A Traditional Floodplain Fishery of the Lower Amazon River, Brazil *

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Abstract

This paper describes fishing activities of households in four communities located on a floodplain lake system of the lower Amazon river. An average of 42 households were interviewed about their fishing activity on a monthly basis. The fishery is a typical multi-gear, multi-specific artisanal fishery. Approximately ten types of fishing gear are utilized, of which the three main types of gillnets account for 51% of the total catch. The catch per trip averaged 15 kg, for an annual total of 2 295 kg per household. Some 40 species or groups of species are caught, although four species account for 50% of the total. There is a strong seasonal pattern to the fishery, with catch per trip and catch per unit effort (CPUE) highest in the low water season (September-November). While there are marked differences between subsistence and commercially oriented fishing strategies, these differences are more in degree than in type, since fishers use the same types of gear and most fishers regularly sell part of their catch.

Introduction

The floodplain or *varzea* fisheries have been one of the major resources of the Amazon economy since the beginning of European colonization of the region over four hundred years ago. Historically, fish has been the main source of animal protein for the floodplain population and seasonally important as a means of obtaining cash and trade goods. Over the last three to four decades, Amazon fisheries have undergone major changes associated with technological innovations, the growth in regional and export oriented markets, and the decline of alternative economic activities, especially jute farming (Smith 1981; McGrath et al. 1993; Goulding et al. 1996). As a result, floodplain farmers have abandoned jute and turned to commercial fishing to supply local markets and fish processing plants. In the process, the traditional seasonal commercial fishery which produces dried and salted fish for the regional trading system has given way to one that is more intensive and less seasonal. It provides fresh, iced fish for major regional urban centers and export oriented fish processing plants.

While the intensification of commercial fisheries has had a major impact on floodplain ecology and economy, the process of change is still in its early stages. Although there are significant regional differences in the development of the fisheries over much of the Amazon floodplain, traditional artisanal canoe fishers still dominate local fisheries and account, directly or indirectly, for a major share of the regional catch[1] (Smith 1981; Merona 1990; McGrath et al. 1993). These localized, small-scale floodplain lake fisheries are increasingly regarded as providing a promising basis for the management of floodplain fisheries (McGrath et al. 1997). This paper describes fishing activity in a lake system of the lower Amazon floodplain, with the intent of contributing to our understanding of how fish resources are utilized by traditional fishing populations and of the implications of these fishing strategies for efforts to manage Amazon fisheries.

Study Site and Methods

Study Site

The research on which this paper is based was carried out in the region of Ituqui, a 30 000 ha island on the south shore of the Amazon river, some twenty kilometers downstream from Santarém, the major urban center of the lower Amazon (Fig. 1). The Ituqui region has a population of

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[1]The characteristics of the commercial fleet differ from region to region within the basin. Market size and gear restrictions are probably the main factors influencing development of regional commercial fleets. In regions supplying major urban centers where seines and/or trawls are permitted, such as Manaus, for example, the scale of fishing operations is much larger than in the lower Amazonian region described here in which cities are smaller and trawls and seines are prohibited.

approximately 2 200 people distributed in eight communities, four of which are located on the island and four on the facing shore of the side channel formed by the island. This paper presents the results of an ongoing study of household fishing activity in four *varzea* communities of the island of Ituqui. The study is part of a larger PLEC/WWF-ODA [2] funded project whose objective is to increase the effectiveness of community-based management systems for *varzea* lake fisheries through a program of research and extension.

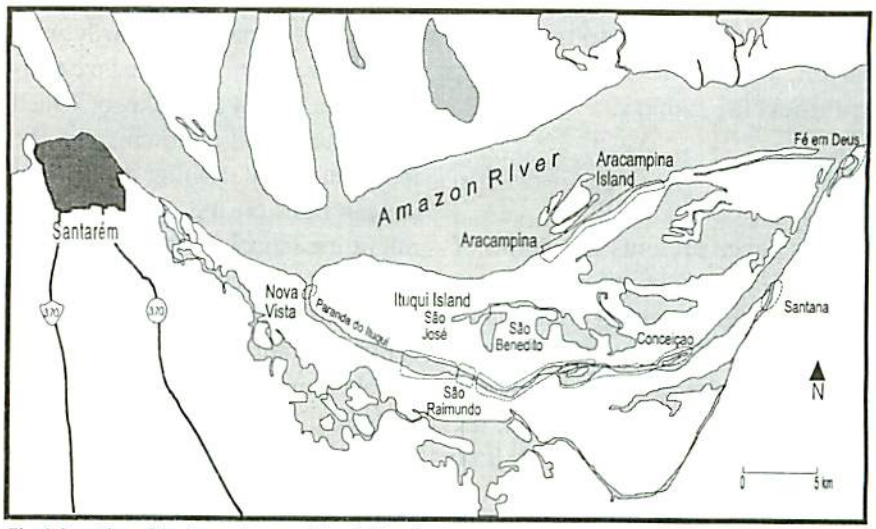

Fig. 1. Location of the Lower Amazon River in Brazil.

Ituqui communities vary in size from 32 to 68 households strung out along the levee bordering the river. In addition to the four island communities, there are approximately twenty rural properties, of which about a dozen larger ranches control more than 50% of the island. Table 1 presents a summary of the main economic activities of households in the four Ituqui communities which participated in the study. As is the case elsewhere on the *varzea*, Ituqui smallholders have diversified management strategies combining fishing, farming and the raising of small animals and cattle. Virtually all households fish for subsistence and approximately two-thirds of Ituqui households also sell fish on a full or part time basis.

Table 1. Major subsistence activities of the Ituqui population.

Community	No. of households	Percent of total households					
		Agriculture	Small animals	Cattle	Fishing	Fishing Subs	S/C*
Aracampina (ARA)	64	97	88	72	97	6	91
Santana (SAN)	68	69	78	31	82	24	59
São Benedito (SBO)	37	73	92	81	70	38	32
São José (SJE)	37	89	89	43	97	22	76
Total	206	82	85	55	87	20	67

* Subsistence and Commercial

The Ituqui landscape is typical of that of the lower Amazon floodplain, and is composed of four major landscape features: river channels, natural levees, seasonally inundated grasslands and lake systems (Fig. 2). Natural levees, or *restingas* as they are called locally, border the river and its major side channels. Inland from the *restingas* the land slopes gently downward towards the large shallow lakes which occupy much of the floodplain interior. The natural vegetation of the *restingas* is *varzea* forest while the transitional zone between the *restingas* and the permanent lakes is covered by semi-aquatic grasses. Household resource management strategies exploit all four environmental zones. Because of their higher elevation, *restingas* are the preferred sites for houses and most agricultural activity. The natural grasslands are used for grazing cattle during the low water season, and the *varzea* lakes are the focus of most fishing activity. The river,

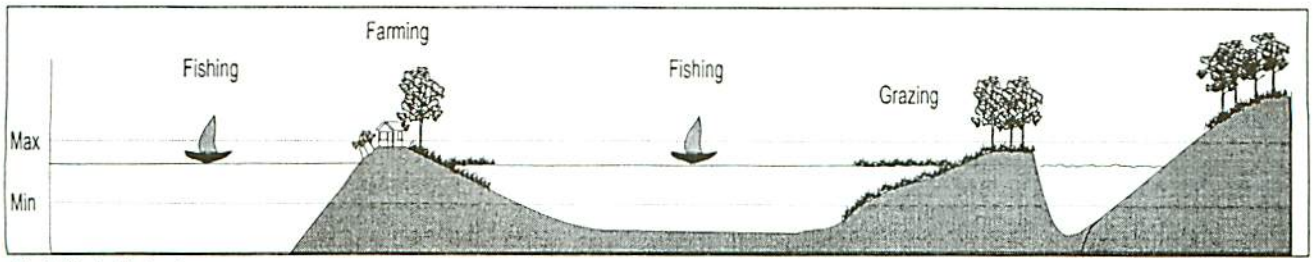

Fig. 2. Floodplain land use.

[2] PLEC-Research Project on People, Land Management and Environmental Change; WWF-World Wildlife Fund; ODA-Overseas Development Assistance of the UK, renamed Department for International Development (DFID).

in addition to its role in transportation, is the site of a seasonal, commercial fishery.

Methods

This paper presents the results of an ongoing study monitoring household fishing activity in four Ituqui communities. The results presented here are based on the first twelve months of this study and cover the period between July 1995 and June 1996. A sample of households corresponding to approximately 20% of the total of the four communities was interviewed on a daily basis during the last week of each month. Interviews were conducted by members of each community working under the supervision of a project research assistant. Interviews contained questions on the previous day's fishing activity; time and duration of the fishing trip; characteristics of the fishing sites visited; type and quantity of gear used; catch size and composition; consumption and sale of fish; repair of equipment; and expenditures and income. An average of 42 households was interviewed each month. The monitoring program combined two sampling methodologies. Half of the households monitored in each community was interviewed every month while the other half was randomly selected each month. Differences between the characteristics of fishing activity in the two data sets are minimal and they have been combined in this study.

Varzea Fisheries

Major Fisheries

Ituqui fishers are involved in two major fisheries, river channels and floodplain lakes, which are composed of overlapping groups of species. In the Ituqui region, the river fishery is associated primarily with migratory catfish, and the lake fishery with a variety of species of which the cichlids and characins are the most important. Fishing in the river concentrates on the exploitation of migrating schools of catfish and begins as water levels start to fall in June, reaches a peak in August and September and drops off rapidly in October and November (Barthem et al. 1991). This fishery supplies a handful of processing plants which export frozen catfish to other parts of Brazil and the exterior. Since the local population consumes very little catfish, these species tend to be of little significance for either subsistence or local consumer markets. A second river fishery, equally seasonal, includes various species of migratory characins which spend the flood season in *varzea* lakes and undertake seasonal spawning and dispersal migrations over the course of the year (Goulding 1980; Ribeiro and Petere 1990).

While the river fishery is oriented towards the export market, the lake fishery tends to be oriented towards local subsistence needs and regional consumer markets. Although the productivity of the lake fishery also exhibits a strong seasonal pattern, fishing activity in the lake is fairly constant throughout the year reflecting both availability as well as the lake fishery's importance for local consumption. The data presented here include activity in both river and lake fisheries. However, the emphasis is on the lake fishery since it is this fishery which is the focus of local community management efforts.

Fishing Activity

The Ituqui fishery is a typical, traditional artisanal fishery in that it is small scale, involving part-time fishers using simple fishing gear and unspecialized fishing vessels (Smith 1979). Virtually all fishing activity is carried out in dugout and plank canoes 3-6 m in length, powered by paddles and, when the wind permits, by sails. The smaller dugout canoes are used in the lake fishery while the larger plank canoes, frequently with a simple removable mast and sail, are used in the river fishery where conditions are rougher. Fishers, working either singly or in pairs, undertake daily fishing trips from their homes. Most fishers store their catch in styrofoam ice chests with a capacity of 50-70 kg of fish. They either transport their catch to market on a weekly basis, or sell it to local fish buyers with motorized boats and a larger storage capacity.

FISHING GEAR

The Amazon fisheries are typically multi-gear (Smith 1981; Cerdeira et al. 1997). Some ten different types of fishing gear are utilized on a regular basis in the Ituqui fisheries, of which three account for 90% of the total catch (Table 2)[3]. The most frequently used fishing gear is the gillnet which accounts for 51% of the total. Three main types of gillnets are employed. The *bubuia*, a heavy, drifting gillnet, is used to catch migrating catfish in the river channel. Two groups of fixed gillnets are used. The *malhadeira*, made of multifilament line of varying weight, is used in various ways within the lake system depending on the species and habitat. The *miqueira* is made of nylon monofilament line and is used in open water and more frequently where visibility is better. In addition to the gillnets, a variety of traditional fishing gear is employed in local fisheries. The cast net or *tarrafa* is the second most important gear type, accounting for 31%

[3] See Smith (1981) for excellent descriptions of fishing gear and their use in a similar ecological and social setting upstream from Santarém, in a region with fewer gear restrictions.

of the annual catch, followed by the fishing pole (*caniço*) with baited hook, which accounts for an additional 9%. A second group of traditional gear types includes the harpoon, used to catch the large, air breathing pirarucu (*Arapaima gigas*), and the longline (*espinhel*), used primarily for large catfish in the river channel. Finally, the bow and arrow and trident continue to play minor but seasonally significant roles in local fisheries.

The large variety of gear types reflects the selectivity of fishing strategies, and enables *varzea* fishers to exploit individual species in the wide range of micro-environments available over the course of the year. One important characteristic of these strategies is the tendency to employ two or more gear types on a single fishing trip, e.g., combining gillnets with the cast net in the low water season and with the fishing pole in the flood season. The mix of gear types also reflects the degree of orientation towards subsistence and commercial fishing. For example, in communities such as São José, where fishers are more commercially oriented, gillnets account for 78% of the annual catch, while in the subsistence oriented community of São Benedito, gillnets are considerably less important. Here, traditional gear types such as the cast net, fishing pole and harpoon account for almost two-thirds of the annual catch (Table 2).

Frequency and Duration of Fishing Trips

In general, fishing trips tend to be of fairly short duration, rarely exceeding twenty-four hours, reflecting the fact that most fishing activity is conducted within a relatively short distance of the fisher's home. For the sample as a whole, fishing trips averaged just under 7 hours (Table 3). However, within the sample the duration of fishing trips varies considerably, with communities such as São Benedito undertaking trips that are only half as long as those of fishers in the neighboring community of São José. The monthly frequency of fishing trips varies between 8 and 22, for an overall average of 17 per month, or four per week. This relatively high frequency of fishing trips reflects the importance of fishing in the household economy, especially when one takes into account the fact that the number of days spent fishing only partially reflects the time invested in the activity, since time spent repairing equipment or collecting bait is not included (Cerdeira et al. 1997).

There are clear differences between communities in the frequency and duration of fishing trips which are typical of the differing strategies of subsistence and commercial fishers (Table 3). The subsistence fishers of São Benedito, for example, take a larger number of shorter trips with the goal of maintaining a steady supply of fresh fish for family consumption, while the commercially oriented fishers with ice chests, such as those of São José, stay twice as long and catch as many fish as they can store with available storage capacity. These patterns are consistent with those observed by other researchers (Smith 1981; Merona 1990; Cerdeira et al. 1997).

FISHING LOCATIONS

Although fishers occasionally undertake fishing trips to other regions, virtually all the fishing trips recorded in this study took place within the Ituqui region, which includes the Ituqui lake systems, the adjacent Maicá lake system, the Amazon river and the side channel which forms Ituqui island (Fig. 1). Within the region, most fishing effort was concentrated in the Ituqui lake system which accounted for approximately 77% of the total catch. The Amazon river and the Maicá lake system accounted for 17% and 6%, respectively, of the total. Within the

Table 2. Catch per type of gear.

	Community				
Gear type	ARA	SBO	SJE	SAN	Total
Gillnet	38	34	78	45	51
Cast net	16	21	9	49	31
Fishing pole	22	28	2	4	9
Harpoon	6	10	2	2	3
Long line	4	5	8	0	3
Bow & arrow	11	0	0	0	2
Trident	3	0	0	0	1
Fixed hook & line	0	0	1	0	0
Fishing corral	0	1	0	0	0
Hand line	1	0	0	0	0
Total	100	100	100	100	100

Table 3. Fishing strategies: subsistence vs. commercial.

Community	Hrs/trip	Trips/mth	Catch/tp (kg)	Catch/mth (kg)	Catch/yr (kg)	Consum/yr (kg)	Sale/yr (kg)
Ituqui (average)	6.8	17	15	244	2 927	632	2 295
SBO (Sub)	4.2	20	7	139	1 669	632	1 037
SJE (Com)	8.6	18	18	295	3 542	632	2 910

Ituqui lake system some 110 fishing sites were visited by fishers, suggesting that fishers are spreading their effort fairly widely throughout the system over the course of the year. However, about 10 sites account for about 30% of the total catch. When the data on fishing sites are classified by community, a distinct territorial pattern of fishing activity emerges with fishers of each community tending to fish in the lakes and channels nearest their community. Moreover, within each community territory a small proportion of sites received the major share of the overall fishing pressure. For example, in the community of Aracampina, 10 of the 51 sites visited over the course of the year accounted for 60% of the total. Once again, the subsistence and commercially oriented communities have different spatial patterns of fishing activity, with fishers from São José exploiting almost twice as many fishing sites as those from São Benedito.

CATCH

Catch per fishing trip is highly variable, ranging from zero to over 150 kg, with an average of 13.5 kg. This average, however, tends to overestimate the scale of fishing activity. While there is great variability in catch size, almost one-third of all fishing trips result in catches between 0 and 5 kg, and 50% between 0 and 10 kg (Fig. 3). In fact, the median daily catch for fishers is only 6.5 kg. As in other aspects of the fishery, there are striking differences between communities. In the more commercially oriented communities of Santana and São José, modal catch is between 5 and 10 kg and almost 40% of catches are over 20 kg. Furthermore, variability in catch size is greater, with a higher frequency of both catches in which no fish are caught as well as of catches over 50 kg. Conversely, in the more subsistence oriented communities of Aracampina and São Benedito the modal catch is between 0 and 5 kg, with only a small fraction of the total over 20 kg. Variability is also lower with a lower frequency of trips with no catch and of trips with a catch over 50 kg.

Average monthly catch for Ituqui fishers is 244 kg for an annual total of 2 927 kg (Table 3). This total is about midway in the range of 2.1-5.1 t per year estimated by Cerdeira et al. (1997) for a nearby location using a similar sampling methodology. Of this total, about 630 kg or 20% is consumed by the households. The remaining 2 300 kg is sold or exchanged with neighbors and relatives. As in other aspects of the fishery, there is considerable variation around this mean. In the subsistence oriented communities, monthly catch is less than half that of commercially oriented communities, 139 versus 295 kg, resulting in a total annual catch per household of 1 700 kg in São Benedito and 3 500 in São José (Table 3). It should be noted that the term "subsistence" is used loosely, since even in the "subsistence" oriented community of São Benedito about two-thirds of the annual catch is either sold or exchanged with neighbors. As Cerdeira et al. (1997) also observe, the difference between subsistence and commercially oriented fishers is typically one of degree rather than type.

CATCH COMPOSITION

The annual catch of the Ituqui fishery is composed of some 40 species [4] or groups of species. However, only a small proportion of this diversity makes a significant contribution to the total catch (Saint-Paul and Bayley 1979; Bayley and Petrere 1989). For example, just four species account for 50% of the total catch and 13 species for 90%. On the other hand, almost half of the 40 species captured occur in

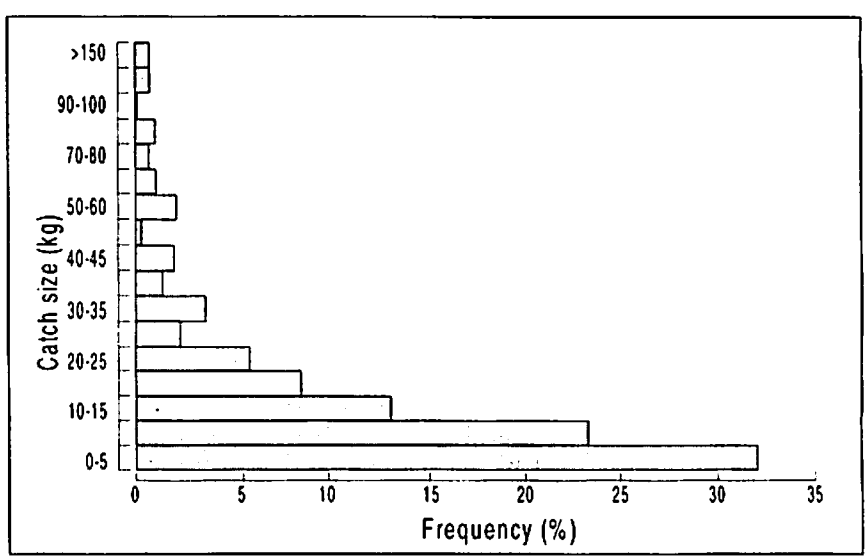

Fig. 3. Size distribution of catch per fishing trip.

[4] The total number of species is actually greater than 40 because several of the "species" listed here are actually groups of closely related species which cannot be distinguished with the sampling methodology used in this study.

negligible quantities, together accounting for only 1% of the total. The largely commercial orientation of the Ituqui fishery is revealed by the fact that catch composition, with two important exceptions, is essentially the same as that landed at Santarém.

There is a marked difference in catch composition between the lake and river fisheries. The three main species in the river fishery are large catfish which are absent from the lake fishery. Other species which are significant in the Ituqui catch occur in both lake and river fisheries, albeit in smaller quantities in the river fishery. These are lake species which spend most of their life cycle in *varzea* lakes but undertake seasonal migrations upriver to spawn[5]. The lake fishery catch, with one important exception, is composed of species which are largely sedentary, reproduce in floodplain lakes and are not significant in the catch of the river fishery. These species are among the ten most important in the lake fishery. The most important species in the lake fishery is the acari, which is an armored catfish much prized by the local population and which accounted for 30% of the total catch[6].

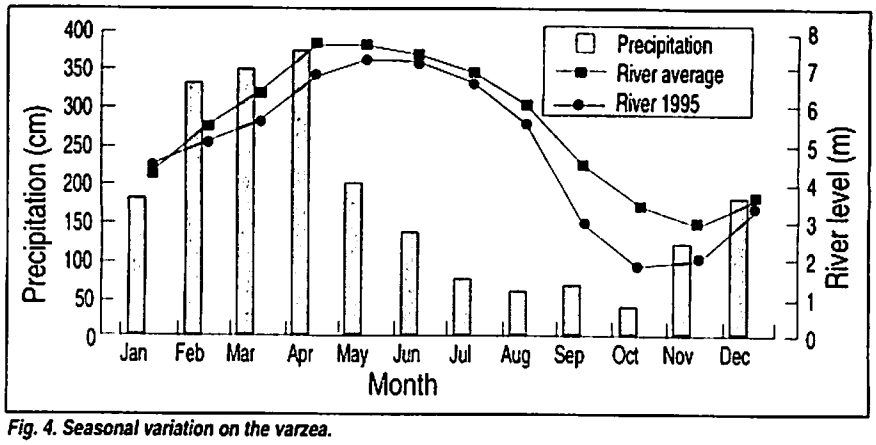

Fig. 4. Seasonal variation on the varzea.

SEASONALITY IN *VARZEA* FISHERIES

As noted earlier, there is a marked seasonality to *varzea* fisheries that is reflected in *varzeiro* fishing strategies in terms of total catch, catch composition, fishing gear and the types of environments exploited over the course of the year (Smith 1981; Merona 1990; Cerdeira et al. 1997). This seasonal variation in local fisheries is driven by the annual cycle of the river and resulting changes in the abundance and distribution of fish. Based on the annual cycle of the river, there are four distinct periods that are characterized by different patterns and intensities of fishing activity. These are: the period of falling river level between July and September; a low water period between October and December; rising water between January and March; and a period of high water from April to June (Fig. 4).

The period of falling water level, July through September, coincides with the upstream migration of several species of large catfish. During this period much of the fishing activity in riverside communities such as Aracampina concentrates on the river fishery. The drifting gillnet and long lines are used to catch catfish migrating upstream (Fig. 5). During the subsequent low water season, fishing activity shifts to the lake fishery. At this time of the year many lakes are too shallow for efficient use of gillnets, and fishers switch to cast nets. This is also the season when the pirarucu fishery is most intense as fish concentrated in the deeper lakes and channels are relatively easy to harpoon or net. During the period of rising water levels, fishers continue fishing in the lakes but use gillnets, as the dispersal of fish with

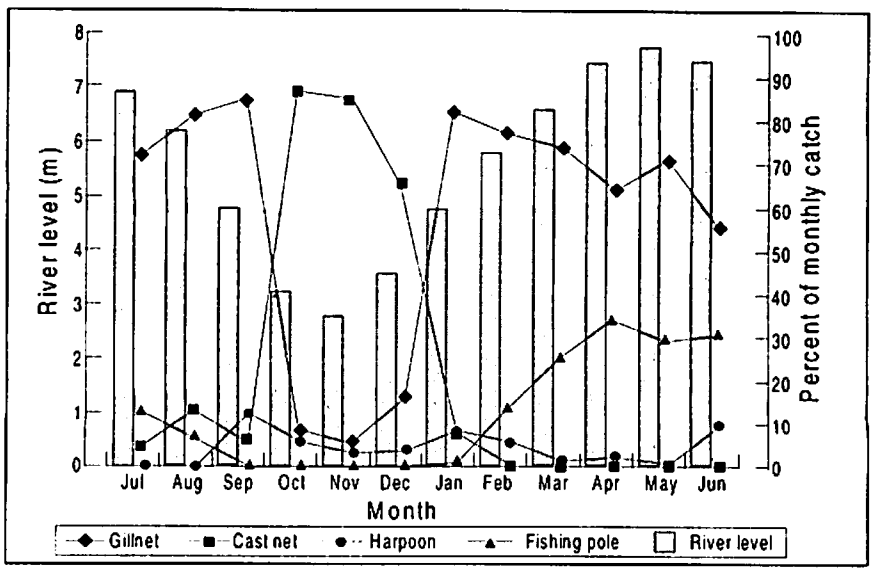

Fig. 5. Seasonal variation in use of fishing gear.

[5] A fourth group of species consists of the pescadas which occur in both fisheries,although they are more abundant in lake environments.
[6] The high proportion of acari in the 1995 catch may reflect the extreme low water conditions that occurred during the dry season.

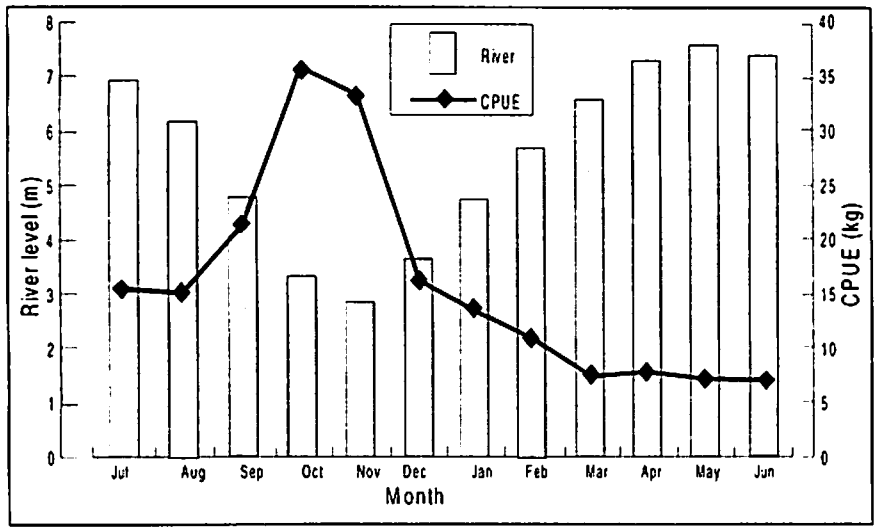

Fig. 6. Seasonal variation in CPUE (kg/fisher/day).

the increasing volume of the lake reduces the efficiency of cast nets. In the final phase, the expanding lake system enters the surrounding *varzea* forest. During this period, fishing poles can be very effective in both forest and floating meadow habitats, accounting for up to 30% of the monthly catch in some communities.

Variation in monthly catch follows a strongly seasonal pattern. Overall, total catch during the six-month "summer dry season" of falling and low water (July-December) was 2 075 kg, two and a half times the 862 kg caught during the "winter rainy season" (January-June) of rising and high water levels. The summer season is not just one of higher total catch but also of higher productivity. CPUE measured in kg per fisher per day rises steadily as water levels fall, peaking in October and November at over 30 kg per day, and falls as water levels rise, to a low of 7 kg per day at the peak of the annual flood in May and June (Fig. 6).

Overall, characterization of the summer season as a time of abundance and the winter as a time of scarcity generally holds for the Ituqui fishery. Household catch during the "winter" rainy season is not much greater than household consumption so that the winter season fishing is strongly subsistence oriented (Fig. 7). Most of the annual cash income from fishing is obtained during the "summer" months when total catch is highest. The contrast observed this year between low and high water seasons is probably greater than in most years due to the abnormally low water levels reached during the 1995-96 dry season (Fig. 4). This may have led to both higher than average rates of natural mortality and to larger than average catches leaving much fewer fish for the subsequent flood season, thereby accentuating the contrast between dry season abundance and flood season scarcity.

The higher productivity of the dry season lake and river fisheries is important to the household economy because it provides cash income at a relatively lower labor cost just when agricultural activities are most demanding of labor and cash. Agricultural income becomes important towards the end of the low water season, when the productivity of fishing is diminishing, so that the fishing and agricultural activities of the household economy complement each other over a significant portion of the annual cycle.

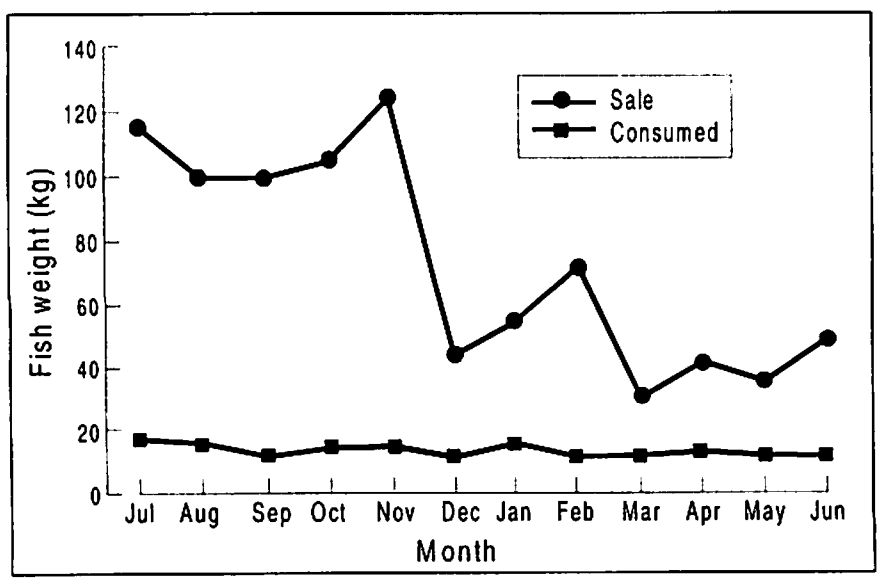

Fig. 7. Household sale and consumption of catch.

Conclusion

The data summarized here reveal a typical multi-gear, multi-specific, artisanal fishery: small scale, utilizing simple technology and involving fishers with diversified economic strategies. To a large extent, the Ituqui fishery is very similar to those described by other researchers (Smith 1981; Merona 1990; Cerdeira et al. 1997) working in different locations along the Amazon floodplain. Taking into account differences in gear restrictions (use of seines especially) and

floodplain ecology, it is surprising how little fishing activity has changed since earlier studies were undertaken (Smith 1981).

The results presented here also have important implications for fisheries management. First, virtually all fishing activity is concentrated in the region, with almost two-thirds of the annual catch being from the Ituqui lake system. Within the system, fishing is also quite localized, with most fishers exploiting lakes within a short distance of their communities. The localized pattern of fishing activity, in which fishers concentrate their effort in distinct though overlapping portions of the lake system, is consistent with a community management model in which fishers assume responsibility for regulating local fishing activity (McGrath et al. 1997). Fishers appear to identify strongly with a distinct territory which is used almost exclusively by members of their own community. A second characteristic of the fishery is that despite the relatively large number of species captured, a small number accounts for most of the annual catch. Thus, while overall fishing pressure may not yet be excessive, pressure on the most sought after species is high, and in several cases may well exceed sustainable levels. Finally, there are important differences between communities in their degree of orientation towards commercial and subsistence fishing. These differing interests with regard to market and household consumption, both within and between communities, can be a major obstacle in community efforts to manage local fisheries. Thus, while the overall pattern of *ribeirinho* fishing appears consistent with a community management model, a number of important issues must be addressed if communities are to manage local fisheries sustainably.

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