Comparative Study of the Dynamics of Small-Scale Marine Fisheries in Senegal and Ghana

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Abstract

The small-scale fisheries in Senegal and Ghana are described and compared. The structure of the canoe fleets, the trends in landing and the composition of catches are analyzed. Located in upwelling areas of the eastern Atlantic, these tropical multispecies fisheries are influenced by a strong environmental signal. Variability and instability of marine resources raise the problem of interactions among the different dynamics of the environment, of fish stocks and of fishing communities. The changes observed during a decade are interpreted from the perspective of the dynamics of the exploitation. Local and global changes were assessed in terms of fishing tactics and strategies that facilitate description of the adaptability of small-scale fishers to the variability of their environment.

Résumé

Les pêcheries artisanales du Sénégal et du Ghana sont décrites et comparées. La structure des flottilles, les tendances des débarquements et la composition spécifique des captures sont analysées. Situées dans les zones d'upwelling d'Atlantique est, ces pêcheries tropicales multispécifiques, multiengins sont influencées par une forte composante environnementale. La

variabilité et l'instabilité des ressources marines soulèvent le problème de l'interaction entre les dynamiques de l'environnement, des ressources renouvelables et des sociétés de pêcheurs. Les changements observés sur une décade sont interprétés sous l'angle de la dynamique du système d'exploitation. Les changements locaux et globaux sont abordés en termes de tactique et de stratégie de pêche qui permettent de décrire l'adaptabilité et la flexibilité des pêcheurs artisans aux fluctuations de leur environnement.

INTRODUCTION

This paper presents a comparative study of the small-scale fisheries of Senegal and Ghana, from the point of view of the dynamics of exploitation. With respect to fisheries, Senegal and Ghana have at least two things in common: a coastal upwelling system and an important small-scale fishery. The small-scale fisheries of Senegal and Ghana are the largest in West Africa and are among the most important economic activities in these countries. In terms of landings, these small-scale fisheries are the most important in the West African region (Everett and Sheves, 1991) and contribute over 70% of the total catch of fish in each of the two countries. The per-capita consumption of seafood per year is similar in the two countries, being about 25 kg per year (Horemans, 1993). The small-scale fisheries of Senegal and Ghana bear a number of other resemblance, notably in the way they changed over the years.

The main objective of this study is to establish a synoptic description of the fisheries with regard to the structure of their fleet and catch compositions. The evolution of the two fisheries in the last decade is compared, to analyze the responses to changes in their environment and to distinguish global and local changes.

Data on marine small-scale fisheries have been collected through sampling for over twenty years in Senegal and Ghana. The statistics used in this study were obtained from catch assessment surveys and canoe censuses that have been undertaken simultaneously since the beginning of 1980s. The statistics were gathered and preprocessed by the Research & Utilization Branch of the Fisheries Department (FRUB) at Tema in Ghana, and by the Centre de Recherches Océanographiques de Dakar-Thiaroye (CRODT) in Senegal.

1. CHARACTERISTICS OF SMALL-SCALE FISHERIES IN SENEGAL AND GHANA

Situated respectively in the northern and central part of the eastern central Atlantic, Senegal and Ghana are two West African countries separated by thousands of kilometers (Fig. 1); yet they have similar important small-scale fisheries. These fisheries have a long history and have undergone great changes during the last thirty years, especially the introduction of outboard motors and the development of the purse seine nets (Koranteng, 1992; Kébé, 1995).

Many types of fishing gears are used by small scale fishers. In both countries, small-scale gears are classified into five groups: purse nets, drifting gill nets, set nets, hooks-and-lines and beach seines. The group named 'others' includes diverse gears, such as traps or jigs for cuttlefish in Senegal, or no gear (with canoes used only for trans-shipment of catches).

Fig. 1: Location of Senegal and Ghana in Africa.

Table 1 gives the percentage of canoes in each type of fishing gear as enumerated in the most recent census in each country. The following features may be noticed:

i.) a large proportion of nets for small pelagic fishes in Ghana;
ii.) a large proportion of canoes with line gear in Senegal;
iii.) an almost equal proportion of canoes with set nets in Ghana and Senegal;
iv.) a much smaller proportion of canoes with drifting gill net and beach seines in Senegal compared to Ghana.

In Ghana, the common fishing craft is a dugout canoe carved out of a single trunk of wood. These canoes are symmetrical in shape, double-ended and range in sizes between 3 and 18 m long and 0.5 to 1.8 m wide. About 49% of the over 8 600 Ghanaian canoes are motorized, using outboard engines of between 25 and 40 hp (Koranteng *et al.*, 1993). The level of motorization depends on the size of the canoe and on the gear operated. For example the canoes operating purse nets are usually large and almost all of them are motorized. The engine is put on the side (normally on the right), at the rear of the canoe.

Senegalese canoes are almost completely planked except for the area close to the 'keel' which is carved out of a small log. The evolution of the canoe was dictated by geographic constraints, especially by the presence of a strong surf along the northern coast (Chauveau, 1984). The outboard engine is mounted at the rear or at the stern of the canoe through an incision made to the hull. About 90% of the 5 600 canoes used for marine fishing in Senegal are motorized (Kébé, 1995; Samba, 1995). The canoes operating pursing gears and long-range line with insulated ice boxes have outboard engines from 25 to 40 hp; canoes with line, set net or beach seine generally use outboard motors of 8 up to 15 hp (Ferraris, 1993).

In Senegal, the total number of canoes recorded for each gear is usually larger than the total number of operational canoes. This is because one fishing unit may have several gears and undertake different fishing activities depending upon the target

Feature	Ghana	Senegal
Length of the coastline	550 km	700 km
Number of fishing villages (N)	189 including 306 landing beaches	155 including 96 villages with marine canoes
Number of fishers	96,400	≈ 35,000
Number of marine canoes ($Q = \Sigma q_i$, i=1 to N)	8,688	5,661 (north of Sine Saloum in warm season)
Index of canoes distribution Shannon index ($-\Sigma ((q_i/Q) \log_2(q_i/Q))/\log_2 N$	0.902 (1989)	0.802 (maximum value in warm season 1988)
Gears (as % of canoes)		
Purse Seine (PS)	39.8	8.6
Drift Gill Net (DGN)	2.9	0.1
Set Net (SN)	29.7	25.9
Hand-Line (LN)	11.9	59.5
Beach Seine (BS)	8.9	1.3
Miscellaneous (DIV)	6.7	10.0
Catches ($t.10^3$)		
Pelagic	261	271
Demersal	46	46

Table 1: Main characteristics of the small-scale fishery sectors in Ghana and Senegal (1992).

species. This phenomenon of rapid gear switching is one characteristic of small-scale fisheries. In Ghana, only the main gear is taken into account during the census, but several cases of gear switching between set net and line or between the small-pelagic nets ('ali', 'poli' and 'watsa' nets) have been observed (Koranteng, 1990). Many fishing units may also have a set net. The joint utilization of different gears during the same fishing trip is best observed in the strategy of Senegalese fishers.

Migration is an important characteristic feature of small-scale fisheries in West Africa. According to Chauveau (1990), migration of fishers from the Gold Coast (now Ghana), for example, had been recorded by the beginning of the 20th century. Today, Ghanaian fishers may be found in many countries in West and central Africa, especially in Togo, Benin, Cameroon, Côte-d'Ivoire and Guinea. Senegal is also a net 'exporter' of migrant fishers (Diaw, 1991). Senegalese fishers may be found in Mauritania, Guinea, the Gambia, Guinea-Bissau and in other countries in West and central Africa. Distribution, abundance and movement of fish and fish schools are some of the factors that induce migration of fishers. Others are social and economic factors (Odotei, 1991; Haakonsen and Diaw, 1991; Koranteng *et al.*, 1993).

These migrations have, in part, contributed to the diffusion of small-scale fishing technology, skill and expertise. For example, it appears that the storage of fish in insulated, removable fish-holds on canoes was spread in the region by migrant fishers. Ghanaian fishers may have learnt this technique from their Senegalese counterparts in conjunction with long-range and long-duration line fishing. Another example of technology transfer through migration of fishers is the 'chorkor' smoking oven, which originated from a fishing village in Ghana but is now known throughout the West African region (Odotei, 1991; Koranteng, 1995). The major technical innovations have an impact on the relations between producers and tradesmen and consequently on the small-scale fisheries development (Lawson and Kwei, 1974).

Movement of fishers with their canoes also has serious effect on the assessment of the quantity of fish caught by the small-scale fishing fleets (Koranteng, 1992). In Ghana, small-scale fishers land their catches at a certain spot at the end of a daily trip, then return home with empty canoes. Assessment of catches is made by sampling and such an act introduces sampling and coverage errors in the estimations. Therefore, it is important to classify fishing villages between landing and refuge sites and to know and understand the temporal migratory flows between regions. As migration is influenced by variation of fish availability, considering a stable fleet during a long time might underestimate total catches because the migrant canoes are then associated with less productive regions and the most productive regions with an underestimated fleet (Ferraris, 1994).

The oceanographic regime of the Ghanaian and Senegalese coastal waters is characterized by seasonal upwellings. In Ghana, a major upwelling occurs for approximately three months each year, beginning late June or early July and ending in late September or early October, and a minor upwelling occurs three weeks either in January or February (Mensah and Koranteng, 1988). The Senegalese coast is under the influence of the trade winds which create local upwelling conditions and give rise to two main seasons: a cold season from December to May and a warm season from July to October (Roy, 1992). During the upwelling season, biological activity is high and most fishes, both demersal and pelagic, spawn and migrate. Stock availability and catchability are thus variable in the course of the year. These events result in variability in landings.

2. Fleet structure and dynamics

The number of canoes at each landing area or village is obtained from the census of canoes which are conducted once in 2-4 years in Ghana and twice a year in Senegal. The census, also referred as 'frame surveys', form the basis of catch assessment surveys involving the small-scale fishing crafts.

The structure of the Ghanaian fleet (Fig. 2) shows marked differences in gear composition on regional basis. This is due to differences in specialization of the different ethnic groups. There are four regions for small-scale marine fisheries in Ghana (Volta, Greater Accra, Central, and Western; Fig. 4) and each region presents the characteristic gears of the dominant ethnic groups (Ewe, Ga, Fanti). The occurrence of a particular type of gear in a particular location is determined by the target species (Bernaseck, 1986). The same phenomenon is observed in the Senegalese small-scale fishery, pursued by three principal ethnic communities with long fishing tradition. These are the Wolof, Lebou, and Sérère-Nyominka, originating from Saint-Louis (Fleuve), Cap-Vert or Thies-Sud region and the Sine-Saloum Islands respectively (Fig. 5).

The frame surveys undertaken in Ghana show a relative stability in the structure of each region's canoe fleet (Fig. 2). For the country as a whole, the number of canoes increased by 25% between 1981 and 1992. The number of canoes dropped significantly in 1981, due to migration of fishers to neighbouring countries, possibly as a result of unfavorable economic conditions in Ghana at the time (Odoi-Akersie, 1982). Since 1986, the number of canoes operating drift gill nets has generally decreased. This decline has been attributed to the excessive and rising cost of operating this gear (Koranteng *et al.*, 1993). Another possible reason is that with the gradual depletion of the 'wawa' tree from which the dug-out canoes are produced, worn out large canoes are not being fully replaced (Wayo Seini, 1995). On the other hand, set net canoes have increased in number by about 50%. It is possible that the canoes used for techniques showing a decline may now be used for set net fishing.

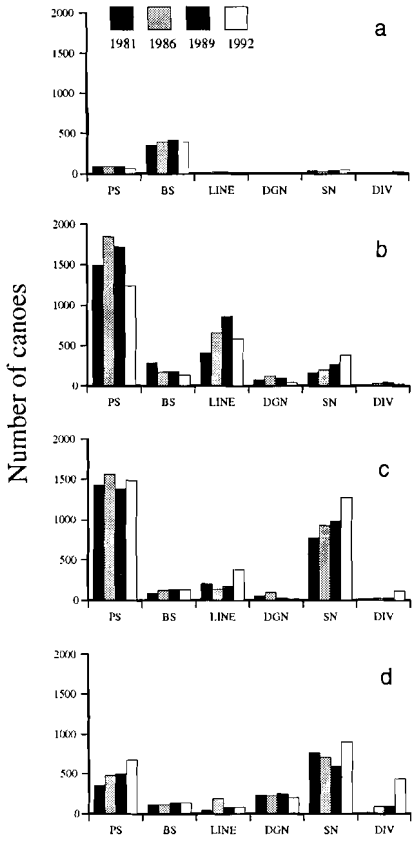
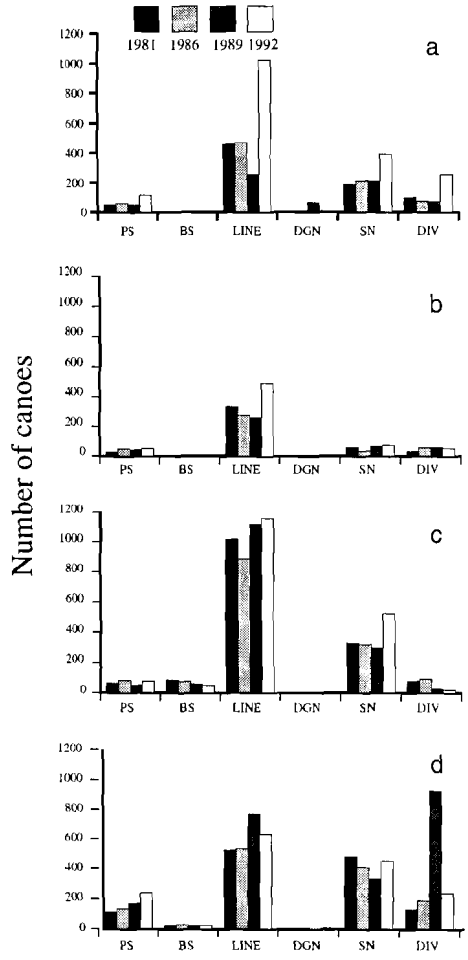


Fig. 2: Structure of the small scale fleet in Ghana: number of canoes by gear and by region from 1981 to 1992 (PS: Purse Seine, BS: Beach Seine, LINE: Hand Line, DGN: Drift Gill Net, SN: Set Net, DIV: Miscellaneous).
a) Volta; b) Greater Accra; c) Central; d) Western.

In Senegal (Fig. 3), there was an increase of 40% in the total number of canoes from 1982 to 1992. The increase was particularly important between 1989 and 1992 with the return of migrant fishers as a result of political conflict between Senegal and neighbouring Mauritania. The increase in line fishing in Senegal is due to the development of the activity of large canoes equipped with insulated ice boxes. Fishing is done far away from home bases. The increase of these canoes may be the sign that fishers prospect for new fishing places. There is the same phenomenon in Ghana, where 157 canoes with insulated removable fish-holds were counted during the frame survey in 1992 (Koranteng *et al.*, 1993).

The fleet structure established through the frame surveys exhibits seasonal variation. For example, in Ghana, the number of canoes with net for catching small pelagic species and located at specific landing beaches, reflects the seasonal pattern of the upwelling (Fig. 6a). This temporal variability in canoe numbers is well marked in the regions on the western part of Ghana where the sardinella season usually starts from (Ferraris and Koranteng, 1995). Fishers from other parts of the country migrate to the west at the onset of the sardinella season. The large fluctuations that occur annually correspond to migration of canoes within and between regions. This movement used to be very important during the major upwelling period (July-September) but in the last decade migration during the minor upwelling season (January-February) has also been remarkable. This could be linked to the increasing importance of the minor upwelling and the resulting increase in the production of sardinellas in the western Gulf of Guinea (Pezennec, 1995).



F g. 3: Structure of the small scale fleet in Senegal: number of canoes by gear and by region from 1982 to 1992 - in warm season (FS: Purse Seine, BS: Beach Seine, LINE: Hand Line, DGN: Drift Gill Net, SN: Set Net, DIV: Miscellaneous.
a) Fleuve; b) Thies Nord; c) Cap Vert; d) Thies Sud.

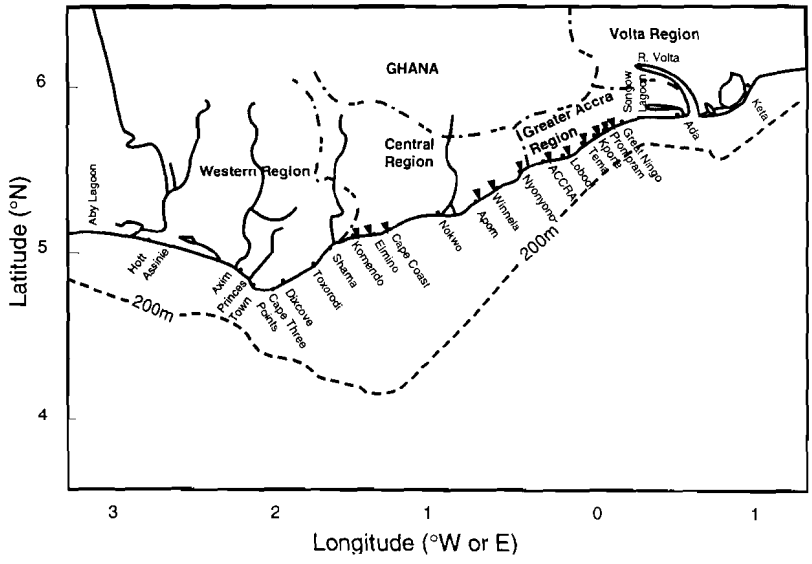


Fig. 4: Map of the Ghanaian coast, showing the four coastal regions considered here.

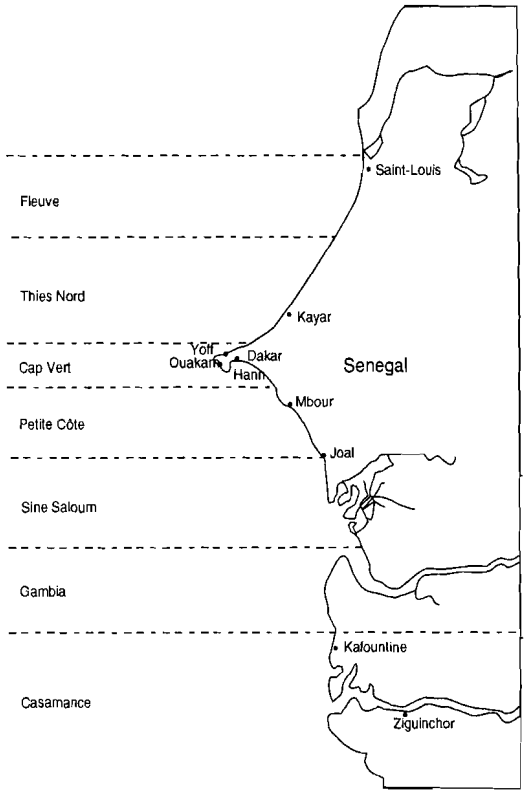


Fig. 5: Map of the Senegalese coastline showing the coastal regions considered here.

The same phenomenon of seasonal variation in the fleet is observable in Senegal (Fig. 6b). Here the profile of number of canoes in the Thies Nord region is complementary to that of the Fleuve region: during each upwelling season, some fishers migrate from the Fleuve region to the Thies Nord region and they return home after the upwelling period. This is related to seasonal migration of Saharian fish species such as grouper (*Epinephelus aeneus*), which migrate south and are then distributed all along the Senegalese shelf until the cold upwelled waters are replaced by warm tropical waters (Cury and Roy, 1988). Since 1991, a movement of fishers from the Thies Sud region to the Fleuve region is noticeable. These fishers, who have been in Senegal since the warm season 1989 (after the conflict with Mauritania), went back to Saint-Louis because of the reopening of the border, and also because of good fishing conditions in the north of Senegal during that time.

With a smaller coastline Ghana has two times the number of fishing villages as in Senegal and a larger number of fishers and canoes (Table 1). The distribution of canoes along the coast was measured by the Shannon index which depends on the relative number of canoes per landing beach (Table 1). This index is usually used in ecology to measure the diversity of species (Pielou, 1975). In this case, it was calculated during the period of low migration. The index was found to be higher in Ghana than in Senegal indicating that canoes are distributed more evenly along the Ghanaian coast than along the Senegalese coast. In Senegal, the canoes are concentrated in about ten main landing centers which are close to consumption centers with road infrastructure. As the distribution of canoes varies between the seasons, the index is low during the cold season when the fishers are concentrated in a few strategic centers. For example, in Kayar located in the Thies Nord region of Senegal, the number of canoes is two times as high during the upwelling period than during the warm season. In Ghana, large fluctuations of canoe numbers are observed at important centers like Elmina (Central

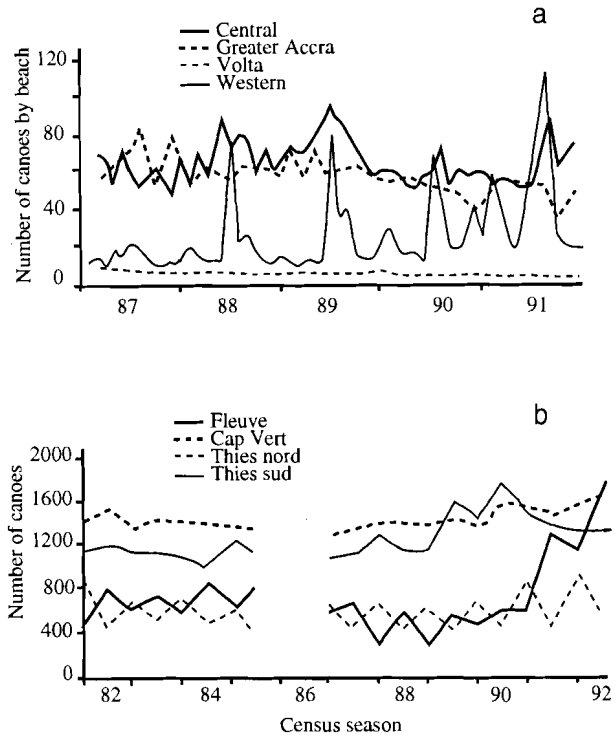


Fig. 6: Seasonal variation in the structure of the artisanal fleet by region in Ghana and Senegal.
a) Average number of canoes using pursing nets in Ghana;
b Total number of operational canoes in Senegal.

Region) and Sekondi (Western Region). Large canoe populations at these centers correspond to the sardinella season when many canoes migrate towards centers that are close to the bulk of the migrating fish and where they are likely to find market and better price for their catch (Ferraris and Koranteng, 1995).

In the last decade or so, the small-scale fisheries of the two countries have also undergone changes in nature as well as in the population of fishing craft. After the decline of the sardinella fishery in Ghana in the early 1970s, a classical case of technological innovation took place: the purse seine-type 'poli' net was developed from the 'watsa' ring net to catch anchovies (Koranteng, 1992). Today, poli net is the major fishing gear used in the sardinella fishery in Ghana. Long-range line fishing has also increased considerably. Some large-sized canoes that were used for purse seining may have been converted into long-range line canoes. These canoes carry ice and stay at sea for about three days (Koranteng, 1990). Set net fishers have also adopted the habit of attaching hooks on lines to the leadline of their nets (Koranteng, 1995).

In Senegal, the number of gears in all categories but 'line' and 'diverse' decreased between 1985 and 1989, due to a transfer of fishing effort to the exploitation of cephalopods as the biomass of octopus increased (Samba, 1995). New fishing methods for cuttlefish, traps and jigs were introduced in Senegal from Japan in 1975. With the increase of octopus stock size, the fishers adapted cuttlefish jigging for this species.

These changes reflect the nature of small-scale fisheries, in which there is the propensity for innovation by the fishers themselves, in response to changing circumstances.

3. TOTAL LANDINGS AND COMPOSITION OF CATCHES

Figure 7 shows the trend of fish landings by small-scale fishers in Senegal and Ghana from 1981 and 1992. The catch of small-scale fishers are composed mainly of pelagic fish species, although some demersal species are also caught. For example in 1992, pelagic species accounted for over 85 percent of the landing in each country (over 260 000 t). About 46 000 t of demersal fishes were landed by the small-scale fishers in each of the two countries in the same year (Table 1).

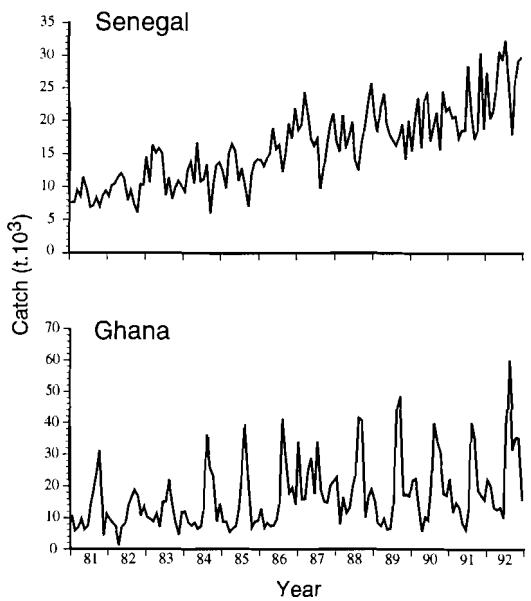


Fig. 7: Total catches of the small-scale fisheries in Senegal and Ghana from 1981 to 1992.

The changes in the composition of catches may be analyzed to detect changes in target species (Fig. 8, 9). In Ghana, the catches of pelagics are dominated by Engraulidae and Clupeidae (Fig. 8). The quantity of sardinellas and anchovies, therefore, greatly influence the percentage composition of the year's landings (Fig. 10a). *Sardinella aurita* is more abundant than *Sardinella maderensis*. Other important pelagic groups in the Ghanaian small-scale fishery are the Scombridae, Carangidae and Istiophoridae.

The pelagic catches in Senegal are dominated by Clupeidae (Fig. 8). The increase in landings since 1985 is due to *Sardinella aurita* (Fig. 11). At the beginning of the decade, catches of purse seine nets were relatively more diversified but less important than presently. Quite noticeable are the catches of bluefish (*Pomatomus saltator*) by purse seine and line gears, a species which disappeared after 1983. Samba and Laloë (1991) found a relation between bluefish catches, upwelling intensity and sea surface temperatures, supporting the idea that the upwelling is a favourable factor determining the migration pattern of migrant Saharian species in Senegal.

In the demersal sector, two families dominate the landings in Ghana (Fig. 9), the Pomadasyidae and the Sparidae. From 1973, the triggerfish (*Balistes capriscus*) became important in the landings of trawlers in Ghana (Mensah and Koranteng,

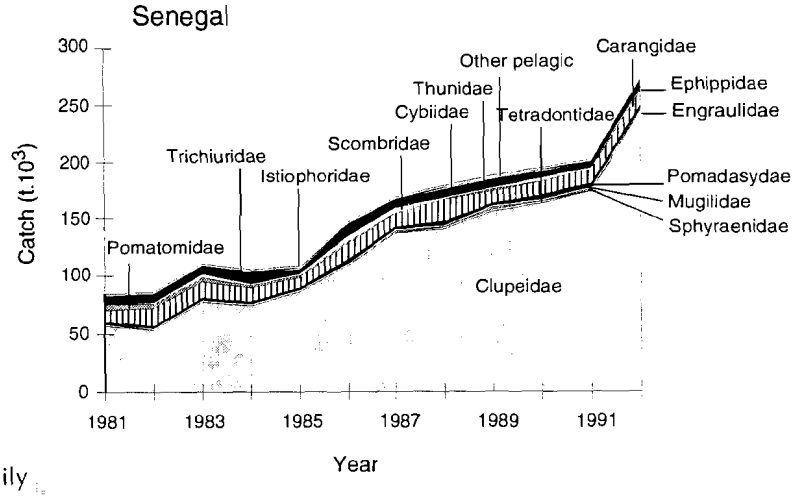
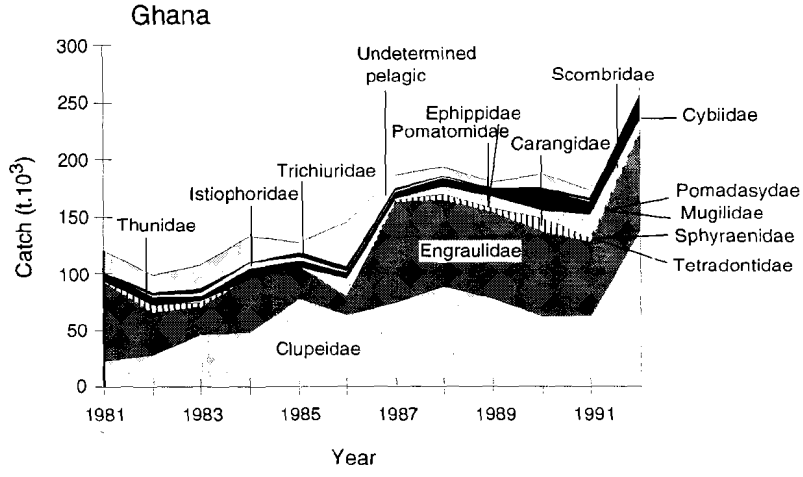


Fig. 8: Pelagic catches, by family and country from 1981 to 1992.



1988). However, the proliferation of triggerfish in the Gulf of Guinea did not show up early in the landings of small-scale fishers. Later increases of triggerfish in the landings of the canoes followed an increase in demand of the fish as a result of improvement in its utilization. The increase of triggerfish in the landings of small-scale fishers resulted essentially from trade between small-scale and industrial fishers on the high seas, with the former buying the catch from the latter. Triggerfish resources in the whole of the Gulf of Guinea have declined hence the reduction in landings of the species by the Ghanaian small-scale fleet since 1988 (Fig. 9). The increase in the landings unidentified demersal species by canoes in Ghana is also noticeable since 1987 (Fig. 9, 10). *Brachydeuterus auritus* (Pomadasyidae) and *Pagellus bellottii* (Sparidae) dominate demersal fish landings by small-scale crafts.

In the last decade, the demersal catches of Senegalese small-scale fishers were dominated by Serranidae, Sparidae and molluscs (Fig. 9). The increase in octopus catches since 1989 reflects the interest of fishers for a new target species

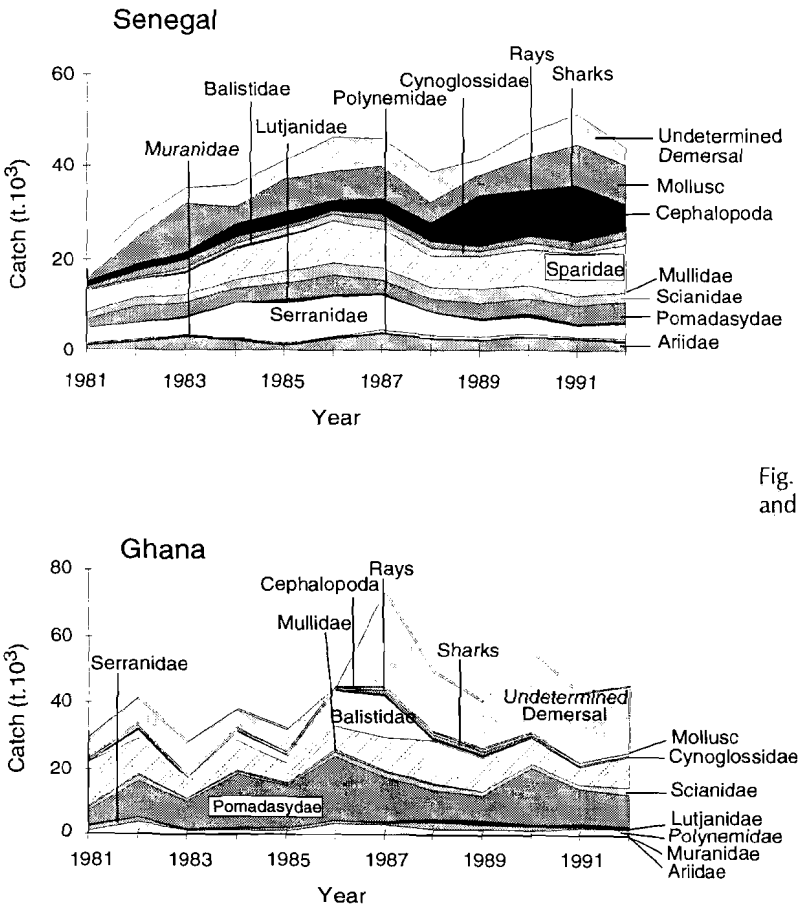


Fig. 9: Demersal catches, by family and country from 1981 to 1992

resulting from the increase in biomass of this species since 1986 (Caverivière, 1995a) and from the development of a market for octopus. There was a simultaneous decrease in the landings of groupers (Serranidae). At the end of the decade, catches of Sparidae (mainly of the genus *Pagellus* and *Sparus*) have increased with expansion of the export market and improvement in the organization of trading (Kébé, 1995). The increase in the landings of rays was a result of the introduction of long line fishing with multiple hooks and the development of the export of processed small-scale catches (Samba, 1995). The changes in catch composition of the line fishery shows a decrease in pelagic species following the disappearance of bluefish (Fig. 11).

There has never been a lucrative market for triggerfish in Senegal and the landings by the small-scale fleet were not important even though this species was abundant in the south of Senegal at the beginning of the 1980s (Caverivière, 1995b), then in the north. However, a trade between small-scale and industrial fishers at sea, similar to what has been observed in Ghana for the triggerfish also occurs in Senegal for cephalopods.

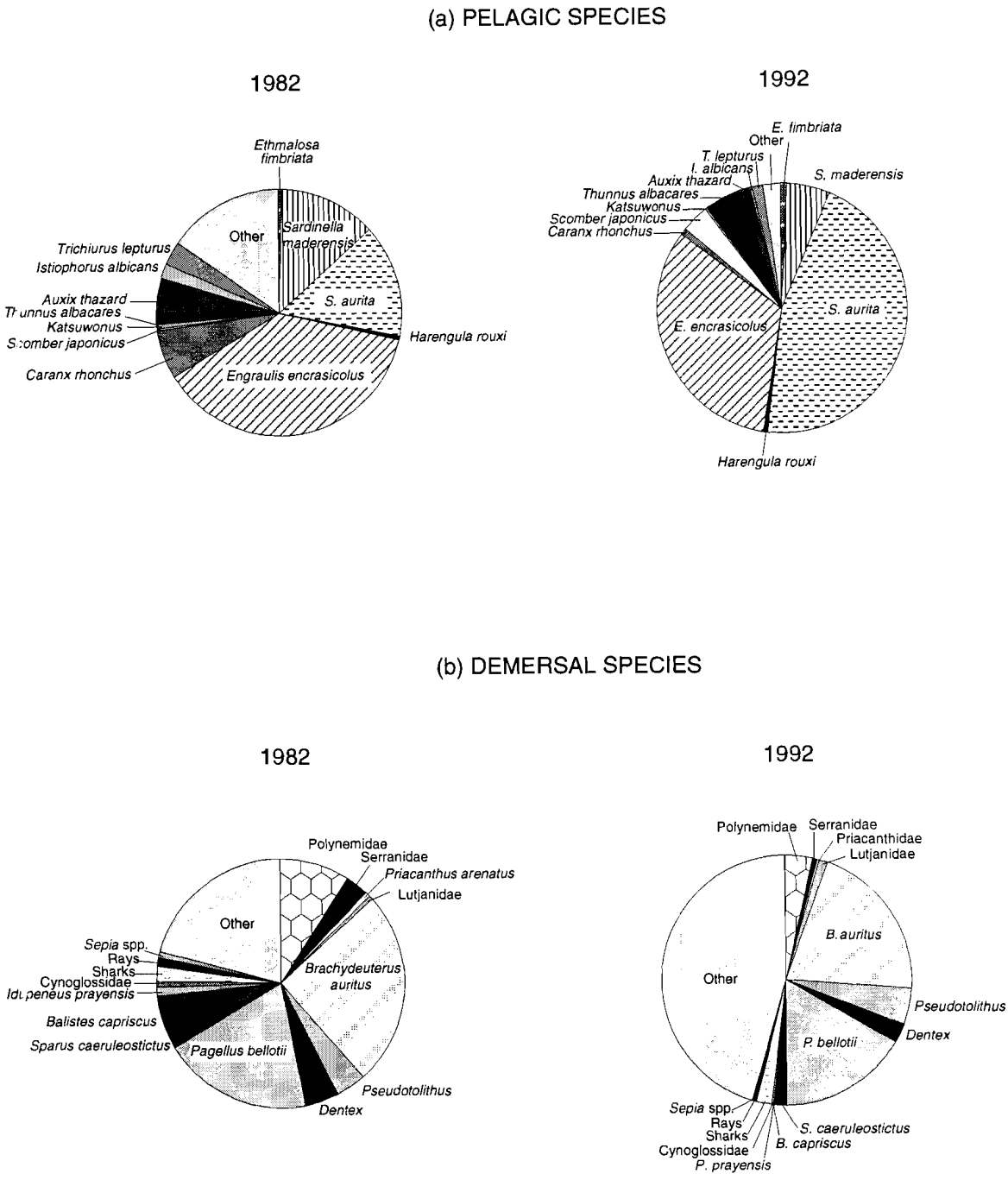


Fig. 10: Changes of species diversity of artisanal fish landings of Ghana, 1981and 1992; a: Pelagics; b: Demersals.

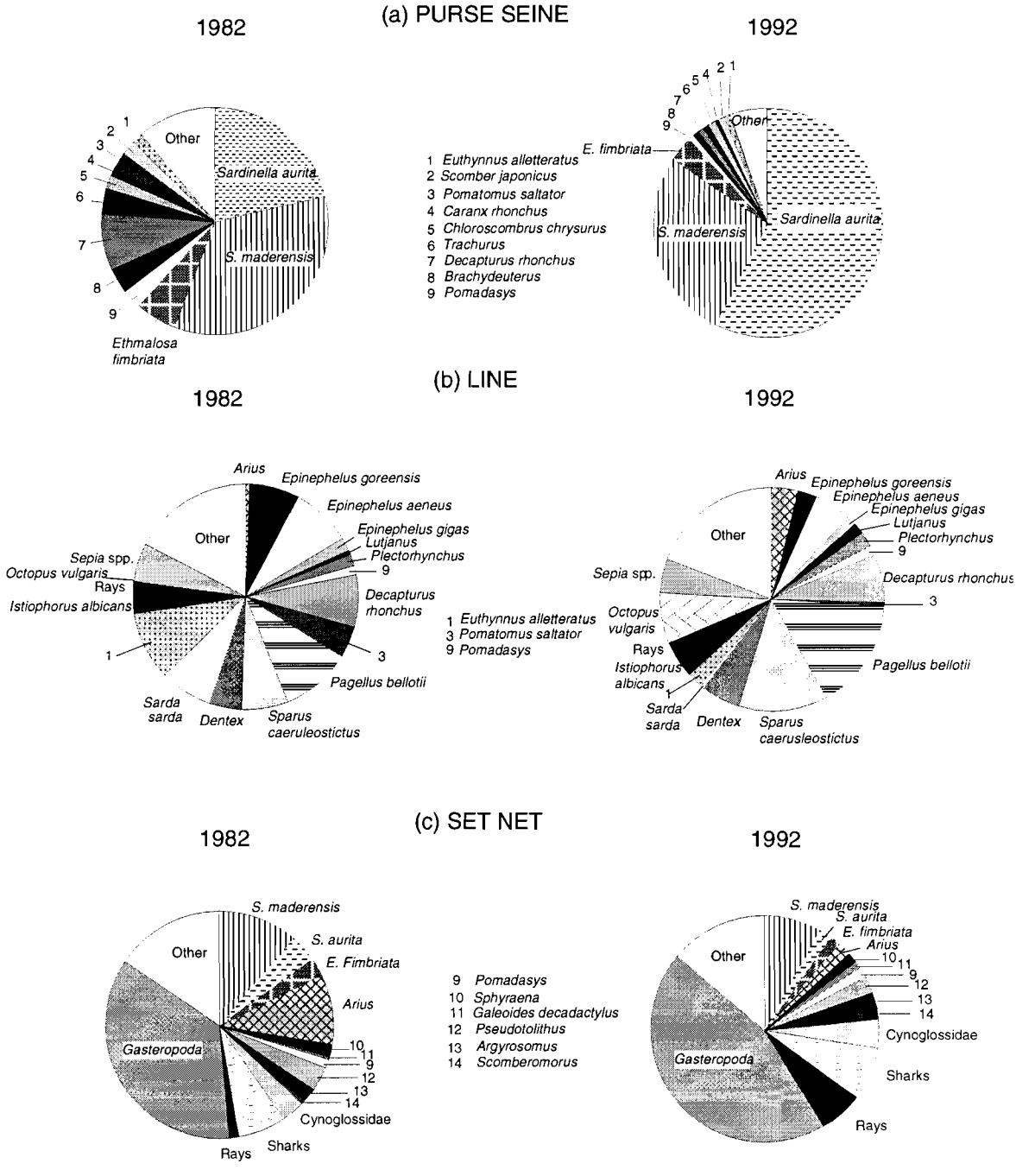


Fig. 11: Changes of species diversity, by gear, of artisanal fish landings of Senegal, 1981 and 1992; a: Purse seines; b: lines; c: set nets.

The species composition in the landings of set net and line fishing in Senegal (Fig. 11) shows a great diversity that reflects differences in target species which depend on the following factors:

i.) kind of set net (for soles, gastropods, sharks or rays, surface or bottom setting);

ii.) fishing season (line fishers target *Istiophorus* in the warm season and *Epinephelus* in the cold or upwelling season);

iii.) fishing practices in accordance with ecological characteristics, fishing villages, ethnic groups, etc. (e.g., in Kayar, Wolof fishers prefer to catch species such as *Pomatomus* or *Pagellus* with line and sole with set net whereas Lebou fishers prefer *Epinephelus aeneus* and do not use fixed gear such as set net).

4. Discussion

The study of changes in the small-scale fisheries in Ghana and Senegal shows in both cases an expanding sector. The two upwelling systems in Senegal and Ghana induce similar characteristics in the small-scale fisheries; particularly a dominant fishery for small pelagic fish species. However, there are differences in species diversity. Environmental variability, a consequence of the upwelling fluctuations, results in uncertainty and instability in marine resources and raises the problem of interactions between the dynamics of the environment, fish stocks and fisher communities (Cury and Roy, 1992).

In the face of variability, small-scale tropical fisheries are characterized by their dynamics and adaptability. Small-scale fishing units have flexibility and ability to switch between various target species in response to trends in relative abundance of fish and to changes in market preference or technical innovation. The situation where a wide range of target species is exploited by boats, shifting seasonally or from one trip to another, is often described as the likely ultimate stage of development of industrial multispecies fisheries. Paradoxically, small-scale fisheries fall into this category (Gulland and Garcia, 1984).

Studies of long-term fishery development often show a 'fishing-up' sequence with an expansion of the fishery as fishers become more mobile and shift their effort to other species in response to a decline in landings of preferred species (Deimling and Liss, 1994). The fact that fishers in Senegal and Ghana developed canoes with insulated ice-boxes to exploit remote fishing grounds or adapted to joint utilization of fishing gears is, perhaps, a sign of the 'fishing-up' sequence in response to yields decrease. But migration and the use of a multiple fishing gears are two intrinsic characteristics of tropical multispecies small-scale fisheries. These characteristics, given alternatives, give them flexibility and provide stability.

There are similarities in nature, extent and evolution of the small-scale fisheries in Senegal and Ghana. In the comparative study of the evolution of these two fisheries over a decade, three principal factors were identified as common responses to changes in the environment. These are:

i.) Migrations: motivated by various causes (socio-economic or biological); they are either short- or long-term, between countries in the sub-region, or between regions within one country;

ii.) Technological mutations: introduction of new technology, innovation, knowledge transfer;

iii.) Switching and joint utilization of fishing gears.

For Senegalese fishers, Laloë and Samba (1990) identified two types of reactions: the strategic (migration and technological choice) and tactical (switching of effort depending on resource availability or market opportunities). The dynamics of exploitation is thus approached in terms of strategy and tactics. A model was developed to describe the

dynamics of the small-scale fisheries in Senegal on the basis of a stock production model adapted for the multispecies and multigear fisheries (Laloë and Samba, 1991). In this model, the terms 'tactics' and 'strategy' are used to describe the decision making process of fishers in response to accessibility of resource, biomass changes, variations in market and/or socio-economic factors. A second model is being developed to simulate decision-making in the Senegalese small-scale fishery on the basis of an expert system and object-oriented formalism, where the whole fishery is viewed from a systemic point of view (Le Fur, this vol.).

The development of the fishery must be studied in a natural-cultural context where each fishery system is composed of interacting factors of physico-chemical, biological and cultural nature (Deimling and Liss, 1994). Catch is reflective of natural factors which create varying levels of abundance of species, and reflective also of cultural factors such as fishing technology, fisheries economics and market preferences. Catch is thus a product of the entire natural-cultural system.

From the point of view of fishing operation, catch is the result of the choice of one gear, one fishing place and one target species. The choice of these three factors may be presented as a tactical decision that needs to be taken by the fisher before or during a fishing trip. Ferraris (1995) defines 'tactics' as a combination of fishing grounds, target species and gears. One can study changes of fishery dynamics in the short term. 'Strategy' is defined as a set of tactics. This concept integrates fishing activity in a given period of time and allows the study of fishing dynamics on a longer term. Local and global changes, from a temporal point of view, may then be interpreted in terms of tactics and strategy. Tactics permit the analysis of the dynamics on the basis of daily fishing activity; a change in tactics is interpreted as a response to some local change in the fishers' environment. Strategy permits the analysis of the dynamics of a fishery on a seasonal or annual basis. A change in strategy reflects changes in global fishing conditions and it impacts on available tactics. However, a local change, for example the introduction of new tactics, may have an impact at the global level.

The responses to biological, ecological or socio-economic changes observed in the Senegalese and Ghanaian fisheries may also be described on a spatial scale. Local changes have reference to spatial peculiarities due to the natural-cultural system and the history of each fishery. Global changes, on the other hand, generated similar changes observed in the two countries. The local dimension refers to the specific tactics and strategies of each fishery, while global dimension led to common responses. Despite observed differences in the small-scale fisheries in the two countries, the changes observed on a decadal basis underline some generic fishing behaviors. These global changes may be due to similar changes in the natural system (e.g., increase in *Sardinella aurita* abundance, proliferation of triggerfish, development of cephalopods, etc.) or in the human system (e.g., the opening of export market and increasing domestic demand related to human demographic growth).

CONCLUSION

The study of the small-scale fisheries in Ghana and Senegal, through the structure and evolution of fleets and catches, underlines the importance of a good understanding of the dynamics of exploitation. The fishers' ability to adjust their activities and to react to perturbations in their environment confer on multispecies and multigear small-scale fisheries great flexibility and stability. The opportunistic behavior of the fishers may give some signals about the condition of the system and the wealth of the resource. Therefore, from a fisheries management point of view, it is important to better understand the reaction of fisher facing changes (Hilborn and Walters, 1992).

Comparative studies of the dynamics of the small-scale fisheries in Senegal and Ghana underlines three important factors in the fishing decision-making: fishing location, fishing gear and target species. The dynamics of the fisheries may be studied by these three factors, expressed in terms of tactics and strategy. Changes in species composition of catches and volume of landings were observed. However, changes in fishing strategy and in landings may be confused with 'real' changes in species composition or abundance. Similar migratory behaviors by fisher, resort to the use of a multiplicity of gears and technological mutation were identified. Thus we found, the specificity and common characteristics of the two fisheries facilitated the study of the dynamics of exploitation in the context of local and global changes.

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