

October 2005



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WESTERN CENTRAL ATLANTIC FISHERY COMMISSION
Twelfth Session

WECAFC LESSER ANTILLES FISHERIES COMMITTEE
Ninth Session

Port of Spain, Trinidad and Tobago, 25-28 October 2005

THE STATUS OF FISHERIES IN THE WECAFC REGION

STATUS OF THE STOCKS OF THE WESTERN CENTRAL ATLANTIC

FAO Statistical Area 31

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INTRODUCTION

The area under the competence of the Western Central Atlantic Fisheries Commission (WECAFC) extends from Cape Hatteras in North Carolina, United States (35°N), to just south of Cape Recife in Brazil (10°S). It includes an area of nearly 15 million km² of which approximately 1.9 million km² is shelf area (Stevenson, 1981). The major subdivisions in the area are the Southeast coast of the United States, the Gulf of Mexico, the Caribbean Sea and the Northeast coast of South America which includes the Guianas and Brazil.

The WECAFC area includes FAO Statistical Area 31 and a portion of Area 41 occurring offshore of northern Brazil. This chapter deals only with Area 31 (Figure B3.1 and Table B3.1). The region is geographically one of the most complex regions of the world, and is split up into a number of deep ocean basins separated by shallow zones, and a large number of island platforms, offshore banks and the continental shelf. The major island groups in Area 31 are the Bahamas and adjacent banks and islands, which account for over half of the islands and banks shelf area, the Greater Antilles (Cuba, Puerto Rico, the Virgin Islands, and Hispaniola), and the Lesser Antilles (Stevenson, 1981).

The Western Central Atlantic area is characterized by anti-cyclonic (i.e. clockwise) flow of currents. The North Equatorial Current flows westwards just north of the equator and meets with the Guiana current to form a western boundary current. Where this boundary current enters the Western Central Atlantic it splits into the Antilles and the Caribbean currents. The Antilles current flows northwards on the Atlantic Ocean side of the Antilles islands, eventually joining with the Florida Current. The remainder of the western boundary current flows through the eastern Caribbean, mainly between Barbados and Tobago, where it forms the “core” of the north and westward flowing Caribbean Current that eventually enters the Yucatan Channel. However, the Caribbean Current also includes significant meanders, filaments and eddies (Appeldoorn *et al.*, 1987; Smith *et al.*, 2002). The water entering the Caribbean then flows through the Yucatan Channel into the Gulf of Mexico where it becomes the loop current that flows clockwise through the Gulf, and through the Straits of Florida to become the Florida Current. The Florida Current and the Antilles Current combine to form the Gulf Stream, flowing northwards along the east coast of the United States of America and Canada (Stevenson, 1981; Smith *et al.*, 2002). The pronounced overall movement of water from south east to north west through the Western Central Atlantic is probably very important for distribution of larvae, for example of the Caribbean spiny lobster, but the area is also marked by substantial variability, with counter currents, meanders and eddies. The region also comes under the influence of runoff from the major rivers discharging into the region: the Mississippi, Orinoco and Amazon Rivers, and of frequent hurricanes.

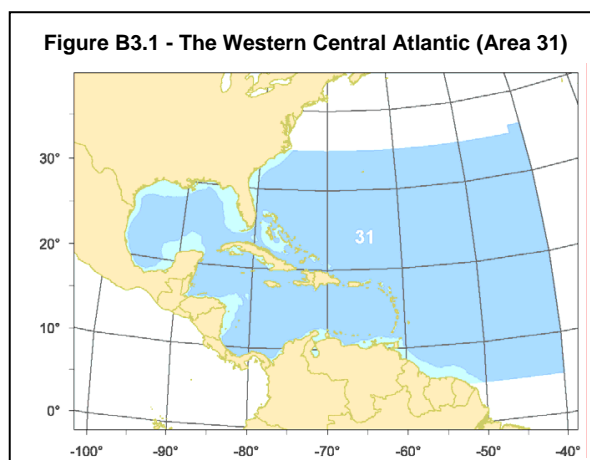


Table B3.1 Locality and area of the major coastal shelf zones in the WECAF area (Stevenson, 1981)

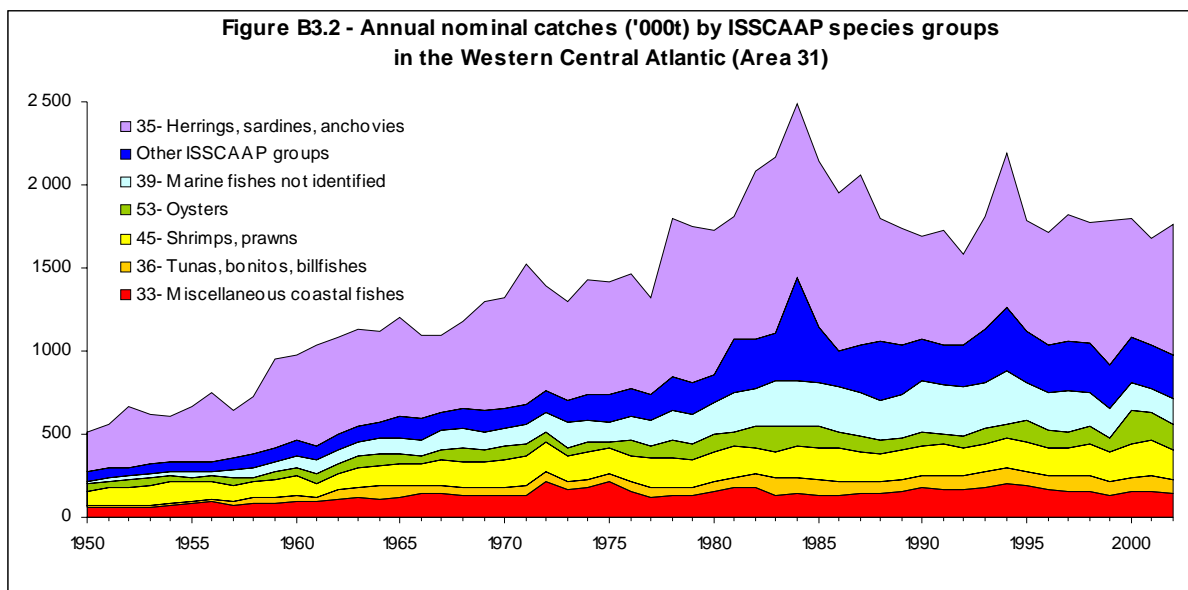
| FAO Area | AREA ('000 km ²) | LOCATION |
|----------|------------------------------|--------------------------------|
| | | Continental Shelf |
| 31 | 110 | U.S. east coast |
| 31 | 600 | Gulf of Mexico |
| 31 | 250 | Yucatan – Eastern Venezuela |
| 31 | 200 | Guyana, Surinam, French Guiana |
| 41 | 360 | Northern Brazil |
| | 1520 | TOTAL Continental shelf |
| | | Islands |
| 31 | 380 | Islands and offshore banks |
| | 1900 | GRAND TOTAL |

* FAO, Marine Resources Service, Fisheries Resources Division

The geographic complexity of the Western Central Atlantic results in equally complex bio-diversity, with at least 1 172 species of invertebrates, fish and tetrapods occurring in the region. Of these, 987 are fish species and 23 percent of the fish species are “rare or endemic to the region”. The zones of highest diversity are the waters of southern Florida, eastern Bahamas and northern Cuba. The Caribbean probably has the highest species-richness in the Atlantic (Smith *et al.*, 2002).

PROFILE OF CATCHES

Nominal catches from the region increased steadily from approximately 500 000t in 1950, to a peak of approximately 2.5 million tonnes in 1984. They subsequently declined but showed some increases in the early 1990s, with just under 2.0 million tonnes being landed in 1994 but have been stable at between 1.5 and 1.7 million tonnes since then (Figure B3.2). A worrying feature of records from the WECAFC region continues to be the poor identification of landings and, for example, Group 39 Marine fishes not identified accounted for nearly 163 000t of the total landings in 2002.



The average landings per year for the years 2000 to 2003 inclusive by ISSCAAP group are shown for each country reporting landings from the WECAFC area to FAO in Table B3.2. The country recording the greatest landings, over 900 000 t per year on average was the United States of America. Venezuela and Mexico also recorded landings in excess of 100 000 per year.

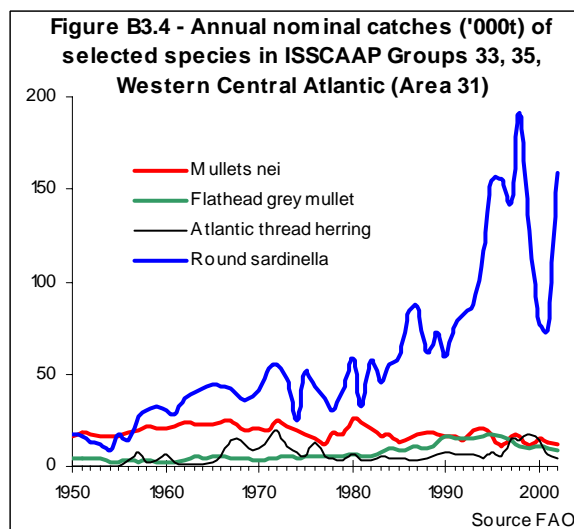
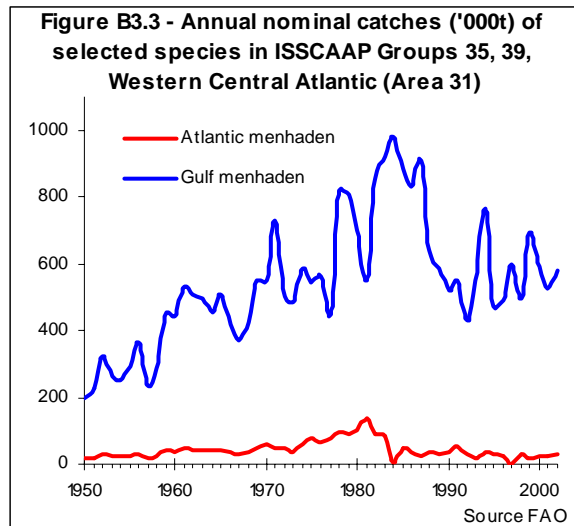
The ISSCAAP group making the largest contribution to catches continues to be Group 35 herrings, sardines, anchovies. It accounted for over 50% of the average annual landings between 2000 and 2003 of the United States of America and over 35% of the landings from Venezuela. The group is dominated by the Gulf menhaden (*Brevoortia patronus*) which occurs from the Yucatan Peninsula to Florida. Catches of the species increased irregularly from about 200 000t in 1950 to close to one million tonnes in 1984 but declined somewhat thereafter and have varied between just under 500 000t and 700 000t in recent years (Figure B3.3). There was also an important fishery for the other menhaden species, Atlantic menhaden (*B. tyrannus*), with peak catches of 140 000t in 1981, but the fishery declined steeply in subsequent years to under 4 000t in 1984. Catches have been under 40 000t since 1992 (Figure B3.3).

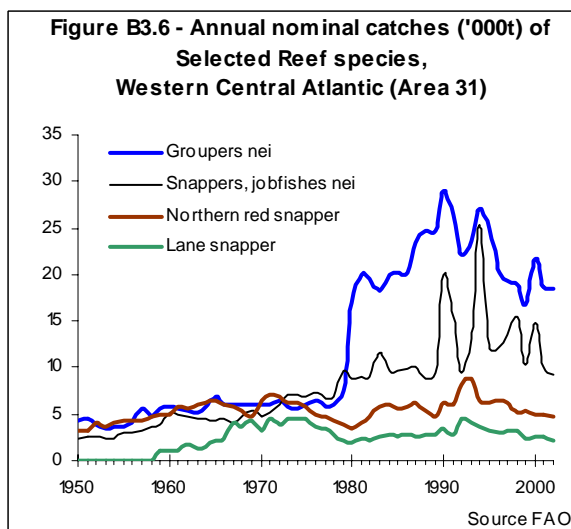
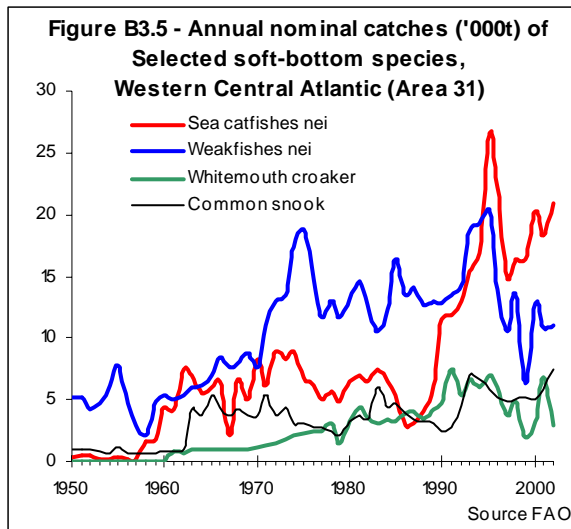
Including the substantive contribution from Group 35, small pelagics accounted for the largest catches by mass. Fishes from seven families dominate small pelagics catches in the region. These are: Exocoetidae (flyingfish); Clupeidae (herrings and sardines); Engraulidae (anchovy and anchoveta); Carangidae (jacks, bumpers and scads); Hemiramphidae (halfbeaks); Belonidae (needlefish) and Mugilidae (mullet). The round sardinella (*S. aurita*) is an important small pelagic species and total

catches of this species increased steeply from 59 000t in 1990 to almost 200 000t in 1998 (Figure B3.4), mostly recorded by Venezuela. Landings decreased substantially in 2000 and 2001, with catches just over 70 000t, but increased again to approximately 160 000t in 2002. Other small pelagic species occurring in ISSCAAP Groups 33 (Miscellaneous coastal fishes), and Group 35 (Herrings sardines anchovies) include the flathead grey mullet (*Mugil cephalus*), unidentified mullets and the Atlantic thread herring (*Opisthonema oglinum*), all of which have generated catches under 20 000t in recent years (Figure B3.4). Atlantic thread herring landings fell to 7 000t in 2001 and to 5 000t in 2002, less than half those of immediately preceding years. There has been a substantial increase in landings of the unidentified jacks and crevalles of the genus *Caranx*. Fished mainly by Mexico and Venezuela, catches of this group approximately doubled from the early 1980s to their 1997 and 1998 values of over 12 000t, although they have fallen to around 9 000t per year since then. The four-winged flyingfish (*Hirundichthys affinis*) supports locally important fisheries in some of the lesser Antilles islands, including Barbados, Grenada and Tobago. Catches of this species peaked at nearly 6 000t in 1988, but more typically fluctuate between 1 000 and 2 800t, as they have done throughout the 1990s and up to 2002. The common dolphinfish (*Coryphaena hippurus*) is another pelagic species important to the small island states. It is also landed by the United States and Mexico, and a directed fishery for the species has developed in Venezuela in recent years. Catches of common dolphinfish in the region doubled from 2 014t in 1984 to 4 629t in 1997 but varied between 3 200t and 3 900t over the next few years.

The ISSCAAP Group 33 – miscellaneous coastal fishes also makes an important contribution to the catches of the region and is caught in substantial quantities by Mexico, the United States of America and Venezuela (Figure B3.2 and Table B3.2). This group covers a wide diversity of species, of which the following contribute most to catches: sea catfishes (*Ariidae*); groupers, seabasses etc. (*Serranidae*), especially the groupers (*Epinephelus* spp.); grunts, sweetlips (*Haemulidae*); snappers, jobfishes (*Lutjanidae*), especially the unidentified snappers (*Lutjanus* spp.) and the yellowtail snapper (*Ocyurus chrysurus*); croakers, drums (*Sciaenidae*) especially the weakfishes (*Cynoscion* spp.) and the whitemouth croaker (*Micropogonias furnieri*); the ponyfishes (*Leiognathidae*); and the snooks (*Centropomidae*) especially the common snook (*Centropomus undecimalis*). The catches made up by members of this group totalled 132 000t in 2002, somewhat lower than during most of the previous decade.

The miscellaneous coastal fish can be subdivided into two broad groups based on habitat: those occupying areas with soft substrata and those typically occurring over reefs. Amongst those occupying areas with soft substrata, unidentified sea catfishes accounted for the highest catches in recent years, showing a substantial increase from under 5 000t in 1988 to over 18 000t since 2000. (Figure B3.5). These species are recorded on the FAO database as being landed by mainland countries, especially Mexico and Venezuela. Unidentified weakfishes peaked at over 20 000t in 1995 but have also





subsequently declined (Figure B3.5). Catches identified as spotted weakfish (*Cynoscion nebulosus*) totalled more than 6 000t in recent years, with the exception of 2001 when catches fell to 4 900t. The whitemouth croaker and common snook were also important contributors to catches of fish from soft-bottomed habitats. Landings of both these species have shown increases since 1950, with the whitemouth croaker generating catches of over 5 000t from 1991 to 1996, oscillating in the following years from 1 900t to 6 800t. The common snook has produced landings of between approximately 5 000t and just over 6 000t since 1995 (Figure B3.5).

Amongst the dominant reef fishes in catches, those of unidentified groupers increased markedly in the late 1970s and early 1980s, from under 10 000t, to above 20 000t. Since the peak in the late 1980s, they show a generally decreasing trend (Figure B3.6). Catches of Nassau grouper (*E. striatus*) have fallen from 3 200t in 1967 to well under 500t in recent years. While FAO data indicate that catches of red grouper (*Epinephelus morio*) fell from a peak of over 12 000t in 1980 to 86t in 2002, they do not appear to include the catches of the species from Mexico. A report by Monroy *et al.* (2001) provided catches of red grouper from Campeche Bank by Mexico and Cuba. Those data showed that landings had declined substantially from the peak of nearly 20 000t in 1972 but were still above 8 000t in

2001. Catches of northern red snapper (*Lutjanus campechanus*) and lane snapper (*L. synagris*) remained relatively constant in the 1970s and 1980s but, after reaching peaks in the early 1990s, showed steady declines from then to 2002, the most recent figures available.

There are also important fisheries for snapper on the Brazil-Guianas shelf, targeting particularly the southern red snapper (*L. purpureus*) but also lane snapper and the Vermillion snapper (*Rhomboplites aurorubens*). Several of the countries of the Brazil-Guianas shelf have local and foreign fleets fishing for snapper in their waters and Venezuelan vessels are particularly active, fishing legally in the EEZs of most countries in the area. Venezuela has reported that between about 3 500 and 5 000t of southern red snapper are landed annually in Venezuela, with over 50 percent caught in foreign waters (FAO, 1999a).

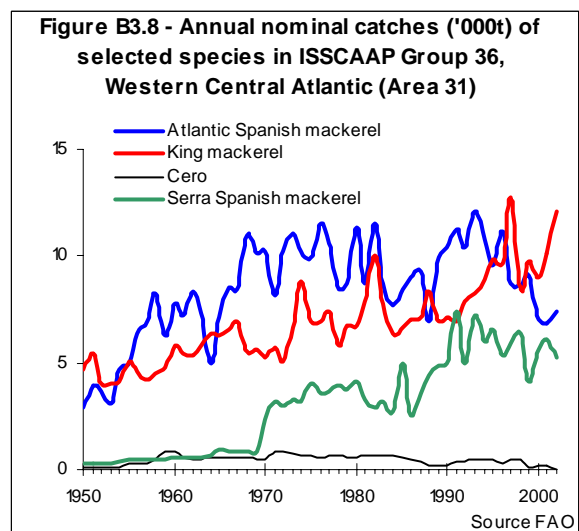
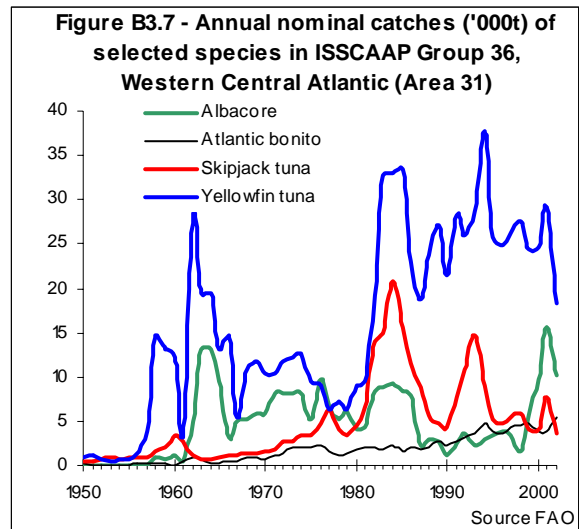
The catches of ISSCAAP Group 36 tunas, bonitos, and billfishes have increased over the last three decades and catches during the 1990s averaged 87 000t, compared to averages of 80 000t in the 1980s and 52 000t in the 1970s. Catches reached 104 000t in 2001, the highest on record, and decreased in the following year to 84 000t. Venezuela accounted for nearly 30 000t per year on average between 2000 and 2003, followed by Mexico (above 14 000t) and Taiwan Province of China (7 900t). St Vincent and the Grenadines recorded average landings of 4 900t per year during this period (Table B3.2). For management purposes, this group is divided into two sub-groups, the oceanic species whose distribution extends beyond the WECAFC region and can be trans-oceanic, and the coastal large pelagics whose distribution is largely confined to the WECAFC region. Amongst the oceanic species, by far the largest catches are for yellowfin tuna (*Thunnus albacares*), catches of which increased

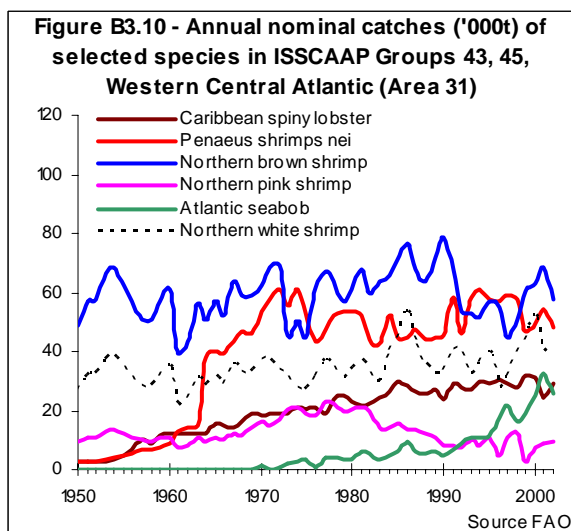
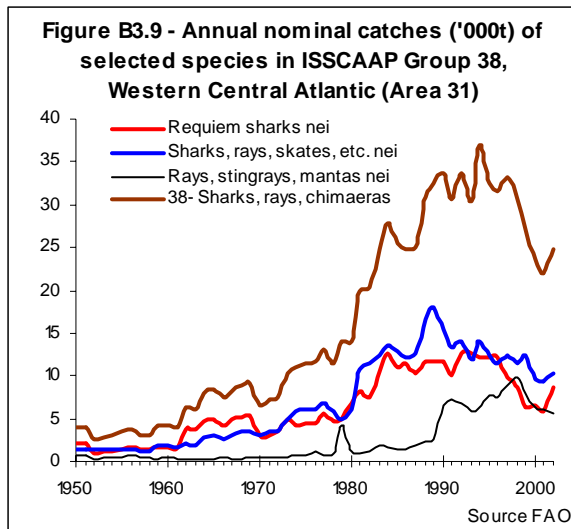
steeply in the early 1980s, as a result of increasing fishing effort mainly by fleets from within the region. Nearly 30 000t of the species was landed in 2001, compared to about a half of this amount or less for the other major species (Figure B3.7). However in 2002 yellowfin tuna catches fell to just over 18 000t.

The coastal large pelagic catches were dominated by four species of *Scomberomorus*. In 2002, the recorded landings of these four were: king mackerel (*S. cavalla*) 12 131t; Atlantic Spanish mackerel (*S. maculatus*) 7 361t; Serra Spanish mackerel (*S. brasiliensis*) 5 250t; and Cero (*S. regalis*) with 147t in 2001 but no catches recorded in 2002. Catches of Atlantic Spanish mackerel decreased in recent years from a peak in the early 1990s (Figure B3.8).

Sharks (ISCAAP Group 38 – sharks, rays, chimaeras) have attracted considerable attention in recent years, as concerns have been raised about their over-exploitation. Within the WECAFC region, catches of chondrichthyans have escalated spectacularly since 1950, reaching a peak of 37 000t in 1994, but have fallen since then with some oscillation to nearly 25 000t in 2002 (Figure B3.9). Mexico and Venezuela recorded the highest landings of Group 38 between 2000 and 2003, followed by Costa Rica (Table B3.2). The major contributors to the landings in 2002 were: sharks, rays, skates etc nei; requiem sharks nei; and rays, stingrays, mantas etc.; with much smaller landings of shortfin mako, silky shark, smoothhounds nei, nurse sharks, blue sharks and dogfish sharks nei. The dominance of landings in only broadly identified taxonomic categories demonstrates the poor quality of much of the data submitted to FAO from the region. The fact that so little information is available on the species composition of the landings reinforces the need for improved and careful monitoring.

A report by Yegres *et al.* (1996) on the shark fishery in Venezuela, operating beyond the EEZ of that country in both the Caribbean Sea and the Atlantic Ocean in the south western reaches of the WECAFC area, listed 31 shark species as being caught. The most common, by number, in the industrial fleet included blue shark (*Prionace glauca* - 36 percent), reef shark (*Carcharhinus springeri* - 14 percent), and shortfin mako (*Isurus oxyrinchus* - 12 percent), and in the artisanal fleet, Caribbean sharpnose shark (*Rhizoprionodon porosus* - 21 percent), scalloped hammerhead (*Sphyrna lewini* - 14 percent) and small eye hammerhead (*S. tudes* - 12 percent). Bonfil (1997) reported that 34 species of shark occur in the Mexican waters of the Gulf of Mexico, of which 14 are important in fisheries and nine of these he described as being of “prime importance”. Of the nine most important, five *Carcharhinus* and two *Sphyrna* species.





Some of the most valuable fisheries in the Western Central Atlantic are crustacean fisheries, in particular that for Caribbean spiny lobster (*Panulirus argus*) and those for a number of shrimp species, particularly penaeid shrimps (Figure B3.10). Landings of spiny lobster in Area 31 (i.e. excluding those from Brazil) reached a peak of 31 000t in 2000 but fell to 25 000t in 2001 and recovered somewhat to 29 000t in 2002. Landings of this species have a high monetary value per unit mass, and the resource is therefore one of the most valuable in the region. The highest landings between 2000 and 2003 of this group (ISSCAAP group 43) were recorded by (in descending order) Bahamas, Cuba, Nicaragua and the United States of America (Table B3.2).

Recorded catches of unidentified penaeid shrimps were 48 000t in 2002, varying without meaningful trend, between approximately 40 000t and 58 000t since the mid-1970s. The most productive shrimp species is the northern brown shrimp (*Farfantepenaeus aztecus*), with 2002 catches of 57 000t, followed by the Northern white shrimp (*Litopenaeus setiferus*) with catches of 43 000t in the same year. The genus structure of the penaeid shrimps was recently revised by Pérez Farfante and Kensley (referred to in Carpenter, 2002). This new system is applied here. Previously the species within these new genera would have been included in the genus *Penaeus*. One shrimp species where catches have increased in recent years is that for the Atlantic seabob (*Xiphopenaeus kroyeri*). Catches were only approximately 5 000t

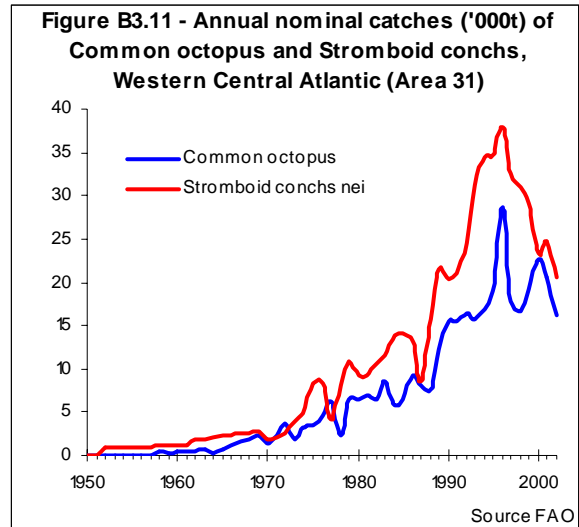
in 1990 but reached over 32 000t in 2001 and declined to 26 000t in 2002. The highest landings of shrimps and prawns (ISSCAAP Group 45) between 2000 and 2003 were recorded by the United States of America (124 000t), Guyana (22 000t) and Mexico (20 000t) (Table B3.2).

Amongst the molluscs, the highest catches (given in total weight, including shell) in recent years have been of American cupped oyster (*Crassostrea virginica*), which varied during the 1990s from less than 59 000t (1991) to a peak of 195 000t in 2000, and ark clams (*Arca* spp.) of which over 45 000t were landed in 2002. Catches of calico scallop (*Argopecten gibbus*) have been highly variable, peaking at nearly 400 000t total weight in 1984, but with no landings recorded in 1991-1993 and again since 1996.

Substantial increases have been observed in recent years in the recorded landings of common octopus (*Octopus vulgaris*) and the stromboid conchs (*Strombus* spp.). Catches of both have increased steadily since 1950 (Figure B3.11). Catches of common octopus were slightly over 8 500t in 1983 and subsequently climbed to an average of over 18 000t in the 1990s, with the highest recorded landings of over 28 000t in 1996. Landings of just over 16 000t were recorded in 2002. It was reported at the Second Meeting of the WECAFC Scientific Advisory Group that landings of octopus on the Atlantic coast of Mexico (the largest producer of squids, cuttlefish and octopus, ISSCAAP Group 57, from 2000-2003, Table B3.2) actually consisted of substantial contributions from both common octopus and a local endemic species the Mexican four-eyed octopus (*Octopus maya*). The increase in catches of stromboid conchs has also been marked. Catches in 1984 were over 13 000t but then fell to approximately 9 000t in 1987. Average annual catches during the 1990s were nearly 30 000t. The

highest recorded landings of over 37 000t were registered in 1997. Catches have declined since then to 20 000t in 2002. Mexico (7 400t), the Turks and Caicos (5 700t), Dominican Republic (1 900t), Belize (1 700t) and Puerto Rico recorded landings of ISSCAAP Group 52, which includes conchs, in excess of 1 000t per annum from 2000 to 2003 (Table B3.2).

All species of Cheloniidae, the sea turtles, have been listed on CITES Appendix 1 since 1977. Despite this, landings of the three species recorded on the FAO database for the WECAFC area (green, hawksbill, loggerhead) and those not identified, remained high until the late 1980s and, in fact, peaked at 1 600t in 1985. Thereafter, they declined rapidly, falling to only 31t in 1999, made up mainly of green and hawksbill turtles. The recorded catches in 2002 were 42t. Marine turtles have been harvested and utilized in the WECAFC region for a range of uses from subsistence to provision of luxury items (Fleming, 2001).



RESOURCE STATUS AND FISHERY MANAGEMENT

The capacity for fisheries management differs markedly between the different coastal states of the Western Central Atlantic. In some countries there are appropriate institutions, with fishing and fisheries being monitored and controlled in attempts to ensure sustainable utilization, while in others fisheries are largely unmanaged or managed only in a rudimentary manner. However, even amongst the most advanced fisheries management agencies in the region, there are problems in coping with the high species diversity, and from the region as a whole there is little information on the status of the important resources and even less on the hundreds of species of lesser importance to the region's fisheries. In its 2002 report to Congress (NMFS, 2002), the National Marine Fisheries Service of the United States (NMFS) recorded that of the 57 stocks falling under the jurisdiction of the Gulf of Mexico Fisheries Management Council (GMFMC), the status of 46 (81 percent) was either unknown or undefined. Of the 179 stocks falling under the jurisdiction of the United States Caribbean Fisheries Management Council (CFMC), the status of 175 (98 percent) was unknown or undefined. As stated in earlier reports, it is very unlikely that the state of knowledge is any higher than this in most other countries in the region.

Based on their stock sizes, neither of the two menhaden species, the Gulf and the Atlantic menhaden, are considered to be overfished (according to the USA Sustainable Fisheries Act, a stock is overfished when its size is below a prescribed biomass threshold, regardless of the cause(s), NMFS, 2002). Amongst the small pelagics, the only quantitative estimate of status available was for the round sardinella in Venezuela, based on virtual population analyses (VPA) by Mendoza *et al.* (1994). They estimated that the stock was lightly exploited at that time, but that may have changed with the increased annual catches showed in Figure B3.4. The high variability in recent years makes this difficult to evaluate. The status of the many other species of small pelagics is largely unknown. Amongst these are the carangids, with 15 genera and 31 species occurring in the region, again indicating the difficulties associated with assessment and management of the resources of the region. The general understanding of the stock status of small pelagics in the region is that they vary from under- to fully-exploited (FAO, 1998). WECAFC has initiated an ad hoc Working Group on Flyingfish of the Eastern Caribbean to facilitate cooperation and communication on this shared resource but the Working Group has not been active since the previous Commission meeting.

The groundfish species are dominated by ISSCAAP Group-33 miscellaneous coastal fishes. Of these, the Nassau grouper (*Epinephelus striatus*) and Goliath grouper (Jewfish, *Epinephelus itajara*) are under rebuilding programmes for both the Gulf of Mexico and the Caribbean Fishery Management Councils. In the Gulf of Mexico, fishing mortality has been reduced below the desired threshold, but this is not reported for the stocks under the CFMC. The Red snapper (*Lutjanus campechanus*) and the Red drum (*Sciaenops ocellatus*) remain on rebuilding programmes for the Gulf of Mexico stocks, and reductions in fishing mortality are still being recommended or required for both of them. Fishing mortality for another two Gulf of Mexico stocks, Vermilion snapper (*Rhomboplites aurorubens*) and Gag grouper (*Mycteroperca microlepis*) is now considered to be above the minimum threshold biomass but a reduction in fishing mortality is recommended. The status of the Greater Amberjack (*Seriola dumerili*) in the Gulf of Mexico was estimated to be "not overfished", but NMFS recommend that a rebuilding programme is required for the stock. The Red grouper (*Epinephelus morio*) is considered to be overfished and to be undergoing undesirably high fishing mortality. A rebuilding programme is under development for the stock. In the coastal waters of Mexico, Red grouper has been estimated to be overexploited (Arenas and Díaz de León, 1998). The status of the remaining reef fishes falling under the jurisdiction of both Management Councils of the USA was unknown.

The latest estimates of the status of the groundfish stocks of the Brazil-Guianas shelf remain those produced under the joint activities of the CARICOM Fisheries Resource Assessment and Management Programme (CFRAMP) and the FAO WECAFC *ad hoc* Working Group on the Shrimp and Groundfish Fishery of the Brazil-Guianas Shelf. The stocks which have undergone preliminary analyses are primarily soft-bottom dwellers and include some local stocks of whitemouth croaker (*Micropogonias furnieri*), Jamaica weakfish (*Cynoscion jamaicensis*) and green weakfish (*C. virescens*), small eye croaker (*Nebris microps*), and king weakfish (*Macrodon ancylodon*). As a result of limited data, the results were only preliminary, but using yield and spawner biomass per-recruit reference points, there were indications that the stocks which were examined were being overexploited (FAO, 1999; 2000). A recent assessment of *L. purpureus* in French Guiana, showed indications of over-exploitation of the stock (Charuau, 2000). The groundfish resources of the Brazil-Guianas shelf are covered by the WECAFC *ad hoc* Working Group on Shrimp and Groundfish Resources of the Brazil-Guianas shelf, which is discussed below in connection with management of shrimp resources.

Apart from these scientifically-based estimates, there is a general acceptance of the fact that the inshore reef and groundfish resources of the region are commonly fully exploited and some are overexploited (FAO, 1998). Mahon (1993) reported that "It is generally accepted that reef fish resources of the island platforms are extremely overexploited in most Lesser Antillean countries".

Interest continues amongst some states of the region for expanding their fisheries for large pelagics, both oceanic and coastal, and in recent years, fisheries for these stocks have increased considerably. The stocks being targeted by these expanding fisheries fall under the mandate of the International Commission for the Conservation of Atlantic Tunas (ICCAT), but assessments are only undertaken for the oceanic stocks within their mandate. Recent assessments available (ICCAT, 2002) indicate that yellowfin tuna, which is considered to consist of a single Atlantic stock, is fully-exploited and possibly overexploited. The ICCAT Standing Committee on Research and Statistics therefore recommended that fishing mortality on this stock should not be increased. Some fishing for bigeye tuna (*Thunnus obesus*) occurs off the coast of Venezuela. The stock is considered to be overexploited and fishing mortality is above the MSY rate. The stock structure of skipjack tuna (*Katsuwonus pelamis*) is not well known, but it is treated as two management units, an eastern and a western unit. The most recent assessment for this stock was done in 1999 and ICCAT (2002) estimated the status of the western stock to be "stable".

Several other large pelagic species fished in the western central Atlantic have also been assessed by ICCAT. The results of the 2002 assessments are: west stock of the Atlantic bluefin tuna (*Thunnus thynnus*) – overfished to a point where recruitment could be low because of low spawner stock biomass; Atlantic blue marlin (*Makaira nigricans*) — biomass estimated to be about 40 percent of

B_{MSY} and over-fishing is considered to have been taking place for the last 10 to 15 years; white marlin (*Tetrapterus albidus*) – the stock is considered to be severely overexploited and that over-fishing is continuing; western Atlantic sailfish (*Istiophorus platypterus*) – current catches are thought to be sustainable; and Northern Atlantic swordfish (*Xiphias gladius*) – status is considered to have improved in recent years and the biomass is estimated to be just below B_{MSY} and the fishing mortality to be below the MSY rate.

Amongst the coastal species, the status of Serra Spanish mackerel and Cero is unknown. NMFS (2002) consider a Gulf of Mexico "group" of the king mackerel to be have been overfished but that, under a rebuilding programme, fishing mortality is now below the threshold. The Atlantic "group" is considered to be "not overfished". Marcano *et al.* (1999) found no signs of overexploitation of King mackerel in their study on a fishery for the species in eastern Venezuela. Neither the Gulf nor the Atlantic "groups" of Atlantic Spanish mackerel are considered overfished by NMFS. Dolphinfinh, which does not fall within the ICCAT mandate, is now considered to be a single stock throughout the Western Central Atlantic (Wingrove, 2000 and Prager, 2000, as reported in FAO, 2002a) and has been estimated to be well above B_{MSY} and fishing mortality to be below the MSY rate.

In relation to the role of WECAFC in research and management of the large pelagic resources, under a FAO Technical Co-operation Programme, 'Preparation for expansion of domestic fisheries for large pelagic species by CARICOM countries' (FI: TCP/RLA/0070), the participating CARICOM countries considered options for management of the shared large pelagic resources occurring within their EEZs. For oceanic large pelagics, it was proposed that CARICOM countries become fully involved in ICCAT's activities and that the CARICOM CFU/CRFM could play a role in coordinating the development and presentation of common positions for CARICOM countries on ICCAT management issues. With regard to coastal large pelagics, it was noted that, with the exception of dolphinfinh, these fell under the mandate of ICCAT but that there was at present no regional management of these resources. The participants in the project raised the option of establishing a Regional Working Group (RWG) on coastal large pelagics with a mandate for assessment of western Atlantic/Caribbean coastal large pelagic fish resources, including those resources not included in the ICCAT mandate. Recognizing ICCAT's management authority, the results of stock assessments and management recommendations of the working group could be forwarded to the ICCAT Commission for consideration. The project participants suggested that, because many of the WECAFC countries are currently not ICCAT Member States, a CARICOM Regional Fisheries Mechanism or a WECAFC Working Group may be appropriate for this purpose.

The status of the stocks of sharks in the region is poorly understood, but there is concern due to their vulnerability to over-exploitation. Bonfil (1997) referred to some assessments undertaken on shark in Mexico, suggesting fishing mortalities ranging from approaching that yielding the maximum sustainable yield (F_{MSY}) to above them. However, he stressed the preliminary nature of these assessments. He did draw attention to the concentration of fishing effort on juvenile sharks in Mexico, which he suggested was one of the most important concerns in these fisheries. Many of the stocks of shark in Area 31 are likely to be widely distributed and hence to require regional and international co-operation for adequate fishery management. WECAFC Members could consider a role for WECAFC in facilitating improved management and sustainable use of sharks in the region, which could include promoting implementation of the IPOA-Sharks. The 3rd Session of the WECAFC Scientific Advisory Committee (SAG) recommended that WECAFC countries that have not yet developed and implemented a National Plan of Action on sharks should do so urgently.

The Caribbean spiny lobster is listed in Annex III of the Protocol Concerning Specially Protected Areas and Wildlife (the SPAW protocol) of the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (the Cartagena Convention). For species listed on Annex III, contracting Parties to the SPAW protocol "shall adopt appropriate measures to ensure the protection and recovery of the species... and may regulate the use of such species in order to ensure and maintain their populations at the highest possible levels". The status of the species was examined at two workshops held in 1997 and 1998 under the auspices of the WECAFC ad hoc Working

Group on Caribbean Spiny Lobster (*Panulirus argus*), attended by scientists from all the major lobster producing nations in the region (FAO, 2001), and reviewed at subsequent workshops in 2000 and 2002. The results from these workshops indicated a resource that is being fully or overexploited throughout much of its range, although there were insufficient data from some areas to estimate the status reliably. The workshops concluded that in most countries there is an urgent need to control and in many cases to reduce the fishing effort in the lobster fisheries. As many countries have open access to their lobster fisheries, this may require implementing restricted entry systems into the fishery, ensuring that the resulting total effort is commensurate with the productivity of the resource, and the licensed fishers are able to obtain acceptable economic returns. In some areas, the size of the lobsters being caught was smaller than desirable and in these cases it was recommended that suitable minimum size restrictions should be implemented and enforced. If extra-budgetary funds are available, a further workshop of the WECAFC *ad hoc* Working Group is planned for 2006. WECAFC Members fishing for spiny lobster may wish to consider facilitating the implementation of this workshop by contributing to the costs of participation by their own delegates.

The other valuable crustacean fisheries in the region are those for shrimp, mainly penaeid shrimp, and also the Atlantic seabob. Stocks of brown, pink (*Farfantepenaeus duorarum*), white (*Litopenaeus setiferus*) and royal red shrimp (*Hymenopenaeus robustus*) have been estimated by the GMFMC not to be overfished in that region, while the status of seabob (*Xiphopenaeus kroyeri*) is unknown. The 3rd Session of the WECAFC SAG emphasised the need for an assessment of the status and potential sustainable yield for the species over its full range while the fishery was still developing and before a state of over-capacity in the fishery and over-exploitation in the resource was reached. The importance of implementing a system of data collection on effort and landings was also emphasised. The CFRAMP/WECAFC workshops referred to above (FAO, 1999, 2000) have made some progress in assessing the status of important shrimp stocks in the Brazil-Guianas continental shelf, along the coastline of Venezuela, Trinidad and Tobago, Guyana, Surinam, French Guiana and the northern coast of Brazil. The results suggest that in most cases, the national stocks of southern white shrimp (*L. schmitti*), southern pink shrimp (*F. notialis*) and brown shrimp (*F. subtilis*) which have been assessed are not being biologically overexploited but were probably being fished above the economic optimum fishing effort. There are indications of high rates of fishing mortality on red spotted shrimp (*F. brasiliensis*). However, in the Gulf of Paria that position is estimated to be reversed, with *F. subtilis* estimated to be overexploited in 2001, while *F. brasiliensis* is estimated to have been close to B_{MSY} in 2001, indicating a fully-exploited stock (Ferreira, Trinidad and Tobago, pers. comm.). The shrimp and groundfish resources in this area have been extensively assessed and management recommendations proposed by the WECAFC *ad hoc* Working Group on Shrimp and Groundfish Resources of the Brazil-Guianas Shelf which met regularly between 1996 and 2000. Lack of extra-budgetary funds have limited its activities since then. There were bilateral workshops involving Trinidad and Tobago and Venezuela in 2002 and in April 2005, and a mission was undertaken to Surinam in February 2005. The Working Group has the potential to make an important contribution to sustainable use of the valuable resources of this shelf, but will require strong commitment from the member countries and, at least for the medium-term future, some extra-budgetary funds.

Amongst the molluscs, the recent catches of Mexican four-eyed octopus (*O. maya*) have been estimated not to be sustainable (Arenas and Díaz de León, 1998). Another molluscan stock, the Queen conch (*Strombus gigas*), is listed on CITES Appendix II which means that international trade in the species is controlled by the national CITES authorities, it is also listed on Annex III of the SPAW protocol of the Cartagena Convention. At the Queen Conch Stock Assessment and Management Workshop held in Belize in March 1999, it was found that many countries did not have sufficient or suitable data to make reliable estimates of the current status of the stocks (CFMC and CFRAMP, 1999). In those cases where there were sufficient data, the estimated status varied from lightly to overexploited. NMFS (2002) reported that Queen conch is the subject of a rebuilding programme in the CFMC, but that fishing mortality is still too high in that management area and needs to be reduced. FAO is providing support to the conch exporting countries of the region and is developing a management manual to assist countries to implement sustainable fisheries and to comply with the CITES requirements for the Appendix-II listed species. While the extent of biological sharing of the

stock between neighbouring countries is uncertain, much could be gained by sharing knowledge and by cooperating in, for example, control and surveillance. WECAFC Members may wish to consider whether the Commission adopt a more formal approach to regional cooperation on this species.

An ecosystem approach to fisheries recognizes that fish resources are dependent on the ecosystems in which they occur. Within the WECAFC region, many ecosystems are undergoing adverse impacts from human activities, and damage to critical habitats is one such concern. Important habitats found in the Caribbean include coral reefs, seagrass beds, mangroves, coastal lagoons, sandy beaches and mud bottom environments. Coral reefs are a cause of widespread concern and are important habitats for many exploited fishery resources. The report Status of Coral Reefs of the World 2002 (GCRMN, 2002) reported that in the northern Caribbean and western Atlantic, coral reefs were continuing to decline although possibly at a slower rate than previously. The main causes of the decline include pollution, disease, overfishing, anchor damage and destructive fishing and tourism practices. In Central America, hurricanes in 2000, 2001 and 2002 caused extensive damage, destroying up to 75 percent of corals in parts of Belize. Intense fishing and overloading by nutrients and sediments from poor land-use are also causing damage. A major effort through a World Bank and Global Environment Facility (GEF) project is working for the conservation of the Mesoamerican Barrier Reef System. The Survey also reported that inshore reefs in the eastern Antilles are degraded while deeper reefs are in better condition. The causes of damage are similar to those for the northern Caribbean.

The Caribbean Environment Programme of the United Nations Environment Programme (UNEP, undated) reports that seagrass beds, mainly turtle grass *Thalassia testudinum* and manatee grass *Syringodium filiforme*, provide food for grazing species including some fish, turtles and sea urchins, shelter for many commercially important species such as snappers, grunts, lobsters and conch, and other ecosystem services. Mangroves are particularly important nursery areas for many commercially important marine species. Seagrass habitats are being damaged and reduced by human activities such as eutrophication and other forms of pollution, and poor land use practices leading to increased sediment transport and deposition from land to the sea. A major cause of damage to mangroves is physical clearance of forests for housing and tourism projects and for development of aquaculture sites. Suitable measures need to be taken to conserve these environments if the marine ecosystems of the region are to be conserved, and if their many benefits are to be used in a sustainable manner.

Once again, the most marked feature of the results and trends presented here is the very high uncertainty about the status of even the more important fisheries resources of the region. In general, greater uncertainty about the status of resources and the impact of fisheries on them requires more cautious management, with a resulting loss of potential benefits. In cases where there is little information, fisheries exploitation needs to proceed very cautiously and should be accompanied by concerted efforts to collect adequate, relevant data to enable the resources to be utilized responsibly. Unless urgent steps are taken to collect sufficient information on landings and effort to provide, at least, the minimum information necessary to ensure sustainable utilization, there is a high risk that landings will continue to decline, as this review shows many have already done. This will lead to further erosion of the social and economic benefits currently being derived from the region's marine resources. As so many of the resources are shared between two or more countries, close co-operation between countries at a variety of international levels will commonly be advantageous and often essential in securing this.

An essential first step for most countries of the region is improvements to the existing fishery monitoring and data collection programmes and systems. Different fisheries, ecosystems and species will require different approaches, and monitoring and assessment programmes will need to be designed to optimize the use of limited human and financial resources in order to obtain the most useful information. In a number of cases, it will be important to identify key species, reflecting social, economic or conservation objectives, and to ensure that they are carefully monitored and regularly assessed, including sub-regionally or regionally where the stocks are shared, so as to ensure that the appropriate management action is taken. Obvious examples of these include species such as

the Caribbean spiny lobster, the commercially important shrimp species, the species important to fisheries for large pelagics, queen conch, and others. In addition, a useful approach in high diversity communities is to monitor selected indicator species for each major habitat type and taxonomic group, to provide an index of the status and trends in broader species groups and, collectively, on the ecological community as a whole.

Further to improving data collection and generation of information to guide management, consideration also needs to be given to implementing management measures and strategies that are less demanding of high quality and comprehensive data, and that are more robust to uncertainties in the available information. In accordance with the ecosystem approach to fisheries, these measures also need to take into account, and minimize where appropriate, negative impacts on non-target species and sensitive habitats. Management measures that, properly applied, can be relatively robust to uncertainty include strict management of fishing effort and fishing capacity, greater use of closed seasons and closed areas (including Marine Protected Areas, MPAs), and suitable gear restrictions aimed at minimizing bycatch of undesired species or size groups and other undesired ecosystem impacts. Fishing should also be prevented where species pass through particularly vulnerable life history stages, such as dense spawning aggregations. No single management measure or approach will adequately address all the conservation and utilization objectives of fisheries, and an effective management system will usually consist of a suite of complementary management measures that, typically, would include a combination of closed areas and/or seasons, gear and vessel restrictions, an appropriate limited entry system, and input (effort) or output (catch) controls. Adequate enforcement of these measures is, of course, essential.

These efforts may require additional financial commitments in several countries, and these additional financial resources are likely to be hard to find. Where commercial fisheries exist, cost-recovery may be an option. However, in considering the costs of effective management, attention also needs to be given to the severe social and economic consequences of the alternative to effective management, which is almost certain over-exploitation of resources, resulting in their depletion and the loss of the benefits being derived from them.

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