ARTISANAL COMMERCIAL FISHERIES AT THE SOUTHERN COAST OF SÃO PAULO STATE, BRAZIL: ECOLOGICAL, SOCIAL AND ECONOMIC STRUCTURES

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SUMMARY

Fishery problems and their management alternatives go beyond the simple scope of fish stock analysis, encompassing the socio-economic and behavioral characteristics of fishermen. A case study is presented in which a fish-oriented community on the São Paulo coast, SE Brazil, is being displaced by southern shrimp trawlers. The two local fishing systems, gillnet and shrimp trawl fisheries, are described, focusing on their current socio-economic characteristics. Local fishermen (n= 51) have a high average monthly income compared to other Brazilian fishermen (USD442 ±265), explained by the fact that they usually have secondary jobs. The fisheries are not as diverse now as tropical fisheries were formerly, as they target only 17 species (Shannon H'= 2.31), two of which are shrimp species. Families are the main units of production for trawlers, but gillnetters work on their own. Shrimp-processing plants dominate the local economy. Trawlers (49%), who were originally from the southern region of Brazil, explain their northward migration as being a consequence of an earlier shrimp failure in their place of origin. Management measures are necessary in order to prevent negative environmental and social consequences brought about by another shrimp failure.

Global overfishing is not a recent concern. Since the 1970's, fishery scientists and various institutions, such as the UN Food and Agriculture Organization, have been alerting the world about current and future problems related to the decline of important fish stocks (Myers *et al*., 1997; Pauly *et al*., 2002). This is relevant for South America, where fisheries play an important role in economies and food security. Fishery production in the region has increased steadily from 1950 onwards (FAO, 2002) but with an important failure during the 1970s due to the collapse of the Peruvian anchoveta (*Engraulis ringens*) population (Klyashtorin, 2001). Marine fish contribute 40-60% (Diegues, 1999) of the fisheries production of Brazil, where they employ >390000 fishermen (SEAP, 2007) who usually inhabit small and poor communities. A failure of this fishing system would result in drastic consequences for thousands of families whose subsistence and small-scale economies are completely dependent upon aquatic resources.

On the São Paulo coast, fishing is practiced at different scales, from the subsistence to the industrial level. Many studies have examined the role of "caiçara" fishing, which refers to communities originating from the blending of indigenous and Portuguese populations along the Brazilian Atlantic Coast, especially in the Southeast (Begossi, 1995; Nehrer and Begossi, 2000; Ramires and Barrela, 2003). The economy of these communities has been historically based on artisanal fisheries and, during periods of economic stagnation, on slash-and-burn cassava cultivation (Adams, 2000). These communities are usually technologically limited, using paddled or motorized canoes or aluminum boats, which restrict how far into the sea fishermen can go (Begossi, 2006a). As a consequence of the exploitation of near-shore fishing spots, communities in different places along the Brazilian coast have evolved an informal marine tenure system that has been stable until recent decades (Begossi, 2001). Some form of control of access to the area is required to assure resource conservation (Begossi, 2006a).

Currently, two tendencies in relation to Brazilian small-scale fisheries are apparent. In some communities, fisheries are being reduced to a subsistence level, being displaced by real estate development and tourism (Diegues, 2006; MacCord and Begossi, 2006). In others, they are becom-

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ing more commercial (Masumoto, 2004), increasing pressure on local resources, usually without any scientific or management support (Lopes, 2008).

Both social and economic organizations of fishermen can influence the way they exploit the local resources (Camargo and Petrere, 2001). Management decisions should consider the complex network of interactions among physical, biological and social factors (Pomeroy, 1995). Fishery management is not yet commonplace in Brazil, especially initiatives in which users have the right to suggest measures. Even when such co-management arrangements take place, challenges like insufficient knowledge of the economic system and incongruence at different institutional scales may cause such initiatives to fail (Kalikoski *et al*., in press). Thus, good knowledge of the fishery system is required. However, sufficient knowledge of the dynamics of tropical fisheries is difficult to obtain, given the complex nature and multi-species/multi-method aspects of fisheries. Johannes (1998) advocates a data-less management approach, where information comes from similar systems and from fishermen. Special attention should be given to systems where the environmental impacts of present fishing methods are known to be significant, e.g., bottom trawling (Jones, 1992).

In this study, the current socio-economic characteristics of a coastal fishing community in São Paulo State (Perequê) is examined, including its two main fishing groups, shrimp trawlers and gillnet fishermen. Two goals are: to build a profile of the ecological and socio-economic aspects of Perequê's trawl and gillnet fisheries, and to undertake a preliminary assessment of the dynamics of these fisheries. Greater understanding of such fisheries is crucial to any future management proposals, as similar management measures are not expected to work similarly for both fishing systems. By characterizing the local fisheries and fishing practices, we intend to offer a preliminary but broad support for locally based management alternatives, as the study addresses tropical fisheries for which knowledge is scarce and alternatives for sustainable exploitation are needed.

Materials and Methods

Area of study

Perequê Beach lies north of the Santo Amaro Island (Guarujá municipality) (23°59'S/46°15'W; Figure 1), in the Atlantic Forest Domain. According to an estimate by the Fishermen's Organization, ~8000 people live in this neighborhood. The beach is in a bay sheltered by some small islands. Up to 200 boats, especially bottom otter trawlers, can be anchored close to the beach.

The first "caiçaras" to live in this area built their houses on the beach sand, close to small streams and rivers. Different cultural groups participated in the subsequent land occupation process, mainly fishermen coming from the southern Brazilian states, where blending with indigenous groups was not so common. The families that arrived first during the migration process occupied the remaining land, limited by the mangrove zone and the mountains. People who arrived during the 1990s built wooden houses in the mangrove zone, supported by sticks that keep the houses above the water level. These people included both southern fishermen and northeasterners, who came to the richer southeast looking for jobs and better living conditions. Such demographic growth was not followed by investments in infrastructure. The mangrove dwellers do not have sewage treatment; sewage is discharged into the mangroves or into streams. Despite such conditions, many mangrove dwellers say that they prefer to live there rather than on land, since they can leave their canoes in front of their houses, making it easier to go fishing. Because of these conditions, poor hygiene and other health and social problems, such as violence and drug trafficking, are a concern for both tourists and local residents.

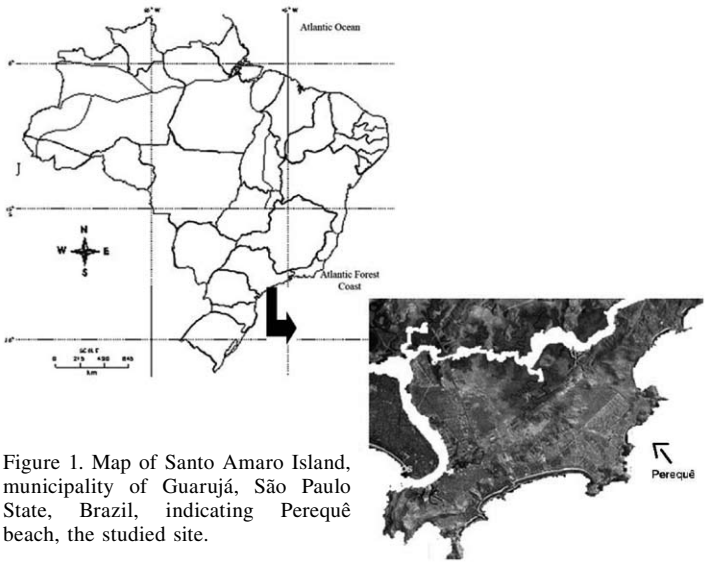

Figure 1. Map of Santo Amaro Island, municipality of Guarujá, São Paulo State, Brazil, indicating Perequê beach, the studied site.

Methodology and data analysis

In May and June 2004, all fishermen older than 20 years who had lived in Perequê for more than ten years and who depended on fishing as their primary economic activity were interviewed. A semi-structured questionnaire was used, containing questions about their socio-economic characteristics (age, birth place, schooling and family structure) and about fishing (equipment used, main species caught and their last fishing trip). Fishermen who use bottom otter trawl nets to catch fish will be referred to hereafter as trawlers, and those who use gillnets to catch fish will be referred to as gillnetters.

A reverse stepwise multiple regression analysis was used to identify the variables that best explain the fishermen's average income (R), measured in Brazilian currency, the Real (USD1.00= R$3.10 in May 2004). The independent variables of the regression model are A: other activities besides fishing (yes/no), categorical variable; H: motor power (hp), numerical variable; C: boat length (m), numerical variable; M: does another fisherman help on the boat? (yes/no), categorical variable; T: experience as a fisherman (years), numeric variable; and K: amount captured in the last fishing trip (kg), numeric variable. This leaves the initial model as

$$R = u + A + H + C + M + T + K + H \times M$$

where u: equation intercept, and H×M: interaction between length of the boat and power of the motor. The interaction term was initially used to determine whether boat length and motor power jointly influence fishermen's income.

In a preliminary model, whether being a trawler or a gillnetter influences the result (type of fishermen as a categorical variable) was also tested. If so, both groups could not be considered in the same regression model, and specific variables for each group, such as net size for gillnetters, would need to be considered. However, the result was not different between types of fishermen ($t = -0.5449$; $p = 0.59$).

Part of the data was grouped into social and fishery fleet datasets and subjected to two discriminant function analyses, followed by a canonical analysis. The purpose of these analyses was to show whether trawlers and gillnetters have enough distinct social aspects or fleet characteristics to be considered as different groups. The variables included in the social analysis were age, having a secondary job, experi-

ence as a fisherman in years, literacy (measured as school years), state of origin, marriage, and average income. Having another job and being married are binary categorical variables, meaning that only yes or no answers were allowed in the model. Fleet analysis included boat length and engine power (numerical variables), and whether the boat was owned by the fisherman (binary variable).

Results

The existence of two groups of fishermen in Perequê was clear from the first interviews: trawlers specialize in shrimp, and gillnetters specialize in fish and, occasionally, white shrimp. Fifty one fishermen were interviewed, corresponding to 25% of the local fishermen, estimated by the Fishermen's Organization to include 200 people. Bottom otter trawling (towed by a single boat) is practiced by 73% of the interviewees, while gillnets (mainly set gillnets but also driftnets) are used by 23% of them.

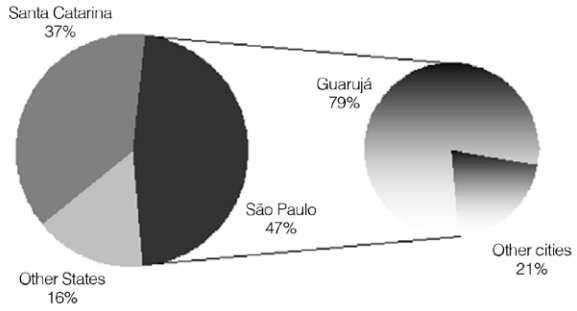

Figure 2. Region of origin of the interviewed fishermen (n= 51).

Among the interviewees, approximately half (n=23) were born in Perequê or a nearby coastal community and are characterized as "caiçara", while the other half (n=21) came from southern Brazilian states. Most *caiçara* fishermen are gillnetters (68%), while people who came from southern Brazil are trawlers (95%), the type of fishing commonly practiced in their region of origin. However, some *caiçara* gillnetters (23%) have all the equipment needed to trawl and claim to switch to this activity when gillnet fishery is not profitable, while 11% of trawlers say that they use hand lines sporadically. Instead of switching to a different method, trawlers use bigger mesh size nets if they think there is some chance of catching the highly valued white shrimp (*Penaeus schimitti*).

Socio-economic characterization of Perequê artisanal fisheries

The 51 fishermen interviewed range in age from 23 to 61 years old (average= 41 ±11), skewed toward older ages. Most of them (24) were born in São Paulo State (Figure 2). The average time of residence in the region for those who were not born in Guarujá is 22 years (±11.3). About half (51%) of these migrants came to Guarujá searching for better work conditions, especially due to the shrimp failure in the south (49%), or came with their parents (30%), who were looking for better conditions. Perequê's fishermen have been fishing for a long time (25.78 ±12.45 years), even considering only the time fishing in the study area (20.26 ±12.04 years).

The monthly income of the fishermen is difficult to estimate due to its high variability. Some fishermen receive unemployment benefits paid by the government (R$260.00 or USD84 in May 2004) during the closed season for shrimp, but others do not. Most fishermen also work as recreational fishermen on the weekends, renting their boats and taking tourists to the best fishing spots (USD 48-65 per day). Considering all of these additional activities, the average income is roughly estimated to be USD442 or R$1370 per month (SD= ±265.00USD; Range: 32.50-1451.60USD), a high value by Brazilian standards, even when compared to the average income of São Paulo State, the highest income state in the country, of USD294.35 (IBGE, 2004). Trawlers have a slightly greater average income (USD464.19) than gillnetters (USD360.64), but this difference is not significant (Mann-Whitney U= 197.5; p=0.19). The regression model shows that 22% of their income is explained by having complementary jobs and by boat length (R= 770.81 +296.96A +64.38C; r^2= 0.22, p<0.01, g.l.= 50), showing the importance of diversifying (getting a second job) and intensifying (having a bigger boat) their economic activities.

The majority (72%) of the families count on the income of some other member, which represents about 29% of a family's income on average (127.10 ±83.87USD). The wife usually provides this contribution by working either in shrimp-processing plants or in fish stores. The older sons of fishermen usually work in the local seafood restaurants, suggesting an economy totally based on fisheries. About 33% of the fishermen also count on the direct support of their sons, who sporadically fish with them to learn the trade and to help during the shrimp season. Daughters and wives clean the shrimp at home if the fishermen believe they can sell their product for higher prices than those of the shrimp-processing plants or fish stores.

The two groups of fishermen represent distinct social groups. The discriminant analysis separated them by features including age (gillnetters are older), the practice of another activity besides fishing (trawlers usually work on the weekends for recreational fishermen) and experience as a fisherman (trawlers have less experience). Literacy, marriage, average income and, surprisingly, state of origin were not included in the best-fit model. Even though the two groups show significant differences for these factors, the model shows that there is some overlap (Figure 3), resulting in a high Wilk's λ, with a low overall discriminant power (λ= 0.712; F(3.47)= 6.33; p=0.0011; eingenvalue= 0.404).

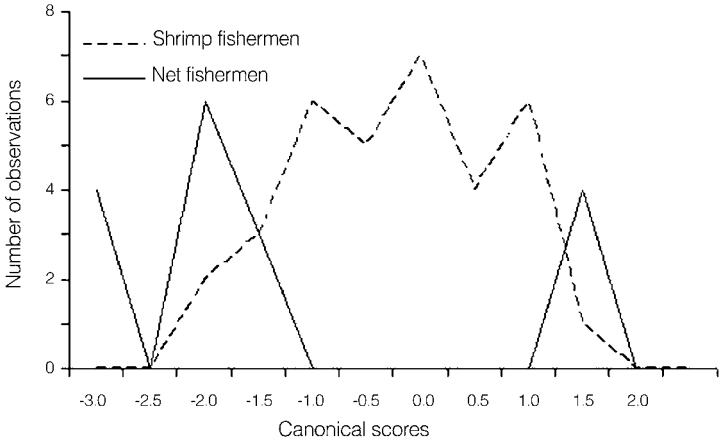

Figure 3. Canonical scores distribution for trawlers and gilnetters' social data. The more the canonical scores overlap, the more similar the groups are ($n_{trawlers}$= 37; $n_{gillnetters}$= 14).

Fleet characterization and resource extraction

Almost all fishermen (82%) have their own boats, which are usually small (average size of 8.8m; Figure 4). There is no difference in the size of the boats used by trawlers and gillnetters (t= 1.75; p>0.05). Motors range is 10-90hp, with the majority (64%) being 18-22hp (average of 25hp). Shrimp boats usually have more powerful engines (Mann-Whitney= 95.5; p<0.05), because they are used constantly when trawling. The size of the boat is correlated with its engine power, regardless of whether it is used for fish or shrimp fishing (r_s= 0.75; p<0.0001).

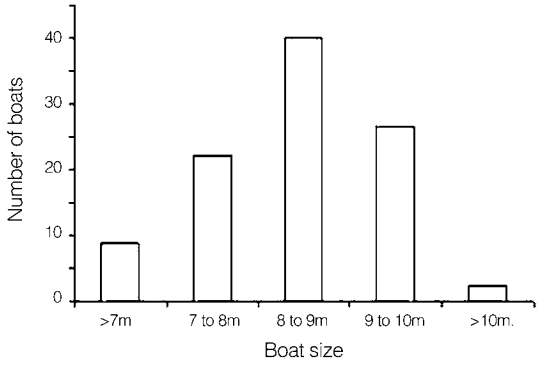

Figure 4. Frequency distribution of boat sizes used in the net and shrimp fishery (n= 44 boats). Three fishermen had two boats each, while the remaining had just one.

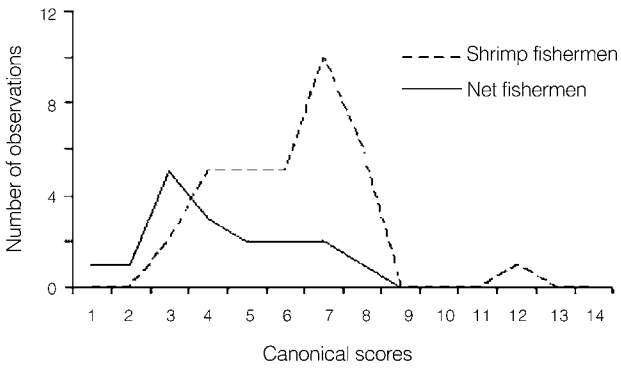

Figure 5. Canonical scores distribution for trawlers and gillnetters' fleet data. The more the canonical scores overlap, the more similar the groups are ($n_{trawlers}$= 37; $n_{gillnetters}$= 14).

The discriminant analysis of fleet data did not clearly separate trawlers and gillnetters, suggesting that both groups share many fleet features. The model is significant only because of a social variable: whether the fisherman owns his boat (Wilk's λ= 0.84; F(1.48)= 4.53; p= 0.016; eingenvalue= 0.404; Figure 5). Gillnetters always own their boats, while trawlers sometimes work for boat owners.

Some interviewees were either not working during the study period (12%) or were working for other fishermen (20%) in a profit/expense-sharing arrangement. Shrimp-processing plants may also own boats. Among the fishermen who have their own boats, 33% have helpers (one per boat), who are mainly relatives other than wives and sons (71%), included in the profit/expense-sharing deal. A gillnetter, regardless of his return, always needs someone to help him due to the size of the nets used.

Local fishermen target relatively few species (n= 17), even when considering the diversity caught by both groups of fishermen (Shannon H'= 2.26; evenness= 0.80). However, both groups of fishermen may bring in a more diversified catch due to bycatch or low selectivity of fishing methods, or because different species can be grouped under the same name (e.g., shark). This more diversified product eventually enters the market chain. Species that were cited by more than five fishermen as their main target are listed in Table I, with their main fishing season and the gear used in their capture.

Initial estimates based on the catch taken in each fisherman's last fishing trip suggest a high and very variable average return of fish and shrimp (shrimp= 110 ±126kg; fish= 80 ±106kg). Such a high return can be attributed to sea bob shrimp (*Xyphopenaeus kroyeri*), mackerel (*Scomberomorus brasiliensis*) and mullet (*Mugil platanus*), which are also the most unpredictable fishing resources and have the largest standard deviations (Figure 6). The diversity index calculated for the fish and shrimp caught in the last fishing trip of each fisherman is low for both groups of fishermen (Shannon H'_{shrimp}= 1.53; evenness= 0.67; Shannon H'_{fish}= 2.26; evenness= 0.91; Table I).

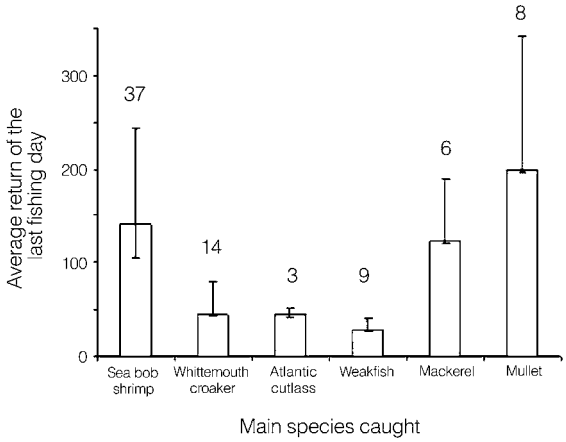

Figure 6. Average return (kg) of the fishermen's last fishing trip before the interview, considering just the main species caught (n= 51 interviewees). Numbers above the bars correspond to the number of interviewees who cited each species.

Most fishing trips take place close to the Perequê beach, in the region that includes the municipality of Guarujá and a nearby town to the north, Bertioga. Trawlers fish in the Bertioga region a few times a year, when, according to 84% of them, they follow the shrimp migration. In these rare more distant trips, fishermen continue fishing for a week before returning home. Gillnetters perform most of their fishing trips outside Perequê Beach; even when fishing along closer beaches, they prefer to stay anchored there and to sell the fish where they are located in order to save money that would otherwise be spent on fuel. Gillnetters who take one-day fishing trips say that they sell their product to the fish stores in Guarujá

TABLE I
MAIN TARGETED SPECIES, FISHING GEAR AND MAIN FISHING SEASON, ACCORDING TO FISHERMEN'S CITATION

Family	N	Scientific name	Local name	Gear used	High fishing season
Peneaidae (Shrimps)	37	*Xyphopenaeus kroyeri*	Sete-barbas	Trawl (100%)	Winter
	37	*Penaeus schimitti*	Camarão branco	Trawl (100%)	May-Jul (winter) (41%)
Carcharhinidae and Shyrnidae	14	*Carcharhinus* spp.; *Sphyrna* spp.	Cação	Gillnet (100%)	Summer and winter (29%)
Mugilidae	14	*Mugil* platanus.	Tainha	Gillnet (100%)	Winter (58%)
Sciaenidae	51	*Micropogonias furnieri*	Corvina	Hook and line (22%)	May-Jul (winter) (22%)
	14	*Cynoscion* spp.	Pescada	Gillnet (100%)	Summer (36%)
Scombridae	14	*Scomberomorus brasiliensis*	Sororoca	Gillnet (100%)	Winter (43%)
Trichiuridae	51	*Trichiurus lepturus*	Espada	Gillnet, and hook and line (9.8%)	Year-round (4%)

Only species that were cited at least five times were included in the table. Number next to each citation represents the percentage of fishermen who mentioned each piece of information in relation to the total of interviewees (N).

(37.5%) or to restaurants and beach kiosks (62.5%) or sell it from home (19%), when the quantity is small.

Shrimp is mainly sold (86%) to the shrimp-processing plants. Trawlers who have their own boats can switch buyers based on opportunity costs, looking for better deals. However, trawlers claim to be loyal to their buyers, sporadically accepting better offers that might be made by customers or by commercial buyers when the fishermen arrive on the beach. With the exception of fishermen who work for a boat owner, all of the fishermen claim to sell white shrimp with no middleman. This species of shrimp is caught in smaller amounts and commands higher prices, so it is more advantageous to sell it to individual customers or to restaurants (R$12.00-30.00 per kilogram in 2004, at local markets).

Discussion

Fisheries practiced in this region of the São Paulo coast are differentiated from some others practiced by small Brazilian coastal communities, which are usually marked by local populations with long histories and old land ties. This can be seen in the higher income level (about five times the minimum wage) in comparison with other fishing communities, where this value varies from 165 to 282USD (2-3.4 times the minimum wage in May 2004; Hanazaki, 1997). However, typical fishing communities in Brazil usually gather and harvest other resources in their environment, contributing to a decrease in the family expenses, while the inhabitants of Perequê harvest all their animal protein from the sea. Their better wages are due to the relatively high shrimp production and to the opportunity to work as recreational fishermen during weekends. The attractive income, compared with other coastal communities, help explain why people still move to the area.

Brazilian coastal fishing communities are usually small and composed of related families who inhabit the same place for many generations and who use more rudimentary fishing methods, resulting in small-scale fisheries (Begossi, 1995; Hanazaki and Begossi, 2000; Mendonça *et al*., 2000; Ramires and Barrela, 2003). This makes Perequê fishermen more similar to urban fishermen, as those that can still be found in Rio de Janeiro (Nehrer and Begossi, 2000). The influx of fishermen to the area has certainly shaped the community profile and probably contributes to the observed lack of community cohesion. There is no consistent political organization. Fishermen's cooperative organizations are usually able to make more equitable decisions and to enforce more reasonable regulations than governments (Jentoft, 1989), but fishermen in Perequê apparently see the local association distrustfully, as was appreciated in informal conversations with fishermen.

In some western African countries, migration of fishermen occurs across national borders (Diaw and Haakonsen, 1992). In these places, there have been some attempts to recognize that fishermen do not always follow political boundaries. This can result in positive consequences, such as the production and supply of animal protein and the creation of employment and technological progress, but also in negative outcomes, such as conflicts and political prejudice, when such fishermen are subjected to different laws because they are foreigners (Diaw and Haakonsen, 1992). In a case study about Ghanaian canoe fisheries, it has been shown that migration is not only a consequence of local overfishing, but also a result of economic (e.g., cost of living) and political (e.g., fuel subsidies) circumstances (Overa, 2000). Even though intercountry migration is not the same as migration between the states of a single country, these phenomena are comparable, because Brazil shows large social and cultural differences between its regions.

Kinship ties are apparently important to the socio-economic structure of Perequê. Families are the basic units of production, and they are totally dependent on shrimp in the case of shrimp trawlers. In gillnetters' families, by contrast, the sons also work as fishermen's helpers but the wives are usually housewives, although they were responsible for cultivating cassava and other subsistence crops in the past (Marcílio, 1986).

Processes observed in the study area, such as diversification through greater economic flexibility (e.g., having a second job) may be a robust response to external changes, such as those brought about by migration and by technological changes in fisheries (McCay, 1978; Begossi, 2006b). By adapting to new situations, these communities can partially retain the cultural and social characteristics that define them. On the other hand, some fishermen prefer to try to catch more fish (intensification) by obtaining bigger boats, which may reduce the resilience of the system by focusing solely on one economic activity. Intensification can also be observed in some northern coastal communities in São Paulo (e.g., Picinguaba and Ubatuba), where fishermen now target specific species (Masumoto, 2004). This results in a low diversity index compared to the subsistence fisheries observed in 'caiçara' communities elsewhere (Hanazaki and Begossi, 2000; Ramires and Barrela, 2003). In other countries, such as Bangladesh, Brunei Darussalam, Indonesia, Malaysia, Thailand, Sri Lanka, Vietnam and the Philippines, "artisanal" fisheries use a diversified technology aimed at multiple species, which does not necessarily imply sustainable exploitation (Silvestre and Pauly, 1997). In Perequê, fishermen who diversify their economic activities are usually not the same individuals that use more efficient fishing methods. Thus, two different strategies are used in the area. The first strategy apparently is sustainable and resilient, while the second does not seem to be sustainable in the long run.

Management Implications

The high dependence of the studied community on shrimp makes it necessary to adopt management strategies, considering that shrimp stocks are extensively overexploited elsewhere in Brazil and in the area of this study, the southeastern Brazilian coast (D'Incao *et al.,* 2002; Leite and Petrere, 2006). Fishermen report and we also observed that new fishermen are still settling in the area, usually invited by their relatives who fish there. This is probably due to the lack of clear signs of declining stocks, since productivity remains high based on the returns from the most recent fishing trips. However, the fishermen claim that productivity has decreased over time. This is likely to happen due to an increase in overall effort, unnoticed by the community as a whole but perceived by individuals.

The failure to adopt management alternatives that protect the fisheries and, consequently, the fishermen, may result not only in overfishing but also in the collapse of this community. This is probably true for many other similar communities in Brazil and elsewhere, whose economy is based solely on one product, as is the case in coastal and estuarine environments (bonga *Ethmalosa fimbriata*) and in the freshwater sector of Nigeria (catfish *Chrysichtys nigrodigitatus*) (Moses *et al*., 2002). Gómez *et al*. (2006) have analyzed the causes for the decline of artisanal fisheries in the northwestern Mediterranean, taking into account the same socio-economic factors considered here. The authors report that trawling increases in importance with the decline of other artisanal fishing methods. Unfortunately, they also show that after a certain point, even the establishment of marine protected areas does not assure the reversal of poor artisanal fishing conditions through the recovery of stocks (Gómez *et al*., 2006).

Not acting to prevent such problems may lead to another human migration cycle, as species may already be locally overexploited. The special case presented here is challenging. Former local management practices and strategies developed by "caiçaras" are not reliable, due to the influx of southern migrants with different habits.

However, as pointed out by other authors (Overa, 2000), migration can be seen as a fishermen's strategy as well, whereby they try to make the best of social, environmental and cultural conditions. Thus, migration deserves further attention and should be treated as part of the fisheries dynamics. Through this rapid assessment, two distinct groups of fishermen, gillnetters and trawlers have been identified, who cannot be subjected to the same management measures, as they have different species targets and are involved in different economic schemes. It is also important to consider the time of the year during which each species is exploited most intensively, as this might be related to biological abundance, species migration patterns and, in the case of sea bob shrimp, to the high productivity in winter, soon after the end of the closed season (between March and May in 2004). More attention should be given to the intensity of shrimp exploitation, which is apparently high in the region and is not effectively regulated in Brazil as a whole (D'Incao *et al*., 2002).

Regardless of the management measures adopted in the area, the direct participation of local fishermen is needed. Previous cases in Brazil show that top-down approaches tend not to be respected (Reis and D'Incao, 2000). On the other hand, Brazil and other Latin American countries have also produced examples of management measures proposed, discussed and applied with the support of local communities that led to satisfactory resource protection and, in some instances, to resource recovery (Castello *et al*., 2009; Castilla and Defeo, 2001). In some cases, this co-management regime has been initiated by the communities themselves, who may or may not already have local rules regulating access to the resources (Seixas *et al*., 2009). In others, the initiative has come from the government (through the Federal Environmental Agency, IBAMA) or from NGOs and research institutions (Viana *et al*., 2004).

"Fishing agreements" are the most common co-management methods adopted in the country, because they are simple. This scheme implies one new law, with rules defined by the resource users (in this case, fishermen) regulating access to the resources (McGrath *et al*., 1993). Law enforcement is, in this case, performed by the resource users themselves, which overcomes another problem of top-down approaches: the non-enforcement of the law due to lack of personnel and funding.

From this preliminary study, it is clear that the two groups of fishermen use different fishing resources in the same area without any restrictions: everyone fishes everywhere throughout the year, with the exception of the closed season for shrimp. A fishing agreement in the area, with regulations locally defined with the support of IBAMA, NGOs and universities, would turn an open access area into a common resource pool. We here suggest some points that should be taken into account in a future fishing agreement, but the details must be discussed with the local fishermen. Among these points, we suggest definition of areas for gillnetters and areas for trawlers, a minimum distance from the coast and from islands for trawling, closed seasons for important fishing resources (which may include species that do not have a closed season defined by law), minimum mesh sizes for both fishing groups, permitted fishing gear and closed areas for fish and shrimp reproduction.

Other communities in Brazil and in other tropical countries could benefit from this rapid assessment approach, which provides a non-detailed but thorough picture of fishing communities for which information is limited or non-existent. Larger data sets are more appropriate in devising management schemes, but as pointed out by Johannes (1998), a small amount of data is better than no data at all. The information gained from the socio-economic analyses carried out here can be used by governments or other interested institutions to draw up plans for management strategies following locally the characteristics and needs of local fishermen.

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PESQUERÍAS ARTESANALES COMERCIALES EN LA COSTA SUR DEL ESTADO DE SAO PAULO, BRASIL: ESTRUCTURA ECOLÓGICA, SOCIAL Y ECONÓMICA

Priscila Fabiana Macedo Lopes, Arlaine S. Francisco y Alpina Begossi

RESUMEN

Los problemas de las pesquerías y las alternativas de manejo rebasan el análisis simple de la disponibilidad de especies, abarcando las características socioeconómicas y las conductas de los pescadores. Se presenta un estudio de caso donde una comunidad orientada a la pesca de peces de la costa de SaoPaulo, SE de Brasil, está siendo desplazada por la pesca de arrastre de camarones. Se describen los dos sistemas de pesca, red y arrastre, enfocando sus características socioeconómicas actuales. Los pescadores locales (n=51) tienen un alto ingreso promedio en comparación a otros pescadores brasileros (USD 442 ±265), explicado por el hecho usual de tener trabajos secundarios. Las pesquerías no son tan diversas como lo fueron las pesquerías tropicales, ya que solo buscan 17 especies (H' de Shannon= 2,31), dos de las cuales son especies de camarones. Las familias son las unidades de producción principales para los arrastradores, mientras que los pescadores de red trabajan por su cuenta. Las plantas de procesamiento de camarones dominan la economía local. Los pescadores de red (49%), quienes provienen originalmente del sur de Brasil, explican su migración al norte como consecuencia de la falta de camarones en sus lugares de origen. Para evitar las consecuencias negativas tanto ambientales como sociales de una nueva falta de recursos camaroneros, se requiere tomar medidas para el manejo de las pesquerías.

PESCARIAS ARTESANAIS COMERCIAIS NA COSTA SUL DO ESTADO DE SÃO PAULO, BRASIL: ESTRUTURA ECOLÓGICA, SOCIAL E ECONÔMICA.

Priscila Fabiana Macedo Lopes, Arlaine S. Francisco e Alpina Begossi

RESUMO

Os problemas das pescarias e as alternativas de manejo ultrapassam a análise simples da disponibilidade de espécies, abrangendo as características socioeconômicas e as condutas dos pescadores. Apresenta-se um estudo de caso onde uma comunidade orientada à pesca de peixes da costa de São Paulo, Sudeste do Brasil, está sendo deslocada pela pesca de arrasto de camarões. Descrevem-se os dois sistemas de pesca, rede e arrasto, focando suas características socioeconômicas atuais. Os pescadores locais (n=51) têm um alto ingresso médio em comparação a outros pescadores brasileiros (USD 442 ±265), explicado pelo fato usual de ter trabalhos secundários. As pescarias não são tão diversas como foram as pescarias tropicais, já que somente buscam 17 espécies (H' de Shannon= 2,31), duas das quais são espécies de camarões. As familias são as unidades de produção principais para os arrastadores, enquanto que os pescadores de rede trabalham por sua conta. As plantas de processamento de camarões dominam a economia local. Os pescadores de rede (49%), que vem originalmente do sul do Brasil, explicam sua migração ao norte como consequência da falta de camarões em seus lugares de origem. Para evitar as consequências negativas tanto ambientais como sociais de uma nova falta de recursos camaroeiros, se requer tomar medidas para o manejo das pescarias.