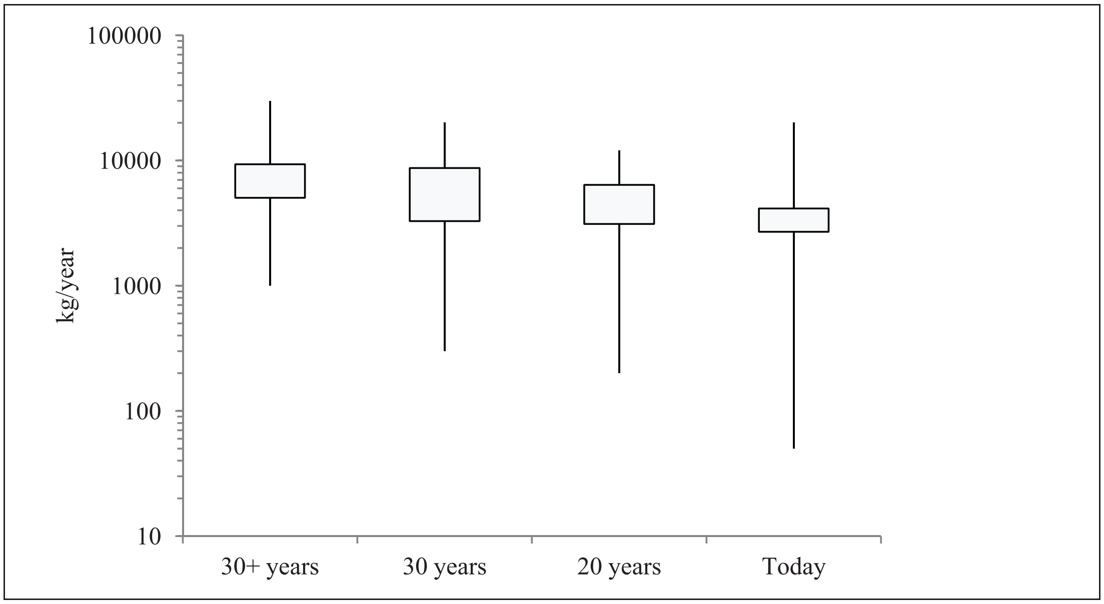


Figure 58: Changes in catches of croaker reported by fishers in a good season in the fixed gillnet fishery of Z3, Pelotas, over different time periods

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.

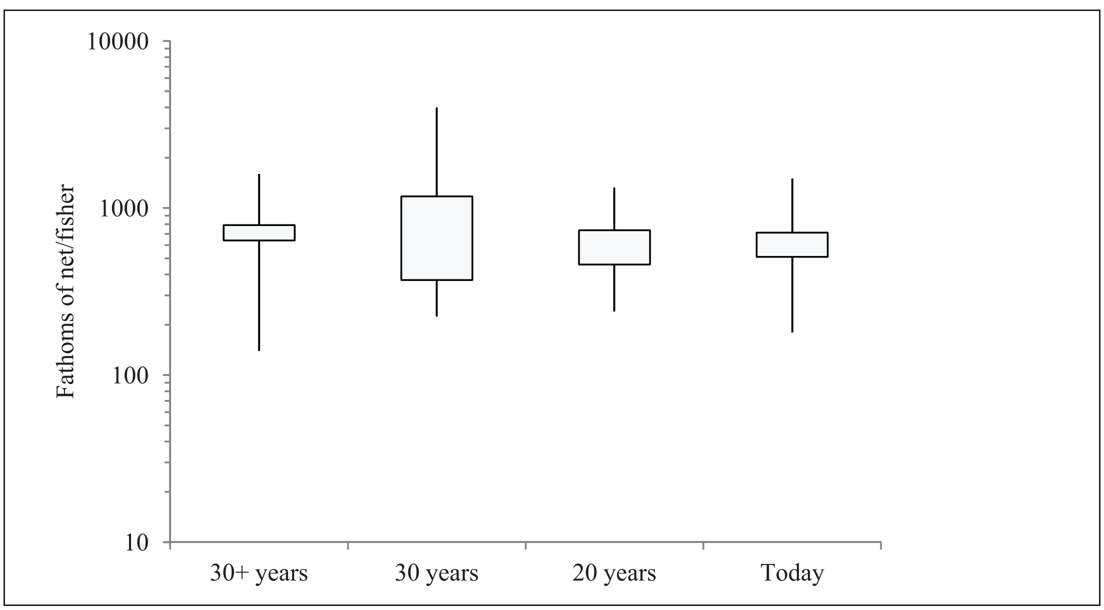


Figure 59: Changes in fishing effort (fathoms of net per fisher) in the fixed gillnet fishery for croaker of Z3, Pelotas

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.

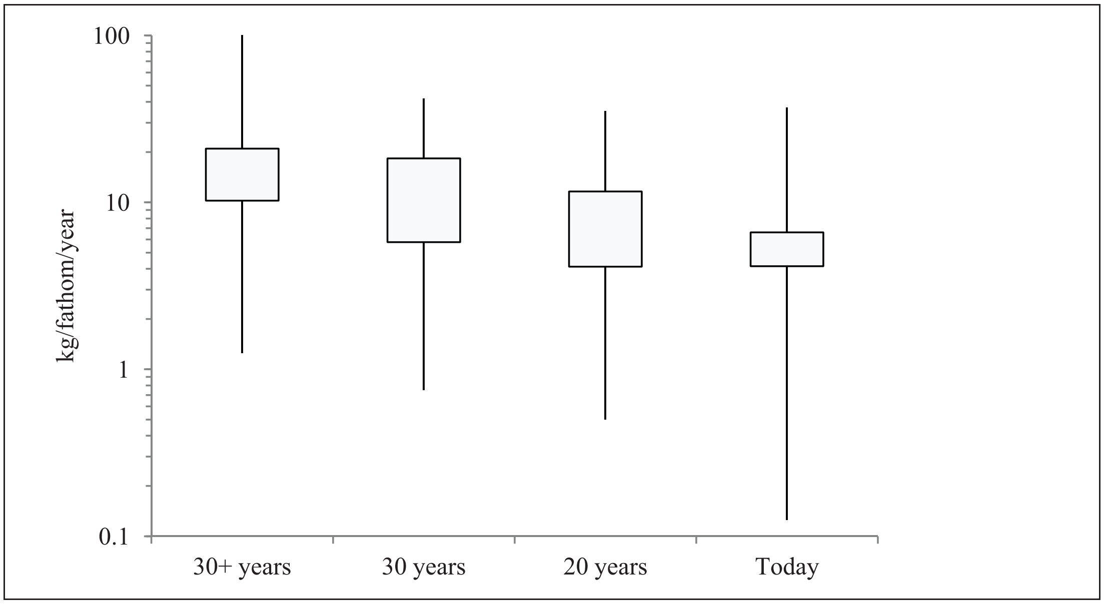


Figure 60: Changes in individual CPUE (kg/fathom/year) in the fixed gillnet fishery for croaker of Z3, Pelotas

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.

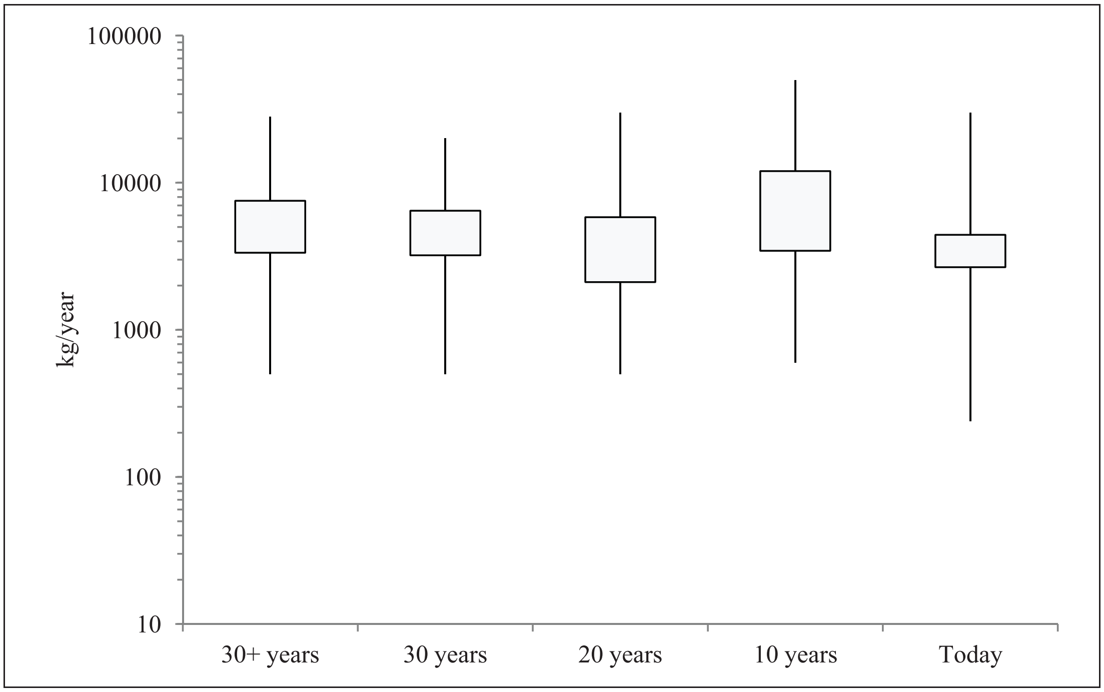


Figure 61: Changes in catches of mullet by fisher in a good season (all gear) in the municipality of Rio Grande

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.

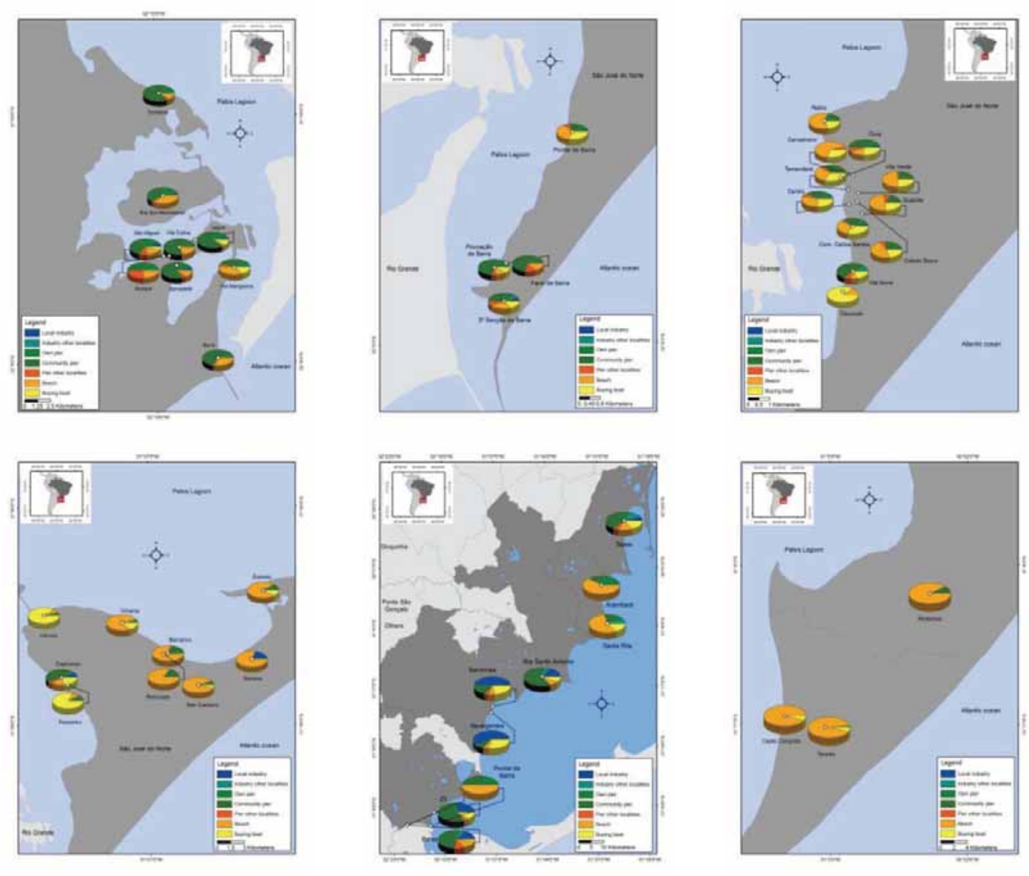


Figure 62: Proportion of fishers using different types of landing sites

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.

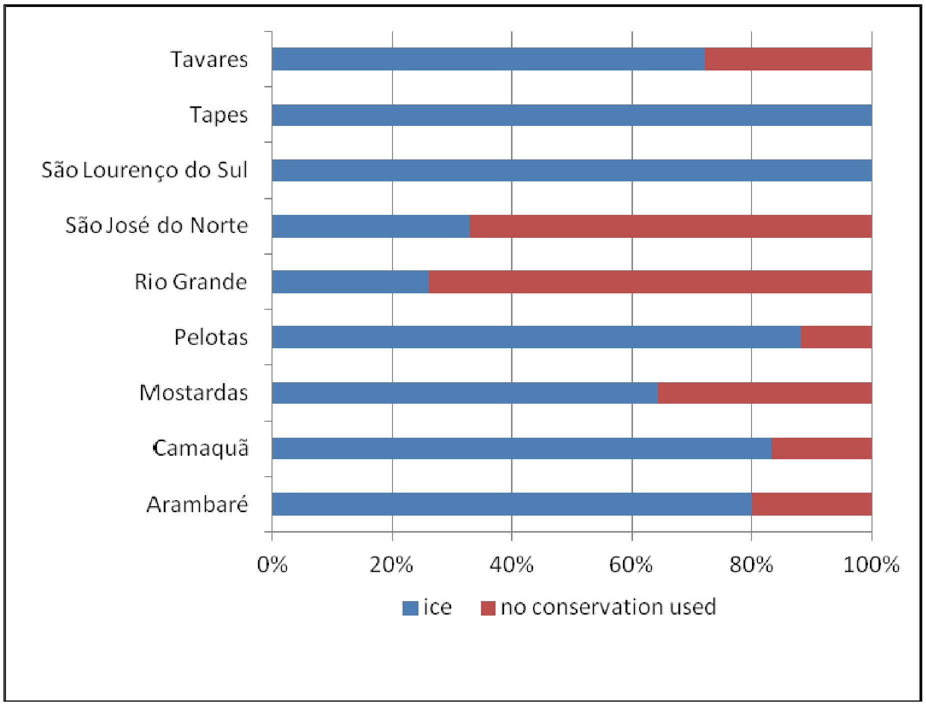


Figure 64: Percentage of fishers using ice on board to conserve catches by municipality

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).

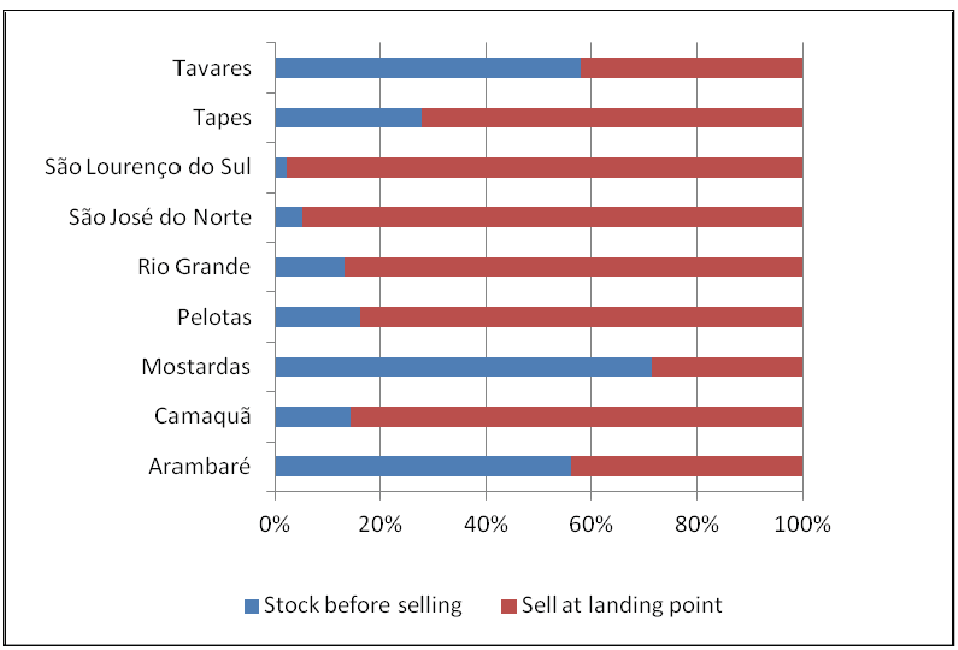


Figure 65: Percentage of fishers who sell the catches at landings point and who store fish before commercialization

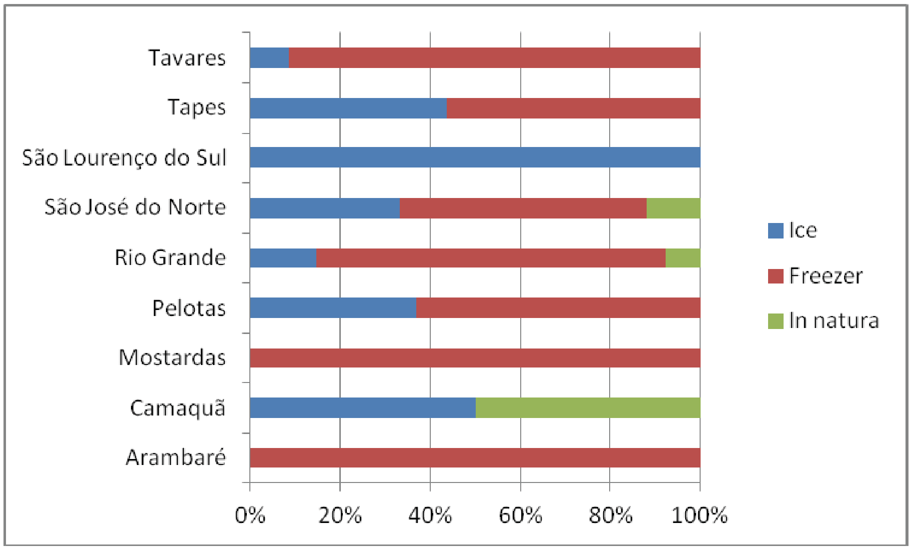


Figure 66: Percentage of fishers using different types of fish conservation before commercialization

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.

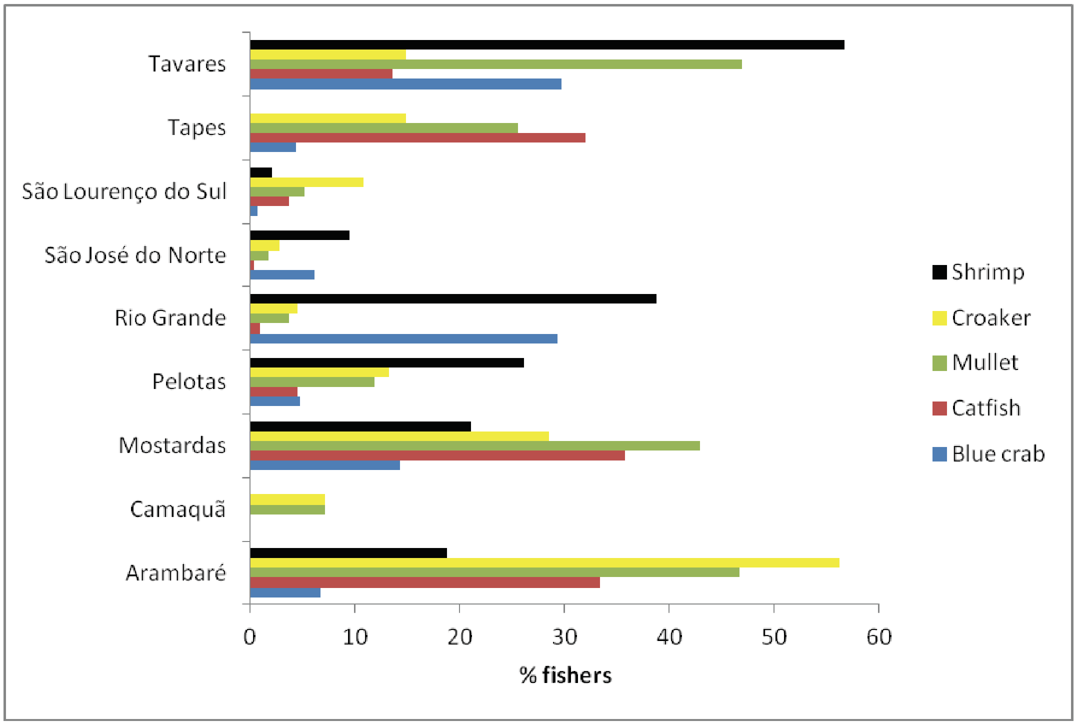


Figure 67: Percentage of fishers conducting some type of processing of catches before commercialization

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.

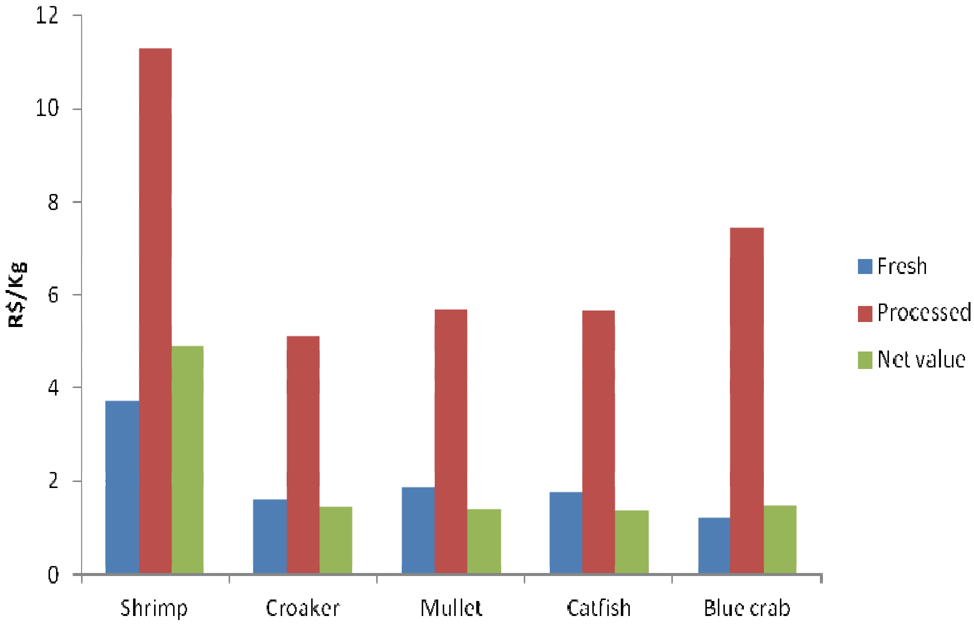


Figure 69: Average prices paid per kilo of fresh and processed shrimp (peeled), croaker (fillet), mullet (fillet), catfish (fillet) and blue crab (shelled). The calculated net value per kg is also shown (after the losses and costs with processing)

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).

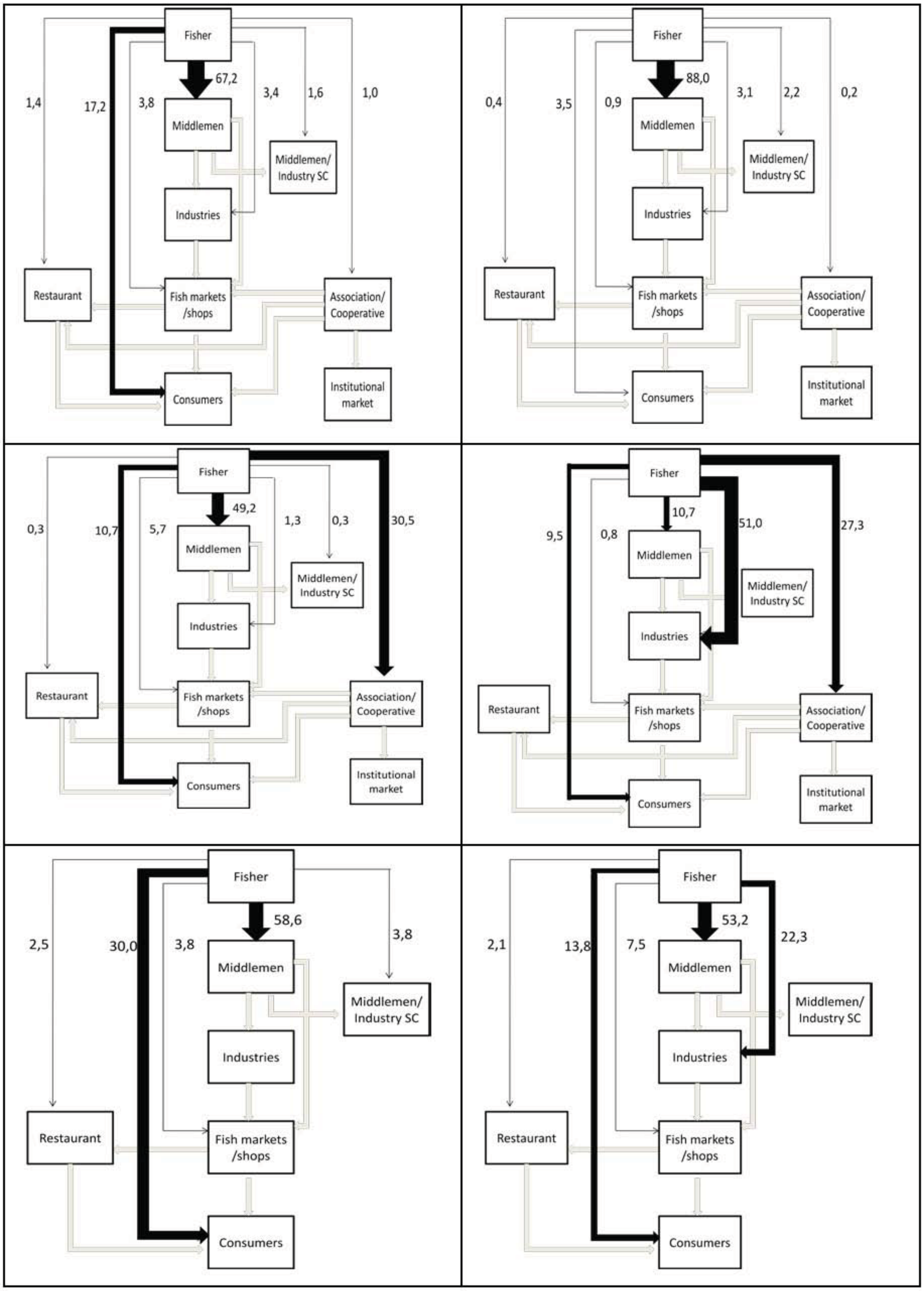


Figure 70: Supply chain for the municipalities of Rio Grande (upper left), São José do Norte (upper right), Pelotas (middle left), São Lourenço do Sul (middle right), Tavares (bottom left) and Tapes (bottom right)

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 Grande[3] 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).

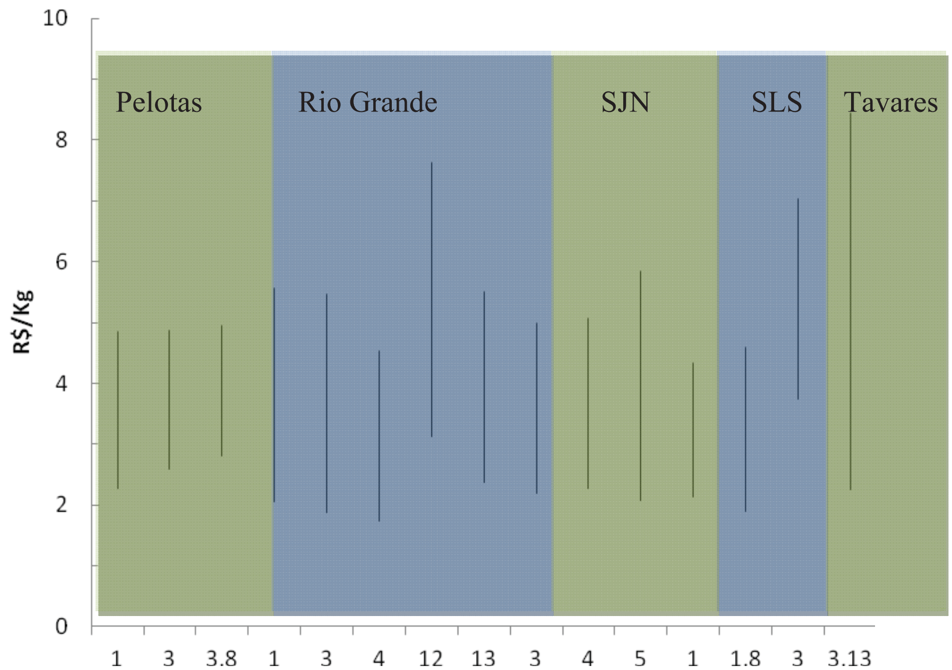


Figure 71: Price of fresh shrimp received by fishers according to the type of commercialization in each municipality (*Note*: SJN = São José do Norte; SLS = São Lourenço do Sul). Figure 71 shows the price of fresh shrimp received by fishers according to the type of commercialization in each municipality: 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.

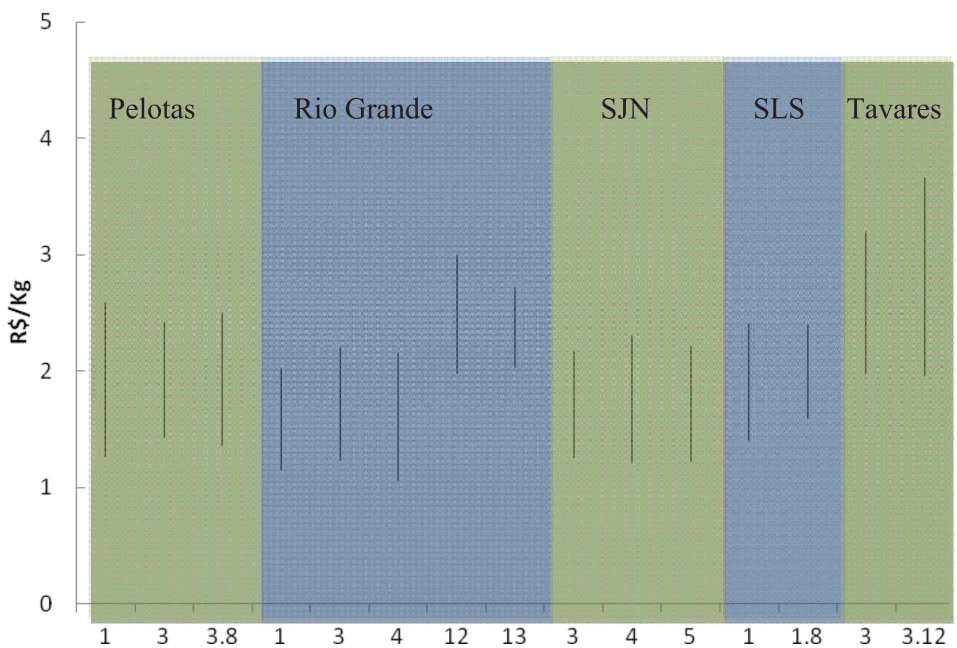


Figure 72: Price of fresh mullet received by fishers according to the type of commercialization in each municipality (*Note*: SJN = São José do Norte; SLS = São Lourenço do Sul). Figure 72 uses the same method as above but for mullet instead of shrimp. The prices shown are for fresh mullet received by 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.