

# Artisanal fishing and coastal conservation in West Africa

Campredon, P.<sup>1\*</sup> & Cuq, F.<sup>2</sup>

<sup>1</sup>Fondation Internationale du Banc d'Arguin, Station Biologique de la Tour du Valat, Le Sambuc, 13200 Arles, France ; <sup>2</sup>Géosystèmes, UMR 6554 et FR 2195 CNRS, Institut Universitaire Européen de la Mer, UBO, Place Copernic, 29280 Plouzané, France; \*Corresponding author; Fax +33490972242; E-mail campredon@tour-du-valat.com

**Abstract.** Artisanal fishing is an activity which has long occupied an important place on the West African coast. In less than 20 years, the increasingly widespread use of motors in fishing boats and cold storage facilities both on board and on land have enabled fishermen to master the constraints of space and time. Furthermore, globalization has created a demand for new products, thus influencing the behaviour of fishermen and consequently the status of some fish, turtle and marine mammal species. Development policies for artisanal fishing do not adequately reflect the importance of these changes. They tend to use inappropriate scales of reference, be it spatially (national borders take precedence over ecosystems) or temporally (the long-term consequences of development plans are seldom considered). Some international conservation organizations are testing promising new approaches to managing resources more sustainably and restoring degraded ecosystems, and their recent experiences can serve as useful examples to others. It is recommended to grant special rights of access to resident fishermen. In defending 'their' resources, they will also protect the ecological functions of the area. Close collaboration with administrations and development assistance agencies is needed to assess consequences of political decisions on the use of resources. The important role of marine protected areas as a tool for fishing management should be better documented and strengthened. These areas should not be considered as isolated units but rather as vital parts of a comprehensive system for improved coastal zone management. Consistent with the ecosystem approach, fishermen and their communities, being the main users of coastal resources, should also play a major role in the design and implementation of any fishing management actions.

**Keywords:** Banc d'Arguin Coastal Zone Management; Gambia; Guinea-Bissau; Marine resource; Mauritania; Protected area; Rights of access; Senegal.

**Nomenclature:** del Hoyo et al. (1992) for birds; Ceret & Opic (1986) for fishes.

## Introduction

In Africa, as in other parts of the world, local fishermen are among the main groups of coastal resource users. Although some West African peoples possess an age-old tradition of subsistence fishing, drawing on their own techniques and boats, and sometimes migrating along with fish populations, artisanal fishing was, until recently, a largely seasonal activity practised in local waters for subsistence purposes. In the last 20 years, major changes have occurred, the most significant being the increasingly widespread use of outboard motors and cold-storage techniques, both on board boats and on land. The result of these changes is better control over temporal and spatial factors which formerly limited the fishing effort. Against this development, it is useful to attempt to understand the relationship between artisanal fisheries and coastal resources along the West African coast from Mauritania to Guinea-Bissau, and to analyse the impact of some current initiatives to promote sustainable use of these resources.

### *The West African coast*

The coastal waters of West Africa (Fig. 1) are influenced by the cold Canary Island current and a permanent upwelling (especially in Mauritania) which stimulates high levels of plankton production, as well as by the warmer South Equatorial current which follows the intertropical convergence front as far as Cap Blanc (Cuq 1993). These converging currents explain the simultaneous occurrence in Mauritania of species from discrete biogeographical regions, including not only plant species, but also fish, cetaceans and birds. The northern Mauritanian coastline is made up of rugged cliffs which harbour the only remaining monk seal (*Monachus monachus*) colony considered viable in the long term (Marchessaux 1986; Gonzalez et al. 1997); this population dropped sharply from ca. 300 to ca. 100 individuals in May-June 1997 when a massive die-off occurred,

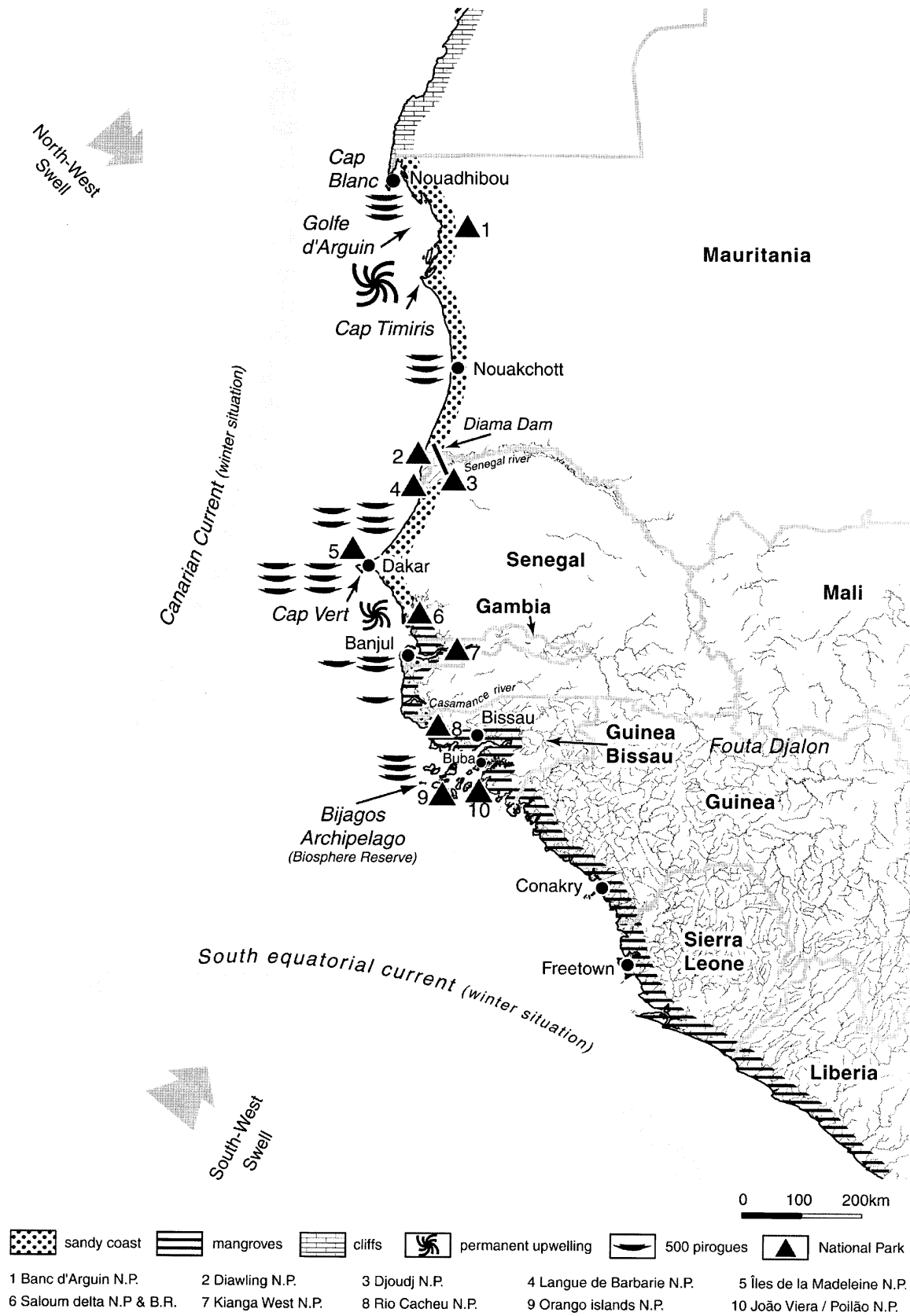


Fig. 1. Subsistence fishing and coastal conservation of the West African coast.

probably caused by a bloom of toxic algae (Harwood et al. 1998).

The Banc d'Arguin stretches along the Mauritanian coast from Cap Blanc to Cap Timiris; the sea breaks along its shallow shelf and covers a vast area of sheltered shoals with *Zostera* and *Cymodocea* beds and, to the leeward side, scattered mangroves. The latter are made up of monospecific stands of *Avicennia germinans* with an estimated surface area of 300 ha (Naurois & Roux 1965) and are the northernmost mangroves found on the West African coast. Some 15 islands provide breeding habitats for bird colonies totalling between 37 000 and 52 000 pairs (Campredon 1987; Anon. 1998).

A further 400 km<sup>2</sup> of intertidal mud flats are used by over 2,3 million wintering Palearctic waders (Trotignon et al. 1980; Altenburg et al. 1983; Zwarts et al. 1998), representing the world's highest concentrations of these species. The occurrence of such a great number of birds as well as cetaceans – e.g. Atlantic humpbacked dolphin (*Sousa teuszii*), bottlenose dolphin (*Tursiops truncatus*) and killer whale (*Orcinus orca*) – reflects the abundance of ocean resources present (Robineau & Vely 1998); indeed, the Golfe d'Arguin is the main spawning ground and nursery for many commercially important fish species (Boely et al. 1978; Troadec & Garcia 1980). These characteristics prompted the establishment of the Banc d'Arguin National Park in 1976; the Park is also listed as a World Heritage site by UNESCO and as a Site of International Importance under the Convention on Wetlands (1971, Ramsar, Iran). It is the largest coastal park in Africa with a surface area of 12 000 km<sup>2</sup>, 6500 km<sup>2</sup> of which are marine biotopes. A fishing community of 1 100 people lives within the Park's boundaries in nine villages along the shore. These people, the Imraguen, are the only group allowed to live on Park land and to fish within its waters, using only traditional sailing boats.

The waters to the south of Cap Timiris are deeper and less sheltered. The shore is fringed by sandy beaches, dunes and sebkas extending in a fairly straight line south towards the Senegal river delta. Until relatively recently, the ecology of the lower delta was directly determined by rainfall levels in the Fouta Djallon mountains in Guinea, commonly known as the region's 'water tower'. During periods of unusually low rainfall, sea water flowed up to 300 km upstream from the mouth of the Senegal; conversely, heavy rains caused flooding along the entire lower delta (Gac et al. 1986). The Diama dam, built to stop seawater intrusions into the upper reaches of the river and commissioned in 1985, profoundly altered the ecological dynamics of the river estuary. The effects of the dam itself, combined with those stemming from human activities and drought, have had a significant impact on the delta's flora and

fauna, one example being the complete disappearance of *Acacia nilotica* and mangroves, the former sites of which are now used for salt mining (Duvail et al. 1998). The reduced exchanges of salt and fresh water have led to a drastic decline in fishing resources; potential catches fell from 24 000 tons in the 1970s (Reizer 1974) to 7500 tons 20 years later, with marked drops in some species such as *Lates niloticus*, *Gymnarchus niloticus*, *Citharus citharus* and *C. lates* (Diouf et al. 1991). Protected areas were subsequently established in the lower Senegal delta, one in Mauritania and two in Senegal (Vincke & Thiaw 1995). The Diawling National Park has a surface area of 35 600 ha on the right bank of the river and contains mainly halophytic biotopes. The Djoudj National Park, ca. 16 000 ha in size, is an important site for large breeding (*Pelecanidae*, *Ardeidae*, *Anatidae*) and wintering (*Phenicopteridae*, *Anatidae*) bird populations. Further south, Langu de Barbarie National Park (2000 ha) also provides habitats for a bird fauna mainly consisting of *Laridae*.

From the Senegal delta south to the Cap Vert peninsula, the coastline is sandy and pounded by waves, then sandy and slightly more sheltered with nursery areas stretching down to the Saloum delta. This delta is where the 'Southern Rivers' coast named by the Portuguese in the 15th century begins. Its typical features are rias lined with *Avicennia* and *Rhizophora* mangroves, extending all the way to Sierra Leone. The hydrological regime of the Saloum, like that of the Casamance, is dependent on local rainfall, thus distinguishing it from the Gambia river which rises in the very rainy Fouta Djallon in Guinea. The combined effect of low rainfall in recent years and hydraulic works for agriculture has produced greatly increased salinity levels, causing the Saloum and the Casamance to function as reverse estuaries, with water salinity increasing in a downstream-upstream direction. This has had a particularly negative impact on the mangrove environment, including sea turtles and manatees *Trichechus senegalensis* (Diouf et al. 1993). A portion of the Saloum delta, mainly on the Senegalese side, is included in a National Park (76 000 ha) which is itself encompassed within a Biosphere Reserve (180 000 ha). On the Gambian side of the river, 4940 ha fall within the Park, and another 11 000 ha are protected by Kiang West Park, which lies further upstream (Schwarz 1992).

The coastline of Guinea-Bissau is heavily indented by a series of rias whose extensive mangroves cover approximately 248 000 ha (Da Silva 1999), or 7% of the country's surface area. The broad continental shelf and the contour of the coastline give rise to relatively strong tides and currents, and high concentrations of sediment and suspended organic matter create high water turbidity. The Bijagos Archipelago is located off the coast of Guinea-Bissau and was classified as a Biosphere Re-

serve in 1996 (Cuq 2001). Two core areas have been settled as national parks: Orango Islands National Park in 1999 and João Viera / Poilão national park in 2001. The largest West African nesting beach, and possibly the largest of all Atlantic sites for the green turtle *Chelonia mydas* (Broderick et al. 1998) is found there, as are relatively large populations of Atlantic humpbacked dolphin, manatee, hippopotamus (*Hippopotamus amphibius*) in the salty waters of the sea inlets, Cape clawless otter (*Aonyx capensis*) and crocodiles (*Crocodylus niloticus*, *Osteolemus tetrapsis*) (Limoges & Robillard 1989; Anon. 1994; Joao Lopes 1998; Almeida e Silva et al. 1999).

### Artisanal fishing

The type of artisanal fishing described here is conducted on foot or from open boats powered by outboard engines with less than 100HP or, in the specific case of the Imraguen, using sailing boats. Until quite recently, artisanal fishing along the Mauritanian coast was an activity engaged in solely by the Banc d'Arguin's Imraguen people. Their technique consisted of wading into the sea with nets made of plant fibres and fishing the migrating schools of grey mullet *Mugil cephalus* which they would then dry on the beach for long-term storage. This type of fishing, which sometimes took place with the help of bottlenose dolphins whose movements pushed the schools of mullet toward the shore (Busnel 1973), is now dying out. The gradual decline in mullet populations began when fishing during the spawning migration increased in a drive to obtain mullet roe for export to Europe. When the Imraguen began to use sailing boats sold to them by Canary Island fishermen, they were able to significantly expand their fishing range and thus increase their potential harvest. The most serious turn of events, however, was the arrival of fishermen from neighbouring countries who began fishing at the outer limits of the Park in pirogues equipped with outboard motors and purse seines; total annual mullet catches went from a few hundred tons in the 1980s to 7000 tons in 1994 (Anon. 1996). What is more, only the roe was kept and sold to Italy, the fish carcasses being discarded behind the beach. A further consequence of this new fishery was incidental catches of dolphins (*Turciops truncatus*, *Sousa teuszii* and *Delphinus delphis*) which subsequently washed up on the beaches; this reached a peak in December 1995 when 130 dolphins were found dead. Furthermore, it is likely that the Senegal delta was once one of the mullet's main spawning grounds, and the area has been rendered partially inaccessible by the Diama dam. The Imraguen fishermen have thus gradually shifted to other species, with the added incentives of

cold storage facilities in Nouakchott and regular visits from fish traders using off-road vehicles, which are now quite common. At the same time, the development of a market for ray and shark fins, which can command prices of up to 100 USD/kg in Hong Kong or Singapore, has prompted the Imraguen to target these species which have consequently become seriously endangered (Ducrocq 1997). The decline of these species has been further accelerated by their biological characteristics, which result in very slow population renewal rates (Hamlet 1997). Some of the most seriously threatened species are those belonging to the genus *Pristis* (which seems to have completely disappeared from the area) and also *Rhynchobatos lubberti*. The use of standing nets has furthermore significantly increased the numbers of turtles and dolphins caught inside the National Park, not only because of their large mesh size (20 cm), but also because the nets are left in place for periods of at least 24 hours (Hamerlynck et al. in press).

Subsistence fishing has developed apace in Mauritanian waters over the last 20 years, largely because the mobility of migrant fishermen using outboard engines enables them to occupy fishing grounds located far away from their homes. There are now 2750 motor-driven pirogues in Mauritania, and catches of demersal species have fallen from 38000 tons in 1987 to 21000 tons in 1997 (Diop 1998). Against this development, it is easy to understand why the 6500 km<sup>2</sup> marine area of the Banc d'Arguin National Park (PNBA), with only ca. 100 authorized fishing vessels, is perceived as a new Eldorado. The resulting pressure on the Park reflects a crisis in which the Park Authority is accused of freezing an unnecessarily long stretch of its coastal waters for 'purposes of bird conservation' while the fishing community is going through economically difficult times. The Park Authority has maintained its position, supported by the Imraguen and by international conservation organisations, arguing that the Park is the single most important breeding and nursery area in Mauritania and as such holds the key to the long-term viability of the fishery sector.

With respect to zoning, the conservation area (the Park) is adjacent to an area zoned for development (outside the Park's boundaries) without any overall management model covering both areas. This explains the disparate development of the coastal zone (inside vs. outside the Park) observed over the last 20 years. In Park waters, the number of boats has been restricted with a view to maintaining a artisanal sustainable mullet fishery. Total catches were estimated at 109 - 1446 (mean = 478) tons until the late 1980s (Anon. 1997a). The fish were processed by the Imraguen women with no waste: the fillets were dried, as was the roe, and the heads were boiled to produce oil.

Outside the Park's boundaries, along a coastal stretch of approximately 80 km, the lack of any active management made it all too easy for about 100 pirogues to set their purse seines and catch up to 7000 tons of mullet in one season (Anon. 1997a). This harvest was not processed using traditional means, thus depriving the women of their livelihood, but even worse was the fact that the only part actually kept was the roe. Due to the migratory habits of the species, this method of fishing produced knock-on effects within the Park. The Imraguens catches declined rapidly, and to make matters worse, the market price of mullet roe also fell substantially. The move to ray and shark fishing was further hastened by the high prices fetched by their fins on the international market and by their high density in the Park's waters. The Imraguen thus went from a subsistence economy to a money-based economy in only a few years. Despite the positive aspects of this change, such as newly found individual wealth, its negative effects on the women's role within the community and their earning power, the waste of resources and loss of biodiversity are all too clear.

In Senegal and The Gambia, artisanal fishing is an integral part of the historic culture of peoples such as the Lebou of the Cap Vert peninsula and the Nhominka of the Saloum (Cormier Salem 1992). A survey conducted in 1998 estimated the number of pirogues in use along this part of the coast at close to 6055 in Senegal (Samb 1998) and 1500 in The Gambia (Saine 1998). Fisheries in the lower Senegal delta have suffered a sharp decline which began when Diama dam was commissioned; indeed, the potential harvestable fishing resources have dropped by about 75% since the 1970s (Diouf et al. 1993). This decline also occurs, albeit to a lesser extent, in the estuaries to the south and in fact all along the coast, due to overfishing as well as deteriorating environmental conditions such as increased water salinity (Pages & Citeau 1990). A related phenomenon is the loss of commercial value of catches because of decreasing fish and (especially) shrimp size, and the decline in species diversity (Le Reste et al. 1986). Far from limiting incursions by the pirogue fleet, this situation encourages extreme measures, such as the use of dynamite off the coast near Dakar, and forces artisanal fishermen to expand their operations further out to sea and toward neighbouring countries. In Senegal, for example, catches by pirogues account for 90% of pelagic species landed – especially round sardinella (*Sardinella aurita*) and Madeiran sardinella (*S. maderensis*) although these species have customarily been fished using industrial means (Anon. 1992). Conversely, trawlers now regularly enter the six-mile exclusion zone restricted to artisanal fishing and do considerable damage to the seabed ecology there; trawling is also responsible for much lost fishing

gear and thus many disputes with pirogue fishermen (Bakhayokho & Kebe 1989; Kebe & Le Reste 1993). Conflicts have also developed between fishing and other economic sectors such as seaside tourism, which is difficult to reconcile with the fish processing (salting and drying) on beaches used by tourists, and conservation, with the last remaining forests being sought as a source of wood for pirogue construction. Finally, conflicts also break out between ethnic groups, especially in the Casamance region where the Diola, who are occasional subsistence fishermen, now have to cope with intruders from the north coming in to harvest already overstretched resources with highly effective methods which surpass their own. The result is often confrontation which sometimes leads to loss of human life (Cormier-Salem 1992).

Guinea-Bissau is somewhat different in that its coastal-dwelling population has no strong fishing tradition (Baran & Tous 1999). Fishing is mainly an off-season activity for these farmers, who fish either on foot using castnets or from dugout canoes very close to shore. In mangrove-rich areas and in the Bijagos Islands, molluscs gathered by the women (mainly wild oysters (*Crassostrea gasar*), arks (*Anadara senilis*) and murex shells (*Murex* spp.) provide more protein than any other food in the local diet (Anon. 1994). It is interesting to note that the oysters grow mainly in clusters on the aerial roots of *Rhizophora* trees, and are often harvested by cutting these roots rather than picking the oysters off one by one, thereby subjecting the mangroves to an additional source of stress. Another very old tradition involves the Nhominka, who migrate from the Saloum to the Bijagos Islands in the dry season and set up camp on the coast there, then return to the Saloum to grow rice when the rainy season begins. This means that traditionally there was little fishing during the rainy season, which is also the breeding season for many fish species.

In the last 15 years, these camps have begun to expand and become more permanent settlements, and the fishermen have converted to ray and shark fishing solely for the fins. Their use of shark nets also means high incidental catches of sea turtles and manatees (Almeida e Silva et al. 1999). The relative abundance of resources on this stretch of the coast has also attracted fishermen from Guinea who come to southern Guinea-Bissau where they settle and join the shark fishing fleet. First-hand accounts and research both tell of the virtually total disappearance of some species, i.e. sawfish *Pristis pectinata* and hammerhead shark *Sphyrna* spec. (Anon. 1997b). It is these same fishermen who are searching the country's last forests for the tall trees they need to build pirogues (usually silk-cotton trees, *Ceiba pentandra*) and cutting the mangroves to provide firewood for smoke-curing

bonga shad *Ethmalosa fimbriata*, or for export to villages in Guinea.

### Possible solutions

In an attempt to reconcile conservation requirements with subsistence fishing on the Banc d'Arguin, an exclusive fishing right has been granted to the Imraguen living inside the Park. This right comes with a condition attached: the use of engines is prohibited on all fishing craft. The Park Authority reasoned that this would afford adequate protection to the marine ecosystem and its resources. However, in the 25 years since the decision was taken, the situation has become more complex and the former balance has, to a certain degree, been upset. During this period several problems arose one after another. In the mid-1980s, the Imraguens dilapidated their old fleet, left behind by Canary Islanders over 50 years earlier, and virtually replaced it by motor-driven pirogues because of a lack of viable alternatives. But the use of engines is prohibited in the Park and furthermore, had the Imraguen switched to motor boats, it would have been impossible to distinguish them from other fishermen, and thus impossible to control illegal fishing. In 1988, the Banc d'Arguin National Park initiated a programme to restore the fleet and build a number of new sailing boats; this was made possible by support from the Fondation Internationale du Banc d'Arguin – (FIBA), the World Conservation Union (IUCN) and by the Netherlands Development Assistance Agency (NEDA). The programme and its various components, establishment of a boat construction yard and a cooperative, training the Imraguen men in boat-building and the women in sail making, was an important step toward strengthening the Imraguen community of which the sailing boats are a symbol, and thus helping them to claim their rightful stake in the Park's resources. Other important considerations were the fact that the boats use a non-polluting and renewable form of energy and are a major asset in the development of ecotourism which should, in time, alleviate pressure on fishing resources.

The sharp rise in the number of motorized pirogues and the decline of fishing resources outside Park boundaries have led to a marked increase in illegal fishing inside the Park. Although the Imraguens presence and the right they enjoy to harvest these resources are positive factors for ensuring more effective patrolling within the marine area of the Park, the small size of their fleet and their use of wind power limit their impact. Just when this problem was beginning to reach alarming proportions, support from the Worldwide Fund for Nature (WWF) enabled the Park to purchase three fast patrol boats. The fact that each of these has an Imraguen

member on its crew demonstrates the importance they attach to protecting Park waters.

Another structural difficulty stems from the fact that the resources sought by the Imraguen are migratory by nature and as such are not covered by Park management and protection provisions once they have left the Park. All of the efforts made, through perpetuating artisanal fishing methods with a limited number of boats, were made useless in just a few years by purse seine fishing outside the Park at the height of the mullet breeding season. Once the balance had been upset, chain reactions were quickly set in motion: fishing of a cartilaginous species developed, numbers of sea turtles harvested increased significantly and, more recently, demersal species (*Sparidae*, *Serranidae*) were targeted. The situation of the Imraguens is likely to improve because these alternative resources are still plentiful, especially compared to levels outside the Park. Furthermore, the growing awareness emerging simultaneously among fishermen and the Park Authority of the fragile nature of the ecological balances in the area has led to the establishment of a procedure for monitoring catches as well as a yearly consultation mechanism for defining acceptable fishing methods and necessary restrictions. Following studies carried out by the Park's scientific department which highlighted the vulnerable status of elasmobranches, these new procedures were implemented and decisions were taken to reduce net lengths by 25%, to institute a closed season on *Rhinoptera marginata*, *Rhinobatus cemiculus*, *Paragaleus pectoralis* and *Rhizoprionodon acutus* to protect these species during the breeding season, and to order the release on capture of young *Sphyrna lewini* less than 1 m in size (Ducrocq 1998). The catch monitoring procedure, the consultation process involving the Imraguen to determine yearly fishing policies and the unique patrolling system are features of an emerging management-centred approach which sets the PNBA apart from the rest of Mauritania's waters.

A similar conflict exists between local and migrant fishermen to the south, in Guinea Bissau. There, a working partnership between the village communities, the Ministry of Fisheries and IUCN has made it possible to launch a pilot project for the sustainable management of fishing resources on the Rio Grande de Buba. The site displays a set of characteristics which makes it representative of the majority of problems facing artisanal fishing in this region: it is, for example, an important breeding area for species including barracuda *Sphyrna sphyraena*, for which foreign fishermen have the equipment to harvest, while the means of the local fishermen limit them to subsistence catches. Artisanal fishing mainly relies on the use of castnets along the shoreline and standing nets which are set across the smaller chan-

nels of the ria. The migrant fishermen are seasonal occupants and their quarry is the barracuda, which they fish during the spawning season, mainly with drift nets. The project is founded on the assumption that if resident (local) fishing community possess the means to develop their fishery as well as a priority right of access to the resources, they will seek to defend these resources, and this will generate a sense of responsibility for the resource which is the first step to acquiring attitudes of good stewardship. The local fishermen took part in an estimation of potential available catches during experimental fishing operations organised by the Centre for Applied Fisheries Research (CIPA). Based on the results of this assessment, proposals were submitted to the Ministry of Fisheries recommending that the drift nets be replaced by line fishing during the barracuda breeding season and that annual quota be established for motor-driven pirogues which would give access to non-resident fishermen only if the local community does not use the full quota.

When implemented, these measures initially resulted in an overall drop in fishing activity and then, beginning in 1996, in larger catches per unit of effort (Anon. 1997c). In order to maximize the value of catches landed, processing and marketing were reorganised; processing reverted to traditional chilli conservation techniques while on the marketing front, an alternative to the popular salt cod (bacalhau) was made available and a weekly market was opened in the town of Buba. The success of these initiatives is greater than anyone could have hoped, especially the 525 women who make up the processing and marketing groups and whose income has risen substantially. In a broader context, it is interesting to note that the Ministry of Fisheries considered that the experience was sufficiently positive to warrant an amendment to the legislation on artisanal fishing; the law now includes the possibility of granting priority access to resident fishermen (Baran & Tous 1999).

## Conclusions

A wide range of social, economic and environmental causal factors have contributed to the current situation in subsistence fishing. Overfishing along some portions of the coast has driven some fishermen to cover larger areas and this is made possible, in part, by the ready availability of outboard motors. With debts to repay and a quickly developing market economy, fishermen have been forced to seek short-term profitability through the harvesting of shared renewable resources; this is strikingly illustrated by the fact that sharks and rays are fished solely for their fins, mullet for their roe and barracuda during the breeding season. It must be said,

however, that apart from the most vulnerable species (elasmobranchs, turtles, manatees and monk seals), artisanal fishing causes little harm compared with the big trawlers which enter areas reserved for smaller vessels and destroy the seabed (Watling & Norse 1998).

Recent experiences in several West African countries highlight a number of lessons which can be learned from the relationship between coastal resource management and artisanal fishing:

1. Migrant fishermen use an aggressive strategy which entails staking out claims to new fishing grounds and controlling distribution channels. They are much better equipped, and often more destructive, than the resident fishermen who act as members of a community who are aware that they are drawing on shared resources (Cormier-Salem 1992). Experience confirms that granting special rights of access to resident fishermen is an effective counter-measure; in defending 'their' resources, they will also protect the ecological functions of the entire area. Their presence also contributes to providing patrolling of fishing grounds at a lower cost, an important consideration in countries where there is little funding for such activities. This approach should be adopted, especially in essential fish habitats such as breeding areas and nurseries.

2. Close collaboration with administrations and development assistance agencies is needed to make these partners more aware of the inevitable ecological and biological limits on resource use, the specific characteristics of renewable resources, the need for management specifically designed for nursery areas (even some oceanographic research centres in the region do not appear to realise this), so as to enable them to gauge the consequences of political decisions, as well as the siting and specifications of infrastructure works, the size of boat motors, tax incentives, etc. Development assistance agencies in general, and Europe and Japan in particular, given their heavy involvement in commercial fishing, should strive to play a more exemplary role.

3. Artisanal fishing is one of many economic activities which take place along the coast, i.e. industrial fishing, tourism, farming, transport, town planning and conservation. In order to ensure a more harmonious co-existence of all these activities, it is essential that an integrated approach be applied through a coastal planning process. Such processes are under way in several West African countries, such as Guinea-Bissau. Given the nature of the problems and the mobility of both the resources and the fishermen, this work must not only be encouraged but also extended to the region as a whole. A recently established West African coastal planning network launched by IUCN aims to foster just such a regional approach.

4. Marine Protected Areas (MPAs) will have a key

role to play in integrated coastal zone management (ICZM) in several respects. First, they are needed to maintain healthy population levels of vulnerable species from overfishing so that they can subsequently help populations outside the protected area to recover (Roberts 1995). To this end, MPAs should not be considered as isolated units but rather as part of a whole within which they are complementary to other areas of the coastal zone. Secondly, the basic mission of MPAs includes defining and implementing methods for the sustainable management of their resources. This requires sometimes lengthy experimentation, but the results of these experiments can often be used in other non-protected areas of the coastal zone. In this instance, various categories of stakeholders having a direct interest in Mauritanian fisheries contacted conservation organisations (IUCN and FIBA) to request assistance in setting up a management model for mullet populations based on their experience in protected areas.

5. Because they are permanent dwellers on the coastal strip and because they know the area inside out, subsistence fishermen are key persons. They should be considered as the primary managers of coastal ecosystems and their resources, and it is only by working with them and helping to address their concerns that we will be able to manage the coastal zone better and safeguard the interests of fishermen and conservation alike.

**Acknowledgements.** This article was made possible by the work of many researchers in the countries mentioned herein. We would like to thank them through their institutions: the Banc d'Arguin National Park and the National Centre for Oceanographic and Fisheries Research (Mauritania), the Dakar-Thiaroye Centre for Oceanographic Research (Senegal), and the Centre for Applied Fisheries Research (Guinea-Bissau). The IUCN offices in these three countries provided much valuable documentation on their activities in the places and fields involved. Philippe Tous, Mathieu Ducrocq, Mika Diop, Luc Hoffmann and Jean-Yves Pirot reviewed the text and made many useful suggestions.

## References

- Anon. (Centre de Recherche Océanographique de Dakar Thiaroye). 1992. *La situation des ressources halieutiques en 1991 et recommandations en matière de gestion*. Document interne, Dakar.
- Anon. (Ministère du Développement Rural et de l'Agriculture – Union Mondiale pour la Nature) 1994. *Planificacao costeira da Guiné Bissau. Relatório tecnico, vol.1*. IUCN, Bissau.
- Anon. (Centre National de Recherche Océanographique et des Pêches) 1996. *Note sur la situation des ressources maritimes*. Document interne, Nouadhibou.
- Anon. (Centre National de Recherche Océanographique et des Pêches) 1997a. *Note sur l'exploitation des mulets et des sardinelles*. Document interne, Nouadhibou.
- Anon. (Centro de Investigação Pesqueira Aplicada), 1997b. *Capturas da pesca artesanal, Rio Grande de Buba (abril 1995 / abril 1997)*. Documento Cientifico no. 8., Guinea Bissau.
- Anon. (Centro de Investigação Pesqueira Aplicada) 1997c. *Resultados da pesca experimental no Arquipelago dos Bijagos, Rio Grande de Buba e Rio Cacine*. Documento Cientifico no. 9, Guinea Bissau.
- Anon. (Tour du Valat) 1998. *Les oiseaux d'eau coloniaux nicheurs dans le Parc National du Banc d'Arguin. Rapport annuel d'activités*. Fondation Internationale du Banc d'Arguin, Arles.
- Almeida e Silva, M., Araujo, A., Djedjo, F., Gomes, L. & Monteiro, H. 1999. *Plano nacional de conservação do Manatim africano (Trichechus senegalensis) na Guiné Bissau*. IUCN-Instituto para a Conservacao da Natureza, Bissau.
- Altenburg, W., Engelmoer, R., Mes, R. & Piersma, T. 1983. Recensement des limicoles et autres oiseaux aquatiques au Banc d'Arguin, Mauritanie. *Gerfaut* 73: 243-264.
- Bakhayokho, M. & Kebe, M. 1989. Problématique des relations entre pêche artisanale et pêche industrielle: cas des ressources démersales. In: Durand, J.R., Lemoalle, J. & Weber, J. (eds.) *La recherche face à la pêche artisanale – Symposium ORSTOM/IFREMER*, pp. 593-602. ORSTOM, Paris.
- Baran, E. & Tous, P. 1999. *Pêche artisanale, développement et cogestion durables des ressources. Analyse d'un succès en Afrique de l'Ouest*. IUCN, Bissau.
- Boely, T., Chabanne, J. & Fréon, P. 1978. Schémas migratoires, aires de concentrations et périodes de reproduction des principales espèces de poissons pélagiques côtiers dans la zone sénégal-mauritanienne. In: *Rapport du groupe de travail ad hoc sur les poissons pélagiques côtiers ouest-africains de la Mauritanie au Libéria (26°N à 5°N)*, pp. 63-70. Commission des Pêches pour l'Atlantique Centre-Est / Proceedings Atlantique Centre-Est, Dakar.
- Broderick, A.C., Catry, P. & Araujo, A. 1998. *A proposal for a strategy for the conservation of marine turtles in Guinea Bissau*. IUCN, Bissau.
- Busnel, R.G. 1973. Symbiotic relationship between man and dolphins. *Trans. N. Y. Acad. Sci. Ser. 11*, 35(2) : 112-131.
- Campredon, P. 1987. La reproduction des oiseaux d'eau sur le Parc National du Banc d'Arguin (Mauritanie) en 1984-85. *Alauda* 55 : 187-210.
- Ceret, B. & Opic, P. 1986. *Poissons de mer de l'Ouest Africain tropical*. Editions ORSTOM, Paris.
- Cormier-Salem, M.C. 1992. *Gestion et évolution des espaces aquatiques: la Casamance*. ORSTOM, Paris.
- Cuq, F. 1993. Remote sensing of sea surface and coastal features in the area of the Golfe d'Arguin, Mauritania. *Hydrobiologia* 258: 33-40.



- Cuq, F. (ed.) 2001. *Un système d'information géographique pour l'aide à la gestion intégrée de l'archipel des Bijagos (Guinée-Bissau). Notice de la carte, constitution et exploitation du SIG*. Géosystèmes, Brest; annex Carte de l'environnement littoral de l'archipel des Bijagos. 10 feuilles à 1 : 50 000.
- Da Silva, A.S. 1999. *Les mangroves de Guinée Bissau. In Conservation et utilisation rationnelle des forêts de mangrove de l'Amérique latine et de l'Afrique, vol. II*. International Tropical Timber Organization / International Society for Marine Ecology. UNESCO/COMARAF, Paris.
- de Naurois, R. de 1969. Peuplements et cycles de reproduction des oiseaux de la côte occidentale d'Afrique. *Mem. Muséum Natl. Hist. Nat. Nouv. Sér. A Zool.* 56: 1- 312.
- de Naurois, R. de & Roux, F. 1965. Les mangroves d'*Avicennia* les plus septentrionales de la côte occidentale d'Afrique. *Bull. Inst. Fondam. Afrique Noire* 27: 843-857.
- Del Hoyo, J., Elliott, A. & Sargatal, J. 1992. *Handbook of the birds of the world*. Lynx Edicions, Barcelona.
- Diop, M. 1998. *Pêche, commerce international et biodiversité. Cas de la Mauritanie*. UICN, Dakar.
- Diouf, P.S., Kébé, M., Le Reste, L., Bousso, T., Diadhiou, H.D. & Gaye, A.B. 1991. *Plan d'action forestier – Pêche et aquaculture continentales. Vol 1: Diagnostic*. Centre de Recherche Océanographique de Dakar Thiaroye - Ministère du Développement rural et de l'Hydraulique - Food and Agriculture Organization, Dakar.
- Diouf, P.S., Bousso, T., Diadhiou, H.D. & Kebe, M. 1993. La pêche dans les estuaires du Sénégal. In: Bâ, A., Bouland, P., Diouf, P.S. et al. (eds.) *Actes de l'atelier de Gorée sur la gestion des ressources côtières et littorales du Sénégal*. UICN, Gland.
- Ducrocq, M. 1997. *La situation de l'exploitation des requins et autres poissons cartilagineux dans l'ouest africain. Réseau régional de planification côtière*. Bubaque, Guinée Bissau.
- Ducrocq, M. 1998. *Exploitation des elasmobranches dans le Parc National du Banc d'Arguin: une expérience de participation des pêcheurs artisans à l'interprétation des résultats de la recherche et à l'aménagement de leur pêche*. Fondation Internationale du Banc d'Arguin, Arles.
- Duvail, S., Mietton, M. & Hamerlynck, O. 1998. L'après-barrage dans le bas-delta mauritanien : scénarios de gestion des eaux et modèles de développement. In: *Actes des VII<sup>e</sup> Journées de Géographie tropicale*, pp. 681-694. Ouest Editions Presses Académiques, Nantes.
- Gac, J.Y., Carn, M. & Saos, J.L. 1986. L'invasion marine dans la basse vallée du Sénégal. *Rev. Hydrobiol. Trop.* 19: 93-108.
- Gonzalez, L.M., Aguilar, A., Lopez-Jurado, L.F. & Grau, E. 1997. Status and distribution of the mediterranean Monk seal *Monachus monachus* on the Cabo Blanco peninsula (Western Sahara - Mauritania) in 1993-1994. *Biol. Conserv.* 80: 225-233.
- Hamlet, W.C. 1997. Reproductive modes of elasmobranchs. *Shark News* 9: 1-3.
- Harwood, J., Lavigne, D. & Reijnders, P. 1998. *Workshop on the causes and the consequences of the 1997 mass mortality of Mediterranean monk seals in the western Sahara*. Instituut voor Bos- en Natuuronderzoek, Scientific Contributions 11. Amsterdam.
- Joao Lopes, A. 1998. *Etude de la population d'Hippopotames Hippopotamus amphibius du Parc de Cacheu et des régions de Susana et Varela, Guinée Bissau*. UICN, Bissau.
- Kebe, M. & Le Reste, L. 1993. Conflits liés au secteur des pêches sénégalaises. In: Bâ, A., P. Bouland, P., Diouf, P.S. et al. (eds.) *Actes de l'atelier de Gorée sur la gestion des ressources côtières et littorales du Sénégal*. UICN, Gland.
- Le Reste, L., Fontana, A. & Samba, A. 1986. *L'estuaire de la Casamance: environnement, pêche, socio-économie*. Institut Sénégalais de Recherche Agricole – Centre de Recherche Océanographique de Dakar Thiaroye, Dakar.
- Limoges, B. & Robillard, M.J. 1989. *Résultats de l'inventaire faunique au niveau national et propositions de modification à la loi sur la chasse*. Centre d'Etudes et de Coopération Internationale – Ministère du Développement Rural et de l'Agriculture – Union Mondiale pour la Nature, Bissau.
- Marchessaux, D. 1986. *Conservation du Phoque moine, Monachus monachus, sur la péninsule du Cap Blanc, République Islamique de Mauritanie. Plan d'aménagement de la réserve satellite du Cap Blanc. Rapport final*. World Wildlife Fund for Nature, Gland.
- Pages, J. & Citeau, J. 1990. Rainfall and salinity of a sahelian estuary between 1927 and 1987. *J. Hydrol.* 113 : 325-341.
- Reizer, C. 1974. *Définition d'une politique d'aménagement des ressources halieutiques d'un écosystème aquatique complexe par l'étude de son environnement abiotique, biotique et anthropique*. Thèse de Doctorat, Université d' Arlon.
- Roberts, C.M. 1995. Rapid build-up of fish biomass in a Caribbean Marine reserve. *Conserv. Biol.* 9: 815-826.
- Robineau, D. & Vely, M. 1998. Les cétacés des côtes de Mauritanie (Afrique du nord-ouest). Particularités et variations spatio-temporelles de répartition: rôle des facteurs océanographiques. *Rev. Ecol. (Terre Vie)* 53: 123-152.
- Saine, A. 1998. *Fisheries, International trade and biodiversity. Case studies: The Gambia*. UICN, Dakar.
- Samb, B. 1998. *Pêche, commerce international et biodiversité. Etude de cas: Sénégal*. UICN, Dakar.
- Schwarz, B. 1992. *Identification, establishment and management of specially protected areas in the WACAF (West and Central Africa) Region: National and regional conservation priorities in terms of coastal and marine biodiversity*. IUCN, Gland.
- Troadec, J.P. & Garcia, S. 1980. *The fish resources of the eastern central atlantic. Part one : the resources of the Gulf of Guinea from Angola to Mauritania*. FAO (Food and Agriculture Organization) Fisheries Technical Paper 186.1, Rome.
- Trotignon, E., Trotignon, J., Baillou, M., Dejonghe, J.F.,

- Duhautois, L. & Lecomte, M. 1980. Recensement hivernal des limicoles et autres oiseaux aquatiques sur le banc d'Arguin, Mauritanie (hiver 1978/1979). *L'Oiseau R.F.O* 50: 323-343.
- Vincke, P.P. & Thiaw, I. 1995. Protected areas and dams: the case of the Senegal River delta. *Parks* 5: 32-38.
- Watling, L. & Norse, E.A. 1998. Disturbance of the seabed by mobile fishing gear: a comparison to forest clearcutting. *Conserv. Biol.* 12: 1180-1197.
- Zwarts, L., van der Kamp, J., Overdijk, O., van Spanje, T.M., Veldkamp, R., West, R. & Wright, M. 1998. Wader count of the Banc d'Arguin, Mauritania, in January/February 1997. *Wader Study Group Bull.* 86: 53-69.

Received 11 September 2000;  
Revision received 9 April 2001;  
Accepted 21 May 2001.  
Coordinating Editor: R. Paskoff.