

DESCRIPTION OF THE FISHERIES STRUCTURE IN THE MANGROVE-DOMINATED REGION OF BRAGANÇA (STATE OF PARA, NORTH BRAZIL)

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Resumo. Este trabalho tem por objetivo descrever a pesca da região Bragantina (litoral NE do Pará, Brasil). A frota pesqueira que predomina nesta região é do tipo artesanal. Ela atua entre Salinas (PA) e a Baixada Maranhense (PA), aproximadamente num raio de 400 km. A frota pesqueira artesanal é responsável por 50 % da produção total de pescado do estado do Pará. A produção pesqueira da frota industrial do estado do Pará é totalmente voltada para exportação. A maior parte da produção pesqueira de Bragança é exportada para outros estados. Apenas uma parte da produção permanece em Bragança. O pescado que é normalmente comercializado, no mercado do peixe, é considerado como de segunda qualidade. Por consequência do aumento da frota pesqueira no município de Bragança, entre os anos de 1986 e 1989, houve aumento da produção pesqueira. Porém, mesmo com o aumento da frota pesqueira a atividade da pesca comercial não supriu a demanda de emprego para a população local. Mesmo depois da introdução das redes de "nylon" os tradicionais métodos de pesca como os currais ainda são usados. Eles são construídos principalmente durante o inverno sobre os bancos de areias ao longo do estuário do rio Caeté. O tipo de curral mais comum nesta região é denominado de enfiador ou enfia. Um outro tipo de curral construído na região é denominado de coração. Este tipo de curral é pouco utilizado pelo fato de necessitar freqüentemente de reparos. Dependendo do local onde os currais são construídos eles podem ser considerados como estuarinos (de dentro) ou ostrieros (de fora). Outro método de pesca utilizado na região é a tapagem. Este método consiste em bloquear um igarapé na floresta do Manguezal, durante a preamat, com uma rede de espera. A despesca é realizada assim que os peixes começam a sair da floresta com a maré vazante.

Abstract. The present fisheries structure in the region of Bragança in the State of Pará, Brazil, is described. It is characterized by a distant fishing area, reaching over 400 km from Salinas to the Baixada Maranhense, and a predominant artisanal fishing fleet. Half of the fish production of the state depends on the artisanal fishery, whereas fish for export are supplied by industrial fishery. A high proportion of the total fish landings is exported to other states and only a minor part of mainly secondary quality fish, is sold in the local markets. The enlargement of the fishing fleet of the municipality of Bragança resulted in an increase in landings between 1986 and 1989. However, commercial fishing activities do not offer sufficient employment for the local population. Before the introduction of nylon net material the main fishing devices of the region were traps (*cornal*), cast nets (*urnafá*), long lines (*espindel*) and harpoons (*arpão*). Despite this introduction, traditional devices as trapping barriers made out of fences (*curral*) are still in use. These are constructed in the winter season on sand banks along the estuary of the river Caeté (Bragança region). The *enfiador* type is the most frequent in the region. The *coração* type is not as common, mainly because its maintenance is more difficult. Depending on the spatial location within the estuary, outward and inward traps can be distinguished. Net barriers across small mangrove tidal creeks, by which fish are captured during ebb tide leaving the mangrove forest region, are another popular fishing method. Accepted 7 May 1998.

Key words: Mangroves, fisheries, Brazil, catch composition, landings, fisheries structure, fishing methods.

INTRODUCTION

The State of Pará is situated in the north of Brazil. The region encompasses 560 km of marine littoral and 20,512 km² of inland waters and is dominated by macro tides (4–5 m). The climate is tropical (mean air temperature 25.7°C), with hot dry periods from May to December and conventional rains from January to April. Annual precipitation exceeds 2,545 mm. The Caeté Bay, which connects Bragança with the open sea, belongs to the northern part of

the South Atlantic Basin (Fig. 1). During the rainy season increased freshwater runoff by the rivers Caeté and Urumajó reduces salinity (≈ 17), while during the dry season marine waters with higher salinity (> 35) prevail (Cobraphi 1984).

Although the Amazonian river fishery has been described by many authors (Smith 1981, IDESP 1989), information on its estuary and coastal fishery is very scarce. The entire north Brazilian coast is dominated by mangrove forests. There are varying degrees of association between mangrove-dwelling

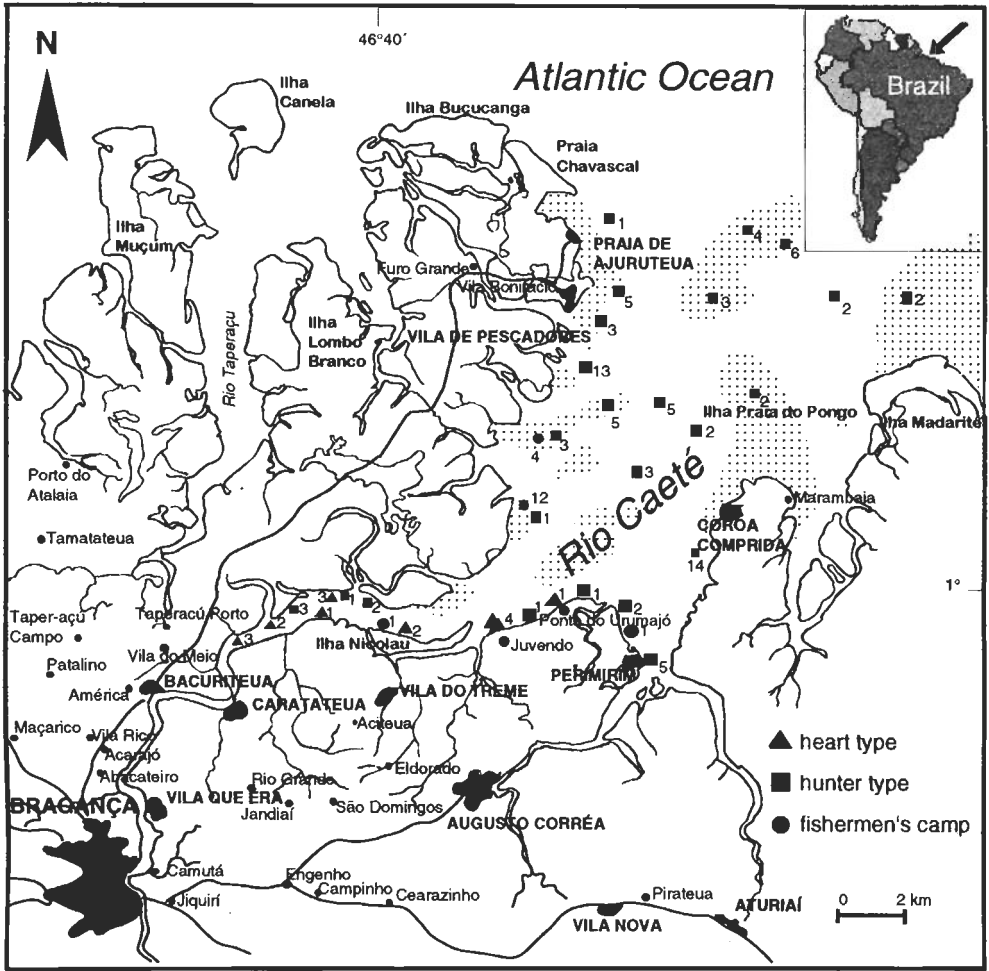


FIG. 1. Map of Caeté Estuary (modified by Souza Filho 1995) with locations of the trapping barriers.

fish and their habitat. Mangrove has been found to serve as breeding grounds for marine animals of commercial value (Ward 1976) and many fish species occur in mangrove during at least a certain period of their life (e.g., Heald & Odum 1970, Lear & Turner 1977, Saenger *et al.* 1977).

The impacts of direct, large-scale damage to the mangrove system through deforestation, prevention of water circulation, or the creation of artificial ponds for shrimp aquaculture are clearly manifested and have been the subject of diverse studies. Since most of the empirical studies (e.g., on the migratory behavior of fish) focus on ontogenetic disturbances,

the following line of argument may appear convincing: mangroves are nurseries, because juveniles grow there in relatively protected surroundings, so destruction of this habitat will lead to substantial reductions in population size.

A long-term German-Brazilian integrated project on Mangrove Dynamics and Management (MADAM) has recently started in the region of Bragança. Ecological and population studies of fish from the Caeté Estuary are presently under progress. The last decade has seen a rapidly growing interest throughout the world in the economic and social aspects of traditional small-scale fisheries development. The

objective of this paper is to give a primary summary of the regional fisheries structure based on information obtained by interviewing fishermen, analysis of statistical records and description of the fishing devices, excluding shrimp fishery. Special attention is given to the fishing gear since it is part of the material culture of most of the people, and to the issue of subsistence fishing because it plays an important role in the nutrition of the local population. More detailed studies on fish community structure and biomass in the estuary and their relevance for recruitment are in progress.

RESULTS

Fishery structure

Fishing areas. According to IDESP (1989) Bragança's fishery is of high economic importance for the region. Fishing activities are concentrated on the continental shelf stretching over 400 km, including the municipality of Salinas down to Baixada Maranhense. Fishing villages like Ajuruteua, Bacuriteua, Taperaçú-Porto, Vila do Castelo, Treme and other places, locally referred to as beach areas (*praias*), constitute the main sources for the provision of seafood for the local communities and adjacent villages.

Fishing fleet. The regional fishery can be divided into industrial and artisanal branches. The industrial trawlers, principally located in Belém, fish in the offshore regions for pinkshrimp (*Penaeus subtilis*) and pargo (*Lutjanus purpureus*). In coastal waters, estuaries, rivers, and lakes however, artisanal fisheries are practiced by local fishermen, principally from small or medium-sized wooden boats, propelled by motor, oar, and/or sail.

The most recent official statistic for 1987 shows that 11.5 % of the total number of 4,365 vessels in the State of Pará were registered in Bragança region (IDESP 1989). They can be classified into seven types: small sized rowing boats (*casquinho* or *montaria*), canoes (*curicaca*), motorized canoes (*bastardo*), and small (8–12 m length), medium sized (longer than 12 m) and self-sufficient industrial ships with regional differences in type. The number and mean size of ships and their engine power, based on recent inquiries in 1996, show that of 502 fishing boats in Bragança, 40 % were equipped with mostly low power engines, followed by canoes with oars (32 %) and sailing canoes (26 %) (Table 1), thus characterizing the regional fleet as almost entirely artisanal. Within the Bragança region seven villages can be

distinguished. Of these the city of Bragança has the largest motorized fishing fleet. The majority of these boats, with a self-sufficiency of 4 to 8 days, are constructed for offshore fishing.

The composition of the fishing fleet for each of the seven fishing villages in the municipality of Bragança is shown in Fig. 2. It shows that overall the main type of vessel is motor boats (38 %), followed by rowing boats (36 %) and sailing boats (26 %). Motor and rowing boats dominate Bragança, Vila do Castelo and Ajuruteua. In contrast, Bacuriteua (74 %) and Caratateua (41 %) have mainly rowing boats, which are normally used in the interior part of the estuary for the collection of fish from traps, net barriers, long-lines and for the transportation of salted

TABLE 1. Composition of the fishing fleet of Bragança municipality.

Village	Type of boat	Mean length (m)	Mean hp	Total number
Ajuruteua	motor	6.0	15	18
	sailing	5.0		60
	rowing	4.0		42
Caratateua	motor	8.6	17	9
	sailing	6.0		7
	rowing	4.5		46
Bacuriteua	motor	7.4	11	6
	sailing	5.6		4
	rowing	4.6		7
Vila do Castelo	motor	7.6	17	13
	sailing	5.3		30
	rowing	4.3		13
Taperaçú - Porto	motor	7.5	11	26
	sailing	5.5		4
	rowing	4.7		23
Treme	motor	7.6	12	23
	sailing	5.5		35
	rowing	4.5		26
Bragança	motor	8.6	23	98
	iron	20.0		15
	sailing	5.5		2
	rowing	7.8		13
Total				502

and dried fish to the market. In the village of Treme, on the other hand, the numbers of rowing canoes, canoes with sail and motor boats were equal.

Landings. In Bragança at least 9 different landing locations are used for the artisanal fishery, all located adjacent to the fish market. Of these, 8 are privately owned and one belongs to the municipality. The fishing port of the municipality is in charge of the fish landing statistics. Private enterprises transmit the fisheries data of each ship to the supervisory board of the administration (*prefeitura*) of Bragança. Between 1986 and 1989 a total amount of 9,948 metric tons of fish was officially recorded with a peak annual production of 2,777 tons in 1989 (Table 2), probably due to an expansion of the fishing fleet during this time.

One of the most recently established landing locations for fish is the Furo Grande, a tide channel (Fig. 1) which is used by boats coming from the beaches of Ajuruteua, Ilha do Canela, Taperacú and Bragança.

Fish are brought by truck equipped with cold-storage to the different regional markets according to the local preferences. For instance Peixe pedra (*Geniatremus luteus*) is sold to São Luis/MA, and Serra (*Scomberomorus* spp), Pescada amarela (*Cynoscion acoupa*), Corvina (*C. microlepidotus*), and Bandeirado (*Bagre bagre*) to Belém/PA and Fortaleza/CE. The local fish market in Bragança receives Gó (*Macrondon ancylodon*), Uricica amarela (*Cathorops spixii*), Uricica branca (*Cathorops* sp.), Sardinha (*Cetengraulis edentulus* and *Anchovia clupeioides*), Bagre (*Arius hertz-*

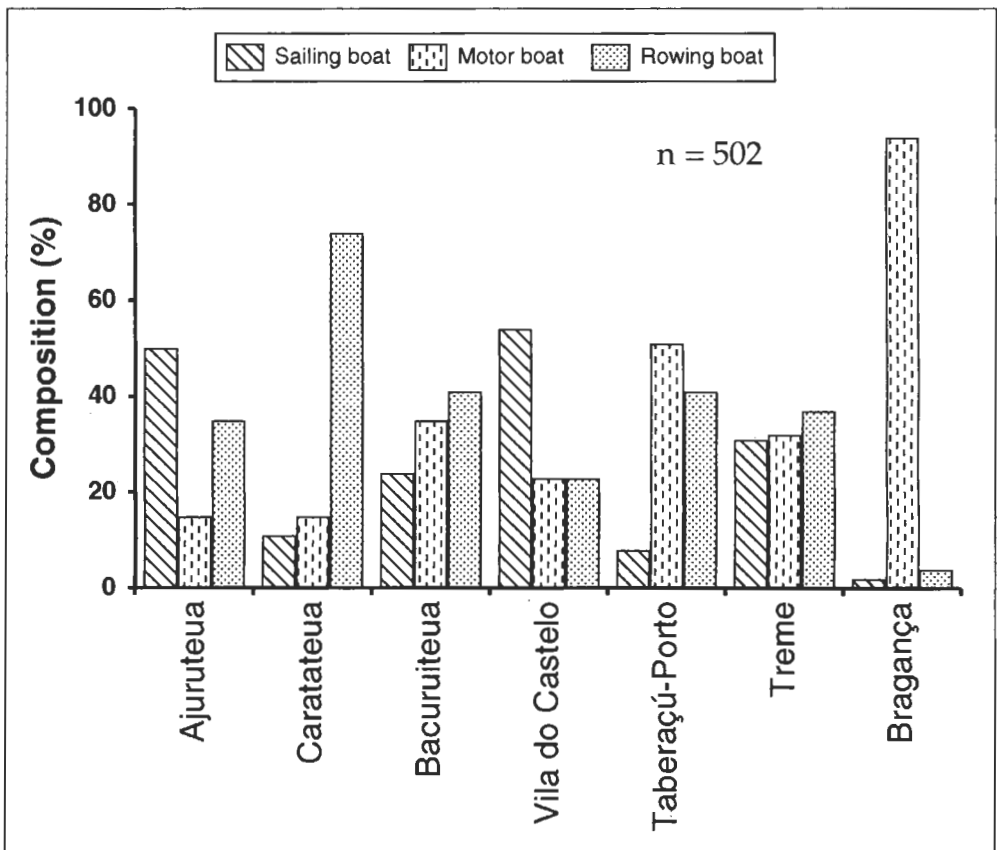


FIG. 2. Composition of the fishing fleet for each fishing town of the municipality of Bragança.

TABLE 2. Fish landings by species at Bragança during 1986–1989 in metric tons (IBGE).

Local name	Scientific name	Family	1986	1987	1988	1989	Total
Pargo	<i>Lutjanus purpureus</i>	Lutjanidae	853	718	262	21	1,854
Caçõo	–	Sphyrnidae, Carcharinidae	194	233	214	379	1,020
Gó	<i>Macrondon ancylodon</i>	Sciaenidae	174	193	335	308	1,009
Cangatã	<i>Arius quadriscutis</i>	Ariidae	165	185	200	282	831
Serra	<i>Scomberomorus</i> spp.	Scombridae	96	113	147	416	771
Pratiqueira	<i>Mugil</i> spp.	Mugilidae	148	146	151	156	600
Pescada amarela	<i>Cynoscion acoupa</i>	Sciaenidae	98	111	115	165	489
Tainha	<i>Mugil</i> spp.	Mugilidae	114	116	104	80	414
Gurijuba	<i>Arius parkeri</i>	Ariidae	95	92	84	109	380
Corvina	<i>Cynoscion microlepidotus</i>	Sciaenidae	82	30	92	144	349
Bandeirado	<i>Bagre bagre</i>	Ariidae	57	66	67	136	326
Arraia	<i>Dasyatis</i> spp.	Dasyatidae	64	75	69	117	325
Bagre	<i>Arius hertzbergii</i>	Ariidae	47	54	63	117	281
Xaréu	<i>Canax</i> spp.	Carangidae	57	64	63	69	252
Cambeva	<i>Arius grandicassis</i>	Ariidae	122	28	38	62	249
Uritinga	<i>Arius proops</i>	Ariidae	59	61	52	61	233
Timbira	<i>Oligoplites</i> spp.	Carangidae	27	31	36	43	137
Mero	<i>Epinephelus iajara</i>	Serranidae	11	32	49	38	130
Peixe pedra	<i>Geniatremus luteus</i>	Pomadasyidae	16	21	17	15	69
Pescadinha	<i>Cynoscion leiarchus</i>	Sciaenidae	11	14	14	15	54
Dourada	<i>Brachyplatystoma flavicans</i>	Pimelodidae	0	0	21	14	35
Bagralhão	<i>Arius passany</i>	Ariidae	10	10	5	6	31
Carauaçú	<i>Loboto sirinamensis</i>	Lobotidae	6	6	8	5	25
Parú	<i>Chaetodipterus füber</i>	Ephippidae	6	7	7	5	24
Camorim	<i>Centropomus</i> spp.	Centropomidae	7	4	4	6	21
Pirapema	<i>Tarpon atlanticus</i>	Megalopidae	5	6	7	4	21
Piranutaba	<i>Brachyplatystoma vaillanti</i>	Pimelodidae	5	5	5	6	20
Total			2,530	2,417	2,224	2,777	9,948

bergii), Bandeirado (*B. bagre*), Uritinga (*A. proops*), and Gurijuba (*A. parkeri*).

As the Caeté estuary is principally influenced by marine and waters without any notable impact from the Amazon river, Bragança fishing stocks are dominated by marine or brackish water species throughout the year: Pescada amarela (*C. acoupa*), Uritinga (*A. proops*), Camorim (*Centropomus* spp.), Xaréu (*Canax hippo*, *C. crisyus*), Gurijuba (*A. parkeri*), Serra (*Scomberomorus* spp.), Pargo (*Lutjanus purpureus*) and Caçõo (Carcharinidae) (Table 2).

From September to February certain species are out of season and the catch decrease has to be compensated for by buying supplementary fish from other regions in order to maintain the regular provision of fish for the local population (IDESP 1989).

Fish trade. The marketing of fish to local and external markets of Pará State and its cities of Belém, Vigia, and Bragança is shown in Fig. 3. The economically very important artisanal fishery contributes half of the state's fish production (IDESP 1989), supplying principally the local markets of Belém, São Luís and Fortaleza. The landings from the semi-industrial fishery are destined exclusively for the export market.

During the past decade the market structure has changed. Between 1983 and 1986 fish products of Pará State were exclusively exported to other states. However, since 1985 local commercialization has increased, and an equilibrium was reached between the quantity of fish consumed inside and outside the state in 1987. Fish export and local consumption have been about equal in Belém since 1984 and in Vigia since 1987.

At the end of the 1970s or beginning of the 1980s several fishing companies from the north-east of Brazil with branch offices in Bragança specialized in the catching of Pargo (*Lutjanus purpureus*). These companies also purchased most of the artisanal fishery production supplying predominantly the north-east, and in minor quantities the central east (capital Brasília) and the south-east (Rio de Janeiro and São Paulo) with fish. Most important commercial species for export were: Pescada amarela (*Cynoscion acoupa*), Camorim (*Centropomus* spp.), Serra (*Scomberomorus* spp.), Pargo (*L. purpureus*), and Pirapema (*Parapon atlanticus*). Only a small part of their total production supplied the local markets of Bragança, Belém and nearby cities as Capitão Poço, Ourém and Capanema.

In Bragança the majority of high-quality fish and fish products, like Aba (shark fin) and Grude (dried

swimbladders of *A. parkeri*, *A. proops*, and *C. acoupa*) are still exported to other States such as Piauí, Maranhão and Ceará (IDESP 1989, Melo & da Silva 1995). Locally, only fish of inferior quality are consumed, like Bagre (*Arius hertzbergii*), Uricica branca, and Uricica amarela (*Cathorops* sp. *C. spixii*), Gó (*Macrodon ancylodon*), and Mullets (*Mugil* spp.), locally known as Pratiqueira, Caica or Tainha.

Moreover, there is a special fishing fleet in Bragança for the taking of mackerel (*Scomberomorus* spp.) between June–July and November–December (período do serra) using gill-nets (Serreiras) with medium mesh sizes of 8 cm. These fish are sold in north-east Brazil.

Social structure of fishermen. Commercial fishery is only minor employer for Bragança's population. A higher number of people, living in communities along the littoral of Pará, are employed in the artisanal fishery (Melo & da Silva 1995).

Depending on fishing area, there are two categories of fishermen, those fishing inshore (que pesca no estuário) and those fishing offshore (que pesca barra-fora). Fishermen in the first category normally do not sell their products in the town of Bragança directly, due to the long traveling distance. They are visited in their fishing communities in Ajuruteua, Taperaçú, Urumajó, Augusto Correia, Furo Grande, Bacuriteua, and others via boat or car by purchasers to whom they sell their products. The offshore fishermen sell their products directly to both the consumer and fish-traders.

FISHING METHODS

A variety of different types and sizes of fishing devices are used in the artisanal fisheries. Before 1962 *currais* (trapping barriers made of fences), *tarrifas* (cast nets), *espinhel* (long lines), and harpoons were the main local fishing devices. However, after the introduction of cotton or nylon mono-/polyfilament gill-nets traps became less important (Furtado 1987).

Trapping barriers made of fences (*curral*)

Trapping barriers (*curral*) are the most impressive regional fishing devices. They are constructed near-shore on places along the river Caeté and its estuary where they are less exposed to wind and the water currents are weak (Fig. 1). Within the bay strong tidal currents cause large areas of erosion and shifting sand-bank depositions (*cova*), which are suitable grounds for trapping barrier construction.

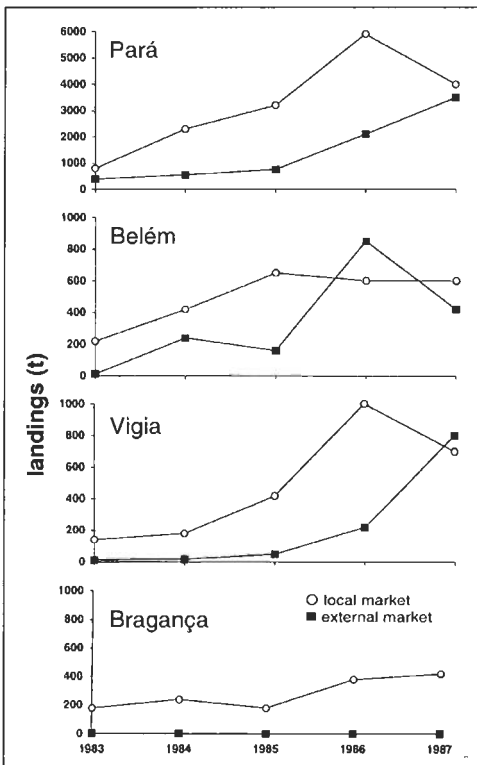


FIG. 3. Landings of fish in tons for the States of Pará, Belém, Vigia and Bragança (after IDESP 1989).



FIG. 4. Trapping barrier of the heart type (*coração*) in the Caeté Estuary.

These are guiding barriers which are created by means of regularly spaced stakes across the migration routes of fish, and are of such shape as to direct the voluntary movements of the fish with the incoming tides into a desired area. Fish enter a catching chamber from which escape is difficult or even impossible. They are normally constructed from mangrove poles and/or bamboo during the winter season, when fishing becomes more difficult due to the heavy convectional rainfalls.

In the region, three types of trapping barrier can be distinguished. Because of their differences in shape they are locally called *coração* (heart), *cachimbo* (pipe), and *enfiador* or *enfia* (hunter) (Furtado 1987). An additional small type of trap is called *cacuri*, but is less frequent. The *coração* type (Fig. 4) is the most abundant in the region of Marudá (Pará state) (Furtado 1987) while the commonest trap in the whole region of Bragança, especially the Caeté estuary, is the *enfiador* (Fig. 5), and to a lesser extent the *coração* type (Fig. 6).

The traps are normally divided into a *sala* (corridor) and a *chiqueiro* (catching chamber). The *espia*



FIG. 5. Trapping barrier of the hunter type (*enfiador*) in the Caeté Estuary.

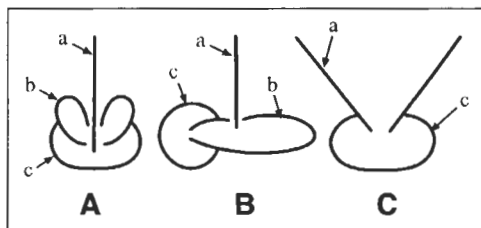


FIG. 6. Diagram of different types of trapping barriers encountered in the littoral of Pará (modified after Furtado 1987). A refers to the heart (*coração*), B to the pipe (*cachimbo*), and C to the hunter type (*enfiador*). [a = fence (*espia*), b = corridor (*sala*), c = catching chamber (*chiqueiro*)].

(fence) extends straight out from the shore and leads to the entrance of the corridor. The *coração* or *enfiador* trap is arranged to further guide fish into the funnel entrance. The fish get from the fence into the corridor and then pass down to the catching chamber where they congregate for capturing by a seine net. The *espia* is made out of stakes of a height of up to 4.4 m. According to the fishermen, trapping efficiency is strongly influenced by the position of the fence. Both the *coração* and *cachimbo* type have only one single fence to guide the fish to the catching chamber while the *enfiador* type is equipped with two fences (Fig. 6).

Normally, the *enfiador* type is more stable and occupies a larger area than the *coração* type. They are positioned with their opening in an upstream direction, so that the fish are led by the high current speed at low tide into the device. The heart type is constructed perpendicularly on river banks normally in an inlet, where water current is reduced. This kind of trap is normally smaller and has a more fragile structure, although its construction requires more skill. It is principally made out of bamboo and *cipós* (liana). Fish are captured during ebb and flood tide.

In some regions along the Caeté estuary, for example near Vila Nova, the region of Tarana or near the Salinas stream, the *coração* traps are connected to each other (Fig. 7). This strategy permits a more continuous capture of fish, because fish can be collected in the first chamber while the second one still continues to catch them.

Internal and external estuary traps can be distinguished. The latter are set up offshore on sandbanks, so that they stay flooded up to a depth of

2.5 m even at low tide. This preserves the fish until collection. Internal traps are constructed nearshore along rivers and channels where they dry out during low tide, with the result that fish have to be collected during each low tide.

Up to 115 traps were counted in the Caeté estuary at the end of the tropical summer in December 1996 (Table 3). Of these, 15 belonged to the *coração* type, whereas 100 were of the *enfiador* type. Of the total number, 1.7 % were still in construction and 5.2 % were abandoned. During the winter trap numbers increase in areas with low wind intensities, whereas the number decreases significantly at the end of the summer due to strong winds.

The traps are placed in the Caeté river following a certain strategy. The large traps of the *enfiador* type, for example, are positioned on sandbanks in the middle of the river or at the river sides, fishing during ebb tides while the fence is always turned towards low tide. It can be noted that the traps are positioned in such a way that catching efficiency is highest during low tide, whereby the traps are constructed in alignment on the same sandbank. A special double trap was found between the Furo da Ostra and Furo

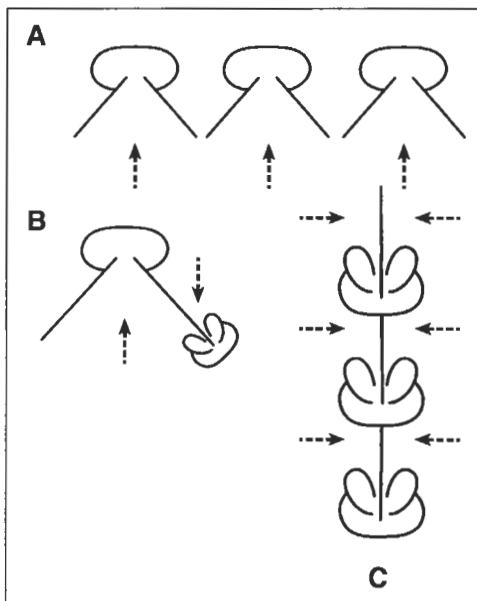


FIG. 7. Arrangement of trapping barriers in the Caeté estuary. The arrows indicate tidal current.

TABLE 3. Type, location and numbers of traps and *ranchos* in the Caeté Estuary.

Locality	Position	Number	Type	Condition	Area (m ²)	Height (m)
Nicolau Island	S 0°57.965' W 46°37.808'	2	<i>conação</i>	fishing	60	4.5
Nicolau Island	S 0°57.965' W 46°37.808'	1	<i>ranchu</i>		18	6
In front of Ig. Itaicy	S 0°58.607' W 46°43.591'	3	<i>conação</i>	fishing	30	4.5
Ig. Itaicy	S 0°58.468' W 46°43.591'	2	<i>conação</i>	fishing	50	4.5
Behind Ig. Itaicy	S 0°58.378' W 46°43.369'	3	<i>enfia</i>	fishing	497.4	5
Vapor afundado	S 0°58'221' W 46°42.888'	1	<i>conação</i>	fishing	90	4.5
In front of Ig. Salinas	S 0°57.850' W 46°42.050'	4	1 <i>enfia</i> 3 <i>conação</i>	fishing fishing	175.5 90	5 4.5
Ig. Salinas	S 0°57.696' W 46°40.853'	2	<i>enfia</i>	1 fishing 1 not active	52 -	5 -
Tarana (left side)	S 0°56.094' W 46°37.628'	1	<i>enfia</i>	fishing	497.4	5
Tarana (left side)	S 0°55.866' W 46°37.491'	12	<i>ranchos</i>		18	6
Tarana (sandbank)	S 0°55.728' W 46°37.429'	7	<i>enfia</i>	fishing		5
Furo da Ostra	S 0°55.214' W 46°37.078'	3	2 <i>enfia</i> 1 <i>mixed</i> (*)	fishing		5
Caeté mouth (sandbank)	S 0°55.124' W 46°36.966'	3	<i>enfia</i>	fishing		5
Furo da Ostra (sandbank.)	S 0°54.791' W 46°36.537'	7	4 <i>ranchos</i> 3 <i>enfia</i>	fishing	18	6 5
Lateral canal's sandbank	S 0°54.791' W 46°36.537'	5	<i>enfia</i>	fishing	5	
Furo do Meio	S 0°53.748' W 46°36.198'	5	<i>enfia</i>	3 fishing 2 being repaired		5
Furo do Café	S 0°53.374' W 46°36.106'	13	<i>enfia</i>	6 fishing 7 being repaired		5 5
Furo Grande	S 0°52.616' W 46°35.875'	3	<i>enfia</i>	fishing		5
Ajurateua Village (Caeté mouth)	S 0°51.686' W 46°35.470'	5	<i>enfia</i>	fishing		5
Ajurateua beach	S 0°49.970' W 46°35.557'	1	<i>enfia</i>	not active	-	-
Caeté mouth (middle sandbank)	S 0°51.567' W 46°34.840'	3	<i>enfia</i>	fishing		5
Caeté mouth (middle sandbank)	S 0°51.534' W 46°34.887'	4	<i>enfia</i>	fishing		5
Caeté mouth (right side)	S 0°52.776' W 46°34.194'	6	<i>enfia</i>	5 fishing 1 not active		5
Caeté mouth (right side - sandbank)	S 0°53.543' W 46°33.339'	2	<i>enfia</i>	1 fishing 1 not active		5
Croa Comprida	S 0°53.543' W 46°33.300'	4	<i>enfia</i>	2 fishing 2 in construction		5

TABLE 3. Continued.

Locality	Position	Number	Type	Condition	Area (m ²)	Height (m)
Ponta do Cupim (Caeté mouth)	S 0°53.562' W46°32.210'	2	<i>enfia</i>	1 fishing 1 not active		5
Croa Comprida Island	S 0°54.945' W46°33.939'	14	<i>enfia</i>	8 fishing 2 in construction 4 not active		5
Urumajó River (mouth)	S 0°56.993' W46°35.452'	5	<i>enfia</i>	not active		5
Pirimirim Point	S 0°57.095' W46°35.613'	3	2 <i>enfia</i> 1 <i>ranchão</i>	fishing		5 6
Vila Nova	S 0°57.350' W46°36.511'	2	1 <i>coração</i> (*) 1 <i>enfia</i>	fishing fishing		4.5 4.5
Vila Nova	S 0°57.821' W46°36.749'	5	4 <i>coração</i> (*) 1 <i>enfia</i>	fishing fishing		4.5 4.5

(*) Combined traps (see Fig. 7).

do Café (Fig. 1) functioning as an *enfiador* type during ebb tide, and as a *coração* type during flood tide (Fig. 7).

Net barriers (*tapagem*)

This method has its origin in the State of Maranhão. For temporary net barriers (*tapagem* or *zangaria*) the outlets of small mangrove tidal creeks are blocked by an approximately 50 m long and 5 m high net. The mesh size, however varies depending on the size of fish destined for capture. The net is positioned during high tide and fastened on wooden poles, which are stuck in the mud after the fish have spread into the inundated mangroves. Fish are collected in the small pools that form six hours after locking up the creek during the stagnation of low tide. The most common net used is called locally *caiqueira* or *tainheira* (Table 4). During the summer season however, a shrimp net, with a mesh size of only 1 cm, is used.

Gill-nets (*malhadeira*)

Gill-nets (*malhadeira* or also locally known as *caçoeira*, *severeira*, *tainheira*, *caiqueira*, *pratiqueira*, *pirapemeira*) are also frequently used in the region. They are either of individual size and shape made by the fishermen themselves or are made by machine. However, the demand for the cheaper machine-made gill-net is higher (US\$ 3,800) than for the better quality hand-made nets (US\$ 4,200). The different types of nets frequently used in the region are listed in Table 4. They are normally operated as anchored floating gill-nets to catch mid-water fish. They are usually set across the direction of the migrating fish so that when they try to make their way through the mesh they get stuck.

Cast-nets (*tarrafá*)

Hand cast-nets (*tarrafá*), normally constructed with a central line and without pockets, are frequently used

TABLE 4. Description of the different types of gill-nets used in Caeté Estuary and along the Pará coast.

Local name	Scientific name of target species	Type of thread	Number of thread	Length (m)	Height (m)	Position in water column	Site
Caiqueira	<i>Mugil</i> spp.	monofilament	25	50-1,500	3	surface	inshore
Corvineira	<i>Cynoscion microlepidotus</i>	polyfilament	24	800	5	bottom	inshore
Pescadeira	<i>Cynoscion acoupa</i>	polyfilament	43	2,600	6	bottom	inshore
Sereira	<i>Scomberomorus</i> spp.	monofilament	60	3,000	4	surface	offshore
Tainheira	<i>Mugil</i> spp.	monofilament	40	50-2,000	4	midwater	inshore
Caçoeira	<i>Selachii</i>	polyfilament	2	5,000	7	bottom	offshore



FIG. 8. Fishermen's camps (*ranchos*) are pile-work barracks located along the bay.

DISCUSSION

The description of the fisheries structure shows the importance of Bragança as a trading place for the industrial fishery in coastal and offshore waters. The exploitation of the resources within mangroves is mostly limited to subsistence fisheries and other small-scale exploitation. This is because of the technical difficulties involved in employing equipment used for commercial fisheries inside the mangrove forest.

This paper is restricted to fish. However, local catches from the mangrove-rich Bragança region are dominated especially by the mangrove crab, *Ucides cordatus*. This has been shown by an initial inquiry which demonstrated that at least half of the rural population lives from crab collecting and processing (Glaser pers. com).

From the literature there is little doubt that the presence of mangroves enhances the size of catches in adjacent coastal and offshore waters. This seems to be particularly true for shrimps (Macnae 1974). A summary is given by Gundermann & Popper (1984) for the Indo-Pacific showing that in some regions more than 90 % of the species caught by commercial fisheries require estuarine conditions

to complete their life-cycle. Whether this evident relationship between mangrove estuaries and fish harvest is true for the Bragança region is still under investigation.

The study of fishing gear and fishing methods is an integral part of fisheries science. Biologists as well as gear technologists are interested in the influence of fishing gear on the living resources of the water. An extensive overview on this subject is given by Brandt (1984). For the local population in the region investigated here artisanal fishery is the predominant type of fishing. Artisanal fisheries are labour intensive, capital extensive, traditional in nature and pursued for subsistence purposes, for commercial profits or for both. In Brazil, regional fisheries activity seems not to be of economic importance for the country but is essential for the local population. However, stocks might be endangered due to the absence of realistic, binding regulations to govern the harvest of fish. Data on the population dynamics of the fish species captured by the local population are still not available but they are necessary. Therefore it is important to improve resource management in order to maintain long-term food supply and employment in this sector. Artisanal fishing communities have to

be encouraged rather than industrial fisheries. The integration of the poor rural population into the national economy is of high priority. A multidisciplinary view of artisanal fisheries resources, technology, and socio-economics is required. Present knowledge is not sufficient for the preparation of an integrated management plan.

Fisheries research has to be intensified in order to fill the gaps in our knowledge and achieve sustainable fisheries resource management. Additional economic and social studies are needed to define management priorities. Therefore programs have to be developed to strengthen local or regional research facilities and provide necessary training and equipment to support resource management. Statistics are a key element of a successful management and research program. Without reliable landing data, fish population dynamics cannot be calculated. The statistics so far available for the Bragança region are completely inadequate. The data collection for the basis of an assessment started recently by the joint Brazilian/German integrated project MADAM must be continued with high priority. Essential input can be expected from socio-economics, providing information on the organization of production and on the social dimension of the fishing community.

There is evidence of stock overexploitation, especially because of a recent increase in fisheries effort and a decline in traditional fishing methods. This might endanger the subsistence fishery in the estuary and hence management concepts need to be considered. Fisheries management is not a single discipline challenge. This is accordance with Trinidad et al. (1993), who recommended that we move away from traditional solutions to fisheries management problems and instead look at measures that attack fisheries-related problems not as emanating from the fisheries themselves but from sectoral interlinkages. Consequently a multidisciplinary approach is necessary to appreciate the problems and potential of fisheries around Bragança.

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