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<b>WESTERN CENTRAL ATLANTIC FISHERY COMMISSION (WECAFC)</b> Thirteenth Session
<b>WECAFC LESSER ANTILLES FISHERIES COMMITTEE</b> Tenth Session
Cartagena de Indias, Colombia, 21–24 October 2008
<b>STATUS OF THE STOCKS OF THE WESTERN CENTRAL ATLANTIC</b> <i>FAO Statistical Area 31</i>

## INTRODUCTION

1. 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 km<sup>2</sup> of which approximately 1.9 million km<sup>2</sup> 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.

2. The WECAFC area includes FAO Statistical Area 31 and a portion of Area 41 occurring offshore of northern Brazil. 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).

3. 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*

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

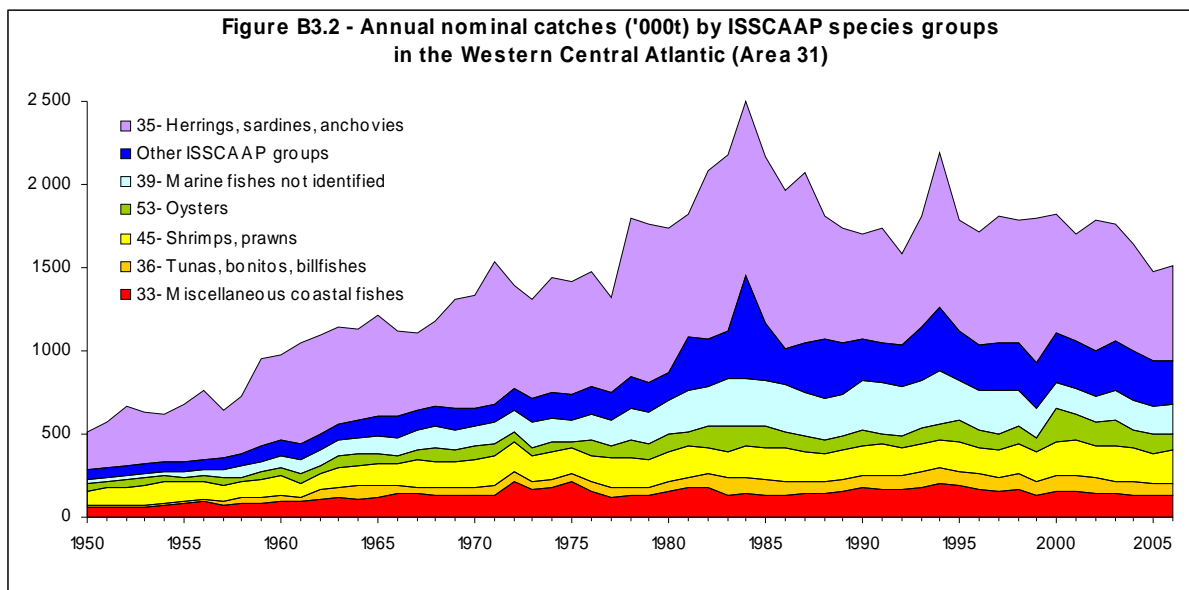
FAO Area	AREA ('000 km <sup>2</sup> )	LOCATION
		Continental Shelf
31	110	U.S. east coast
31	600	Gulf of Mexico
31	250	Yucatan – Eastern Venezuela
31	200	Guyana, Surinam, French Guiana
41	360	Northern Brazil
	1520	TOTAL Continental shelf
		Islands
31	380	Islands and offshore banks
	<b>1900</b>	<b>GRAND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

*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.

4. 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

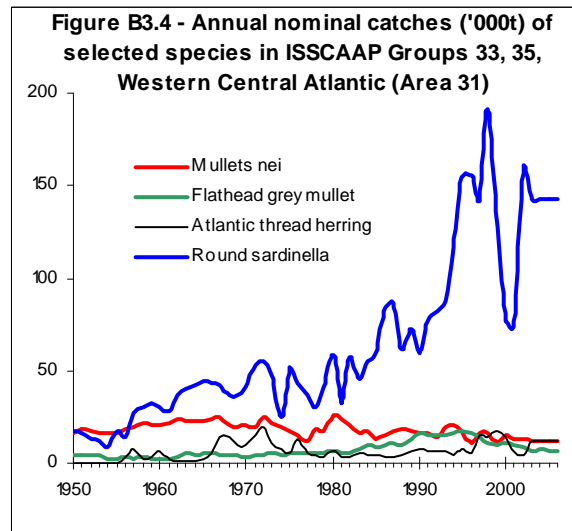
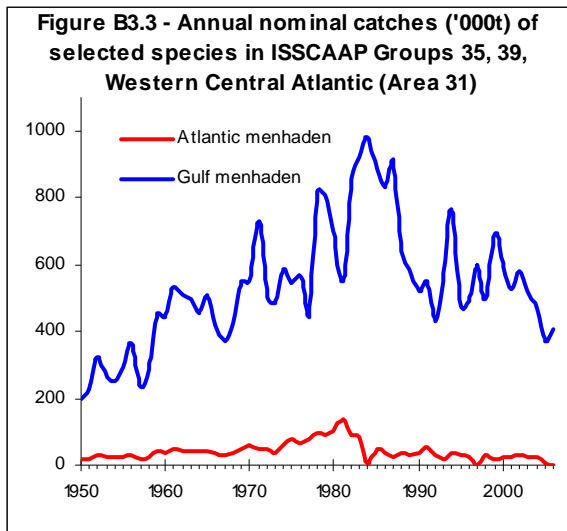
5. Nominal catches from the region increased steadily from approximately 500 000 t in 1950, to a peak of approximately 2.5 million tonnes in 1984. They subsequently declined but showed some increases in the early 1990s, with just under 2.0 million tonnes being landed in 1994. Since then they have been relatively stable at between approximately 1.5 and 1.7 million tonnes (Figure B3.2). Poor identification of landings from the WECAFC region continues to be a cause of concern. For example, Group 39 Marine fishes not identified accounted for 175 000 t of the total landings in 2006 and other reported landings also frequently do not provide the information at a sufficiently detailed taxonomic level (Table 2). Further, the FAO Fishery and Aquaculture Information and Statistics Service (FIES) has reported that there has been a decrease in fishery statistics submissions from the Caribbean area and contacts with the national correspondents in this regard are becoming increasingly difficult.



6. The average landings per year for the years 2004 to 2006 inclusive by ISSCAAP group are shown for each country reporting landings from the WECAFC area to FAO in Table 2. The country recording the greatest landings, approximately 870 000 t per year on average, was the United States of America while Venezuela and Mexico also recorded landings in excess of 200 000 t per year. Guyana, Surinam and Cuba recorded average annual landings above 30 000 t, with all other countries recording landings of below 12 000 t per year. Brazil did not record any landings from the western central Atlantic but an annual average of 497 000 t was recorded as having been taken by the country within the south west Atlantic during the same period.

7. Group 35 herrings, sardines, anchovies continues to be the ISSCAAP group making the largest contribution to catches. Catches of Gulf menhaden (*Brevoortia patronus*), which occurs from the Yucatan Peninsula to Florida, typically account for over half of the total annual catch from the group as a whole. Catches of the species increased irregularly from about 200 000 t in 1950 to close to one million tonnes in 1984 but declined somewhat thereafter and varied between just under 500 000 t and 700 000 t until 2003 but have declined since then and were 408 000 t in 2006 (Figure B3.3). There was also an important fishery for the other menhaden species, Atlantic menhaden (*B. tyrannus*), with peak catches of 140 000 t in 1981, but the fishery

declined steeply in subsequent years to under 4 000 t in 1984. Catches have been under 40 000 t since 1992 and were recorded as 183 t in 2006 (Figure B3.3).

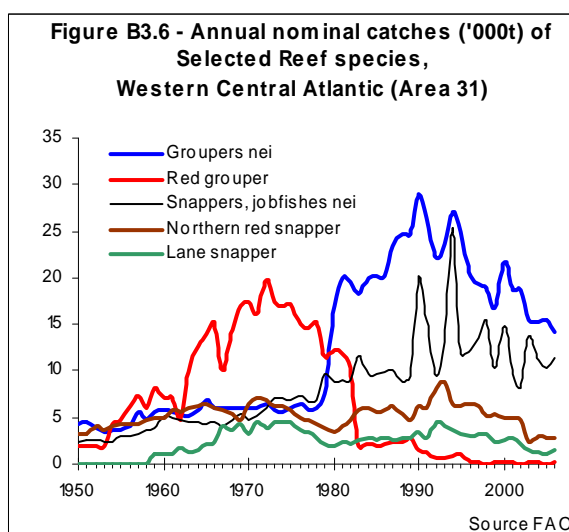
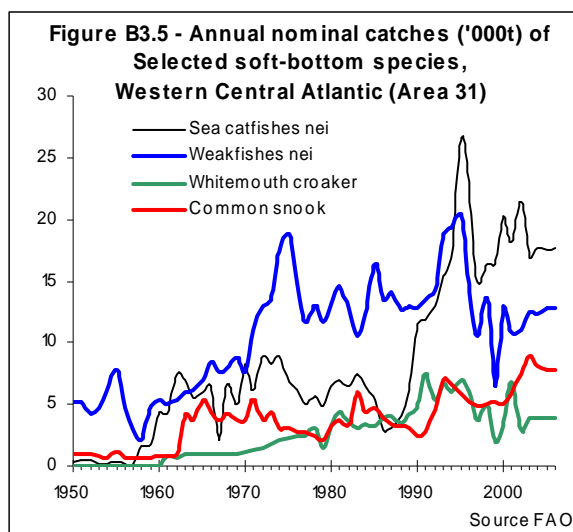


8. Together with the menhadens, small pelagics accounted for the largest catches by mass in the region. They comprise fishes from seven families: Exocoetidae (flyingfish); Clupeidae (herrings and sardines); Engraulidae (anchovy and anchoveta); Carangidae (jacks, bumpers and scads); Hemiramphidae (halfbeaks); 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 59 000 t in 1990 to almost 200 000 t in 1998 (Figure B3.4), mostly recorded by Venezuela. Landings decreased substantially in 2000 and 2001, with catches just over 70 000 t, but increased again to approximately 160 000 t in 2002 and have remained stable at 143 000 t since then. 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 20 000 t in recent years (Figure B3.4). There have been indications of a slight decline in catches of the first two groups while Atlantic thread herring landings have been variable but without clear trend since the late 1990s. Not illustrated here, landings of the unidentified jacks and crevalles of the genus *Caranx* have continued to fluctuate around approximately 11 000 t since the mid-1990s. These species are fished mainly by Mexico and Venezuela. The four-winged flyingfish (*Hirundichthys affinis*) supports locally important fisheries in some of the Lesser Antilles islands, including Barbados, St Lucia, St Kitts and Nevis, Grenada and Tobago. Catches of this species peaked at nearly 6 000 t in 1988, but thereafter tended to fluctuate between 1 000 and 2 800 t. Of possible concern is that catches have declined more or less steadily from over 2 800 t in 1998 to under 1 000 t in 2006, the lowest on record since 1950. The common dolphinfish (*Coryphaena hippurus*) is another pelagic species important to the small island states. It is also landed by the United States, Cuba and Mexico. Catches of common dolphinfish in the region doubled from 2 014 t in 1984 to 4 629 t in 1997 but have shown a decline since then and were recorded as approximately 2 600 t in 2005 and 2006.

9. 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 2). This group covers a wide diversity of species, of which the following contribute significantly 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 averaged over 135 000 t between 2004 and 2006 (Table 2), fluctuating without clear trend since the 1970s.

10. 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. Some of the more dominant examples of those occupying areas with soft substrata are shown in Figure 3.5. The highest recorded catches were of unidentified sea catfishes which peaked at 27 000 t in 1995 and have fluctuated around approximately 18 000 t since then. (Figure B3.5). These species are recorded on the FAO database as being landed by mainland countries, especially Mexico and Venezuela. Landings of common snook have increased more or less consistently since 1950 and were recorded as 8 000 t in 2006. Unidentified weakfishes peaked at over 20 000 t in 1995 but have

also subsequently declined, remaining stable at around 12 000 t in the 2000s (Figure B3.5). The whitemouth croaker supported catches of over 5 000 t from 1991 to 1996, oscillating in the following years between 1 900 to 6 800 t and were stable at approximately 4 000 t from 2003 to 2006. Catches (not shown in figure) identified as spotted weakfish (*Cynoscion nebulosus*) fell from a peak of more than 6 000 t in 1998 and 1999 to less than 2 000 t from 2004 to 2006.

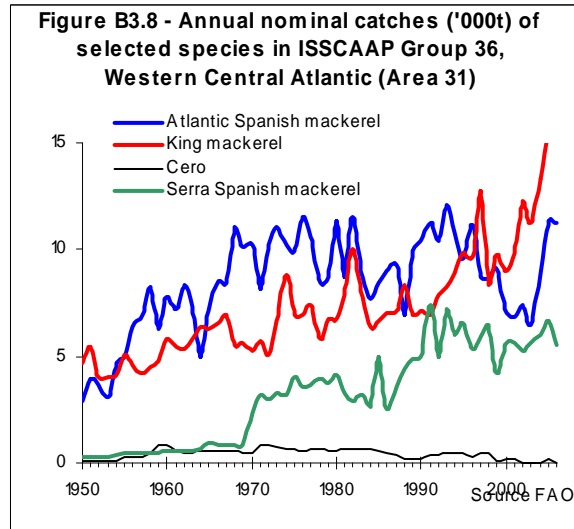
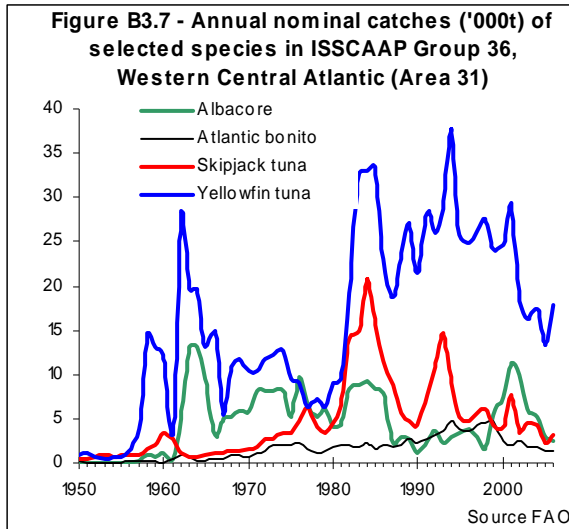


11. There has been a decline in recorded catches of the dominant reef fishes in recent years, which is cause for concern (Figure B3.6). Unidentified groupers increased markedly in the late 1970s and early 1980s, from under 10 000 t, to above 29 000 t but since that peak have declined and were approximately 14 000 t in 2006. Recorded catches of Nassau grouper (*E. striatus*) and red grouper (*Epinephelus morio*) have fallen from earlier peaks and have been well below 1 000 t in recent years. In the case of red grouper, as explained in previous status reports, the recorded landings do not appear to include the catches of the species from Mexico and the trend shown in Figure 3.6 is likely to be misleading. A report by Monroy *et al.* (2001) provided catches of red grouper from Campeche Bank by Mexico and Cuba which showed that landings had declined substantially from the peak of nearly 20 000 t in 1972 but were still above 8 000 t in 2001. Catches of northern red snapper (*Lutjanus campechanus*) and lane snapper (*L. synagris*) remained relatively constant in the 1970s and 1980s but have shown steady and on-going declines since then.

12. 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 5 000 t of southern red snapper are landed annually in Venezuela, with over 50 percent caught in foreign waters (FAO, 1999).

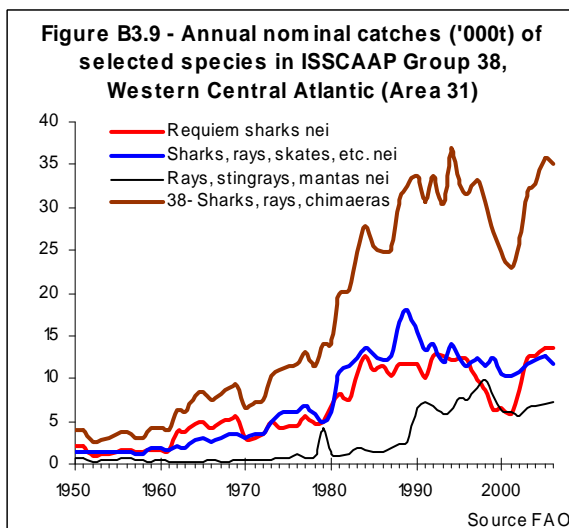
13. The catches of ISSCAAP Group 36 tunas, bonitos, and billfishes have increased over the last three decades and catches during the 1990s averaged 87 000 t, compared to averages of 80 000 t in the 1980s and 52 000 t in the 1970s. Catches have shown a steady decline from 98 000 t in 2001 to 70 000 t in 2006 (Figure 3.2). 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. The overall decline is reflected in declines in the catches of all the oceanic species shown in Figure B3.7, with very marked declines in yellowfin tuna (*Thunnus albacares*) and skipjack tuna (*Katsuwonis pelamis*). Venezuela and Mexico each accounted for approximately 20 000 t per year on average between 2004 and 2006. The USA, St Vincent and the Grenadines, Japan, Trinidad and Tobago, Taiwan Province of China and Spain recorded average landings of above 3 000 t per year during this period (Table 2).

14. In contrast to the oceanic species, catches of the dominant coastal large pelagic species, apart from Cero (*S. regalis*), have increased in recent years (Figure B3.8). Those of king mackerel (*S. cavalla*) exceeded 15 000 t in 2006, their highest level in the time series. The Atlantic Spanish mackerel (*S. maculatus*) catch was 11 300 t in 2006, close to the peak of 12 000 t in 1993 while Serra Spanish mackerel (*S. brasiliensis*) was 5 500 t in 2006, slightly down on the landings of 2005 but still close to the peak of 7 200 t achieved in 1993. No landings of Cero were recorded in 2006.



15. There is global concern about the status of Sharks (ISSCAAP Group 38 – sharks, rays, chimaeras) and the risks of their over-exploitation. Within the WECAFC region, catches of chondrichthyans escalated spectacularly after 1950, reaching a peak of 37 000 t in 1994 (Figure B3.9). They subsequently declined but rose sharply again after 2001 and in 2006 were approximately 35 000 t and close to the 1994 peak. This is of particular concern because there is very little knowledge of the status of sharks in the region and equally little management of their exploitation. Mexico and Venezuela recorded the highest landings of Group 38 between 2004 and 2006 at above 11 000 t per year. USA, Guyana and Cuba reported catches of over 2 000 t (Table 2). The major contributors to the landings in 2006 were: sharks, rays, skates etc nei; requiem sharks nei; and rays, stingrays, mantas etc.; with a number of other species and species groups contributing smaller masses, including blue sharks, hammerhead sharks, shortfin mako, silky shark, smoothhounds nei, blacktip sharks and dogfish sharks nei. The poor species identification of catch records demonstrates the poor quality of much of the data submitted to FAO from the region and clearly demonstrates the need for improved and careful monitoring.

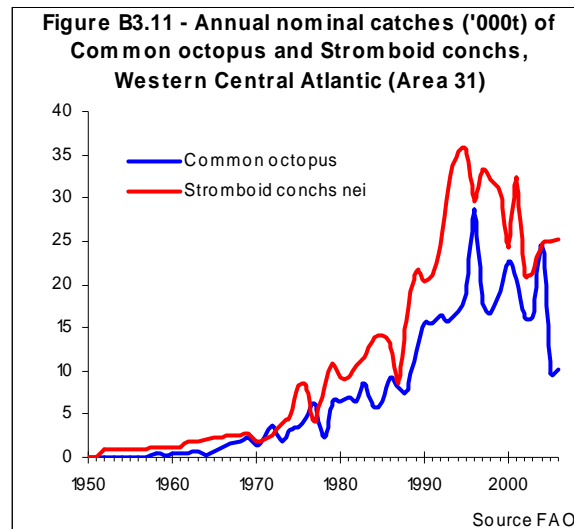
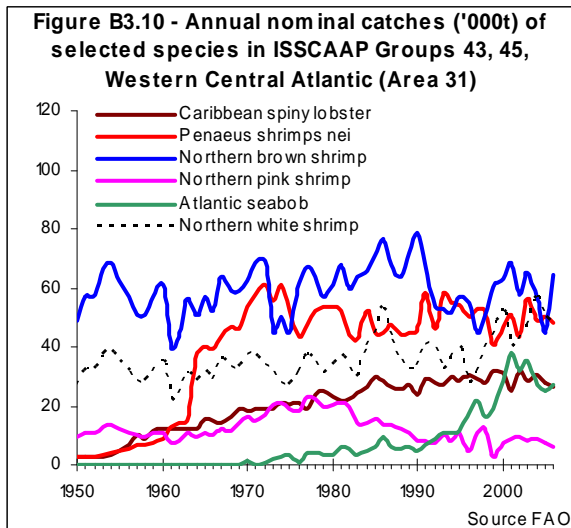
16. The best information available on the status of sharks in the region remains that reported to WECAFC in 2003. That includes a report by Yegres *et al.* (1996) on the shark fishery in Venezuela, operating beyond the EEZ of that country in both the Caribbean Sea and the Atlantic Ocean in the south western reaches of the WECAFC area, which 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 “prime importance”. Of the nine most important, five were *Carcharhinus* and two *Sphyrna* species.



17. The crustacean fisheries of the WECAFC area are collectively of high economic value, especially those for Caribbean spiny lobster (*Panulirus argus*) and 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 31 000 t in 2000, fell to 25 000 t in 2001, but recovered somewhat, fluctuating around 30 000 t for a few years but declined to 26 000 t in 2006. Landings from Brazil peaked at over 11 000 t in 1991 but have declined, with considerable variability, since then and were 6 700 t in 2006. The highest landings between 2004 and 2006 of the lobsters, ISSCAAP group 43, were, as in the previous reporting period, in descending order, Bahamas, Brazil, Cuba, Nicaragua and the United States of America. Recorded catches of unidentified penaeid shrimps continued to vary without meaningful trend, between approximately 40 000 t and 58 000 t since the mid-1970s. Catches of the northern brown shrimp (*Farfantepenaeus aztecus*), the most productive single shrimp species, declined from 68 000 t in 2001 to 44 000 t in 2005 but rebounded to 64 000 t in 2006, while catches of the Northern white shrimp (*Litopenaeus setiferus*) peaked at 57 000 t in 2004, declining to 47 000 t in 2006. Catches of the Atlantic seabob (*Xiphopenaeus kroyeri*) may be levelling off after the spectacular increase from approximately 5 000 t in 1990 to over 38 000 t in 2001 and ranged between 25 000 and 27 000 t from 2004 to 2006. The highest landings of shrimps and prawns (ISSCAAP Group 45) between 2004 and 2006 were recorded by the United States of America (132 000 t), Mexico (28 700 t) and Venezuela (28 000), while Guyana, Belize, Colombia, Honduras and Suriname recorded landings well in excess of 10 000 t (Table 2).

18. Amongst the molluscs, the highest catches (given in total weight, including shell) in recent years have been of American cupped oyster (*Crassostrea virginica*) and ark clams (*Arca* spp.). The former, varied during the 1990s from less than 59 000 t (1991) to a peak of 195 000 t in 2000 but fell to 98 000 t in 2006. Catches of ark clams have been between 45 000 t and slightly over 46 000 t since 2002. Catches of calico scallop (*Argopecten gibbus*) peaked at nearly 400 000 t total weight in 1984 but no landings have been recorded since 1996.

19. After substantial increases up to the mid-1990s in the recorded landings of common octopus (*Octopus vulgaris*) and the stromboid conchs (*Strombus* spp.), both have shown declines since then (Figure B3.11). Catches of common octopus were slightly over 8 500 t in 1983 and subsequently climbed to an average of over 18 000 t in the 1990s, with the highest recorded landings of over 28 000 t in 1996. Landings of only 10 000 t were recorded in 2005 and 2006. As reported in previous versions of this document, landings of octopus on the Atlantic coast of Mexico (the largest producer of squids, cuttlefish and octopus, ISSCAAP Group 57, from 2004 to 2006, Table 2) actually consist of substantial contributions from both common octopus and a local endemic species the Mexican four-eyed octopus (*Octopus maya*). A further 1 100 t of unidentified octopus was also recorded in 2005, almost all of which was landed by Venezuela.



20. The increase in catches of stromboid conchs has also been marked but, after peaking between 1993 and 2001, they have declined, probably in part resulting from concerns about over-fishing and actions by CITES, and were approximately 25 000 t per year from 2004 to 2006. It must be noted that catches are reported to FAO in a range of different forms ranging from whole in the shell to out the shell and cleaned. Further, the form in which they are reported is frequently not reported. The figures reported here are simply the aggregation of the reports from each country in the form submitted and are therefore only approximately indicative of the true trends. Mexico (6 700 t), Turks and Caicos (5 500 t), Jamaica (4 600 t), Belize (2 200 t) and Dominican Republic

(1 300 t) recorded landings of ISSCAAP Group 52, which includes conchs, in excess of 1 000 t per year from 2004 to 2006 (Table 2).

21. All species of Cheloniidae, the sea turtles, have been listed on CITES Appendix 1 since 1977. 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 1 600 t in 1985. Thereafter, they declined rapidly, falling to only 31 t in 1999, made up mainly of green and hawksbill turtles. The recorded catches in 2005 were 21 t. 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

22. 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.

23. Notwithstanding the decline in catches in recent years of the Gulf menhaden, both it and the Atlantic menhaden are reported to be reasonably stable (FWRI, 2006). For the small pelagics, the only quantitative estimate of status available remains that, now more than 10 years old, 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. That may have changed with the increased annual catches showed in Figure B3.4 but the fact that catches well in excess of 100 000 t have been sustained, with variability, since 1996 suggests that the stock is not being over-exploited. The status of the many other species of small pelagics is largely unknown. The general understanding of the stock status of small pelagics in the region is that they vary from under- to fully-exploited (FAO, 1998). The decline in reported catches of flyingfish may simply be normal inter-annual variability and, as effort has not changed significantly in recent years, there is no reason to suspect over-exploitation at this stage (R. Mahon, pers.comm.). The steadily increasing catches of common dolphinfish, followed in recent years by a sustained decline, presenting a classic over-exploitation curve, may however indicate an overfishing problem, particularly as trends in fishing mortality for this species are unknown (R. Mahon pers.comm.). Given the social and economic importance of the species in the region, in particular for some small island developing states, urgent action is required to assess the true trends in the fishery and resource status and to take corrective action if found to be necessary.

24. The groundfish species are dominated by ISSCAAP Group-33 miscellaneous coastal fishes. For the Caribbean Fishery Management Council (CFMC), reef fishes have been aggregated into groups for management purposes. Grouper Units 1<sup>1</sup>, 2<sup>2</sup> and 4<sup>3</sup> are considered to be overfished, to be experiencing overfishing or both and are undergoing rebuilding programmes under the CFMC (NMFS, 2008). A review of Nassau and Goliath grouper in the WECAF area drew attention to marked declines in both species and called for urgent management action to prevent further declines and promote recovery (Sadovy and Eklund, 1999). The species are particularly vulnerable when they aggregate for spawning and management measures need to include adequate protection during those periods.

25. The Gulf of Mexico stocks of Red snapper (*Lutjanus campechanus*) and Greater Amberjack (*Seriola dumerili*) are overfished and experiencing overfishing. Both are undergoing rebuilding programmes and further reductions in mortality are required. Gag (*Mycteroperca microlepis*) and gray trigger fish (*Balistes capricus*) are subjected to overfishing (NMFS, 2008). The latter is also estimated to be overfished and is subject to a rebuilding programme. 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. Within the CFMC, Snapper Unit 1<sup>4</sup> was subjected to overfishing and approaching an overfished condition (NMFS, 2008).

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<sup>1</sup> Consists only of Nassau grouper.

<sup>2</sup> Consists of goliath grouper.

<sup>3</sup> Consists of red, misty, tiger, yellowedge and yellowfin groupers.

<sup>4</sup> Consists of silk, black, vermillion and blackfin snapper.

26. 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*), smalleye 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 assessed were being overexploited (FAO, 1999; 2000). A more 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.

27. 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".

28. Interest continues amongst some states of the region in 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 ICCAT only assesses the oceanic stocks within their mandate. Recent assessments available (ICCAT, 2008) indicate that yellowfin tuna, which is considered to consist of a single Atlantic stock, is fully-exploited and possibly overexploited. Catches of the species have been declining since 2001. Some fishing for bigeye tuna (*Thunnus obesus*) occurs off the coast of Venezuela. Based on a 2007 assessment, the exploitation rate on the stock is considered to be moderate, with fishing mortality estimated to be at or below the fishing mortality rate ( $F_{MSY}$ ) at which maximum sustainable yield (MSY) will be obtained, and the stock is estimated to be close to the MSY level. 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 is still that of 1999 and ICCAT (2008) reported the status of the western stock to be "stable".

29. Several other large pelagic species fished in the western central Atlantic have also been assessed by ICCAT (2008). The results of the most recent assessment were: west stock of the Atlantic bluefin tuna (*Thunnus thynnus*), based on a 2006 assessment – depleted and experiencing overfishing; Atlantic blue marlin (*Makaira nigricans*), assessed in 2006 – biomass most likely remains well below  $B_{MSY}$  but estimated that fishing mortality has recently declined but is still larger than  $F_{MSY}$ ; white marlin (*Tetrapterus albidus*), assessed in 2006 – biomass most likely remains well below  $B_{MSY}$  but  $F$  may be low enough to avoid further depletion but probably larger than the  $F_{MSY}$ ; western Atlantic sailfish (*Istiophorus platypterus*) – no new assessment has been done since 2001 and current catches are thought to be sustainable; and Northern Atlantic swordfish (*Xiphias gladius*) – a 2006 assessment indicated that biomass had improved possibly due to strong recruitment in the late 1990s, combined with reductions in reported catch, fishing mortality was estimated to be below  $F_{MSY}$ .

30. Amongst the coastal species, the status of Serra Spanish mackerel and Cero is unknown. NMFS (2008) reported that a Gulf of Mexico "group" of the king mackerel is undergoing a rebuilding programme and was now neither overfished nor undergoing overfishing. The Atlantic "group" is considered to be in a similar state. 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. Dolphinfish, 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, 2002) and was estimated at that time to be well above  $B_{MSY}$  and fishing mortality to be below the MSY rate. The decline in recent years in the FAO records is nevertheless cause for concern and could be the result of increased fishing effort in recent years.

31. As reported to the 12<sup>th</sup> Session of WECAFC in 2005, the implications and requirements for any expansion in fisheries for large pelagics in the WECAFC area were considered in a FAO Technical Cooperation Programme, 'Preparation for expansion of domestic fisheries for large pelagic species by CARICOM countries'<sup>5</sup>. The project recommended that in the case of oceanic large pelagics, CARICOM countries should become fully

<sup>5</sup> Report can be downloaded from <ftp://ftp.fao.org/docrep/fao/007/y5308e/y5308e00.pdf>

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 dolphinfish, 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 member countries of CARICOM should move forward urgently in this regard, particularly if the recent increases in catches reported to FAO (Figure B3.8) reflect increasing fishing effort.

32. Knowledge of the status of the stocks of sharks in the region remains very poor. The FAO website<sup>6</sup> containing National Plans of Action under the IPOA for the Conservation and Management of Sharks includes Plans of Action from only two countries in the WECAFC region: Mexico and the United States of America. ICCAT (2008) has assessed the status of two pelagic shark species that are important retained species in the WECAFC region, blue shark and shortfin mako. The North Atlantic blue shark stock is considered to be above the MSY biomass and may be close to the unfished biomass, although there is considerable uncertainty around that estimate. In contrast, the North Atlantic shortfin mako shark stock may be below the biomass that can support MSY and trends in catch-per-unit effort (CPUE) suggest depletions of fifty percent or more. Bonfil (1997) referred to some preliminary assessments undertaken on shark in Mexico, suggesting fishing mortalities of  $F_{MSY}$  and greater. He drew 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 cooperation 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 should include promoting implementation of the IPOA-Sharks, including the development and implementation of National Plans of Action. The 3<sup>rd</sup> 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.

33. 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 most recently examined at a workshop in Mérida, Mexico, in September 2006 organized by FAO/WECAFC in cooperation with UNEP, the Caribbean Fishery Management Council (CFMC) and the CARICOM Regional Fisheries Mechanism (CRFM). The status of the national populations of spiny lobster in the participating countries estimated at that workshop show cause for concern. In nine of the 15 participating countries the stock was considered to be fully exploited or stable but, of those, Cuba, Mexico and the United States of America reported that, despite good management and control, the populations in those countries are showing signs of declining because of other, not well understood, factors. In the remaining six countries, the stock was estimated to be over-exploited. In 2007, Brazil submitted a proposal to place the Brazilian national population of lobster (including *Panulirus argus* and *P. laeviscauda*) on Appendix II of CITES but subsequently withdrew the proposal. The WECAFC Scientific Workshop recommended a number of management measures that needed to be implemented or strengthened including, for example, strengthening enforcement of and compliance with existing regulations, controlling effort to sustainable levels, and taking action against widespread IUU fishing and the associated intra-regional trade (FAO, 2007a).

34. In the subsequent Managers' Workshop, the delegates expressed their commitment to continue to work towards the implementation of pertinent management measures that would improve the current situation of the stocks. As one means to this end the representatives agreed that countries should ensure that they include a minimum size of capture of equal to or above 74 mm carapace length as a means to help in assuring that 50 percent of the stock will reach maturity before capture. They also agreed that countries that already have minimum sizes in place should take action to implement and enforce them effectively (FAO, 2007a).

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<sup>6</sup> <http://www.fao.org/fishery/publications/sharks/npoa/en>

35. 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*) and white (*Litopenaeus setiferus*) have been estimated by NMFS (2008) not to be overfished in that region, while the status of royal red shrimp (*Hymenopenaeus robustus*) and seabob (*Xiphopenaeus kroyeri*) is unknown. The 3<sup>rd</sup> Session of the WECAFC SAG emphasized 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. As far as is known, this has not yet been done in the region. The importance of implementing a system of data collection on effort and landings was also emphasized. The most recent estimates of status of the stocks of the Brazil-Guianas continental shelf are those from the CFRAMP/WECAFC workshops referred to above (FAO, 1999; 2000). At those workshops it was estimated 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.). A meeting of the WECAFC *ad hoc* Working Group on Shrimp and Groundfish Resources of the Brazil-Guianas Shelf was tentatively scheduled for May 2007 but, unfortunately, the extra-budgetary funds necessary for this could not be obtained. Attempts will be made to obtain funds for a workshop in 2009. 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 in the medium-term, some extra-budgetary funds.

36. 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). The Queen conch (*Strombus gigas*), is listed on CITES Appendix II and on Annex III of the SPAW protocol of the Cartagena Convention. A Regional Workshop on the Monitoring and Management of Queen Conch was held in Kingston, Jamaica in May 2006, jointly organized by FAO/WECAFC and UNEP-CEP and in partnership with CFMC and CRFM. The workshop concluded that there is still considerable and important lack of knowledge about key aspects of the Queen conch resource including the detailed stock structure, actual fishing mortality rates and effort, the inter-relationship between shallow-water and deep-water components, and the distribution of larvae and origin of recruits. Intra-regional IUU fishing was considered to be a serious problem for this species. A number of countries lacked an effective national policy for fisheries on the species and in some cases where there is a good policy it was not being put into effect. The workshop stressed the need for greater coordination among the relevant regional and international organizations operating in the area. The workshop was very effective in bringing the countries together to combine knowledge and expertise for improved management of the valuable resource (FAO, 2007b). WECAFC Members may wish to consider how to continue and strengthen such activities.

37. The need to take into account the wider ecosystem in fisheries management is recognized in both integrated coastal area management (e.g. Article 10 of the FAO Code of Conduct for Responsible Fisheries) and in the ecosystem approach to fisheries. Environmental degradation and damage is a concern in much of the WECAFC region. Important habitats that, because of their proximity to the shore and hence to human impacts, may be under particular threat include coral reefs, seagrass beds, mangrove swamps, coastal lagoons, beaches and mud bottom habitats (UNEP-CEP undated). The latest available report on the Status of Coral Reefs of the World (GCRMN, 2004) reported that the coral reefs of the wider Caribbean have experienced a major and 'possibly catastrophic' decline over the last 25 years, with coral cover on many reefs falling from 50% to 10% during this period. The major causes of the decline were reported as being white-band disease, mass mortality of sea urchins resulting in overgrowth by algae and coral bleaching. The decline has affected mainly the staghorn and elkhorn species (*Acropora cervicornis*, *A. palmate* and others) which used to be the major reef building corals in the region. It was also reported in that study that there has been some recovery in some areas and an apparent reduction in incidence of white-band disease but that coral bleaching has apparently been increasing over the last two decades.

38. As presented in the 2005 version of this report, 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 (UNEP-CEP, undated). Mangroves are particularly important nursery areas for many commercially important marine species while estuaries and coastal lagoons provide important feeding, nesting and nursery areas for many fish species. Mud banks, as in the case of the Brazil-Guianas shelf for example, are often habitats for very important shrimp and groundfish resources. All of these habitats are susceptible to damage and disruption by human and natural impacts other than fishing, including coastal zone development,

tourism, pollution and eutrophication, oil spills and other impacts from the oil and gas sectors, and climate change. Management of fishing mortality and other impacts from fisheries will not be sufficient to ensure sustainable use of resources if impacts from other sectors, or natural events, are damaging the habitats or other critical ecosystem components. It is essential for fishery managers to monitor the impacts from outside the fishery and take steps to ensure that they are avoided or ameliorated if the marine ecosystems of the region are to be conserved and their goods and services are to be used in a sustainable manner.

39. Another and possibly growing issue of concern is the incidence of marine invasive species in the region. A recent survey identified a total of 118 marine invasive species that included 39 fish and 31 arthropod species (UNEP, 2006). Some of these species are or have the potential to cause damage to marine ecosystems. For example, four marine species: the Asian green mussel *Perna viridis*, the brown mussel *Perna perna*, the wood-borer *Sphaeroma terebrans*, and the Australian jellyfish *Phylloriza punctata* are considered to have significantly impacted marine environments in the Americas, while the Lionfish *Pterois volitans* has continued to spread in the Bahamas since it first came to the attention of the Department of Marine Resources in 2005 (UNEP, 2006 and L. Gittens pers. comm.). UNEP (2006) reported that none of the relevant national agencies were giving close attention to marine invasive species at present but they were aware of the potential importance of the problem.

## CONCLUSIONS

40. This review addresses a wide range of topics of relevance to fisheries, fish resources and marine ecosystems in the WECAFC region. The overall picture is of a wider marine ecosystem under considerable pressure from fishing and a range of other human and natural impacts. It is important to identify and address the most urgent of these in order to prevent any further degradation in the ecosystem and possible irreversible changes. An underlying and serious constraint, particularly but not exclusively related to fishery, is the very high uncertainty about the status of even the more important fishery resources of the region. This problem has been reported to WECAFC over many years but has yet to be addressed and, in fact, judging from the statistical returns to FAO may even be deteriorating (FIES, FAO pers comm.). In accordance with the precautionary approach, and general understanding, high levels of uncertainty require cautious management and actions. Greater knowledge reduces the amount of precaution required, up to a limit, thereby allowing greater benefits to be obtained from a renewable resource without increasing the risk of unsustainable use. 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 cooperation between countries at a variety of international levels will commonly be advantageous and often essential in securing this.

41. An essential first step for most countries of the region is improving 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 some cases, it will be necessary to identify broad indicators of the status of fished resources and ecosystem condition that allow management to monitor their state with the available capacity and adjust fishing impacts accordingly. These broad indicators could include, for example individual key species, reflecting social, economic or conservation objectives, or community characteristics such as species and size composition of multi-species communities. In all cases their reliability as indicators of real trends in the resources and ecosystems will need to be verified.

42. In addition, consideration 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 and that take into account, and minimize undesired, negative impacts on non-target species and sensitive habitats. Such measures could 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 usually encompasses a number of complementary management measures that is likely to include closed areas and/or seasons, gear and vessel restrictions, an appropriate limited entry system, and input (effort) or output (catch) controls. Of course, as highlighted in the 2006 workshop on queen conch, the best policies and regulations will be of no value unless they are implemented and enforced.

43. 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. 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.

### IMPLICATIONS FOR WECAFC

44. Members and Observers of WECAFC may wish to discuss this report and consider possible action to address some of the causes for concern such as:

- means to improve the current widely unsatisfactory and deteriorating reporting by Members to FAO on catches in the region, including the poor taxonomic identification of landings;
- strengthening fisheries management capacity, within the context of an ecosystem approach, in those countries requiring improvement and for the region as a whole;
- the need to ensure management of the fisheries and sustainable use of the coastal large pelagics;
- improving knowledge on the status and impacts of fishing on sharks in the region and ensuring their conservation and sustainable use;
- the need ensure suitable protection of critical habitats for fishery resources such as coral reefs, seagrass beds and mangroves;
- the threat of marine invasive species to marine ecosystems.

45. In addition, the attention of the Commission is drawn to the conclusions and recommendations from the 4<sup>th</sup> Session of the WECAFC Scientific Advisory Group on the State of Fisheries in the WECAFC Region (in particular paragraphs 8 – 15).

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### REFERENCES

- Appeldoorn, R., Dennis, G.D. & Monterossa Lopez, O.** 1987. Review of shared demersal resources of Puerto Rico and Lesser Antilles Region. *In* *FAO Fisheries Report*, No. 383: 36–106.
- Arenas, F.P. & Díaz de León, A.** (eds). 1998. *Sostenibilidad y pesca responsable en México: evaluación y manejo 1997–1998*. Secretaria de Medio Ambiente Recursos Naturales y Pesca, México.
- Bonfil, R.** 1997. Status of shark resources in the southern Gulf of Mexico and Caribbean: implications for management. *Fish. Res.*, 29: 101–117.
- Charuau, A.** 2000. Assessment of *Lutjanus purpureus* in French Guiana. *In* Reports from the CFRAMP/FAO/FishCode stock assessment workshop on the shrimp and groundfish fisheries on the Guiana-Brazil shelf. Belem, Brazil, 25 May–10 June 1999. *FAO Fisheries Report*, No. 628.
- FAO.** 1998. Report of the Seventh Session of the Working Party on the Assessment of Marine Fishery Resources. Belize City, Belize, 2–5 December 1997. *FAO Fisheries Report*, No. 576. 39p.
- FAO.** 1999. National reports and selected assessment reports presented at the CFRAMP/FAO/DANIDA stock assessment workshop on the shrimp and groundfish fisheries on the Guiana-Brazil shelf. Port-of-Spain, Trinidad and Tobago, 7–18 April 1997. *In* *FAO Fisheries Report*, No. 600. Rome, FAO. 200p.
- FAO.** 2000. Reports from the CFRAMP/FAO/FishCode stock assessment workshop on the shrimp and groundfish fisheries on the Guiana-Brazil shelf. Belem, Brazil, 25 May–10 June 1999. *FAO Fisheries Report*, No. 628. Rome, FAO. 206p.
- FAO.** 2002. Large pelagic fisheries in CARICOM countries. Assessment of the fisheries and options for management. Report of FAO TCP Project RLA/0070. FAO, Rome.
- FAO.** 2007a. Report of the fifth regional workshop on the assessment and management of the Caribbean spiny lobster. Mérida, Yucatán, Mexico, 19–29 September 2006. *FAO Fisheries Report*, No. 826. Rome, FAO. 99p.
- FAO.** 2007b. Regional Workshop on the Monitoring and Management of Queen Conch, *Strombus gigas*. Kingston, Jamaica, 1–5 May 2006. *FAO Fisheries Report*, No. 832. Rome, FAO. 174p.
- Fleming, E.H.** 2001. *Swimming Against the Tide: Recent Surveys of Exploitation, Trade and Management of Marine Turtles in the Northern Caribbean*. TRAFFIC, North America, Washington. 185p.

- FWRI.** 2006. Menhaden-1. Florida Fish and Wildlife Conservation Comm.  
[http://research.myfwc.com/engine/download\\_redirection\\_process.asp?file=Menhaden.pdf&objid=5301&dltype=article](http://research.myfwc.com/engine/download_redirection_process.asp?file=Menhaden.pdf&objid=5301&dltype=article)
- GCRMN.** 2004. Status of Coral Reefs of the World: 2004 Executive Summary. Global Coral Reef Monitoring Network. Ed. C. Wilkinson. Australian Institute of Marine Science, Townsville.
- ICCAT.** 2008. The source of information used here was the Summary reports of the most recent stock assessments, available at <http://www.iccat.es/assess.htm>; Accessed on 6 September 2008.
- Mahon, R.** 1993. Lesser Antilles. *In* Marine Fishery Resources of the Antilles. *FAO Fisheries Technical Paper*, No. 326: 5–98.
- Marcano, J.S., Lárez, A., Carrion, A. & Heredia, O.** 1999. Pesquería de carite rey, *Scomberomorus cavalla*, por la flota artesanal cordelera del Estado Nueva Esparta, en el oriente de Venezuela y áreas adyacentes. *Mem. Soc. Cien. Nat. La Salle*, 58 (149).
- Mendoza, J.J., Fréon, P. & Guzmán, R.** 1994. VPA estimates of a fishing mortality and exploited biomass from *Sardinella aurita* catch-at-length data in eastern Venezuela. *Naga*, 17: 32–36.
- Monroy, C., Gimenez, E., Burgos, R. & Moreno, V.** 2001. Informe de investigaciones conjuntas Mexico-Cuba sobre mero (*Epinephelus morio*, Valenciennes 1828) en el Banco de Campeche. Ministerio de la Industria Pesquera, Cuba. 43p.
- NMFS.** 2008. Status Determination Tables A-B, National Marine Fisheries Service 2008 Status of U.S. Fisheries. Second Quarter Update. <http://www.nmfs.noaa.gov/sfa/statusoffisheries/SOSmain.htm>. Accessed on 6 September 2008.
- Sadovy, Y. & Eklund, A-M.** 1999. Synopsis of biological data on the Nassau Grouper, *Epinephelus striatus* (Bloch, 1792), and the Jewfish, *E. itajara* (Lichtenstein, 1822). NOAA Technical Report NMFS 146. NMFS, Seattle. 65p.
- Smith, M.L., Carpenter, K.E. & Waller, R.W.** 2002. An introduction to the oceanography, geology, biogeography, and fisheries of the tropical and subtropical Western Central Atlantic. *In* Carpenter, K.E. (ed.) 2002. The Living Marine Resources of the Western Central Atlantic. Vol. 1: Introduction, molluscs, crustaceans, hagfishes, sharks, batoid fishes and chimaeras. FAO, Rome.
- Stevenson, D.K.** 1981. A review of the marine resources of the WECAFC region. *FAO Fisheries Technical Paper*, No. 211. 134p.
- UNEP.** 2006. National and Regional Capacities and Experiences on Marine Invasive Species, Including Ballast Waters, Management Programmes in the Wider Caribbean Region - a Compilation of Current Information. By V. Lopez and U. Krauss. CAB International, CLARC, Trinidad & Tobago. 105p.
- UNEP-CEP.** undated. The Caribbean Environment Programme. United Nations Environment Programme, Kingston, Jamaica.
- Yegres, H., Alio, J.J., Marcano, L.A. & Marcano, J.S.** 1996. Biología y pesquería de tiburones en Venezuela. *ICCAT Coll. Vol. Sci. Pap.*, 45(3): 309–315.



Average Catches by country and species for 2004-2006	Abalones, winkles, conchs	Miscel. demersal fishes	Sharks, rays, chimaeras	Marine fishes not identified	Herrings sardines anchovies	Miscel. marine molluscs	Lobsters, spiny-rock lobsters	Scallops pectens	Miscel. pelag. fishes	Miscel. coastal fishes	Tunas, bonito bill-fishes	Clams, cockles, arkshells	Oysters	Shrimps prawns	Mussels	Flounders, halibuts, soles	Squids, cuttlefishes, octopuses	Crabs, sea-spiders	Total by country
Suriname				18854										12755				30	31639
Taiwan Province of China			383	102							5766								6251
Trinidad and Tobago		2820	1788	1916	12		12		327		4121			781			8	16	11801
Turks and Caicos Is.	5498						364				1								5863
United States of America	31	786	2757	2988	490585	898	2266	141	3372	24207	7763	5166	159902	132277		1046	54	37621	871860
US Virgin Islands	688			34		25	150		83	585	50								1615
Vanuatu											1442								1442
Venezuela, Boliv Rep of		11998	11294	12496	151619	1492	1060		13456	60578	20908	47074	2252	27980	2712		1980	16650	383549
<b>Total by species</b>	<b>26240</b>	<b>20154</b>	<b>35780</b>	<b>183306</b>	<b>650534</b>	<b>2560</b>	<b>32007</b>	<b>141</b>	<b>36001</b>	<b>137269</b>	<b>84406</b>	<b>54849</b>	<b>210181</b>	<b>283889</b>	<b>2712</b>	<b>1263</b>	<b>26746</b>	<b>61343</b>	