Artisanal fisheries in Brazil

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INTRODUCTION

Artisanal fisheries have been receiving an increasing level of attention from governmental and academic institutions in Brazil in recent years. The reasons for that are many, but the most important are: the general failure of governmental policies for the development of the fisheries sector, which were focused almost exclusively on industrial fisheries; the growing recognition of the importance of artisanal fishers who, without support from the government, continue to supply local and regional markets; the innumerable pressures that artisanal fishing communities have been suffering, owing to the expansion of the interests of the real-estate and tourism sectors and environmental degradation - factors that often force artisanal fishers to move to cities, having lost their land; the coverage given to these conflicts by the press; the recent political liberalisation in Brazil after the fall of the military regime (1964 to 1984), which allowed the marginalized and forgotten groups of society to express themselves more freely, especially in defence of their rights and aspirations in the Constituent National Assembly; the work carried out by non-governmental organisations, in particular, the Catholic Church, through the activities of the Fisheries' Pastoral mainly in the north and north-eastern states, and the birth of the National Movement of Fishers (MONAPE) in 1989.

The development of artisanal fisheries faces many challenges due to the lack of policies, strategies and concrete experiences that can support sustainable fisheries production, better organization and improvement of the livelihood of fishing communities. There has been a continuous worsening of the problems affecting the production of artisanal fisheries owing to the depletion of fisheries resources, environmental degradation of coastal areas, and ultimately to the ineffectiveness of governmental strategies in overcoming the obstacles that impede the sustained development of the artisanal fishing communities along the Brazilian coast. The overall lack of information about artisanal fisheries is a subsidiary problem that gives low political visibility to the sector and thus helps perpetuate its status.

This report aims to provide a broad perspective of the status of artisanal coastal fisheries in Brazil, and to put forward some alternative strategies for the development of the sector. In describing artisanal fisheries, we opted to concentrate as much as possible on general regional characteristics, but also highlight special features of relevance to particular fisheries when necessary.

1. COUNTRY DESCRIPTION: PHYSICAL SETTINGS, GEOGRAPHICAL BOUNDARY, FISHERIES REGIONS AND JURISDICTION

Artisanal fishers are organised into a number of fishing communities settled along the coast and in small coastal towns in Brazil. Artisanal fishing is conducted in a variety of coastal ecosystems. The characteristics of habitats, fauna, productivity and oceanography of these ecosystems greatly influence the way fishing activities are developed. On a broad scale, the Brazilian coastline can be divided into 5 large ecosystems with distinct environmental characteristics of importance to capture fisheries (Matssura, 1995; Figure 2).

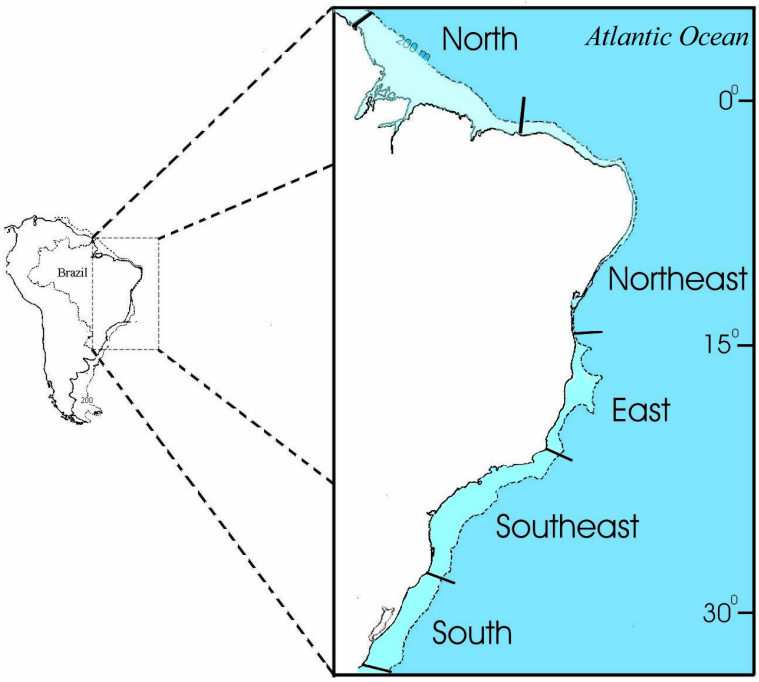

Figure 2. Major marine coastal ecosystems of Brazil.

Biological production is high in the North, as a result of the continental runoff from the Amazon River (Teixeira and Tundisi, 1967). The wide continental shelf and the rich benthic community favoured the development of industrial trawling activities in this region, mostly for shrimps and large catfishes. The Northeast and East regions present oligotrophic conditions due to the influence of tropical waters from the Brazil Current. Rocky bottoms and a mostly narrow continental shelf induced the development of hook-and-line and longline fisheries for rockfishes, sharks and tunas. In the Southeast, primary production is mainly driven by seasonal upwelling of nutrient-rich, cold subtropical waters pumped by alongshore winds and by cyclonic vortexes originating from the Brazil Current (Bakun and Parrish, 1990; Matsuura, 1995). The southern part of the Brazilian coast is under the influence of the Subtropical Convergence between the southward and northward Brazil and Malvinas currents. The confluence of water masses and the high volume of continental runoff provide physical and chemical conditions for high biological production on the shelf (Seeliger *et al.*, 1997). Trawling is the main type of fishing activity in the southeastern and southern regions, although the presence of highly abundant pelagic stocks,

mainly sardine, in the Southeast has also led to the development of an important purse seine fishery since 1950.

Within each of these major ecosystems there is a variety of inshore and coastal ecosystems where diverse communities of artisanal fishers live and work. Coral reefs, mangroves, estuaries and coastal lagoons are particularly important coastal ecosystems. Coral reefs occur along 3,000 km of the northeast and east coasts and off oceanic islands. Mangroves extend almost along the entire coast of Brazil, from Oiapoque (Amapá) to Laguna (Santa Catarina), occupying an area of about 25,000 km^2. The most extensive areas of mangrove are associated with the mouth of the Amazon River in the north of Brazil. Coastal lagoons are found in the southern, southeastern and northeastern regions, and are especially important in the states of Alagoas, Rio de Janeiro, Santa Catarina and Rio Grande do Sul. The Patos lagoon, located in Rio Grande do Sul, southern Brazil, is recognized as one of the most important centres for artisanal fisheries in Brazil.

2. DESCRIPTION OF FISHERIES AND FISHING ACTIVITIES

Two main fish production systems co-exist in Brazil: industrial and artisanal fisheries. Industrial fisheries are defined as fish harvesting undertaken by large boats that belong to a fishing company. Social and technical division of labour is high, and production is sold to processing companies and large markets. Industrial fisheries concentrate their harvesting on high market value species such as lobster, shrimp and tuna, or highly abundant stocks such as sardine.

There is a continuing debate on the definition of the term “artisanal fisheries”. SUDEPE (the Superintendency for the Development of Fisheries, which was the governmental agency for fisheries development from 1967 to 1988) defined the artisanal fishery as the fishery carried out by boats with less than 20 tonnes of capacity. This definition is clearly unsatisfactory considering that some industrial fishing boats also fall into this category. As a result, statistics on the production of artisanal fisheries are not accurate.

In this study coastal artisanal fishers are defined as independent fish harvesters whose livelihood is based on fishing, on a part or full time basis, using labour and knowledge intensive fishing techniques, and employing family or community labour, often on a sharing basis, for harvesting in coastal habitats. The fish caught are normally sold in the local market, usually through middle-men, although some is for home consumption. The artisanal fisheries sector has a long-standing tradition in Brazil. Before the governmental incentives to develop industrial fisheries in 1967, artisanal fisheries accounted for more than 80% of the fish production in the country. Today it is responsible for approximately 54% of the total marine landings of about 516,000 tonnes (data for 2002; Figure 1).

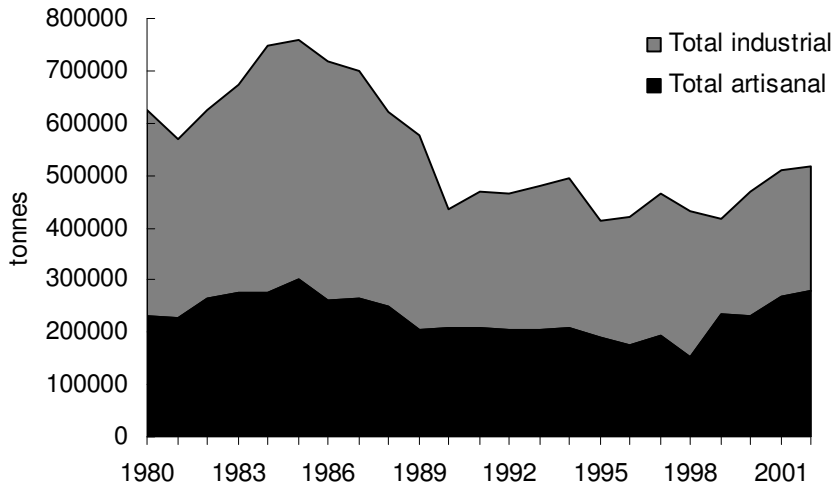

Figure 1. Landings by main types of marine fisheries (source: IBGE; IBAMA; CEPENE; Freire, 2003).

Table 1 summarizes the available information on the artisanal coastal fisheries fleets operating in each region along the coast. Fishing activities in the North, Northeast and East coasts of Brazil are predominantly small-scale – the sector accounts for more than 90% of total landings in these regions. Industrial fisheries account for most of the fisheries production, with artisanal fisheries representing 34% and 8% of the total landings in the Southeast and South respectively, in recent years.

In the North, artisanal fisheries are concentrated in the estuary of the Amazon River, other smaller estuaries, bays and shallow coastal waters and in the extensive mangrove areas that cover the coast. Coastal fisheries use small (< 8 m) to medium size (8 – 14 m) wooden boats and employ various types of gillnets, longlines and fish weirs to catch catfish, weakfish, mullets, sharks, mackerel, among other species of fish. Gillnets and hook and line are used for hard bottom species such as groupers and snappers as well as mackerel on offshore reefs and banks. Trawling is also used to catch shrimp in coastal areas. The capture of freshwater species is common during the rainy season when the shelf is strongly influenced by the runoff from the Amazon River. The fisheries inside the estuary use small boats and canoes, with rows, sail or small engines, and employ gillnets, hook and line and fish weirs to catch catfish, mullets, weakfish and freshwater species. In the mangrove areas the main activity is the manual collection of crabs, *Ucides cordatus*.

Artisanal fisheries in the Northeast are based on small to medium size boats (most of them < 12 m) using sail or small engines, canoes using oars or sail and sail rafts. There is a large diversity of species and fishing gear/methods used in coastal fisheries in the Northeast. Lessa et al., (2004) identified, for instance, at least 16 types of gear used by small-scale fishers in Pernambuco, one of the states of the Northeast region. In general gillnets, longlines and hook and line are used in coastal and offshore waters to catch snappers, groupers, mackerel, sardines, pompanos, tunas and dolphinfish. Lobsters are captured mostly with gillnets ('caçoeiras') and by diving. Shrimp trawling is conducted in certain areas close to the mouth of estuaries. Gillnets, trammel nets, cast nets, manual trawling and traps are employed closer to shore and inside estuaries and coastal

lagoons to capture anchovies, mullets, needle-fish, shrimps, among other species. The manual collection of crabs and mollusks in mangrove areas is particularly important throughout the region.

On the East Coast, particularly in the state of Espírito Santo, Martins & Doxsey (2006) identified the following types of fisheries of small and medium size scale: an offshore hook and line and longline fishery, based on boats of 8 to 15 m long with engines, targeting reef associated and pelagic species; a hook and line fishery, based on boats of 6 to 8 m long with engines, targeting specifically the triggerfish *Balistes capriscus*; a coastal fishery with hook and line and gillnets, based on small boats with oars, catching mostly Scianidae fish; a fishery targeting tunas and other large pelagics around oil drilling platforms based on well-equipped, medium-size boats; shrimp fisheries based on trawling boats of 7 to 10 m long; and lobster fisheries based on small boats, using oars or small engines, and employing gillnets and diving. Mangrove areas in estuaries are also important for the manual collection of crabs.

In the state of Rio de Janeiro, on the Southeast coast, the most important artisanal fisheries utilize gear such as hook and line, gillnet, beach seine, shrimp trawls and manual collection of shell/crab. One of the most traditional activities is the beach seine fishery based on large canoes and seine nets to encircle migrating schools of bluefish, mullets and bonitos (Silva, 2002). Shrimp are caught in the coastal lagoons using fixed nets, manual trawling and cast nets. Small purse seiners also participate in the sardine fishery in coastal waters. In the state of São Paulo, one of the most important and traditional fisheries is the engraulidid *Anchoviella lepidendostole* fishery. The fishery occurs mainly in estuaries and is carried out with wooden canoes, 4 to 5 m long, using oars or small engines, and employing trawling nets and other types of gear (Gasalla and Tomás, 1998). In the state of Paraná, fishing activities are predominantly small-scale (Andriguetto Filho et al., 2006). Important fishing activities in the region are the trawl fishery for marine shrimps along the coast and in estuaries, the gillnet fishery for sharks and demersal fishes (mostly Scianidae) and the estuarine fisheries for juvenile shrimp, engraulidids and mullets. The manual collection of crabs and mollusks is also significant. Further south, in the state of Santa Catarina, beach seining for coastal fishes, estuarine fisheries for shrimps with fixed nets and trawling, gillnet fisheries for croaker, weakfish and flatfish, and jigging (‘zangarilho’) for squid are important artisanal fishing activities (Sunye & Morison, 2006).

Finally, in southern Brazil, artisanal fisheries operate mostly in coastal lagoons, estuaries and shallow coastal waters using wooden boats, most of them with less than 10 meters and under 20 gross tonnes. The main artisanal fishing activities are the gillnet fisheries for croaker, mullets and flatfish, and the fishery for shrimps with fixed nets and trawling (Reis et al., 1994; D’Incao, 1991; Kalikoski et al., 2002). A medium-scale commercial fishery operates in coastal waters (Reis et al., 1994). The fleet is composed of wooden boats, 12 to 15 m long, with more powerful engines, and targets demersal fishes (mostly Scianidae) and also pelagic species such as the bluefish *Pomatomus saltatrix* using gillnets and hook and line.

Table 1. Characteristics of artisanal fishing activities in Brazil. Sources: CEPENE, 2002; Isaac et al., 2006; Castro et al., 2004; BDT, 2002; Gasalla and Tomás, 1998; Reis et al., 1994; Pinto da Silva, 2004).

Gear type	Type and size of boats	Number of boats	Average crew size	Main targeted species
North				
Manual collection; Gillnet; Fish weirs; Hook and line; Longline; Trawling	Wooden canoes and boats, < 8 m, using oars, sail or small engines	10,265[a]	2 – 3	crab, *Ucides cordatus;*catfish, Ariidae; weakfish, *Cynoscion* spp. ; shrimp, Penaeidae; sardine, Clupeidae; mackerel, *Scomberomorus* spp. ; croaker, *Micropogonias furnieri;* mullet, *Mugil spp.*
	Wooden boats, 8 to 15 m, using sail and/or engine	3,358[b]	up to 10	mackerel, *Scomberomorus* spp. ; weakfish, *Cynoscion* spp. ; catfish, Ariidae; snapper, Lutjanidae; sharks; sardine, Clupeidae; shrimp, Penaeidae; crab, *Ucides cordatus*
Northeast				
Gillnets; Trammel nets; Cast nets; Beach seine; Trawling; Hook and line; Longline; Diving; Manual collection	Wooden canoes, 3 to 9 meters, using oars or sail	10,480	2 – 3	needle-fish, *Hemiramphus* spp. ; snappers, Lutjanidae; groupers, Serranidae; tunas, *Thunnus* spp. ; dolphinfish, *Coryphaena hippurus;* Mackerel, *Scomberomorus* spp. ; Pompano, Carangidae; Anchovies, Engraulididae; Sardines, Clupeidae; Mullets, *Mugil*, spp. ; Lobsters, *Panulirus* spp. ; Shrimp, Penaeidae; Crab, *Ucides cordatus;* Oysters and mussels
	Rafts and other small sail boats, < 11 m	5,603	2 – 3	
	Medium size wooden boats, < 15 m, using engines	6,003	3 – 5	
East				
Hook and line; Longline	Wooden boats, 8 to 15 m, with engines	372	5 - 6	Snappers, Lutjanidae; Groupers, Serranidae; Dolphinfish, *Coryphaena hippurus*
Hook and line	Wooden boats, 6 to 8 m, with engines	402	3 - 4	Trigger fish, *Balistes capriscus*; Other demersal fish: Sparidae, Pomadasydae and Haemulidae
Hook and line; Gillnet	Small (< 8 m) wooden boats, using oars	725	2-3	Coastal demersal fish, Scianidae
Trolling; Hook and line	Medium size wooden boats with engines	170	6	Yellowfin tuna, *Thunnus albacares;* Dolphinfish, *Coryphaena hippurus;* Billfishes; *Seriola* spp. ; *Acantocybium* spp.
Otter trawling	Wooden boats, 7 to 10 m, with engines	248	2 - 3	Shrimps, Penaeidae
Gillnet; Diving	Small wooden boats, using oars or engines	186	2	Lobsters, *Panulirus* spp.
Southeast				
Trawling nets	Wooden canoes, 4 to 5 m, using oars or small engines	no data	no data	Anchovy, *Anchoviella lepindostole*

Beach seining	Large wooden canoes	65	2-3[c]	Bluefish, *Pomatomus saltatrix;* Mullets, *Mugil* spp. ; Bonitos, *Acantocybium* spp.
Gillnet; Trawling; Fixed nets; Beach seining; Hook and line; Jigging; Manual collection	Wooden boats, 6 to 14 m, using oars or engines	no data	no data	Shrimps, Penaeidae; Juvenile Anchovies, Engraulididae; Croaker, *Micropogonias furnieiri;* Weakfish, *Cynoscion* spp. ; Squids, *Loligo* spp. ; Flatfish, *Paralichthys* spp. ; Mullets, *Mugil* spp. ; Crabs and molluks
South				
Gillnet; Fixed nets; Trawling; Manual trawling	Wooden boats, < 10 meters, using engines	no data	2 -3	Croaker, *Micropogonias furnieri;* Mullets, *Mugil* spp. ; Sharks; Flatfish, *Paralichthys* spp. ; Shrimps, *Penaeidae*
Gillnet; Hook and line	Wooden boats, 12 to 15 m, using engines	no data	6 – 8	Demersal fishes, Scianidae; Bluefish, *Pomatomus saltatrix*

a. based on data for the states of Para (4,475 boats) and Maranhão (5,790 boats).
b. Based on data for the states of Para (1,502 boats) and Maranhão (1,856 boats).
c. According to Pinto da Silva (2004) there are 150 fishers in the beach seine fishery of Arraial do Cabo; crew size was derived from this number and number of canoes.

3. FISHERS AND SOCIO-ECONOMIC ASPECTS

Characteristics of fishers

Fishing and mollusc harvesting were important activities for indigenous people before the arrival of the Portuguese colonisers in the XVI century. In several areas of the coast there are shell middens ('sambaquis') demonstrating that indigenous people fed on molluscs and fish for several centuries. Jean de Léry, a French Calvinist who visited Brazil in early 1500, described fishing techniques used by coastal Indians such as bone hooks, and small nets made of fibres found in the forests as well as canoes and rafts ('jangadas') made of floating logs. Fishing was also important along the Amazonian rivers and Indians used fish as their basic source of protein.

Until the end of slavery in 1888, fishing activities in the Northeast were undertaken mainly by African slaves. Small farmers also used part of their time for fishing, along the coast. Coastal fish species, such as mullet, were the basis for protein consumption in coastal farms, towns and villages. The social upper classes, however, imported salted cod from Portugal (Silva, 1997).

A variety of human cultures based on fisheries are found along the coast. In the South region, between Rio Grande do Sul and Santa Catarina, live the descendants of the Azoreans and Portuguese that settled in the region in the 17th century. The first European generations were both peasants and fishers, but since the late 1940s they have concentrated mainly on fishing. The 'caiçaras' who live between Paraná and the state of Rio de Janeiro are descendents of the Indians, Portuguese colonisers and African slaves. They practice small-scale agriculture associated with artisanal fishing. The 'jangadeiros' (raft-fishers) live in the Northeast coast, from Bahia to Fortaleza; and they depend almost exclusively on artisanal fishing, using the 'jangada' (a raft with sails) that is very suitable for the type of sea, wind, and sandy coast of the area.

The cultural background and the environmental setting favored the development of different relationships with the sea. Small farmer-fishers combined fishing with agricultural activities in the provinces of São Paulo and Rio de Janeiro. In the Northeast region, coastal communities have developed a long tradition of coastal fishing, separated from agriculture. Cultural factors, as well as the shape of the continental shelf, could be responsible for the different relationships between agricultural and fishing activities. The continental shelf is narrower in the Northeast than in the Southeast, and thus, most of the fish species in the Northeast live in rocky habitats further from the coast. This requires fishers with good navigational skills and fishing knowledge. The sandy coast in the Northeast also inhibited intensive agricultural activities. Therefore, the artisanal fishers in the Northeast have a strong tradition of dealing with the open sea. Most of the fishing activity in this area was carried out within a system involving a petty mode of production, where some of the caught fish was used for subsistence and some as a commodity.

Coastal legislation has contributed to (but also interfered negatively with) the development of traditional sea tenure. Since the middle of last century a stretch of 33 meters of land measured from the 1833 highest tide belongs to the State (called 'Terras

de Marinha"). This area cannot be privately owned and no permanent construction can be made in that area without State permission. Small-scale fishers, although they have no legal entitlement, occupy these areas. They have customary rights of occupancy ('posse') to live in those areas, where they build their thatched roof houses. The same right ('posse') is transferred to the nearby coastal waters when they occupy a place in the estuaries and lagoons to build their fish weirs ('cercos').

The State, through the Navy, also tried to control artisanal fishers through forced services. As a result, rebellions occurred in 1903 in Rio de Janeiro and Ceará. To control these rebellions, in 1921 the Brazilian Navy created the first fishers guilds ('Colônias de Pescadores'). According to the guild regulations, all fishers should be registered in order to receive permission to fish. In practice, each coastal municipality had its own guild that regulated the lives of fishers. However, with the promulgation of the new Brazilian Constitution in 1988, fishers were given rights to organise their own free associations.

Commercial fishing began to develop more intensively beginning in the 20th century, particularly in the southern states, where the Portuguese and Spanish migrants started to use larger boats for fishing sardine, which was also used for canning. Industrial fishing further developed after the 1960s with the support of a large fisheries development programme undertaken by SUDEPE. Before then, most of the fishing was done by artisanal fishers along the coast and rivers.

It is extremely difficult to calculate the number of artisanal fishers, considering that the 'official' criteria based on boat size is not accurate. According to data from the 2000 census, there are about 248,000 fishers on the coast organised into fishers' guilds. The Northeast has approximately 62% of the total number of guilds, followed by the Southeast with 16%, South with 12% and the North with 10% (data provided by the Confederation of Fishers, 1986). Also, according to the Confederation there are approximately 288,500 fishers who are not affiliated with the guilds. Thus, there are approximately 536,000 artisanal coastal fishers in Brazil.

Data obtained from IBGE (Brazilian Institute of Geography and Statistics) in the 1970s indicated that around 70% of artisanal fishers lived in coastal/rural areas and 30% resided in urban areas. In the North and in the Northeast, fishers lived mainly in rural communities, while in the Southeastern and Southern regions they were mainly urban dwellers. Considering that since the 1970s, rural-urban emigration (which in Brazil is also synonymous with emigration from the interior to the coast) has been a widespread phenomenon, one can acknowledge that the degree of urbanisation of artisanal fishers is much higher now.

In different regions of Brazil, mainly in the Northeast and the North, women have traditionally participated in fishing activities by harvesting shellfish ('marisqueiras'), or fishing along the seashore ('pescadeiras'). Women also have been the main labour force in the processing of fish in artisanal and industrial fisheries. Until the 1988 Constitution, women were not legally permitted to work in fisheries, which were considered a male activity. SUDEPE only allowed women to work as harvesters of shellfish or algae. It was only in 1988 that a Presidential act abolished the prohibition on female labour in

fisheries. In spite of the legalisation controlling their role, women rarely participate in deep-sea fishing, since fishers consider that their presence on board a boat will bring bad luck ('panema'). This situation is slowly changing and in some states of the North and the Northeast regions some women work with their families in small-scale fishing. There are also cases of widows who work alone in artisanal fishing boats. Some of these women are now even presidents of fisher's guilds; however, these are still isolated cases.

The majority of women work as shellfish harvesters, selling the yield to increase the domestic income. In some states of the Northeast region, such as Bahia, approximately 20,000 'marisqueiras' participate actively in earning domestic income. In states such as Maranhão, northern Brazil, women participate in fishing "on foot" with small shrimp nets. The shrimp is brined, dried and sold by the women. This activity is also common in other states of Brazil. The activity of women is also important in some fishing communities where they weave and darn the fishing nets. In many other communities, women work in small-scale agriculture, producing yucca flour, which is the basic diet of coastal populations in many areas. Urban industrial employment is another field where women are active participants, working in the fish processing industry. In many cases the work force is almost entirely female.

The role of women in fishing activities has decreased in some cases due to technological changes and over-exploitation of coastal resources. Women who take an active part in fishing still maintain their traditional status—their activities are viewed as "support" in running the household. The majority of the fishers' guilds maintain the traditional gender division of labour. The 'double-workday' of women continues to be thought of as 'part time activity'. A woman involved in the administration of the *colônias* is still considered a little 'out of place'.

There are recent trends in the role of women in fisheries, which are worth mentioning. During the past five years, in the state of Pará, women have attained more than 10% of the registered members of the guilds. They are also seeking alternatives to traditional set-ups like the 'colônias'. Several women's associations have flourished, providing women the possibility of holding positions of higher political/administrative importance. There have been several factors motivating women to unite and form associations, for example the need to generate income and explore alternative avenues to do so. Government programmes and the initiatives of non-governmental bodies working with small producer groups have also influenced these women's organisations. Groups that already existed in the community (mostly linked to the Catholic Church, such as Mothers' Clubs, Grassroot Ecclesiastical Communities) are enthusiastically supporting these new associations.

In the 'colônias' where women are admitted, integration occurred naturally. Once groups are formed, the exchange of ideas and access to new social spaces induced a reconsideration of traditional roles. These groups tend to follow examples set by other organisations that have been successful in welcoming women (Barbosa et al, 2000). During the 1990s, other various organizations supported and strengthened the role of women in fishing, such as the Fisher's Pastoral, the National Movement of Fishers

(MONAPE) and several NGOs (i.e. Terramar, supported by the International Collective in Support of Fishworkers) (Maneschy, 1999).

Social and economic aspects

Socio-economic data on artisanal coastal fisheries are generally scarce. The situation deteriorated even more after the termination of SUDEPE in 1989. There are several reasons for the scarcity of socio-economic information. One cause is the dispersion of fishing communities along the coast, which makes the task of collecting information extremely difficult. Another factor that has hampered the development of programs to evaluate the socio-economic status of artisanal fisheries is governmental priority in, and support to industrial fisheries to the detriment of the artisanal sector. Among the main data deficiencies are those concerning economic aspects of the fishery, such as employment and income level, types of technologies employed, and organizational aspects of fishing communities. Some small improvements in data availability have been observed in recent years when governmental welfare programs began to collect and disseminate information on the fishers who applied for the benefit, such as the unemployment benefit received by fishers during fishing closures.

In terms of fishers' productivity, the available data from SUDEPE, Fishers Confederation and IBGE indicate that productivity increased from 1.49 tonnes/fisher in 1967 to 1.81 tonnes/fisher in 1986 and decreased to 1.12 tonnes/fisher in 2000. The decrease in the last 15 years could be caused by the depletion of coastal resources as well as other factors such as the increase in the participation of non-fishers in fishing in recent years [explain] and the consequent reduction in the productivity per individual fisher.

The infrastructure for landing, storage and commercialization of fish is very precarious. In general, the large ports have no infrastructure to accommodate landings from artisanal fisheries. In many fishing communities, especially in the Northeast, fish is landed on the beach and from there it enters a long chain of dealers until it gets to local/regional markets. The situation seems to be even worse in fishing communities close to urban centers, because they lack adequate structures to land and process fish in urban conditions. Past experiences in the Northeast in the construction of fisheries production facilities for landing and cold-storage associated with cooperatives (funded during the 1980s by the Inter-American Development Bank, IDB) did not work satisfactorily. The vast majority of these facilities ended up in the hands of middle-men. At the same time, many cooperatives failed because they were formed in a rush, without the proper evaluation of the administrative capacity of fishing communities and of market demands. More recent experiences in the Northeast with the 'Pro-Renda' (a governmental program that aims to increase the income level of poorer communities) seem to be more successful than the previous experiences with cooperatives. The program is based on strengthening the existing fishers' guilds, improving techniques to maintain the quality of fish on board using freezers, and developing new markets for artisanal fisheries production. Fish marketing, improvement of the quality of fisheries products, and the processes of intermediation within the market chain continue to be the critical points for the development of artisanal fisheries and increasing the income levels of artisanal fishers.

Fishing livelihoods are not homogeneous along the coast. Along the northern coast, many fishers combine fishing with agriculture. In the Northeast, most fishers depend exclusively on fisheries. Their livelihoods are under threat from the rapid expansion of shrimp aquaculture, tourism, and urban development, as well as from overfishing of important stocks. Along the southern and southeastern coast, there are clear signs of depletion of most stocks, as well as environmental degradation which requires mechanisms of control and regulation. In the past, many fishers who lived in coastal villages also maintained other activities such as small-scale agriculture, forestry, and handcrafting. With the increasing level of conflict with industrial fisheries, along with the expansion of urbanization and tourism, many artisanal fishers have turned to aquaculture or to working in general services in cities.

The urbanization of artisanal fishers, i.e. the move of fishers from rural to urban areas, is a phenomenon evident in many states, but particularly in the southeastern and southern regions. Even in the 1970s approximately 70% of fishers in these regions lived in or around urban centers, whereas in the northern and northeastern states most fishers lived in coastal villages while only 44% lived in urban centers. Although there is a general lack of information, it is probably correct to assume that today most coastal artisanal fishers live in, or close to urban areas, with the exception of fishing communities in northern Brazil and in the states of Maranhão and Piaui. According to data available in the IBGE database for 1991, the level of urbanization reaches 22% in certain areas of Maranhão, 48.5 % in Ceará, 62.5% in Paraíba, 70% in Rio de Janeiro, 83.5% in Santa Catarina and 98% in São Paulo. The increasing level of urbanization in artisanal fisheries has many drivers, including mounting economic pressure from the tourism industry that led to the appropriation of coastal areas from fishing communities; the shift from agriculture and other extractive activities; the lack of basic infrastructure to support fishing activities (e.g., supply of ice and diesel) and the lack of access to basic social services (e.g., health and education) in coastal villages compared to urban centers; the proximity to markets in the cities; and the implementation of environmental conservation units along the coast that expelled many fishers from their traditional fishing areas. Fishers that have moved to cities are often involved in urban activities (construction, general services, tourism, etc.) to complement their earnings during fishing closures.

Fishers' access to infrastructure and to social services is normally precarious in coastal communities as well as in urban zones. Table 2 compares some statistics that characterize the living conditions in certain artisanal fishing communities of selected coastal states.

Table 2. Percentage of households with access to basic services in fishing communities in selected areas of coastal States. Sources: Diegues, 1999; Costa, 2004.

Locality	Access to treated water	Sewage system	Regular collection of domestic waste
Maranhão	< 5. 0	7. 0	0. 5
Ceará	7. 0	7. 0	24. 0
Rio de Janeiro	62. 0	3. 0	no data
São Paulo	71. 0	<5. 0	no data
Santa Catarina	52. 0	3. 5	no data
Rio Grande do Sul	68. 0	69. 0	65. 0

Education level of fishers

The information provided by fishers that applied for unemployment benefits in 2003 ('Ministério do Trabalho e Emprego') indicates that the illiteracy rate is 44.6% among men and 53.5% among women. Only 9% of men and women have completed elementary-level education and only approximately 1% completed high school. These figures indicate that the educational level of fishers is extremely low and well below the national average. From the same source of data it is estimated that only 13% of fishers are less than 30 years old, which reveals the difficulty of recruiting young members of the community into the fishery.

Fish marketing and processing

Most of the frozen fish traded in large cities in super-markets is imported or is supplied by commercial fishing industries. Artisanal fisheries' production is generally traded in coastal towns and regional centres. Most of the crabs, mussels, oysters and other shellfish originate from artisanal fisheries, and marketing is sometimes done through cooperatives. In Santa Catarina (in southern Brazil), many small-scale fishermen are becoming oyster cultivators, partly due to the decrease in fish stocks. Mussels are also being cultivated by small-scale fishermen along the northern coast of São Paulo.

The network of fish trade in artisanal fishing villages is complex, often involving middlemen on several levels, from the beach to the neighbouring cities and the central markets in state capitals. In the Amazonian region for instance, artisanal fishers (especially those who live far from the cities) are totally dependent on the middlemen. In Pará the fish bought by the "geleiro" is resold to the "weigher" who in turn sells it to the "retailer" and from there it is sold in the "retail market". In the 1970's, due to the roadways network development, the traders in the cities, as well as the fishing companies, used to send their trucks to the beaches to purchase fish from artisanal fishers. The fishing companies paid for the fuel of the motorised artisanal boats in exchange for the exclusive rights to purchase the catch.

4. COMMUNITY ORGANIZATION AND INTERACTIONS WITH OTHER SECTORS

Community organization

Artisanal fishers are organised into 'colônias', similar to the Iberian guilds, created in the beginning of the century by the Brazilian Navy. The objective for the creation of these guilds was to organise the fishing communities spread out along the coast into reserves for the Navy. The directors of the 'colônias' are elected by fishers whom are legal members of the Colônias, and the directors in turn elect the president of the Provincial Federation. The president of the National Confederation was personally nominated by the Agriculture Minister, to which the fishing sector was institutionally attached until 1989.

Before the 1988 Constitution, a majority of the directors of the 'colônias' were representatives of other social and professional sectors, such as fish traders and lawyers, who utilised the fishers' organisations for political purposes. In 1973 a new statute was established for the 'colônias', but no substantial changes occurred as this new law was promulgated during the military regime and there was no consultation whatsoever with the fishers. In the beginning of the 1980's, for the first time artisanal fishers of Pernambuco (Northeast) organised mass meetings against the environmental degradation of the rivers and estuaries, caused by the large sugarcane mills. The movement to re-democratise the country towards the end of the military dictatorial regime had an important influence on the democratisation of the overall electoral process. This process was stronger in the Northeast, where the 'Pastoral dos Pescadores' (Fishers'Pastoral) created by the National Conference of Bishops of Brazil played an important role. After 1986 the artisanal fishers created the 'Movimento pela Constituinte da Pesca', which enabled artisanal fishers to express their demands in the National Congress for the first time: free and democratic association, end to fiscal incentives for industrial fishing, labour rights, recognition of women's work, development programmes, control of environmental degradation, among other demands.

In 1989, with the declaration of the Constitution, the Movement phased out, but MONAPE (National Fishers's Movement) became operational. The main challenge for MONAPE is the stimulation of an independent and democratic organisation of artisanal fishers, seeking to maintain the rights earned by the 1988 Constitution and to fight for new social and labour rights. The MONAPE has organised various national meetings of its members, also inviting representatives from organisations of fishworkers from neighbouring countries like Conapach, in Chile. MONAPE is active only in the northern regions where it is based, as well as in some states of the Northeast. Unfortunately, MONAPE has not succeeded in establishing itself as a national movement capable of offering alternatives to the existing institutional framework that is marked by protectionism and the lack of clear and effective policies favouring artisanal fishing, as mentioned before.

Before the Constitution of 1988, fishers were only allowed to organise themselves into traditional 'colônias' whose role was mainly related to social services. The new

Constitution allowed fishers to create their own trade unions; however, few of these unions were established effectively. In the 1980's the Pastoral de Pesca, which is linked to the Catholic Church, began working to secure the rights of other workers (i. e. , retirement benefits) to artisanal fishers. Today, fishers have the right to inscribe themselves as autonomous workers in the National Institute of Social Security, and pay a contribution until retirement (60 years for men and 55 years for women). According to the Organic Law of Social Security, they can apply for retirement on grounds of health problems, health benefits and maternity allowances. In the regions in which fishing closures are used as management strategies, fishers that are associated to the 'colônias' and have a license from the Ministry of Agriculture receive an allowance (unemployment benefit) to compensate for the period without fishing.

Interactions between fishers and with other sectors

While the traditional use of the coastal ecosystems by artisanal fisheries has had little impact on coastal resources, the latest utilisation of coastal ecosystems by urban-industrial activities has intensified the degradation of these environments considerably. The degradation and contamination of coastal areas has caused significant negative consequences to the productivity of the sector and the quality of life in fishing communities.

The most important ecosystem along the coast is the Atlantic Forest that covered around 1,000,000 km^2 at the beginning of the Portuguese settlement. This forest reaches the coastline in many parts of the country; thus mangroves can be considered part of this large forest. The Atlantic Forest has a biological diversity as high as the Amazon Forest, with a large number of endemic species. The forest has been destroyed even more intensively since the increase of the urban-industrial development in the 1960's. Only around 5 to 10 % of this large, forested biome still exists today, and it is mainly located along the coasts of Southern Rio de Janeiro, São Paulo and Paraná States. The Atlantic Forest is also home to different human cultures, such as Indians and their descendants, the 'caiçaras' and 'jangadeiros' that have developed a deep knowledge of, and traditional management system for the forest and their adjacent coastal ecosystems.

During the colonial period, the coastal zones were used as trade centres and as the gateway to enter the hinterland, where mineral and agricultural resources were abundant. Major cities were usually located on the coast, thus ensuring communication with the colonial power overseas as well as the hinterland. Marine resources, with the exception of whale hunting, were also exploited at a subsistence level. During that period, boat construction was one of the few important industries on shore and was responsible for intensive woodcutting in some Northeastern provinces. After Independence, and particularly during the second half of the 19th century, most of the important economic activities, such as coffee, rubber and sugar-cane plantations, shifted from the coastal zone to the hinterland. At the beginning of the 20th century, industrialisation led to a shift from producing goods for the internal market to importing and exporting [??] products. Small industrial plants for processing cotton and food products were concentrated both in the hinterland and on the coast.

After the 1950s, Brazil pursued an industrial economic model oriented towards export. Most of the large heavy industries (chemical, petrochemical, fertiliser) were and still are located in estuaries and bays, as well as next to other fragile coastal ecosystems: in São Luís Island (for aluminium processing) in the Northern State of Maranhão, in the coastal lagoons of Maceió, (Alagoas), in Salvador Bay, in the Vitória Island (for iron export), Rio de Janeiro bay, Santos-Cubatão, in São Paulo, and in the Patos lagoon in Rio Grande do Sul. Huge harbours for export of mining production were established in São Luís (Maranhão) and Vitória (Espírito Santo). Examples of these large industries settled on the coast are: chemical industries in Arraial do Cabo (Rio de Janeiro) in Aratu and Camaçari in Salvador (Bahia); oil and chemical industries in Cubatão (São Paulo); Dow Chemical, Petrobrás and Petroflex in Rio de Janeiro; Salgema in Maceió (Alagoas); fertiliser production in many cities around the coast; coal mining near the coast of Santa Catarina and Rio Grande do Sul; and iron production in Cubatão (São Paulo) and in Vitória (Espírito Santo). Paper pulp production, involving large areas of eucalyptus plantations, is important along the coast of Espírito Santo and southern Bahia. Many alcohol distilleries have been established along the coast, particularly in the Northeast. As a result, pollution has been heavily concentrated in this zone and coastal degradation has been extensive (Figure 3).

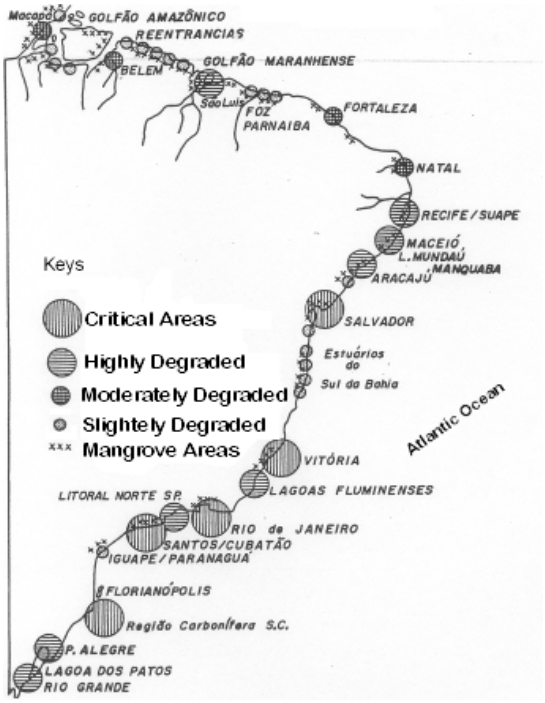

Figure 3. Levels of Degradation of Estuarine Ecosystems in Brazil (Diegues, 1999).

Increasing urbanisation has a major impact on coastal areas, since five of the nine metropolitan areas in Brazil are located on the coast. In 1990, Rio de Janeiro had 9.6 million inhabitants; Recife 2.5 million; Salvador 2.4 million; Fortaleza 2.2 million; and Santos 1.3 million inhabitants. In addition, many State capitals are also on the coast: São Luís (655,000 inh.); Natal (606,000 inh.); Maceió (626,000 inh.); Vitória (523,000 inh);

João Pessoa (695,000 inh); and Florianópolis (254,000 inh). Many of these coastal cities have a high demographic growth, attracting migrants from the hinterland and a high percentage of these migrants live in "favelas" (slum areas in Salvador, Fortaleza, Rio de Janeiro)

Coastal cities are expanding as poor people migrate from the countryside, where the modernisation of Brazilian agriculture has led to an increasing concentration of productive land in the hands of a small number of [??] land owners and groups, both national and multinational. With the expulsion of small landowners and peasants from the countryside, slum areas have been established in large coastal cities. Most sewage systems are inadequate, resulting in increasing pollution of coastal rivers, estuaries, lagoons, and bays.

As road transportation has the highest priority in Brazil's transportation system, many highways have been constructed along the coast. One clear example is the BR-101 built in the 1970's, which links many coastal capitals. During the construction process, many beaches and mangrove areas were damaged as the road was built along the coast between Santos and Rio de Janeiro. These coastal roads have also encouraged the construction of villas by tourists, and have displaced many small-scale fishing villages to inland and to the mangrove areas, resulting in the destruction of the Atlantic Forest.

Oil exploration and production is an important economic activity along the Brazilian coast, which started in 1973. The main oil drilling areas along the coast are in Campos (Rio de Janeiro), Sergipe, Piauí, Rio Grande do Norte, Amazon basin and Recôncavo Baiano. Over 56% of the oil produced in Brazil comes from marine basins. There are important harbours where oil is brought ashore, the most important of which is situated in São Sebastião (São Paulo), where tourism, fisheries, mangroves, and other coastal habitats suffer from frequent oil spills in the area. Coal is also produced in the coastal area of Santa Catarina and Rio Grande do Sul. Reefs are also exploited for construction, mainly along the Northeastern coast.

Tourism and recreation have become among the most important factors influencing the use of coastal areas and resources. Around 1.6 million foreign tourists visit the country annually, in particular the coastal tourist resorts, generating $1.55 billion and roughly 1.4 million jobs. In 1992, EMBRATUR (Brazilian Agency for Tourism) established a National Plan for Tourism that created several tourism development centres in coastal areas. In 1991, SUDENE (Agency for the Development of the Northeast) and EMBRATUR created PRODETUR (Programme for the Development of Tourism) and requested a $1.6 billion loan to the Interamerican Development Bank. This large programme is directed along the Northeastern coast, involving the construction of large hotels, roads, improvement of airports and urban infrastructure, such as water and sewage. This programme follows the intensive use of the coastline which exists today in Cancun, Mexico. The ecological and social impacts of this programme have not yet been properly assessed, but social and ecological groups in the area are reacting against it, since local communities and the environment suffer the most.

In addition to the increasing degradation of inshore and coastal environments, overfishing is affecting the large stocks of shrimps, lobsters, catfish and sardines that are shared between artisanal and industrial fisheries. A recent analysis of the status of fisheries resources targeted by artisanal fisheries revealed that the percentage of collapsed stocks increases from North to South, and are in the order of 3% in the North, 12% in the Northeast, 29% in the Southeast and 32% in the South.

Aquaculture is a fast growing activity along the North and Northeastern coast affecting several inshore ecosystems such as mangroves, sand barriers, and lagoons. The highest impact comes from shrimp cultivation, which is starting to be implemented in the states of Ceará, Rio Grande do Norte, Paraíba, Maranhão and Pernambuco, resulting in massive destruction of mangroves and associated ecosystems. Large-scale shrimp cultivation is also affecting the livelihood of artisanal fishers as they are losing their traditional fishing areas.

5. ASSESSMENT OF FISHERIES

Fisheries assessment research has gone through distinct phases over the years (Castello and Haimovici, 1991). The first strategy for assessing fish stocks was implemented in the late 1950s with the establishment of a national system of fisheries statistics and assessment of industrial fishing fleets. The next stage, initiated during the 1970s, aimed at surveying and assessing the productive potential of fish stocks along the coast (Neiva and Moura, 1977). During the 1980s and 1990s the Environmental Agency (IBAMA) established a system of technical working groups, 'Grupos Permanentes de Estudo' (GPE), for each of the main fisheries resources, i.e., shrimps, demersal fishes, sardine, lobsters, snappers and tunas. The objective of the GPEs was to provide recommendations for both management and research based on the analysis of biological, technological and socio-economic information of these major resources. Thus, for most of these stocks there are estimates of biomass, optimal exploitation rates, and maximum sustainable yield obtained through the application of assessment models that range from simple production models to Virtual Population Analysis.

Not much has been done to assess in a systematic and continuous way the status of the less abundant and diverse fish stocks targeted by artisanal fisheries, in part because of the lack of data, but also because of a lack of attention from government agencies. However, some localized research initiatives have been carried out by universities and research institutes. Tables 3 to 6 and Figure 4 summarize the available information on the status of stocks targeted by artisanal fisheries in each of the coastal regions (Vasconcellos et al., 2004); this information is discussed in the text sections below. The results are based on published assessments of the status of marine fisheries stocks, analysis of time-series of landings of artisanal fisheries compiled by Freire (2003) and Vasconcellos *et al.,* (2004) for the period of 1980 to 2002, and the list of species that are threatened by extinction, overfished, and threatened by overexploitation included in Annexes I and II of Norm No. 5, May 21st, 2004, Ministry of Environment.

North

Information on the status of stocks of importance for small-scale (or artisanal) fisheries in North Brazil is scarce. Most of the information available refers to stocks that are also important to industrial fisheries, such as shrimp, lobster, catfish, and the southern red snapper (Table 3). The pink shrimp is under intense fishing pressure, and is probably exploited at its maximum biologically sustainable level, whereas the stocks of the seabob shrimp could possibly sustain higher catches. Recent reported landings of lobsters are very close to the predicted maximum sustainable yield, which indicates that the stock is probably fully exploited. The stock of catfish shows signs of recovery after being overfished for many years. The stock of Southern red snapper has also recovered from a state of overfishing, but is now considered under high risk of becoming overfished again. The status of the stock(s) of the mangrove crab is unknown. Landings statistics indicate a decrease of about 50% in production since the early 1980s, although it is difficult to ascertain if the decrease is due to overfishing, or to the deterioration of the data collection system for fisheries statistics. All of the above species are listed in Annex II of the IN No. 5/2004, and are either overexploited or threatened by overexploitation. The total reported landings of these species for the year 2002 represents approximately 13% of the small-scale fisheries production in Northern Brazil. The exploitation status of the remaining stocks is unknown. Through the analysis of trends in fisheries landings by species, Vasconcellos *et al.,* (2004) concluded that there is a total of 74 small-scale fisheries stocks in the Northern Region, and that 27% of these stocks are in a developing stage, 24% are in a mature stage, 41% are in senescent stage, 4% in recovery and 3% collapsed (Figure 4). Approximately 56% of the total stocks could possibly sustain higher catches if managed sustainably in the future, while the remaining 44% (composed of stocks in a senescent or collapsed stage) are probably overfished.

Table 3. Exploitation status and relative importance to small-scale fisheries of previously assessed marine stocks in North Brazil. Species are classified according to IN No. 5/2004, "*I*" being species threatened by extinction and "*II*" being species that are overexploited or threatened by overexploitation (Vasconcellos et al., 2004). [IN ALL THESE FIGURES, IT IS NOT CLEAR WHAT THE % MEANS, I.E. % OF WHAT?]

Stock	**Exploitation status**	**Classification IN No. 5/2004**	**Small-scale fisheries landings (2002)**	
			tonnes	**%**
Pink shrimp, *Farfantepenaeus* spp.	Intensively exploited; decreasing production	II	1. 240	0. 9
Seabob shrimp, *Xyphopenaeus kroyeri*	Under exploited	II	1. 235	0. 9
Catfish, *Brachyplatystoma vaillantii*	Recovering	II	1. 923	1. 4
Lobsters, *Panulirus* spp.	Fully exploited	II	1. 460	1. 1
Southern red snapper, *Lutjanus purpureus*	Risk of overfishing	II	4. 363	3. 2
Mangrove crab, *Ucides cordatus*	Unknown; decreasing production	II	7. 507	5. 5

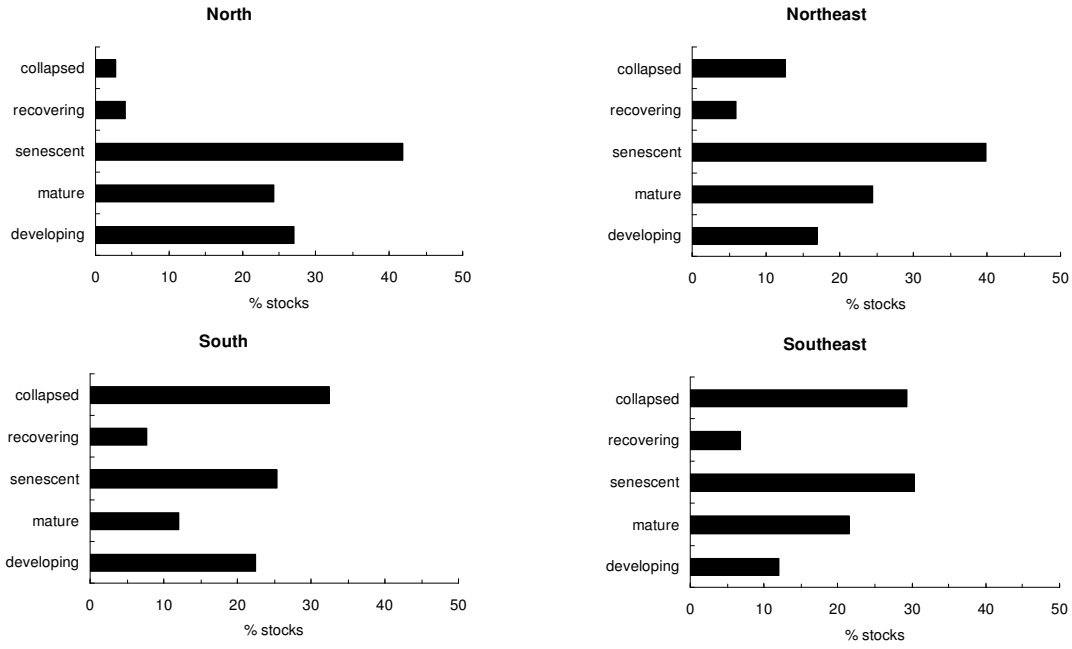

Figure 4. Development stage of small-scale fisheries stocks in North, Northeast, Southeast and South Brazil according to the analysis of trends in reported fisheries landings (Vasconcellos et al., 2004).

Northeast

Very few stocks have been assessed in Northeast Brazil (as defined in Vasconcellos et al., 2004). The Northeast region encompasses the Northeast and part of the East biophysical regions in Figure 2. The available information is summarized in Table 4. Stocks of lobsters are being overfished and show a decreasing trend in landings since the 1990s. Stocks of the two main Lutjanidae species, the yellowtail snapper and the vermilion snapper, are either intensively exploited or overfished. [IN THE FOLLOWING SENTENCE, AND ANYWHERE ELSE THIS APPLIES, ARE THERE COMMON NAMES THAT CAN BE GIVEN?] The other important Lutjanidae, *Lutjanus jocu* and *L. vivanus*, are considered fully exploited, whereas *L. analis* and *L. syanagris* are moderately overfished. Landings of groupers show a decreasing trend over time with long-lived species being overfished, resulting in the targeting of smaller and shorter-lived groupers. The stocks of mackerel are under moderate levels of exploitation. There are no assessments of the status of the stock(s) of mangrove crabs. The decrease in landings of mangrove crabs in most Northeastern States is understood as a sign of overfishing. Likewise, there are no assessments of the status of seabob shrimp stocks in the Northeast although the trend in landings indicates that the stock(s) are still moderately exploited with potential for supporting higher yields. Among the above mentioned resources there are species considered in threat of extinction, such as the mutton snapper *L. analis* and the grouper *Mycteroperca tigris*, and species considered overexploited or threatened by overexploitation. These resources account for about 24% of the total small-scale fisheries landings in 2002. The status of the resources accounting for the remaining 76% of the landings is unknown. An evaluation of the development stage of 253 small-scale fisheries stocks in the Northeast concluded that 16% are in a development stage, 25% can be considered mature, 40% are in a senescent stage, 6% in recovery and 13% collapsed (Vasconcellos et al., 2004; Figure 4). Thus, about 47% of stocks could possibly sustain higher yields while 53% are probably overexploited and require more restrictive management measures if they are to be fished sustainably.

Table 4. Exploitation status and relative importance to small-scale fisheries of previously assessed marine stocks in Northeast Brazil. Species are classified according to IN No. 5/2004, "*I*" being species threatened by extinction and "*II*" being species that are overexploited or threatened by overexploitation (Vasconcellos et al., 2004).

Stock	**Exploitation status**	**Classification IN No. 5/2004**	**Small-scale fisheries landings (2002)**	
			tonnes	**%**
Lobsters, *Panulirus* spp.	Overexploited; decreasing production	II	4. 604	4. 7
Yellowtail snapper, *Ocyurus chrysurus*	Overexploited	II	2. 619	2. 7
Vermilion snapper, *Rhomboplites aurorubens*		II	?	?
Dog snapper, *Lutjanus jocu* and silk snapper *L. vivanus*	Fully exploited	–	799a	0. 8

Mutton snapper *Lutjanus analis* and lane snapper *L. synagris*	Overexploited	Ie	1. 183b	1. 2
Groupers, Serranidae	Overexploited	Ic, II	1. 686c	1. 7
Mackerels, *Scomberomorus* spp.	Moderately exploited	–	3. 806d	3. 9
Mangrove crab, *Ucides cordatus*	Probably overexploited, decreasing production	II	2. 987	3. 1
Seabob shrimp, *Xyphopenaeus kroyeri*	Moderately exploited	II	5. 547	5. 7

a. Only *L. jocu*.
b. Only *L. synagris*.
c. Only *Mycteroperca* spp. , *M. bonaci*, *Epinephelus* spp. and *E. itajara*. *M. tigris* are considered threatened by extinction in some states of the Northeast. *E. itajara*, *E. marginatus*, *E. morio*, *E. niveatus* and *M. bonaci* are considered overexploited or threatened by overexploitation.
d. Total landings of Scombridae; no specific data.
e. *Lutjanus analis* is considered threatened by extinction in some states of Northeast, Southeast and South Brazil.

Southeast

Table 5 summarizes the available information about the status of small-scale fisheries resources exploited in Southeast Brazil. As defined in Vasconcellos *et al.,* (2004), the Southeast encompasses the Southeast and part of East biophysical regions defined in Figure 2. Sardine does not show signs of recovery since the collapse of the stock in the early 1990s. The stock of the broadband anchovy, *Anchoviella lepindentostole,* is under intense fishing pressure and the current level of exploitation is considered unsustainable. The stock of seabob shrimp presents clear signs of overexploitation with a continuous decrease in landings since the late 1980s. The three main demersal fish stocks, the white croaker, royal weakfish and weakfish, are either fully exploited or overexploited. The status of the grey triggerfish is unknown, but the recent increasing trend in landings and *cpue* indicates that stock is probably not yet overfished. The anchovy, *Engraulis anchoita*, is a potential resource in the region, which is not commercially exploited yet. With the exception of the anchovies and the weakfish, all other species are listed in Annex II of IN No. 5/2004, and are overexploited or threatened by overexploitation [including grey triggerfish? But you say the status of that is unknown so how can they put it on a list?]. The species listed above account for 53% of the reported small-scale fisheries landings in 2002, with the grey triggerfish composing 36.1% of this total. The status of the remaining stocks responsible for 47% of small-scale fisheries production is unknown. The analysis of the development stage of 191 small-scale fisheries stocks in the Southeast indicated that: 12% are in a development stage, 21% mature, 30% in a senescent stage, 7% recovering and 29% collapsed (Vasconcellos *et al.*, 2004; Figure 4). Thus, approximately 60% of the stocks are probably overfished and unable to support higher yields in the future unless measures to reduce fishing pressure are applied.

Table 5. Exploitation status and relative importance to small-scale fisheries of previously assessed marine stocks in Southeast Brazil. Species are classified according to IN No. 5/2004, "*I*" being species threatened by extinction and "*II*" being species that are overexploited or threatened by overexploitation (Vasconcellos et al., 2004).

Stock	**Exploitation status**	**Classification IN No. 5/2004**	**Small-scale fisheries landings (2002)**	
			tonnes	**%**
Sardine, *Sardinella brasiliensis*	Collapsed	II	507a	1. 5
Broadband anchovy, *Anchoviella lepindentostole*	Overexploited	–	1. 692b	5. 1
White croaker, *Micropogonias furnieri*	Fully exploited or overexploited	II	1. 062	3. 2
Royal weakfish, *Macrodon ancylodon*	Fully exploited or overexploited	II	601	1. 8
Weakfish, *Cynoscion jamaicensis*	Fully exploited or overexploited	–	359	1. 1
Grey triggerfish, *Balistes capriscus*	Moderately exploited or Fully exploited	II	12. 046	36. 1
Anchovy, *Engraulis anchoita*	Unexploited	–	–	–
Seabob shrimp, *Xyphopenaeus kroyeri*	Overexploited	II	1. 405	4. 2

a. total landings of Clupeidae.
b. total landings of Engraulididade

South

Table 6 synthesizes the available information about the status of small-scale fisheries resources exploited in South Brazil. Fishing intensity directed to the stock of white croaker is considered unsustainable. Stock abundance has been continually decreasing and catches are expected to decrease in the near future. The stock of the longspine drum is also intensively exploited. The royal weakfish is overexploited and the current yield is about half of the estimated maximum sustainable yield. The pink shrimp was intensively exploited for many years by industrial and artisanal fisheries and shows signs of overexploitation; despite the high variability in catches, average landings have been decreasing since the 1980s. Similarly, the stock of seabob shrimp shows a decreasing trend in landings due to overexploitation. The status of the mullet stocks is unknown but the decreasing trend in landings also suggests the species is at biologically unsustainable levels of exploitation. Stocks of long-lived species of importance to small-scale fisheries, such as the marine catfish, the black drum and the guitarfish, have collapsed. The current yield of these species is much lower than the historical peak in landings. The guitarfish is considered threatened by extinction (IN No. 5/2004) while practically all other species are considered overexploited or threatened by overexploitation. The anchovy appears as a potential stock not presently commercially harvested in South Brazil. South Brazil

provides a better situation with respect to data availability; however, approximately half of the small-scale fisheries production comes from stocks with unknown status. An assessment of the development stage of 142 small-scale fisheries stocks exploited in the region indicated that: 22% are in a developing stage, 12% mature, 25% in a senescent stage, 8% recovering and 32% collapsed (Vasconcellos et al., 2004). That is, 58% of the stocks harvested by small-scale fisheries are probably being exploited at unsustainable levels, with more than half of them currently in a stage of collapse.

Table 6. Exploitation status and relative importance to small-scale fisheries of previously assessed marine stocks in South Brazil. Species are classified according to IN No. 5/2004, "*I*" being species threatened by extinction and "*II*" being species that are overexploited or threatened by overexploitation (Vasconcellos et al., 2004).

Stock	**Exploitation status**	**Classification IN No. 5/2004**	**Small-scale fisheries landings (2002)**	
			tonnes	**%**
White croaker, *Micropogonias furnieri*	Fully exploited or Overexploited	II	3. 324	23. 6
Longspine drum, *Umbrina canosai*	Fully exploited or Overexploited	II	472	3. 4
Royal weakfish, *Macrodon ancylodon*	Overexploited	II	437	3. 1
Mullets, *Mugil* spp.	Fully exploited	II	441	3. 1
Catfish, *Genidens barbus*	Collapsed	II	300b	2. 1
Black drum, *Pogonias cromis*	Collapsed	–	–	–
Guitafish, *Rhinobatus horkelii*	Collapsed	Ia	9	<0. 1
Anchovy, *Engraulis anchoita*	Unexploited	–	–	–
Pink shrimp, *Farfantepenaeus paulensis*	Overexploited	II	1. 266	8. 9
Seabob shrimp, *Xyphopenaeus kroyeri*	Overexploited	II	1. 589	11. 3

a. Conidered threatened by extinction in states of Southeast and South Brazil.
b. Total landings of Ariidae.

According to the analysis of fisheries development stages, the percentage of collapsed stocks increases from North to South, being 3% in the North, 12% in the Northeast, 29% in the Southeast and 32% in the South. The available information indicates that small-scale fisheries seem to be less limited by resource scarcity in the North and Northeast, where landings have been increasing in recent years (Vasconcellos et al., 2004) and a larger proportion of stocks are either in a stage of development, mature or recovering from previous overfishing. Nonetheless, the real situation of the stocks in the North and Northeast is more uncertain, particularly in the Northeast, because of the lower quality of fisheries statistics and the overall predominance of small-scale fisheries in these regions. On the other hand, the Southeast and South regions have been experiencing a marked

decline in landings and present a higher percentage of fisheries in a senescent or collapsed stage. Consequently, there are no prospects of increasing production in these regions except through the application of more restrictive fishing measures (for both artisanal and industrial fisheries that share the resources), or through the development of fisheries directed to resources not yet commercially exploited, such as the anchovy.

Other considerations: assessment of ecosystem processes, bio-economic analysis and uncertainties

Ecosystem models have been developed for the Abrolhos Bank (Northeast), Southeastern Brazilian Bight (Southeast) and Southern Brazil shelf ecosystem. These models are basically used as research tools and at this time have not been used as tools for supporting decision making in fisheries management. Bio-economic models have been applied to industrial sardine and trawling fisheries in the Southeastern Brazilian Bight, and probably to other large stocks and fisheries (e. g. shrimps and lobsters).

It is not a common practice in fisheries assessment to quantify uncertainties or to conduct any form of formal risk assessment to make decisions regarding fisheries regulation. [THE FOLLOWING SENTENCES DO NOT SEEM TO DEAL WITH ANY OF THE ITEMS LISTED IN THE HEADING ABOVE] Although biological reference points (MSY, F_{msy}) have been estimated for most of the large stocks, they are not used as target or limit reference points in the legislation. Contents of regulations are the result of a number of influences, economic, political and scientific, but very often, and particularly with the phasing-out of GPEs, these influences are not transparent.

6. FISHERY MANAGEMENT AND PLANNING

Fisheries management

The management of fisheries in Brazil is mainly the responsibility of the federal government, which is responsible for assessing the status of the stocks and for setting and enforcing regulations on the use of aquatic living resources. Governmental institutional arrangements for regulating fisheries activities have been changing over the years. The role of the federal government in marine fisheries management became particularly influential in the mid-1960s with the creation of SUDEPE, an agency of the Ministry of Agriculture with sole responsibility for the development and management of fisheries. Later in 1989, fisheries became one of the agendas of IBAMA, a subsidiary of the Ministry of Environment. The shift of management responsibilities from SUDEPE to IBAMA was not favorable to artisanal fisheries. As IBAMA focuses its attention mostly on environmental issues, environmental legislation and law enforcement, there has been little attention given to the sustained development of artisanal fishing communities. In 1998 the government shifted a large part of the responsibilities of the fisheries sector from IBAMA to the Ministry of Agriculture, constituting the Department of Fisheries and Aquaculture (DPA). The main responsibility of DPA was to promote and execute programs and projects to support the development of the industrial fisheries (its main

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

In 2003, a new fisheries agency was created at ministerial level: the National Secretariat for Aquaculture and Fisheries (SEAP). SEAP has a broader authority than the previous agencies. Its priority is the development of the aquaculture sector, particularly of shrimp cultivation for export, fresh water aquaculture and industrial fisheries. In spite of official speeches, the artisanal sector is not a top priority for this new agency.

In terms of property rights, according to the Brazilian Constitution, the fisheries resources in the coastal zone and in the EEZ are considered common resources under a State property regime (MMA, 2002; Dias-Neto and Marrul-Filho, 2003). The Constitution also asserts that State and society should construct the means to collaborate and participate in the process of decision making for the sustainable use of environmental resources and in the formulation of norms and rules to that effect (Dias-Neto and Marrul-Filho, 2003), which leaves ample scope for the sharing of responsibilities between government and society in the management of fisheries.

The weakening role of the State in fostering the development of artisanal fisheries during the last two decades, mainly after the termination of SUDEPE, contributed to the general lack of organization of the sector. On the other hand, the institutional void favored action to social movements and NGOs in developing projects and management initiatives for the sustainable management of fisheries. Many of these initiatives were born out of a crisis that required solutions and from a process of increasing participation of fishers as new protagonists in decision making. The initiatives were developed around five main

processes that are currently legitimized, some of which are promoted by the government (all of them could be placed within a spectrum of co-management):

1. Within the National System of Conservation Units - SNUC (regulated by Law 9985/2000)
    a. Areas of Permanent Preservation (APA) – defined as "large areas with a certain degree of human occupation and characterized by physical, biological, aesthetical or cultural elements of crucial importance for the quality of life and well-being of human populations, having as main goals to protect the biological diversity, to regulate the process of human occupation and to ensure the sustainable use of natural resources". APAs are managed by a Council constituted by representatives of governmental bodies, NGOs, community organizations, and the local population through specific management plans. Example in fisheries: 'APA dos Corais', Pernambuco, Northeastern Brazil.
    b. Marine Extractive Reserve (MER): defined as "an area used by traditional extractive activity populations, whose livelihood is based on extractive activities but also complemented by subsistence agriculture and animal production, having as main goals to protect the livelihoods and culture of these populations and to ensure the sustainable use of natural resources". MERs are managed by a deliberative Council of organizations and community representatives through a specific management plan. At the time of writing this paper there were 13 MERs implemented or in process of implementation along the Brazilian coast (see section on Marine Protected Areas).
    c. Sustainable Development Reserves (SDR): defined as "areas used by traditional populations, whose existence is based on systems of sustainable exploitation of natural resources, developed through generations and adapted to the local ecological conditions, and that have played a key role in nature conservation and in the maintenance of biological diversity". The objectives of the SDRs are "to preserve nature and at the same time to ensure the necessary conditions and means to sustain and improve the living conditions and the use of natural resources by traditional populations, as well as, to appreciate and conserve the traditional knowledge-practice systems of environmental management of these populations". SDRs are also managed by a deliberative Council of organizations and communities representatives which is responsible for developing and implementing a management plan that defines, inter alia, no-take protected areas, buffer zones and corridors, and areas for sustainable use. The first and most well known example is the Mamiraua SDR in the Amazon region.
2. Other processes
    d. Fishing accords: regulated by Norm no 29/03 of IBAMA, this instrument aims to define and legitimize access rules and norms elaborated by the fishing community to regulate the use of fisheries resources in a given region. This type of instrument does not involve the expropriation of land

(like the Conservation Units above) but only some aspects regulating the exploitation of resources. There are examples of Fishing Accords in fisheries in the Amazon floodplain.

e. Fishing Forums: this is an instrument that is not regulated by the government but it is created as a result of communities' initiatives to organize themselves, and to discuss their problems and seek solutions in partnership with governmental and non-governmental organizations. Since it is not regulated, this instrument can be developed in different ways, with various types of arrangements involving individual stakeholders and institutions. Some examples are the Forum of Patos Lagoon in southern Brazil, the Forum Agenda 21 in Ibiraquera, Santa Catarina, the Forum Terramar in Ceará, among others.

Coastal Marine Protected Areas

The establishment of protected areas – of the various forms noted above – is one of the main government policies concerning coastal ecosystem conservation. The creation of protected areas is under the responsibility of IBAMA and the State's Secretaries for the Environment. Presently, there are 28 protected areas, covering several coastal and marine ecosystems such as coastal and oceanic islands/archipelagos, dunes, mangroves, lagoons and salt marsh habitats. The management of protected areas has been, in general, unsuccessful because of the lack of management plans, enforcement, technical and financial means and research. The main reason, however, lies in the way these protected areas were established—without previous consultation with user groups, in particular traditional populations. According to existing legislation, these groups must be transferred from the places where protected areas are established. It is known, however, that in many areas, traditional communities have used these ecosystems with a low level of environmental impact, and they deserve to be important allies in the conservation process. Another reason for the failure of the protected areas management is that they were created mainly by federal and state agencies. Since local municipalities are excluded from the decision process, they provide very little support to these important conservation areas.

The Marine Extractive Reserve (MER), described earlier, is a relatively recent category of protected areas that reflects a new approach. Through MERs, marine areas are assigned to the exclusive use of a certain number of small-scale fishers. A management plan is agreed upon by a grass-roots institution that assembles the fishers in the area of the reserve. Some six MERs have been officially established by the National Council of Traditional Populations (CNPT- IBAMA) and several others are in the process of being created, particularly in the North and Northeast regions (Figure 5). MERs offer a way to control the highly destructive, still basically unmanaged, development of the coastal zone, while at the same time reinforcing the resource-use rights and territorial claims of local communities to the micro-environments of small-scale fishing. MERs are essentially an effort to modify and extend the concept of "extractive reserves" – a conservation and sustainable development framework successfully instituted in western Amazonian forest economies (primarily rubber-tapper) to coastal aquatic and marine

domains of traditional fishing communities (CNPT[1]; Cunha, 1992; Diegues, 1999, 2001). By taking into account how both, environment and society benefit from helping coastal communities, secure continuing access to their traditional sea territories and livelihood resources, the MER is a radical departure from conventional approaches to setting up and managing marine protected areas. In the past, most MPAs were established opportunistically, or, more recently, almost solely on the basis of biodiversity criteria.

Figure 5. Location of Marine Extractive Reserves in Brazil (source CNPT/IBAMA).

[1] Centro Nacional de Desenvolvimento Sustentado das Populações Tradicionais; http://www.ibama.gov.br/resex/cnpt.htm

The Marine Extractive Reserve initiative is exceptionally promising; it has the potential to unify and reconcile elements that all too often are seen as incompatible: traditional culture heritage and cultural resource preservation needs, sustainable local fisheries, and conservation of marine biological diversity. Various provisions of national environmental legislation (namely *Law No.* 9. 985 instituting *SNUC;* Decree IBAMA No. 22 / 2-10-92), civil codes, and international treaties to which Brazil is a signatory (e. g. Articles 8j, 10c,10d of the Convention on Biological Diversity) endorse the principles on which collectively-held marine extractive reserves are based. However, it remains to be seen whether protected areas can be implemented and effectively managed on a scale broad enough to have biologically significant impacts, as well as questions concerning their social feasibility and economic viability.

To successfully institute a network of MER sites, CNPT also faces a major challenge in dealing with federal, state, and municipal jurisdictional conflicts, inconsistent policies and legislation across sectors, and the need for greater institutional coordination and cooperation in managing marine and aquatic resources within the environment sector as a whole (Cordell, 2002).

Local experiences in community management

In some areas, fishers and coastal communities are doing their own community-based management. In Ceará, for instance, local communities are suffering from the invasion of their beaches by land speculation, tourism and from overfishing of lobster, mainly by the industrial fleet and by divers coming from a neighbouring state. Assisted by local NGO's and research institutions, they have proposed a Coastal Forum, where the various problems are discussed by representatives of local communities, tourism sector, the industrial fisheries sector and the federal, state and municipal governments. Within this forum they have proposed a management plan for lobster fishing, also in coordination with the industrial fisheries sector. When IBAMA announced that no funds and boats were available for surveillance of lobster fishing, they equipped one of their boats in order to ensure compliance with the rules that regulate that fishery. The fishermen that disobey the regulations are first reprimanded and when they violate the agreed legislation again, they are taken to a court. In some beaches, the selling of a plot of land to tourists must be approved by the community council.

In other coastal communities, such as Pirajubaé in Santa Catarina, Mandira-Cananéia in São Paulo, and Arraial do Cabo, in Rio de Janeiro, MERs are being built in order to ensure access to fisheries resources for the members, and limit the access to outsiders, mainly to sport fishermen. In most of these initiatives, there is a strong resource conservation component, and as result they frequently succeed in getting the support of government and non-government environmental organisations. Further south, in the state of Rio Grande do Sul, 21 institutions have created a co-management arrangement (Forum of Patos Lagoon) to seek local solutions to the main conflicts faced by artisanal fishers, such as the impact of industrial fisheries, the control of access to outsiders, and to minimization of conflicts with industrial and port activities on the coast.

Traditional knowledge and traditional fisheries management

The different coastal cultures in Brazil each have a set of knowledge and management practices associated with the sea and fishing activities. In recent years, researchers have emphasised the importance of the knowledge produced and orally transmitted by traditional fishermen and the potential role traditional fishing and related environmental knowledge can play for the development and implementation of fisheries management in the modern world. (Ruddle, 2000; Cordell, 2000a, b). As Ruddle (2000) points out, traditional knowledge continues to guide and sustain the management of many traditional, community-based fishing systems, as well as governing fishing decisions and fishing strategies.

Various maritime anthropology and ethno-ichthiology studies illustrate the richness and resilience of artisanal fishing knowledge in Brazil. Silva (1997) records the analytical categories of the fishers of Piratininga (Rio de Janeiro) and Begossi (1997) documents the species nomenclature and criteria for fish classification system used by fishers on Búzios Island, (São Paulo). Cunha (1992) has described how fishing knowledge operates among artisanal communities and depicted the know-how of fishermen in Paraná and along the Paraíba Coast. Diegues (2000) explains how traditional knowledge functions in the rocky fishing grounds of Rio Grande do Norte and Espírito Santo states. Kalikoski and Vasconcellos (in press) highlight the importance of fishers' ecological knowledge in the definition of management rules in the co-management of artisanal fisheries in the Patos Lagoon, Rio Grande do Sul. Forman (1970), Cordell (1983), Mourão (1971) and Marques, (2001) have made important contributions to the study of traditional knowledge in Brazil.

The ability to identify productive zones of the sea and to find one's bearings in the midst of the immensity of the sea, out of sight of land, is what has been called "the cognitive skill set of fishermen". This knowledge is not evenly distributed among artisanal fishermen but tends to be concentrated in the hands of boat captains and skippers (mestres). There are various ways to transmit this knowledge. In the case of the retrieval of submersed rocky fishing grounds in Galinhos (Rio Grande do Norte), the captain may show to his children or to a selected crew member the geographical signs on land that he is using (mountains, church towers) to trace his routing (Diegues, 2000). In other cases, an apprentice must learn informally through observing and imitating the captain. Instruction to acquire these aspects of fishing knowledge is rarely formal or consciously intentional.

Knowledge of the marine physical environment is extremely important for a safe navigation, for the use of appropriate gear, and for the identification of certain fish species. Among Brazilian artisanal fishers the marine environment is not uniform but it is formed by different microhabitats that include mangrove, lagoons, estuaries, sand, and rocky-based grounds. Some fish species are known to use different microhabitats for different purposes such as feeding, protection, and reproduction. In some cases, some microhabitats must "rest" when some others are used for fishing (Marques, 2001).

The numerous advantageous uses of artisanal sea-tenure systems do not to imply they present a panacea for overcoming all fisheries management problems. Fishing may become highly competitive and arguably in the work setting. It seems to have an inherent tendency to generate conflict. The act of appropriating and controlling access to local sea space and resources by no means renders work environments free of conflicts.

Traditional sea tenure and fisheries management are only now receiving significant attention from scholars, scientists, and fisheries managers in Brazil. One reason for this lack of interest is that vast areas of the country, such as the Amazon and the sea, were treated by powerful industrial and urban elites as “empty spaces”. Traditional populations of the Amazon, particularly the Indians and the riverside populations were “invisible” until recently. This “invisibility” served the ideological purpose of the elites wishing to exploit the Amazon, as only “uncivilised people” were living there. The same biased view was applied to artisanal fishers and their communities. When the Indians and the artisanal fishers started to react to outsider intrusion, often by force, they became “visible”, as did their rich culture and knowledge of ecosystems and management techniques.

In many cases, traditional sea tenure and traditional management techniques have been negatively affected and even abandoned as a result of increasing disruption of fishing communities, and impacts of various activities.

First, artisanal fisheries face today strong competition from industrial fisheries and from the destructive exploitation of the coast. Local fisheries are being flooded with large industrial boats using inappropriate gear. Social, spatial, and technological competition is undergoing between locals and outsiders. Since 1967, industrial fishing has been established using tax incentives and suspension of import tariffs on fishery technology. These incentives have benefited mainly industrial groups. The result of this “fishery modernisation” has been widespread destruction of fish habitats, overfishing and marginalisation of artisanal fishers. At the same time, uncontrolled use of land and sea resources reached a critical intensity. Large chemical and petrochemical plants, nuclear power stations, dredging of harbours, oil exploitation, coastal mining and tourism have threatened extensive areas along the Brazilian coast. Urban expansion and tourism have targeted biologically rich habitats such as mangroves, sand barriers, and islands. One of the most affected ecosystems are the mangroves, from which an estimated two thirds of the fish caught in Brazil feed or breed during their life cycles.

Second, in addition to these impacts on artisanal fisheries, there has been a dramatic increase in the demand for fish in the growing urban centres. Some valuable fish species such as shrimp and lobsters are more intensively exploited. When profitability decreased, most industrial fishing crews started exploiting fish resources with no respect for existing traditional regulations. In some cases, artisanal fishers started using the same forbidden fishing gear in order to survive.

Third, traditional sea tenure is threatened as well by erroneous environmental and aquaculture plans that should benefit artisanal fishers in principle. Government

institutions are encouraging aquaculture; however, traditional extensive aquaculture systems already used by artisanal fishers are very often not considered. As a result, in some cases capital owners and outsiders are the only ones who benefit from these initiatives. The government also promoted the cultivation of species already managed by artisanal fishers. The adoption of these techniques does not necessarily lead to an improvement in the well-being of local communities. For instance, the government planned to introduce mullet cultivation through floating nets ('cercos flutuantes') instead of supporting the existing technique of the traditional 'cerco' made of bamboo poles. In fact, floating nets are more capital intensive, less labour intensive and would disrupt the existing social organisation. In the end, the new technique was eventually rejected by artisanal fishers.

Fourth, another threat exists when environmental protected areas are planned and established. Some of the coastal national parks are being set up in areas traditionally used by artisanal fishers. The well-conserved areas of the Atlantic Forest and associated coastal system have been used by traditional communities for centuries. Due to their isolation as well as to the existing social structure of these communities, those areas have remained well conserved. However, due to existing legislation, traditional populations cannot live in the regions that became protected and have to be transferred to other areas. Highly conflictive situations are being created in almost all protected areas and local communities resist eviction from their traditional land. This is the case in the Ecological Station of Juréia, the Biological Reserve of Guaraqueçaba, the National Park of Lagoa do Peixe, and other areas. When eviction of traditional people occurs, environmentally protected areas are more easily invaded by commercial fishing and logging, and the overall situation becomes even worse.

Instead of using traditional knowledge, some environmental agencies are in fact destroying a suitable basis for environmental and social planning. The present situation is gradually changing in favour of traditional communities, particularly due to the fierce resistance of the traditional people of the Amazon. Rubber-tappers and Indians succeeded in convincing the federal government to create extractive reserves through which the traditional use of forest products is ensured. Other traditional populations of the coastal areas are now requesting the same treatment granted to the rubber-tappers. Now the concept of extractive reserve is by law applicable to other ecosystems where local populations live out of extractive activities, such as oyster and mussel extraction (see section on Marine Protected Areas).

Coastal management

The institution with the highest authority for coastal zone management in Brazil is GERCO (National Program for Coastal Management) that is administered by the Ministry of the Environment. The conditions set forth in the program have to be implemented by each coastal State and Municipality. The program defines the legal aspects for the management of the Brazilian coastal zone, and establishes the basis for the development of regional and local policies, programs and management plans. Although fisheries are important coastal resources, GERCO has no mandate over them.

Social movements and institutional arrangements for coastal management

Since the middle of the 1970s, public concern for coastal conservation has gathered momentum in Brazil. Some of the factors that explain this rising concern are:

(a) *The growing awareness of Brazilian society* about the ecological importance of the coastal area and the increasing degradation of coastal ecosystems. The earlier positions of the Brazilian Government, which led to the country's moniker: "Brazil welcomes polluting industries", has changed since the Stockholm Conference in 1972. This is due to pressure from non-governmental organisations, international institutions and mainly because of the growing awareness of the population concerning environmental issues. In the 1970s, despite the presence of an authoritarian military regime favouring industrialisation at any social or ecological cost, many environmental groups were created. In the final years of the military regime (until 1984) national campaigns were organised by environmental movements on issues such as the destruction of the Amazon and Atlantic Forests, the Pantanal wetlands, as well as pollution in urban centres (such as São Paulo and Rio de Janeiro), and the establishment of nuclear plants along the coast. Hundreds of small groups blossomed to oppose whale-hunting, tree cutting in urban areas and destruction of national parks. Although many of these groups were formed by the middle class and were urban biased, they were instrumental in raising the level of environmental awareness in the country. They succeeded in electing a few representatives in the state legislatures of the more urbanised states such as São Paulo, Rio de Janeiro, and Rio Grande do Sul. In 1986, some candidates with strong environmental concern were elected to the National Congress, which developed the 1988 Constitution. For the first time specific considerations of the conservation of coastal ecosystems were included in the Constitution.

The "Cadastro Nacional de Instituições Ambientalistas – Ecolista", a roster published by WWF/Mater Natura, indicated that there are 1,400 Environmental NGOs registered in 2000, from which 296 were created in 1991-1992. Around 60 of them (14. 7 %) deal exclusively with coastal/marine ecosystems. If the 504 ENGOs dealing with the Atlantic Forest are added, one could say that roughly 61 % of Brazilian ENGOs are, in one way or another, concerned with the conservation of the various coastal ecosystems. A large proportion of the ENGOs are located in the Northeast (30%). Within the ENGOs dealing exclusively with coastal/marine ecosystems, there are some which address species or ecosystems conservation, such as SOS Mata Atlântica, Tamar (sea turtles), Peixe-Boi (manatee), Baleia Jubarte (humpback whales) and the Clube de Observadores de Aves (seabirds, in Rio Grande do Norte). There are also socially oriented ENGOs, which deal specifically with traditional populations and their environment, such as Terramar, Sociedade Civil Mamirauá, Sociedade Civil São Sebastião Tem Alma, Fundação Josué de Castro, etc.

At the societal level, socially oriented environmentalism gained importance vis-a-vis the traditional environmentalism which was focused mainly on protection of species. This

new environmentalism was able to establish alliances with other social movements, political parties and local movements.

(b) *The increasing number of public institutions* dealing with environment conservation. By the end of the military regime, there was space for public discussion and movements concerning environmental issues. Secretariats for Environment were established in many Brazilian States. At the Federal level, SEMA (Special Secretariat for the Environment, created in 1973) and the Ministry of the Environment (created in 1992) have been designated as core agencies for environmental protection.

(c) The importance of the environment was also highlighted by a growing number of u*niversities and government research centres dealing with coastal zones and marine ecosystems*. Well-known oceanographic institutions, such as the Oceanographic Institute at the University of São Paulo, the Oceanography Department at the Federal University of Rio Grande in Rio Grande do Sul, Labomar in Ceará, Labohidro in Maranhão, and the Schools of Fisheries Engineering in Pernambuco and Ceará have contributed to increased knowledge of coastal/marine ecosystems in the Northeast. Some other research institutions linked to Universities, such as Nupaub- Research Center on Human Populations and Wetlands at the University of São Paulo, have also contributed to increasing the knowledge about the relationship between local communities and coastal ecosystems.

The role of the State, of non-governmental organizations, and local institutions in coastal management

Coastal conservation and management became an important issue in Brazil in the late 1970s and in the 1980s when the impacts of industrialisation and urbanisation resulted in a rapid degradation of the coastal environment.

Artisanal fishers started a movement in the Northeast against the pollution of estuaries and rivers caused by the acidic waste of the alcohol-producing distilleries. It was the starting point for a stronger organisation of small-scale fishers, supported by the Catholic Church and some non-government organisations. This social process indicated the emergence of new identities and social awareness among coastal communities and artisanal fishing communities. These identity-building processes often occurred during conflicts that saw these communities opposed to urban expansion that often resulted in the eviction of artisanal fishers from their beaches and adjacent coastal waters. In tropical countries, where warm, sandy, sunny beaches became valuable assets to national and international tourism, artisanal fishers and their activities are seen as obstacles to a free development of market forces. Artisanal fishers and local dwellers are resettled into the corner of their own beaches, which are transformed into tourist resorts. In some other cases, the establishment of large industrialisation projects resulted in high levels of marine pollution, destruction of valuable habitats, such as mangroves, and ultimately led to the social disruption of artisanal fishing communities. In many cases, the social

reaction against these processes led to the establishment of new and politically orientated social movements, such as the National Movement of Fishers (MONAPE).

In the late 1970s, government institutions were created at the federal, state and municipal level to deal with environmental conservation. The first federal institution was SEMA, Secretary for the Environment, created in 1973 and incorporated by the Ministry of the Environment and Legal Amazon, created in 1992. In 1989, IBAMA (Brazilian Institute for the Environment) was created and incorporated to the Ministry of Environment. In 1981, the first comprehensive national law on the environment was promulgated. CONAMA (National Council on the Environment), which is responsible for the main policies concerning the environment, was created with the participation of governmental agencies and NGOs. In 1986, CONAMA approved the first legislation requiring environmental impact analysis for large projects. In 1988, the Brazilian Constitution declared the Atlantic Forest and its coastal zone as one of five crucial areas for management and sustainable development. Brazilian governmental and non-governmental organisations have actively participated in the UNCED-92 during the various discussions about coastal/marine environmental issues that produced Chapter 17 of Agenda 21. Also, ENGOs such the National Forum and MONAPE have participated in drawing up a Fisheries Treaty, signed by non-governmental organisations during UNCED 92. Brazil signed the UNCLOS - Law of the Sea- in November 1982 and ratified it in December 1988. In January 1993, the Brazilian Congress decreed Law 8. 617, on which Brazil defines the 12 miles territorial sea and the 200 miles of Economic Exclusive Zone. Among other important international guidelines, agreements and treaties ratified by Brazil that deal with coastal/marine conservation and fisheries are the Convention on Biological Diversity, the 1995 UN Fish Stocks Agreement and the FAO Code of Conduct for Responsible Fisheries.

7. RESEARCH AND EDUCATION

Information on artisanal fisheries is generally scarce, and the fisheries production statistics present many limitations. The institution with legal responsibility to collect and disseminate fisheries statistics is IBGE (Brazilian Institute of Geography and Statistics), but in 1990, IBGE's system of collection was interrupted. Since 1995, IBAMA started compiling and disseminating the data collected by different institutions in different States, such as the project ESTATPESCA developed by CEPENE (IBAMA's Center of Fisheries Research and Management for the Northeast coast) for the Northeastern states and by CEPENOR (IBAMA's Center of Fisheries Research and Management for the North coast) for Pará, the system of control of landings developed by São Paulo's Instituto de Pesca, Univali, CEPSUL (IBAMA's Center of Fisheries Research and Management for the South coast) and CEPERG (IBAMA's Center of Fisheries Research and Management of Estuarine and Lagoon fisheries) in the Southeastern and Southern Brazil. However, the lack of a standardization of methodologies used in the collection of statistics is a factor that precludes the comparative assessment of fisheries production among States. One particular problem with the landings statistics in some States is the lack of a more precise classification of fisheries production by artisanal fishery types,

with a tendency to aggregate all artisanal fisheries production in a single category of boats with less than 20 tonnes of gross tonnage. One exception is the system of data collection of the project ESTATPESCA, which provides more detailed information about artisanal fishery production in the Northeastern States. Another important limitation of landings statistics is the large volume of catches that are not precisely identified. Landed fish is often classified according to the commercial or common names, which do not allow the precise identification of the species. This problem occurs due to a combination of factors: the difficulty in monitoring of fishing in areas of high biodiversity; the preferential allocation of human and financial resources to the monitoring of large stocks targeted by industrial fisheries, among other causes. Illegal, Unregulated and Unreported fishing is also recognized as a problem that erodes the quality of fisheries catch statistics and leads to an underestimation of fisheries production (Isaac et al., 2006; Peres et al., in press; Vasconcellos et al., in press).

Information on biological and ecological aspects of coastal fisheries resources is not routinely collected by official agencies. Instead, it is produced by research projects conducted by universities and research institutes. The same also applies to socio-economic data. Among the research institutions that routinely carry out studies about fisheries in coastal areas are: the Oceanographic Institute of the University of São Paulo, Oceanography Department of the Federal University of Rio Grande, Univali in Santa Catarina, the Federal Universities of Paraná, Espírito Santo, Bahia, Pernambuco, Rio Grande do Norte and Pará, the Fisheries Institute of São Paulo, Labomar in Ceará, Labohidro in Maranhão, the Schools of Fisheries Engineering in Pernambuco and Ceará. Some other research institutions linked to Universities, such as Nupaub- Research Center on Human Populations and Wetlands of the University of São Paulo, and Nepan – Research Center on Environmental Research of the University of Campinas have also cooperated in increasing the knowledge about the relationships between local communities and coastal ecosystems. There are also some research network initiatives in the country that aim to improve the knowledge of coastal processes, fisheries, and management through collaboration among research institutes. It is worth mentioning the program REVIZEE (Renewable Resources of the EEZ) conducted by a consortium of universities and research agencies to improve knowledge about the oceanography and ecology of fisheries resources in the Brazilian EEZ. The project Coastal Resources of the Millennium Institute (a consortium of universities funded by the Ministry of Science and Technology) is collecting ecological and socio-economic data on coastal fisheries of seven States.

In order to coordinate the various governmental research projects on marine resources, the Interministerial Commission for Marine Resources (CIRM) was created in 1974. CIRM's main responsibilities are the promotion of research and the rational management of marine resources. The Commission was formed by representatives of eight ministries (Navy, Foreign Relations, Agriculture, Transport, Education, Industry and Commerce, Mines and Energy, and Interior) and the Planning Office and the National Council for Scientific and Technological Development. In 1979, a Secretariat was established (SECIRM) and was chaired by the Navy. Since 1988 CIRM has implemented various research projects concerning the marine environment, including the Project Leplac, which

aimed to collect geophysical data to define the limits of the Brazilian EEZ, and the REVIZEE Program, an effort to assess the potential of marine resources according to the framework established by the Law of the Sea. In this process, CIRM has established research agreements with the main oceanographic institutes to collect and evaluate the information.

IBAMA has maintained during most of the 1990s technical working groups on the main industrial fishery resources (lobsters, shrimps, demersal fish, sardine, snappers, tunas and catfish). In general, there is more information for these resources and fisheries than for any other coastal fishery in the country.

8. ISSUES AND CHALLENGES

Historically, artisanal fishers in Brazil have been labeled as inefficient and unproductive and, consequently, considered as objects of social welfare programs. The available information about the sector demystifies this approach by showing, for instance, that the artisanal fishery is as productive as the industrial fishery in terms of total landings volume. Therefore, the artisanal fishery deserves at least the same level of attention for development policies as received by the industrial fishery sector. In fact, it has been argued that the artisanal fishery is more economically viable and more socially desirable, especially for the exploitation of coastal ecosystems. This is justified by a number of factors, such as the nature of the fishery resources available in coastal tropical areas (multi-species and small-stock sizes), the spatial dispersion of fishing communities, the ample utilization of materials locally available, the direct supply of fish to local/regional markets, and the reduced use of fossil fuels.

With a few exceptions the development of fisheries in Brazil has followed an unsustainable path for resource exploitation in the different coastal regions. The causes behind the failures in maintaining resources at biologically sustainable levels must be properly identified to support the development of policies for the sector. In this sense, particular attention must be given to the analysis of the interactions and interferences among the artisanal and industrial sectors. It is not by coincidence that the situation of stocks is more critical in the areas where resources are shared between industrial and artisanal fisheries. For instance, in the South and Southeast, the industrial trawling fishery has been pointed out as one of the main culprits of the overfishing of traditional demersal stocks, because of intense direct harvest of the stocks, and also due to the by-catch and discards of juveniles. Similarly, the rapid development of the industrial purse seine fishery for sardine in the Southeast was one of the main reasons behind the collapse of the stock. Nonetheless, there should also be analysis of the artisanal fishery factors that contributed to each of the fishery collapses.

As artisanal fisheries have been decreasing in importance in the South and Southeast and maintaining their predominance in the North and Northeast it is clear that the strategies for development, management, and assessment of fisheries must be different among these regions. Although conservation policies are important for all regions, they are particularly required in the South-Southeast, due to the depletion of traditional resources and the

decrease in resource availability to artisanal fishers. Strategies of resource conservation and rebuilding (decrease in effort, protected areas, etc.) must be balanced by incentives and strategies to increase fishery profits through the exploitation of alternative resources, the development of alternative economic livelihoods, and other strategies. In fact, the participation of fishers in small-scale, family-based aquaculture has been increasing in recent years in these regions. The feasibility and potential of aquaculture as an alternative to a fishing livelihood is case-specific and needs to be further explored.

In the North and Northeast, where the abundance of resources is not yet a limiting factor for the maintenance of the artisanal fishery, management actions must also deal with the recovery of stocks that are in trouble, but should aim particularly to: establish institutional arrangements and strategies to prevent the increase in fishing capacity to a level beyond the productive capacity of the coastal resources and ecosystems; minimize and mitigate impacts of other coastal activities on fisheries; and provide secure access rights to small scale fishers that have been threatened or displaced by unplanned coastal development.

There is not only a great diversity of habitats and species used by artisanal coastal fisheries, but also a variety of cultures of which fishers are part, with distinct livelihoods and knowledge of resources, the environment, and traditional forms of resource use accumulated through generations along the Brazilian coast. This paper is an attempt to illustrate this diversity and hence, to serve as a reference on the bio-physical, socio-economic, and cultural context in which fishers are placed in each region.

9. REFERENCES

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