recreational fishery and threatens to undermine the conservation ethic developed by this user group.

C. There is a rapidly expanding domestic tuna longline fishery which has a higher billfish bycatch than the historical swordfish fishery.

D. The current statistical and scientific data base is inadequate for stock assessment and is likely to remain so for the foreseeable future. A long term biologically sound management regime, either domestic or international, will not be possible until an adequate and accurate data base is available.

6.0 MANAGEMENT OBJECTIVES

The following management objectives have been developed for the billfish fishery in the Atlantic, Gulf of Mexico, and Caribbean EEZs:

A. Maintain the highest availability of billfishes to the U.S. recreational fishery by implementing conservation measures that will reduce fishing mortality.

B. Optimize the social and economic benefits to the nation by reserving the billfish resource for its traditional use, which on the continental U.S. is almost entirely a recreational fishery. In the Caribbean, the fishery is both a recreational and small-scale handline fishery where billfishes are used as food.

C. Increase understanding of the condition of billfish stocks and the billfish fishery.

7.0 DESCRIPTION OF THE FISHERY

7.1 Description Of The Stocks

7.1.1 Distribution

The marlins and sailfish are widely distributed over the Atlantic Ocean (including the Gulf of Mexico and the Caribbean Sea) from about 35° South latitude to 45° North latitude. All three species are migratory and, as a result, there are marked variations in their seasonal and geographic abundance within the U.S. Exclusive Economic Zone.

The sailfish is primarily an inshore species, with the densest concentrations of adults occurring over the continental shelf and/or near land masses. This species is available year-round off the lower east coast of Florida and the Florida Keys, but is found in greater numbers during winter. In summer, sailfish are also abundant within the EEZ in the northern and northeastern Gulf of Mexico and along the Atlantic coast of the U.S. from northeast Florida to Cape Hatteras, North Carolina. In Puerto Rico and the Virgin Islands they are caught during October through April.

Tagging results indicate considerable movement of sailfish between the Florida Keys and the Miami-Stuart area and some interchange between the Gulf of Mexico and the Atlantic.

Although most recaptures of sailfish tagged off southeast Florida have been near the release site, recaptures have been recorded off Cuba, Cozumel, Venezuela, the Dominican Republic and North Carolina. Of the more than 500 recaptures, no trans-Atlantic or trans-equatorial movement has been recorded.

The marlins are more oceanic in habitat than is the sailfish, ranging from coastal waters to well beyond the continental shelf of the U.S. Both species are also more highly migratory and occupy the surface waters within both the Atlantic and Gulf Exclusive Economic Zones during the warm months of the year only. The white marlin reaches higher latitudes during the warm season than does the blue marlin, and congregates in coastal areas in much greater numbers. Along the Atlantic coast of the U.S., white marlin are seasonally abundant from Cape Hatteras, North Carolina to Cape Cod, Massachusetts, while the blue marlin is not common north of Delaware Bay. In the Caribbean, both species are present throughout the year.

White marlin appear to concentrate off Venezuela during winter. In spring, some of these fish move northward to their summer feeding grounds in the northern Gulf of Mexico or in the Mid-Atlantic Bight. In fall, they move offshore and back to the Caribbean. In more than 300 recaptures of tagged white marlin, no trans-Atlantic or trans-equatorial movements have been recorded.

Blue marlin appear to be concentrated in the Caribbean area year round. In summer, some of these fish move northward along the east coast of the U.S. There is some interchange between the Gulf of Mexico and the Atlantic. Only three of twenty-seven (11%) recaptures showed trans-Atlantic movement. Since these fish were over 300 pounds, it has been hypothesized that only large, mature females make these long migrations.

7.1.2 Life History Features

7.1.2.1 Age and Growth

There are conflicting data on the growth and longevity of the Atlantic sailfish. Length-frequency curves indicate that growth is fairly rapid and the life span of the species is short (3-4 years). However, analysis of rings in dorsal fin spines suggests longevity of about 10 years. One tagged sailfish was recaptured after almost 11 years at large. Age determinations are not available for blue and white marlins, but tag returns indicate somewhat greater longevity for these species. A tagged white marlin was recaptured after almost 12 years at large. Females of all three species attain greater lengths and weights than males and are heavier than males at comparable lengths. The size disparity between the sexes may be due to differential growth rates and/or differential mortality.

7.1.2.2 Maturity

Female sailfish reach maturity at about 30 to 40 pounds (13-18 kg) body weight. Males reach maturity at about 22 pounds (10 kg). Size at maturity for female blue marlin is between 103

and 135 pounds (47-61 kg) and for males between 76 and 97 pounds (35-44 kg). Female white marlin reach maturity at about 44 pounds (20 kg) body weight.

7.1.2.3 Spawning Seasons and Areas

The spawning period for blue marlin in the North Atlantic appears to be fairly protracted. Spawning populations have been identified between April and September in waters with temperatures between 79° and 84°F (26° and 29°C). White marlin in the western North Atlantic spawn during April and May throughout the Caribbean, Gulf of Mexico, and in the Straits of Florida. Sailfish spawn off the lower east coast of Florida from mid-May through September.

7.1.2.4 Food and Feeding

Billfishes are opportunistic feeders, feeding primarily on fish and squid. The species composition of their diet appears to vary geographically.

7.1.2.5 Mortality

Total annual mortality for western Atlantic sailfish estimated from a variety of methods ranges between 41 percent and 50 percent. This is equivalent to an instantaneous rate $Z = 0.52 - 0.69$. Natural mortality is estimated to be $M = 0.34$. For white marlin, the annual total mortality rate was estimated to be 42 percent with 95 percent confidence limits of 16 percent and 59 percent ($Z = 0.55 \pm 0.36$). No estimates of mortality for Atlantic blue marlin are available because few tags have been returned and age structure is unknown.

7.1.3 Stock Structure

As a working hypothesis, both blue marlin and white marlin are divided into two stocks, one in the North Atlantic and one in the south Atlantic. Sailfish are presumed to consist of an eastern Atlantic and a western Atlantic stock. Spearfish are presumed to consist of a single Atlantic-wide stock.

Available data on stock structure of the marlins provide no conclusive evidence for single Atlantic-wide stocks or separate North and south Atlantic stocks or a more complex stock structure. The distribution of catch rates in the Japanese longline fishery shows two distinct seasonal concentrations of both blue and white marlin in the North and south Atlantic Ocean. The location and seasonality of these concentrations suggest two stocks of these species in the Atlantic. Limited evidence from larval distributions and tagging experiments also support the hypothesis of separate North and south Atlantic stocks. However, the catch data show some continuity between the two areas during some months of the year suggesting that intermixing is occurring. The extent of this intermixing is unknown.

Tagging data present a somewhat different picture. Of more than 300 recaptures of tagged white marlin, no trans-Atlantic or trans-equatorial movements have been recorded. Further,

tagging data suggests that this population moves in a relatively limited area within the western North Atlantic which includes the Caribbean Sea, the Gulf of Mexico and off the east coast of the U.S.

Although tagging data for blue marlin are much more limited, they too suggest that blue marlin move between the Caribbean, the Gulf of Mexico and the east coast of the U.S. Three trans-Atlantic tag recaptures indicate that at least some mixing occurs between the western and eastern North Atlantic but appears to be limited only to large mature females.

Analysis of longline data for information on the stock structure of Atlantic sailfish and longbill spearfish had been hampered by the lumping of the two species together in catch records. Using data from Japanese research cruises, this problem has been at least partly resolved. Japanese longline data indicate there is a fairly even distribution of catch rates of sailfish in the western Atlantic along the Brazilian coast and extending up into the Caribbean during several months of the year. These catch rates suggest that there may be considerable mixing between North and South Atlantic Oceans. The coastal nature of sailfish suggests that there is a possibility of two separate stocks of sailfish in the Atlantic Ocean, one on the eastern side and one on the western side. A sizeable concentration of sailfish occurs in the eastern Atlantic off the coast of West Africa. Tagging data again suggests a much more limited movement of sailfish found off the U.S. Atlantic and Gulf coasts. While sailfish apparently move between the Gulf and Atlantic and along the east coast of Florida, there have been relatively few recaptures even from the Caribbean, and trans-Atlantic or trans-equatorial movement is unknown. As with the marlins, a conclusive statement on the stock structure of this species cannot be made.

7.1.4 Abundance and Present Condition

The most recent stock assessment for blue marlin was conducted in 1979 and was based upon historical catch and effort data from the Japanese high seas longline fishery. The production model results based on these data indicated that over-exploitation may have occurred during the early to mid 1970's, but that fishing effort in 1978-80 appears to have been below the level associated with MSY.

However, since billfish are a relatively uncommon incidental catch in the Japanese longline fishery, any assessment based on such data may not reflect the actual status of the resource. Even assuming that catch and effort data for non-targeted species adequately reflects abundance, deficiencies in these data and lack of basic biological parameters for these species largely preclude any meaningful assessments. Therefore, present condition of the resource is not known. This situation is not expected to change in the foreseeable future.

The blue marlin stock may be beginning a recovery from excessive catches and effort of the 1960's and mid-70's. Total fishing effort for blue marlin declined substantially after 1977. Some increase may have occurred in waters adjacent to the U.S. Catch per unit effort (CPUE) and total catch by recreational fishermen in the Gulf of Mexico have increased since 1977. Total catch has

increased from an average of 244 for the period 1977-78 to 299 for the period 1979-80. In 1983, 307 blue marlin were caught by recreational fishermen in the Gulf of Mexico and increased to 347 in 1984, to 458 in 1985 and declined slightly to 443 in 1986 (as reported by the NMFS survey on big game fishing in the Gulf of Mexico). Although the increase has been attributed to a reduction in Japanese catch in the Gulf, some could also be the result of a general increase in abundance or increase in recreational effort or effective effort.

In the three years 1977-79 the white marlin catch in the North Atlantic averaged approximately one half of the average of the previous 10 years. Since 1979 reported landings have been higher, but still below the 1967-1976 average. Japanese CPUE indices have declined substantially over the period 1962-80. The present status of the stock is unknown, but the declining trend and low CPUE levels are cause for concern.

The same problems cited above for blue marlin assessment exist to an even greater extent for white marlin. The data are not available to enable a stock assessment for white marlin, nor are they likely to be in the foreseeable future.

The status of sailfish stocks is unclear, but the most recent analysis indicates that western Atlantic sailfish are only moderately exploited. From the standpoint of maximum yield per recruit, sailfish appear to be somewhat underfished.

7.1.5 Estimates of Maximum Sustainable Yield (MSY)

MSY is estimated to be 2400 to 2500 mt (approximately 20,040 to 20,875 fish) for the North Atlantic stock of blue marlin, and 2100 mt (approximately 115,400 fish) for the whole Atlantic stock of sailfish/spearfish. MSY of white marlin cannot be estimated by standard techniques because no production model fits the currently available data. The average white marlin catch for the period 1967-1977 was 1000 mt. This number, the approximate equivalent of 44,050 fish, is used as a proxy for the white marlin MSY pending improvements in the data base that will allow production modeling.

These estimates of MSY should be considered provisional. Definitive determinations of the status of billfish stocks using production model analysis has been hampered by shortcomings in the data and in some of the production model assumptions. It has not been possible to corroborate any production model results with other traditional population dynamics techniques due to lack of data on age, growth and mortality of the species.

At the 1979 and 1980 meetings of the Standing Committee on Research and Statistics of ICCAT, MSY values were accepted as approximately 3000 mt for blue marlin and 2000 mt for white marlin. The downward revision of the estimate for blue marlin and the inability to develop an estimate for white marlin are the results of an ICCAT sponsored International Billfish Workshop held in June 1981. The purpose of the workshop was to thoroughly review the catch data base upon which assessment analyses are made, review biological data on billfishes, and review current research.

Catch and effort statistics were thoroughly revised as a result of the workshop. This revision has accounted for some marked changes in the data base from ICCAT/1980 to ICCAT/1981 catch statistics. An example of such a change can be seen in the catches for Cuba. In 1980 ICCAT reported catches from the period 1961-78 for blue marlin as 7,340 mt and white marlin as 4,911 mt for a total of 12,251 mt. In 1981, these catches were revised to 4,598 mt of blue marlin, 2,070 mt of white marlin for a total of 6,668 mt. Because of changes of this magnitude and other changes, the stock assessment analyses do show considerable changes from these previous years. It was also emphasized at the workshop that the data base is still provisional and that further improvements will follow the 1981 SCRS meeting.

Nominal catches (mt) from 1975-1985 of blue and white marlin in the North Atlantic and sailfish/spearfish in the West Atlantic reported by ICCAT were:

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Blue Marlin	1924	1243	1171	848	775	936	1082	1474	959	1089	1126
White Marlin	1084	1047	499	426	479	505	778	652	1377	703	782
Sailfish/ Spearfish	426	529	677	708	661	639	577	773	627	808	799

7.1.6 Probable Future Condition of the Stocks

Considering the number of countries currently participating in the fishery both inside and outside of national jurisdictions, the probable future condition of the stocks cannot be definitely assessed without knowing the long range intentions of these countries with regard to their high seas operations and coastal fisheries. However, a rapidly developing U.S. yellowfin tuna fishery in the Gulf of Mexico (estimated fleet size of 250 longline vessels in 1986) and a greatly increased U.S. swordfish longline fleet in the Caribbean (approximately 60 vessels in 1986-87) suggest that effort on these species may be increasing very rapidly. In addition, considering the increasing world demand for protein, accompanied by increasing prices for fresh tuna and billfish in domestic and world markets, sustained or increasing fishing effort is likely. Given the current status of blue and white marlin stocks, further increases in effort are not likely to produce increases in yield and could result in recruitment overfishing and depletion of the stocks. At the very least, increasing effort will lead to reduced availability to the recreational fishery.

7.1.7 Marine Mammal/Endangered Species Interactions

The Endangered Species Act of 1973 (16 U.S.C. Sec. 668dd(c)) names animals endangered or threatened throughout their range and makes it a crime to harm or kill them. There are six endangered whales and six endangered or threatened sea turtles that inhabit, at some time in their life cycle, the waters under consideration in this plan. Direct or incidental taking of these species is prohibited during commercial fishing operations. Since the billfish fishery is mainly a

recreational rod and reel fishery, there is no direct contact with these turtles or whales. However, turtles may be caught incidentally by longlines. Observer data from Japanese longliners indicate that twelve turtles and no marine mammals were caught during 1979 in the Gulf of Mexico. Seventeen turtles and five marine mammals were caught in the Atlantic during the same period. Mortality ranged from 10-50 percent. In 1985, observer data indicates that Japanese longliners caught six turtles and no marine mammals in the Atlantic (since 1982 the Japanese have not fished in the Gulf of Mexico). In 1986 the catch of turtles declined to five while the catch of marine mammals increased to two. The West Indian manatee (Trichechus manatus) and the eastern brown pelican (Pelicanus occidentalis) also occur in the management area and are listed as endangered or threatened species.

The actions proposed in this plan are not likely to jeopardize the continued existence of any endangered or threatened species or result in modification of critical habitat. The Section 7 consultation was initiated and a biological assessment prepared and submitted. The biological assessment concluded that the proposed management measures would not affect endangered/threatened species.

7.2 Habitat

7.2.1 Determinants of Distribution

Water temperature appears to be a major factor influencing the distribution of billfishes. They are generally found in waters with surface temperatures above 70°F (21°C).

Major currents also play an important role in the distribution and migration of billfishes. Concentrations of sailfish, white marlin and blue marlin are found within or near the Gulf Stream, which flows in a northeasterly direction along the Atlantic coast of the U.S. at varying distances from shore. In the northeastern Gulf of Mexico, billfishes are abundant in and around the Loop Current. The northward extent of their migration into the Gulf appears to be related to the northward extent of the current's penetrations. The Loop Current exits the Gulf of Mexico through the Straits of Florida where it becomes known as the Florida Current. Concentrations of sailfish occur within the Florida Current, especially during winter. The northward migration of white marlin from wintering areas off northern South America occurs in association with the Antilles Current, which flows on the north side of the Caribbean Island chain.

Localized occurrence of blue and white marlin is influenced by bottom topography. Steep drop-offs, submarine canyons, and shoals, when located in areas with suitable water conditions, often harbor feeding concentrations of these species. Along the Atlantic coast of the United States, important topographical features of this nature include the Five Fathom Bank off southern New Jersey; the Cigar southeast of the Virginia Capes; the Jack Spot off Maryland; Hudson Canyon, southeast of New York City; Wilmington, Baltimore and Washington Canyons off the Delmarva Peninsula; and Norfolk Canyon off the Virginia Capes. DeSoto Canyon in the northeastern Gulf

of Mexico and drop-offs in the Bahamas, Puerto Rico and the Virgin Islands also attract feeding concentrations of marlins.

7.2.2 Habitat Areas of Particular Concern

There are no habitat areas of particular concern in the sense that the term is generally applied (e.g., estuarine nurseries in the case of estuarine dependent species). The billfishes are highly migratory, oceanic species whose habitat and environmental requirements during early stages of their life cycles are not well known. Billfish spawning grounds are at or near the surface of oceanic waters relatively far from coastal sources of pollution. Offshore pollutants, such as oil spills, may be deleterious to the young stages. Billfish can also be influenced by subsurface and substrate pollutants, such as heavy metals, pesticides and radionuclides, through the food chain. Billfish living on or near canyons of the continental shelf may be affected by pollutants carried through direct ocean dumping.

7.2.3 Habitat Statement

As required under Sec. 303(a)(7) amended by P.L. 99-659, 1986, fishery management plans must contain readily available information regarding the significance of habitat to the fisheries and an assessment as to the effects which changes to that habitat may have upon the fishery.

Recognizing that all species are dependent on the quantity and environmental quality of their essential habitats, it is the policy of the South Atlantic Fishery Management Council to: Protect, restore and develop habitats upon which commercial and recreational marine fisheries depend, to increase their extent and to improve their productive capacity for the benefit of present and future generations. (For purposes of this policy, habitat is defined to include all those things physical, chemical and biological that are necessary to the productivity of the species being managed.) The policy objectives are: 1) To protect the current quantity, environmental quality and productive capacity of habitats supporting important commercial and recreational fisheries. (This objective will be accomplished through the recommendation of no loss or environmental degradation of existing habitat.) 2) Restore and rehabilitate the productive capacity of habitats which have already been degraded. 3) Create and develop productive habitats where increased fishery production will benefit society. The Council shall assume an aggressive role in the protection and enhancement of habitats important to marine and anadromous fish. It shall actively enter Federal decision-making processes where proposed actions may otherwise compromise the productivity of fishery resources of concern to the Council.

7.2.3.1 Significance of Habitat to the Fisheries

The habitat for the billfishes in the management unit is the oceanic pelagic waters of the Atlantic Ocean. Blue and white marlin, sailfish and spearfish venture into coastal waters only occasionally, usually in areas such as the Caribbean Islands where there is little continental shelf or

in southeast Florida, where the shelf is very narrow and the Gulf Stream is in close proximity to shore. Because of their oceanic nature, the specific habitat interactions of these species are not well known.

Sailfish are most common along continental margins, being the least oceanic of the billfishes. Recreational fisheries for sailfish are concentrated off the southeast Florida coast. While some are taken year round, they are most abundant from late fall through early spring.

Sailfish concentrate during strong winter cold fronts, particularly in the area from Fort Pierce to Palm Beach, where occasionally individual anglers may catch several dozen in a single day. These winter concentrations appear to be related to strong winds out of the northern quadrant which affect circulation and current boundary conditions.

In summer, sailfish are more dispersed, being caught at least as far north as Cape Hatteras. However, north of Florida they are relatively uncommon; generally caught when trolling for other species. This distributional shift is presumably related to temperature.

Sailfish, to a greater extent than the marlins or spearfish, do consume a significant amount (approximately 30%) of estuarine dependent fish, particularly clupeids and mullet. However, the opportunistic nature of all the billfishes would presumably moderate the impact of a reduction in availability of any particular prey species.

White marlin are generally more oceanic than sailfish and more common at higher latitudes. Like all oceanic pelagics they are often associated with current boundaries, upwellings, thermal fronts and other oceanic features that act to concentrate nutrients or food. Fisheries thus are concentrated in such areas.

Blue marlin are more oceanic yet. These fish, like most large pelagic predators are associated with oceanic features that concentrate food, although they also appear to concentrate seasonally for spawning. Naturally, recreational fisheries tend to concentrate in those areas.

Little is known about spearfish. There are no directed recreational or commercial fisheries for them, and they are rarely caught, even incidentally, by U.S. vessels. They are apparently found more commonly in waters seaward of the EEZ.

7.2.3.2 Effect of Changes to the Habitat

The habitat of all the billfishes is the water column itself. Because of their oceanic nature, changes to the habitat of sufficient magnitude to directly impact the billfish fishery are relatively unlikely. However, oil spills, ocean dumping, OTEC projects (Offshore Thermal Energy Conversion), and the general degradation of the oceanic environment may impact the survival of larvae and possibly adults (either directly or through the food chain). The effects of sub-lethal concentrations of chemical and other pollutants on these species is not known, but their oceanic distribution suggests a requirement for extremely high water quality. Any degradation of this water quality can be expected to impact their survival which would obviously impact the fishery.

7.2.3.3 Waste Disposal and Ocean Dumping

Waste disposal is defined here as the "intentional release of wastes to the marine environment through direct dumping..." (OTA-0-334, 1987). The western Atlantic Ocean including the state territorial seas and the exclusive economic zone off the eastern United States and Gulf of Mexico have been historically and continues to be used for disposal of wastes including but not limited to; dredged material, sewerage sludge, chemical waste, plastic waste, and radioactive material.

A. Dredge Material: Approximately 149.3 million wet metric tons of dredge material is disposed of in the estuaries, the territorial seas and in areas of the exclusive economic zone associated with the North Atlantic, South Atlantic and Gulf of Mexico. Approximately 18.6% of the total amount (27.8 million wet metric tons) is presently disposed of in the EEZ in the area of jurisdiction of this FMP. The composition of the dredge material varies between areas with some dredge materials being contaminated with heavy metals and organic chemicals originating from industrial and municipal discharges and non-point pollution. The Corps of Engineers classifies only a small portion of the total dredge material to be contaminated but presently has no specific numerical criteria to define such contamination (OTA-0-334, 1987).

B. Ocean Dumping of Municipal Sewerage Sludge: The dumping of sewerage sludge into the marine environment has been occurring for many years. The majority of this activity however has occurred in coastal waters in designated dump sites off the Northeastern States. The dumping of sewerage sludge in US coastal and open ocean waters has risen substantially from 2.5 million wet metric tons in 1958 to 6.6 million wet metric tons in 1985 (OTA-O-334, 1987). Sewerage sludge disposed in the North Atlantic area originates from nine sewerage authorities in New York and New Jersey with most of the material being dumped at a 12-Mile Sewerage Dump Site located in the New York Bight. In the next few years the dumping of all sewerage sludge is to be directed to a Deep Water Municipal Sewerage Sludge Site located 106 miles offshore just off the continental shelf (OTA-O-334, 1987). Most sludge that is presently disposed at sea is and will continue to be contaminated with microorganisms, metals and organic chemicals. These and other toxic chemicals do contribute to the degradation of water quality in the North Atlantic, South Atlantic and Gulf of Mexico. Open ocean environments are generally considered more resistant to degradation from pollutants due to the dispersal, transport and diffusion of wastes yet there are problems in quantifying and limited research addressing the impacts of such activities on oceanic pelagics such as billfish. "Despite these problems of documentation, a strong overall case can be established that waste disposal activities are contributing significantly to substantial declines in the quality of marine waters and harming marine organisms, and in some cases having effects on humans" (OTA-O-334, 1987).

C. Industrial Wastes: The disposal of industrial wastes in US coastal and open ocean waters has declined substantially in the last decade going from a high of 4.6 million wet metric tons in 1973 to approximately 200,000 wet metric tons in 1985 (OTA-O-334,1987). The majority of

this disposal is accomplished at the Deep Water Industrial Waste Site located 10 miles from the Deep Water Municipal Sludge Site cited previously that is located 106 miles offshore in the North Atlantic. In addition to this site two other sites have received significant amounts of industrial waste since 1977; the New York Bight Acid Waste Disposal Site and the Pharmaceutical Waste Site off Puerto Rico (discontinued in 1981). Three industrial firms are presently dumping acid and alkaline wastes into the two marine industrial waste sites located in the North Atlantic. Allied Chemical dumped approximately 30,000 metric tons of hydrochloric acid originating from fluorocarbon refrigerants and polymer manufacturing in the New York Bight Acid Waste Site during 1986. Composition of this waste was as follows 30% Hydrochloric acid, 1 to 2.5% fluoride, suspended solids and total organic carbon at 10 ppm, petroleum hydrocarbon in 1 to 10 ppm range, chromium, nickel and zinc in < 0.01 to 3 ppm range, and Arsenic, cadmium, copper, lead, and mercury in, 0.01 ppm to 1 ppm, with a pH range < 1.0. Presently 10% of the waste in 1984 and 6% of the waste in 1985 was sold as hydrochloric acid and not dumped as waste. DuPont-Edge Moor has been dumping iron and other acidic metal chlorides from titanium dioxide production in the Deepwater Industrial Waste Site since 1968 with approximately 50,000 metric tons being disposed of at the site in 1986. The composition of this waste included; chromium at the level of 100's of ppm, zinc and lead at levels of 10's of ppm, copper and nickel in the 1 to 10 ppm range and cadmium at the level of 0.001 ppm, with a pH range of 0.1 to 1.0. Permits held by this company contain provisions for the cessation of ocean dumping and the development of feasible alternatives. DuPont-Grasselli dumped approximately 110,000 metric tons of sodium sulfate from agricultural chemical production into the Deepwater Industrial Waste Site in 1986. The composition of this waste included; low level molecular organics in the 10's to 100's ppm range, 10% sodium sulfate, chromium, copper, nickel, lead in the range of 0.01 to 0.1 ppm, and cadmium in the 0.001 ppm range, with a pH of 10 to 12.5. The impact of disposal at sea is not viewed as significant as the direct point source discharge of industrial waste into the coastal marine environment. Acid and alkaline wastes when disposed at sea will neutralize within one to four hours once in contact with ocean water. Permits for ocean dumping of acids and alkalines are considered on a case by case basis and must comply with the Ocean Dumping Criteria of the Marine Protection, Research and Sanctuaries Act (OTA-O-334, 1987)

7.2.4 Habitat Preservation, Protection and Restoration Recommendations

A. Research be encouraged that would quantify the impacts of ocean disposal of dredge materials, industrial waste and sewerage sludge on oceanic pelagics such as billfish.

B. The disposal of contaminated sewerage sludge, industrial waste and contaminated dredge material that would degrade the environmental quality of the marine environment utilized by billfish be prohibited.

7.3 Fishery Management Jurisdiction, Laws, and Policies

7.3.1 Federal

The U.S. Department of Commerce, acting on the basis of a fishery management plan developed by the Regional Fishery Management Councils pursuant to the Magnuson Fishery Conservation and Management Act of 1976 (16 U.S.C. 1801 et seq.), has authority to manage the billfish stocks under consideration in this plan in the U.S. EEZ. When approved and implemented by the Secretary of Commerce, this fishery management plan will supersede those aspects of the PMP for Atlantic Billfishes and Sharks which relate to blue marlin, white marlin, sailfish and spearfish. The regulations requiring that all billfishes taken on foreign longline gear within the EEZ be released, that foreign longline fishermen maintain accurate catch and effort records of their bycatch of billfish and the area closures are adopted from the PMP. Implementation of this plan will not affect the shark related aspects of the PMP.

The Coastal Zone Management Act of 1972 (16 U.S.C. 1451) establishes a national policy placing responsibility for comprehensive land and water management of the coastal zone upon the coastal states. Federal actions directly affecting a state's coastal zone must be consistent (to the maximum extent possible) with approved state coastal zone management plans. Fifteen eastern coastal states and two U.S. territories have programs approved by the Secretary of Commerce: Maine, Massachusetts, Rhode Island, New Jersey, Connecticut, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Florida, Alabama, Louisiana, Mississippi, Puerto Rico, and the Virgin Islands. Copies of this plan have been submitted to states with coastal zone management programs with a determination of consistency.

The Marine Protection, Research, and Sanctuaries Act of 1972 (16 U.S.C. 1431-1434) authorizes the Secretary of Commerce to designate as marine sanctuaries those areas of ocean waters within U.S. jurisdiction which he determines to be necessary for the purpose of preserving or restoring their conservation, recreational, ecological, or esthetic values. Four such sanctuaries are established within the management area:

A. The USS Monitor Marine Sanctuary off North Carolina is designated on National Ocean Survey charts as a "protected area". Fishing is prohibited in this area.

B. Gray's Reef National Marine Sanctuary is located approximately 18 nautical miles off Sapelo Island, Georgia. Regulations governing the Sanctuary require permits for certain fishing activities, including bottom trawling and dredging and wire trap fishing.

C. Key Largo Coral Reef National Marine Sanctuary is located adjacent to the John Pennakamp Coral Reef State Park of Key Largo, Florida. Hook and line fishing is permitted in the Sanctuary.

D. The Looe Key Coral Reef National Marine Sanctuary off Big Pine Key, Florida, prohibits the use of wire fish traps in the Sanctuary.

Details on sanctuary regulations may be obtained from the Director, Sanctuary Programs Office, Office of Coastal Zone Management, NOAA, 1825 Connecticut Ave, N.W., Washington, DC. 20235.

7.3.2 State

The coastal states have regulatory jurisdiction and authority in their territorial seas. This normally does not affect the billfish fishery with the exception of the Florida Gulf coast, to some extent the coast of Texas where state authority extends to 9 miles, and the Caribbean where the 100 fathom contour comes within a mile of the shoreline in some places.

Six states, Delaware, Florida, Massachusetts, Texas, Louisiana and Virginia, have laws regulating the utilization or taking of billfishes. Delaware prohibits the sale of sailfish, blue marlin and white marlin; Florida prohibits the sale of sailfish and imposes a bag limit of two sailfish per angler per day; Massachusetts, Texas, Louisiana and Virginia prohibit the sale of marlin.

7.3.3 Other Coastal Nations

Unit stocks of billfish are not contained within the EEZ. MSY for the marlins was estimated under the assumption of North Atlantic stocks and MSY for sailfish/spearfish was estimated under the assumption of a single Atlantic-wide stock. Those coastal nations whose territorial seas and/or economic zones are within the hypothesized range of the stocks have management authority over the stocks within their zones.

Two countries are known to have laws regarding fishing for billfishes within their fishing zones. Mexico prohibits the use of pelagic longline gear in its Gulf economic zone. The sport fishery for billfish is regulated through a permit system. U.S. sport fishermen departing from U.S. ports may fish in the Cuban fishing zone subject to permitting procedures established by the Cuban government in 1978 and during a fishing season which extends from April 1 through September 30.

7.3.4 International

The International Commission for the Conservation of Atlantic Tunas (ICCAT), of which the United States is a party, is authorized to recommend to its contracting parties measures to ensure the maintenance of stocks of tunas and tuna-like fishes, including billfishes, at levels which will permit the maximum sustainable catch.

The PMP recommended development and implementation of an international plan for management of billfishes under the auspices of an international organization such as ICCAT. This FMP reiterates that recommendation. ICCAT has, to date, made no management recommendations concerning billfishes. However, the actions described in this FMP to manage billfish stocks within the EEZ are intended to complement any management initiatives undertaken by ICCAT and

are a step toward the conservation of these stocks and establishment of an international management regime.

7.4 Description of Fishing Activities

7.4.1 Domestic Fishery

7.4.1.1 History of Exploitation

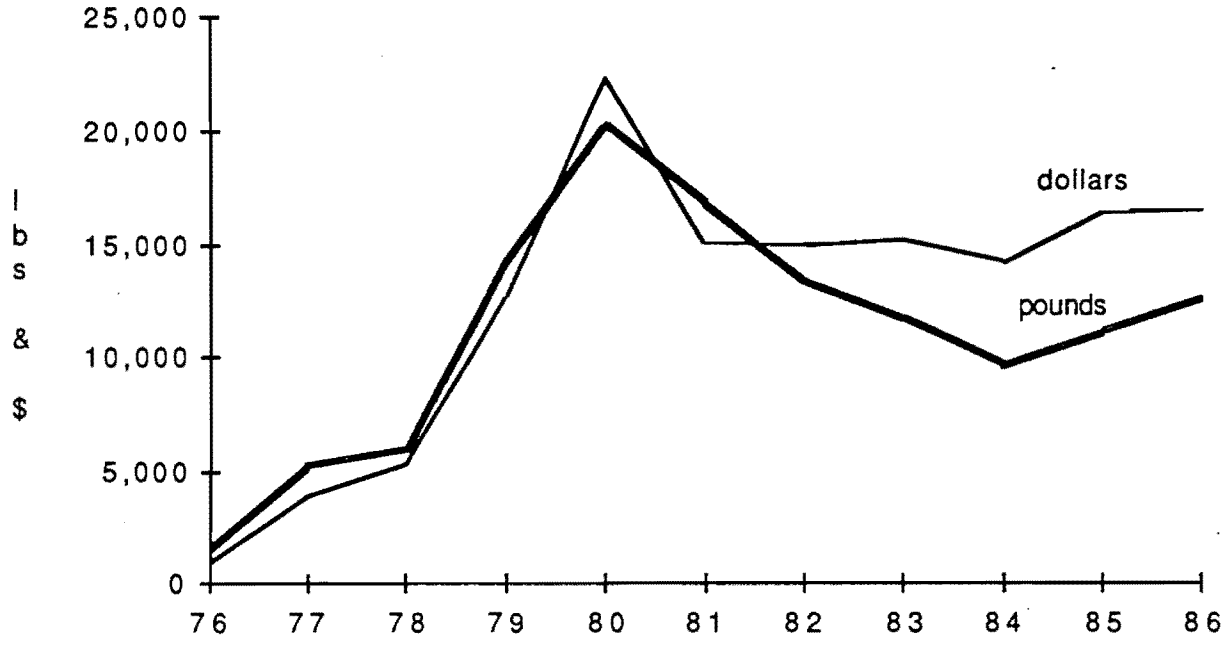
Billfishes have been taken by U.S. recreational fishermen since the early 1900's. However, until the early 1950's the fishery was concentrated in only a few areas along the Atlantic and Gulf Coasts. Expansion in both the number of anglers and the fishing grounds has been rapid since then, largely as a result of improvements in offshore sport fishing vessels and equipment.

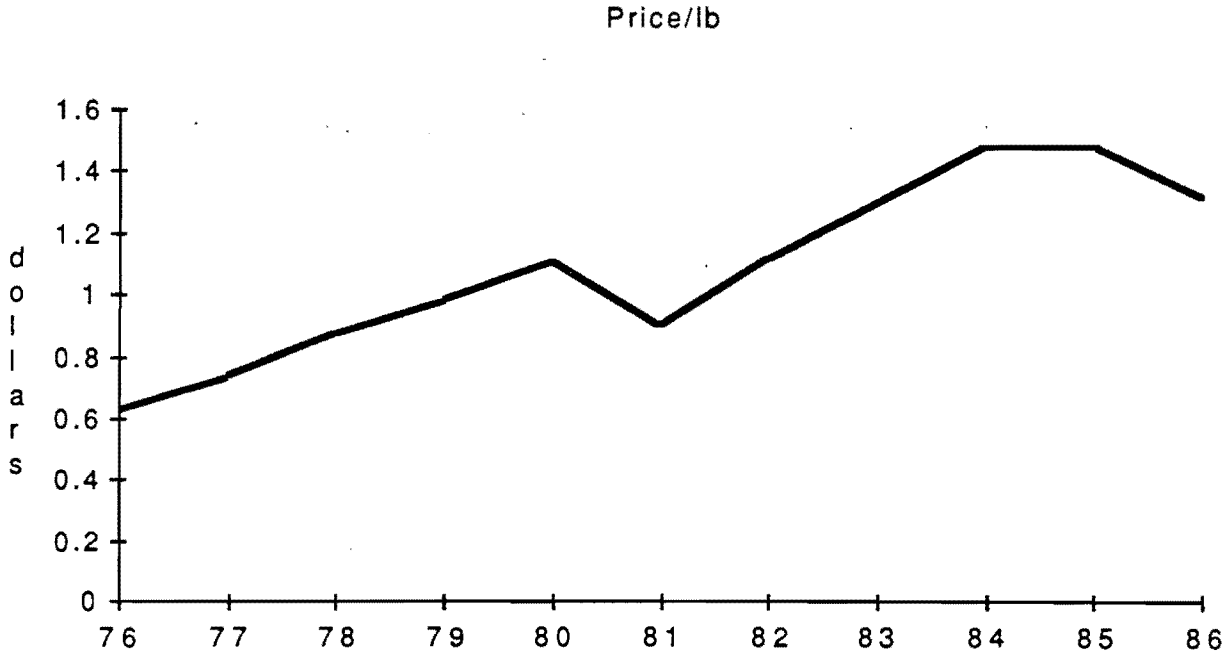
7.4.1.2 Participating User Groups

Most U.S. catches of billfish are by recreational fishermen fishing from charter and private boats. Approximately 19,000 of these boats participated in the billfish fishery during the 12-month period from May 1, 1977 to April 30, 1978.

There is a small harpoon fishery for white marlin in the waters off southern New England. This is essentially a recreational fishery although often the fish are sold. There is no other directed, domestic commercial fishery for billfishes, although they are captured incidental to domestic swordfish and tuna longlining activities. Because billfishes constitute a source of food in Puerto Rico and to some degree in the Virgin Islands, billfish catches are not, strictly speaking, a purely recreational activity. It is very difficult to establish the number of sales by the persons who catch the fish. At present there is no commercial activity geared towards catching billfish but there are small-scale fishermen, who while seeking other species, catch billfish and sell them. Most billfish caught in Puerto Rico are caught by recreational fishermen, but many of these fish enter the food market. It is difficult to say what percentage of billfish are caught by recreational and small-scale fishermen in the U.S. Virgin Islands. In 1985 there were 11,000 pounds of billfish reported sold in Puerto Rico (Figure 1). Most of this is believed to have been caught by recreational fishermen.

The billfish bycatch in the domestic swordfish/tuna longline fishery is not known. However, in 21 observer trips a total of 137 billfish were recorded in 160 sets (Table 1), or 0.86 billfish per set. Although the distribution of observer effort is heavily weighted to the southern region (15 trips in the Gulf of Mexico, 2 in the south Atlantic, 2 in the Caribbean and 2 on the Grand Banks) and thus may not be representative of the entire fishery, a rough estimate of the present billfish bycatch can be made. If, on average, there are 0.86 billfish caught per longline set, and out of 625 permitted swordfish vessels, we assume there are 500 active longliners each making 100 sets per year, then 43,000 billfish will be caught by this fleet annually. By species this breaks down as follows: 18,189 (42.3%) blue marlin; 18,834 (43.8%) white marlin; 4,687 (10.9%) sailfish; and 1,247 (2.9%) spearfish.





	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Weight(lbs)	1,500	5,250	6,000	14,228	20,250	16,756	13,330	11,669	9,562	11,077	12,597
Value($)	$905	$3,892	$5,360	$12,751	$22,410	$15,080	$14,930	$15,170	$14,152	$16,394	$16,549
Price($/lb)	0.63	0.74	0.88	0.99	1.11	0.90	1.12	1.30	1.48	1.48	1.31

Figure 1. Blue marlin commercial landings for Puerto Rico, 1976 - 1986.
(Source: Fisheries Research Laboratory, Statistics Program, CODREMAR, DNR, Puerto Rico)

Table 1. Summary of billfish, swordfish, tuna and sharks caught and recorded by observers on 21 domestic longline trips from 1985-1

	Observer Code	Date	Trip (Days)	Sets/ Trip	Area	Total Hooks	Gear Length (miles)	SWF	Tuna	Sharks	BIM	WhM	SAIL	SPEAR	Total Billfish
1985	FAB1	5/30-6/3	5	5	Northern Gulf	1,810	198	24	72	67	3	6	1	0	10
	ARB1	7/4-7/12	9	7	South Atlantic	1,841	157	71	7	25	4	0	7	0	11
	RRT1	7/26-8/6	12	11	Grand Banks	5,200	338	101	72	91	0	3	0	0	3
	ERG1	9/4-9/8	8	5	South Atlantic	1,152	98	17	11	15	1	0	3	0	4
	JCC1	9/6-9/21	16	14	Grand Banks	14,350	413	448	6	79	0	0	0	0	0
	WGD1	9/13-9/17	5	4	Northern Gulf	3,450	152	4	101	2	6	8	2	0	16
	WHG1	10/4-10-9	6	7	Northern Gulf	2,702	122	15	74	9	1	2	0	0	3
	WGD2	10/24-11/6	13	6	Northern Gulf	2,148	77	7	75	3	1	6	0	0	7
	WHG2	11/5-11/8	4	4	Northern Gulf	1,399	80	4	80	4	5	3	0	0	8
	WHG3	11/13-11/16	4	4	Northern Gulf	1,428	78	1	215	10	4	2	0	0	6
	WGD3	12/4-12/10	7	5	Northern Gulf	1,720	61	5	112	17	1	2	0	0	3
1986	WHG4	1/12-1/19	8	8	Northern Gulf	2,655	138	20	39	5	2	2	0	2	6
	OEM1	1/17-2/3	18	14	Caribbean	3,534	367	120	18	19	1	3	0	2	6
	RAO1	2/4-3/1	26	19	Caribbean	8,870	684	216	74	28	22	3	0	0	25
1987	DEG1	6/25-6/27	3	3	Northern Gulf	2,200	42	2	33	21	0	0	0	0	0
	FLL1	6/28-7/7	10	10	Northern Gulf	6,000	305	3	148	14	1	5	0	0	6
	DEG2	7/7-7/9	3	3	Northern Gulf	1,800	36	1	22	18	1	3	0	0	4
	DTG1	7/21-7/30	10	10	Northern Gulf	5,500	170	6	163	22	0	5	1	0	6
	FLL2	8/16-8/24	9	9	Northern Gulf	5,220	210	3	56	15	1	2	1	0	4
	DTG2	8/20-8/23	4	6	Northern Gulf	3,275	66	2	6	2	1	2	0	0	3
	DTG3	9/9-9/16	8	6	Northern Gulf	2,400	102	4	12	6	3	3	0	0	6

(Source: Domestic longline observer program, SEFC, NMFS)

In the Gulf of Mexico, observer records indicate that 0.98 billfish are caught per set. These trips primarily targeted yellowfin tuna. As the longline fleet continues to shift effort to tunas, the billfish bycatch can be expected to increase. Presently (1988), it is estimated that there are 250 longliners fishing in the Gulf of Mexico. Assuming that the average vessel makes 100 sets per year (a conservative estimate), then 24,500 billfish would be caught in the Gulf of Mexico annually, with the following species composition: 8,355 blue marlin; 14,210 white marlin; 1,397 sailfish; and 564 spearfish. By comparison, the recreational fishery here caught 1,573 marlin in 1983 (the last year for which total catch is available) of which 446 were blue marlin and 1,127 were white marlin (Table 2).

7.4.1.3 Interactions Among Domestic User Groups

The tremendous reduction in foreign fishing effort in the U.S. EEZ has all but eliminated earlier problems of competition and gear conflicts. However, as the foreign fleet declined the domestic fleet grew proportionately. Presently there are estimated to be 250 longline vessels fishing in the Gulf of Mexico for yellowfin tuna (NMFS). There were approximately 625 swordfish permits issued in 1987, this number having increased each year since 1984 when permits first became mandatory.

Unlike foreign longliners fishing in the EEZ, domestic boats are not required to carry observers or release billfish. Until 1984, virtually all U.S. longline vessels targeted swordfish. Swordfish are nocturnal and fishing was done at night. Since billfish are diurnal feeders, the billfish bycatch was small (averaging less than 2 percent of the swordfish catch in numbers). As the swordfish fishery expanded into more southern waters, particularly the Caribbean, the billfish bycatch appears to have increased. Table 1 presents a summary of 21 observer trips taken aboard domestic longline vessels. Although only two trips were taken in the Caribbean, the billfish bycatch observed was 5 percent of the swordfish catch on one trip and 12 percent on the other (overall, 9.2 percent). More importantly, though, since 1984, effort has become increasingly directed at yellowfin and bigeye tuna. Yellowfin feed during the day while bigeye are believed to feed both day and night. As effort on tuna increased, so did the billfish bycatch. In 15 observer trips in the northern Gulf of Mexico, most of which were directed at yellowfin tuna, a total of 88 billfish and 1,208 tuna were caught. Thus, billfish represent 7.3 percent of the tuna catch in numbers. While the ex-vessel price of billfish is low ($0.60 - $1.00 per pound) compared to tuna and swordfish, billfish still represent a saleable product and an increasing number are being landed. Table 3 shows the reported marlin landings for the Gulf of Mexico since 1982. It can be seen that marlin landings increased 1400 percent between 1982 and 1986 and 149 percent from 1985 to 1986. As the potential to supply the market increased, so did demand and price. The price in Puerto Rico has increased steadily since 1976 and by 1985 had already exceeded $1.50 per pound (Figure 1). There is great concern among recreational fishermen that these species, which have historically had little commercial value, will rapidly become established as food fish. Once

Table 2. Gulf of Mexico commercial landings (lbs) of marlin and tuna 1982-1987.

Species	1982	1983	1984	1985	1986	1987[1]
Blue Marlin	0	537	1,870	11,600	21,400	3,900
White Marlin	0	0	8,998	20,600	67,000	8,400
Uncl. Marlin	9,407	2,631	11,066	25,200	53,300	2,200
Total Marlin	9,407	3,168	21,934	57,400	141,700	14,500
Yellowfin Tuna	57,092	153,257	776,145	3,257,100	6,394,200	1,162,100

1 Includes January through August only.

Table 3. Gulf of Mexico commercial landings (lb) of marlin and tuna 1982-1987.

Species	1982	1983	1984	1985	1986	1987[1]
Blue Marlin	0	537	1,870	11,600	21,400	3,900
White Marlin	0	0	8,998	20,600	67,000	8,400
Uncl. Marlin	9,407	2,631	11,066	25,200	53,300	2,200
Total Marlin	9,407	3,168	21,934	57,400	141,700	14,500
Yellowfin Tuna	57,092	153,257	776,145	3,257,100	6,394,200	1,162,100

1 Includes January through August only.

demand becomes widespread, price will increase and longline vessels will begin targeting them. Unless this situation is controlled now, it will be impossible for the objectives of this FMP to be realized.

Pelagic drift gill net fisheries also have a bycatch of billfish. Some swordfish longliners began experimenting in the early 1980's with large mesh (14-20 inch stretch mesh) pelagic drift nets similar to those used off California for swordfish and thresher sharks. These nets are approximately one mile long and 90 feet deep. If deployed in waters frequented by billfish, a billfish bycatch is inevitable. Little documentation of the fishing characteristics or bycatch of this gear is available, though, because few observer trips were ever made onboard vessels employing these nets. However, it is believed that fewer than 10 boats fishing in the New England area, where billfish generally are not abundant, have ever used this gear. In the few observed sets, no billfish were taken by these nets.

Recently drift gill nets have been employed for king mackerel off the southeast Florida coast. These nets are between 1,200 and 5,000 yards long, 50 feet deep and have a 5 inch stretch mesh. In 1987 it was estimated that 419 sailfish were caught in this fishery (13 boats), all of which were discarded dead.

7.4.1.4 Description of Vessels and Gear Employed

Sport fishing for marlins and sailfish is done with rod and reel. The boats used in the U.S. sport fishery for billfishes range from 16 to more than 65 feet in length and the method of power ranges from outboard engines to large diesels. Marlin fishing, as opposed to sailfish fishing, generally requires a large (greater than 25 feet in length), inboard, usually diesel-powered vessel because of the distance that has to be travelled to reach suitable fishing grounds, as many as 75 to 100 miles from shore off many areas on the Atlantic and Gulf coasts. The use of smaller outboard powered boats (in the 16 to 25 foot range) in the fishery is particularly evident off the southeast coast of Florida from Key West to Ft. Pierce and in the northern Gulf of Mexico and the Caribbean where productive billfish fishing waters are only a few miles from shore. The development of small, fast, sea worthy fishing boats (20-30 feet in length) and reliable high-powered outboard engines has made even the offshore fishing grounds accessible to a great many anglers.

7.4.1.5 Fishing Seasons and Areas

The U.S. recreational fishery for billfishes is conducted from every state along the Atlantic and Gulf coasts from Massachusetts southward, as well as from Puerto Rico and the Virgin Islands. Anglers from the U.S. also fish extensively in foreign waters, particularly offshore of the Bahamas, Venezuela, Mexico, Dominican Republic and British Virgin Islands.

The fishery is, for the most part, a seasonal one, which coincides with the months of highest availability of billfishes within the EEZ. Off the Atlantic and Gulf coasts of the U.S., recreational activity is most intense from April through October, except off the lower east coast of

Florida. In this area, fishing for sailfish is a year-round activity, although the peak season runs from November through April. In the Caribbean EEZ, fishing for billfish is a year-round activity with seasonal peaks for each species.

7.4.1.6 Amount of Catches

In 1983, NMFS attempted to determine the total catch of billfishes by U.S. recreational fishermen. This is the most recent year for which a complete census is available. A previous study conducted from May 1, 1977, to April 30, 1978, is believed to have had methodological problems which may have caused catches to have been overestimated. Unfortunately, the 1983 survey did not attempt to document either sailfish or spearfish catches, and as a result these data are incomplete.

Estimates of the catch of marlins, including numbers boated and released, by U.S. recreational fishermen in 1983 are presented in Table 2. Approximately 35 percent of blue marlin and 61 percent of white marlin taken by the U.S. fishery were released in 1983. In 1986, 32 percent of blue marlin, 45 percent of white marlin and 87 percent of sailfish recorded in the NMFS recreational billfish survey were released. The survival rate of released fish is unknown but is believed to be significant according to recreational fishermen and others knowledgeable about the fishery. Acoustical tracking experiments conducted off the southeast coast of Florida indicate that the mortality of sailfish taken by rod and reel, tagged and released, is quite low. Seven out of eight tracked sailfish survived.

Recreational catches of billfishes have been difficult to document with a desirable degree of accuracy. The special characteristics of the recreational fishery for billfish necessitate the design of a survey specific to this fishery to obtain reliable catch and effort information. These characteristics are:

A. billfish are a relatively rare species of fish in comparison with other species sought by marine anglers, and

B. the incidence of billfish fishermen in the total population is relatively low.

The accuracy of recreational catch data is unknown. While the 1983 census was perhaps reasonably accurate for blue and white marlin, sailfish landings are grossly underestimated. In addition, far fewer blue and white marlin were recorded in this study than were estimated in the 1977-1978 study.

Reported commercial landings of billfishes by U.S. longline boats for 1986 are shown in Table 4. These figures are believed to greatly underestimate actual landings. In addition many billfishes are believed to be caught and released by longliners. Survival rate of these released fish is unknown. The number of swordfish permits issued has increased every year. In 1987 there were approximately 625 swordfish permits issued. Further it is estimated that 250 U.S. longliners are fishing for yellowfin tuna in the Gulf of Mexico (most hold swordfish permits).

Table 4. 1986 longline landings and value of swordfish, tuna and billfishes* (in lbs and $).

Area	Swordfish		Tuna		Billfish	
	Dressed Weight	Value	Whole Weight	Value	Whole Weight	Value
NE & MA	3,720,750	$9,332,214	1,818,370	$5,358,043	14,000	$8,400
South Atlantic	1,385,909	$3,869,183	672,913	$1,061,819	36,218	$20,685
Gulf of Mexico	598,500	$1,617,855	6,734,981	$9,637,893	141,400	$89,082
Caribbean	1,902,750	$5,258,335	287,863	$541,811	12,597	$16,549
Total	7,607,909	$20,077,587	9,514,127	$16,599,566	204,215	$134,716
% of Combined Landings	43.9%	54.5%	54.9%	45.1%	1.2%	0.4%

*Caribbean billfish landings include handline and rod and reel
(Source: SEFC, NMFS)

This expansion of the U.S. longline fleet, particularly in southern waters (Gulf of Mexico and Caribbean Sea) is assumed to have resulted in a considerable increase in billfish mortality.

7.4.1.7 Amount of Effort

Approximately 102,919 hours of effort were expended in the recreational marlin fishery in 1983. Assuming 3.5 anglers per boat and 6 hours fished per day, the billfish fishery is estimated to have generated over 60,000 days of recreation in 1983.

The catch and effort estimates resulting from the specialized billfish survey indicate that the time spent fishing for a billfish is large compared to the number of fish caught. The 1977-78 survey estimated that there were 298,797 days fished for billfish. In that time, a total of 6,745 blue marlin were caught (44 boat days to catch one blue marlin); 15,650 white marlin were caught (19 days to catch a white marlin); and 60,007 sailfish were caught (5 days to catch one sailfish). Using 1983 data, assuming 6 hours of fishing per day, it took approximately 20 boat days on the east coast to catch a blue marlin, 14 days in the Gulf of Mexico, and 4 days in the Caribbean; it took 3 days to catch a white marlin on the east coast, 6 days in the Gulf of Mexico and 97 days in the Caribbean.

In 1986, it took, on average, approximately 28 days to catch a blue marlin on the U.S. east coast, 11 days in the Gulf of Mexico, and 4 days in the Caribbean; it took 17 days to catch a white marlin on the east coast (no samples were available north of North Carolina), 10 days in the Gulf of Mexico, and 208 days in the Caribbean. On the Florida east coast, it took just under 6 days to catch a sailfish.

7.4.1.8 Vessel Safety

Amendment by P.L. 99-659 to the Magnuson Act requires that a fishery management plan, must consider and may provide for, temporary adjustments, after consultation with the Coast Guard and persons utilizing the fishery regarding access to the fishery for vessels otherwise prevented from harvesting because of weather or other ocean conditions affecting the safety of the vessels.

No vessel will be forced to participate in the fishery under adverse weather or ocean conditions as a result of the imposition of the management regulations set forth in this fishery management plan, therefore, no management adjustments for fishery access will be provided.

A. Fishery access and weather related safety: There are no fishery conditions or management measures or regulations contained in this FMP that would result in the loss of harvesting opportunity because of the crew and vessel safety effects of adverse weather or ocean conditions. There have been no concerns raised by the Coast Guard or by persons using the fishery, that the proposed management measures directly or indirectly pose a hazard to crew or vessel safety under adverse weather or ocean conditions.

B. No Impact Determination: Vessel safety has not been identified as a relevant or significant issue in the billfish fishery or in the management measures set forth.

C. Adjustments: There are no procedures for making management adjustments in the plan because no person will be precluded from a fair or equitable harvesting opportunity by the management measures set forth.

D. Coast Guard Evaluation: No vessel safety issues, whether pertinent to fishery access and weather-related vessel safety or to other significant or relevant safety issues have been identified by the Coast Guard.

E. Procedures: There are no procedures proposed to monitor, evaluate and report on the effect of management measures on vessel or crew safety, under adverse weather or ocean conditions.

F. Other Safety Issues: There have been no significant and relevant safety issues raised by fishery users, other public or the Coast Guard, therefore, there are no social or economic implications resulting.

7.4.2 Foreign Fishery

7.4.2.1 Participating User Groups

The foreign commercial fishery for billfishes in the Atlantic Ocean is conducted by those nations that maintain longline fleets. The fishing effort of the Atlantic longlining fleet is principally directed at tuna; however, billfishes frequently occur in the same areas and depths as some species of tuna. Consequently, the incidental bycatch of billfishes is sometimes significant. These fishes are retained by the longline fleet and frequently command prices comparable to tunas on world markets.

Those nations currently longlining in the Atlantic are Japan, Korea (ROK), Taiwan, Spain, Cuba, Brazil, the U.S.S.R., Venezuela, Panama and Grenada. Of these, only Japan has historically fished within 200 miles of the U.S. mainland.

7.4.2.2 Vessels and Fishing Gear

A typical piece of gear fished by a longlining vessel consists of a horizontal mainline which may stretch for 60 to 70 miles and from which branch lines with baited hooks (as many as 2,000 per set) are hung vertically. The gear is set and hauled approximately once every 24 hours.

7.4.2.3 Fishing Seasons and Areas

The foreign longline fishery operates throughout the range of the Atlantic billfishes. The main concentration of longline fishing effort within 200 miles of the U.S. has historically been in the northern Gulf of Mexico in spring and summer and off the eastern U.S. coast from late summer through fall. The longline fishery in the Gulf of Mexico EEZ has changed in recent years. Prior to 1973, the fishery was conducted in the summer and the tuna catch was almost entirely

yellowfin tuna. In 1973, the Japanese began catching giant bluefin tuna, a more valuable fish, and the pattern of catch and effort began to change. After 1976, the primary period of effort in this fishery shifted to winter and early spring, the time of greatest availability of bluefin tuna. Catch and effort for yellowfin tuna declined. In 1982 the Japanese were precluded from fishing for bluefin tuna in the Gulf pursuant to ICCAT management recommendations that severely limited bluefin tuna fishing. As a result of considerable opposition from U.S. recreational fishermen, the Japanese voluntarily ceased fishing operations entirely in the Gulf of Mexico in 1982.

7.4.2.4 Catch and Effort

Prior to 1966, almost all of the billfish catch by longliners in the Atlantic Ocean was taken by the Japanese. Since 1970, Japan has been responsible for approximately 19 percent of the total longline catch of billfishes in the Atlantic. Japanese longline effort in the Atlantic diminished considerably in the late 1960's. However, the entry of other foreign longliners into the fishery has more than made up for the decrease in Japanese effort. In recent years, most longline catches of billfish in the Atlantic Ocean have been by Korean, Taiwanese, Cuban and Japanese longlining vessels. From a historical perspective, approximately six percent of the total Atlantic billfish catch by foreign vessels (Japan, South Korea, Taiwan, etc.) has been taken within 200 miles of U.S. continental shores.

Total effort and landings of billfish by the Japanese in the Atlantic have decreased, particularly in the EEZ in recent years. During the years 1964 through 1969, an average of 3 percent of Japanese fishing effort in the Atlantic and 5 percent of billfish catch were within 200 miles of the U.S. coast. In the period 1970-77, an average of 11 percent of total Atlantic fishing effort and 28 percent of the total Atlantic billfish catch occurred within 200 miles of the U.S. In 1984 and 1985 the Japanese caught less than one percent of the total Atlantic billfish catch in the U.S. EEZ.

A Preliminary Management Plan for Atlantic Billfishes and Sharks was implemented on January 17, 1978, by the U.S. Department of Commerce. The PMP determined that there was no surplus of billfishes available for foreign fishing within the EEZ. Consequently, it required that all billfishes taken by foreign fisheries be released without removing them from the water.

Data from the foreign fishery observer program indicate that the Japanese longlining fleet fished approximately 7.5 million hooks within the EEZ from March 20, 1978 to March 19, 1979. Approximately 5,300 billfish were hooked on foreign longlining gear within this period, only 40 percent of which were alive when released.

In recent years, effort has been reduced dramatically in the EEZ. In 1986, for example, 272 white marlin and 37 blue marlin were recorded by U.S. observers (100% coverage). Of those 54 percent of the white marlin and 57 percent of the blue marlin were dead. In 1986 only three Japanese longline vessels fished in the EEZ. The Japanese have agreed not to fish in the Gulf of Mexico and have not done so since 1982.

7.4.3 Interactions Between Domestic and Foreign Participants in the Fishery

7.4.3.1 Competition for the Available Stocks

The U.S. sport fishery for billfishes is seasonal in most areas. Both blue and white marlin stocks in the North Atlantic make extensive seasonal migrations and are available to U.S. fishermen off their shores for only part of the year. The longline fishery, however, is highly mobile and moves seasonally in response to the migrations of target species of tuna. Sport fishermen frequently state that when longliners have been fishing within the EEZ during seasons of peak billfish abundance, sport fishing for billfishes is poor for some time afterwards.

The PMP for Atlantic billfishes and sharks stated the problem between foreign fishing and the domestic fishery as follows:

> "United States fishermen believe that the billfish incidental catch of foreign longline vessels adversely affects U.S. catch rates. Sport fishermen state that they have frequently observed a decrease in their catch after longliners have been fishing near them. The decrease reportedly lasts for some time (weeks or months) after the departure of the longline vessels. This belief is supported by NMFS catch statistics in the Gulf of Mexico (Pristas 1978, 1979, 1980, and 1981). The U.S. catch rates for marlins have increased dramatically since 1978, when the Japanese voluntarily ceased tuna fishing in the Gulf during the summer. Average U.S. catch per unit effort (CPUE) for white marlin increased 77 percent, from 1977-1978 to 1979-1980 (Gulf of Mexico Fishery Management Council, Atlantic Billfish Fishery Management Plan). Blue marlin CPUE increased about 33 percent over the same period. An analysis of NMFS catch statistics for the Gulf of Mexico from 1978 through 1981 demonstrated a very large and abrupt increase in U.S. catch rate and total catch which corresponded with the termination of the Japanese fishery and incidental catch of marlins (Connor Davis, Gulf of Mexico Fishery Management Council, 1982, personal communication). Based on this limited information, it is assumed that, of the billfishes that could have been hooked in the EEZ by foreign longliners, following their former fishing practices, some could be hooked during a fishing season by domestic fishermen whether the change of foreign fishing operations was voluntary or mandatory."

With the reduction of foreign fishing in the EEZ in recent years and the area closures implemented through the PMP, competition and/or conflicts between foreign longliners and U.S. recreational fishermen have all but ceased.

7.4.3.2 Gear Conflicts

There are numerous areas along the Atlantic and Gulf coasts of the U.S. where U.S. sport fishermen have come into direct contact with Japanese longliners. Some of these are in the Gulf of Mexico off Port Aransas, Texas and the Mississippi Delta; off Cape Hatteras, North Carolina; and off New Jersey and Maryland. U.S. fishermen have reportedly destroyed longline gear, although there is no record of U.S. sport fishing gear being damaged by foreign fishermen. Conflicts between foreign commercial and U.S. sport fishermen reached a peak in the late 1960's and prompted private negotiations between representatives of the Japanese fishing industry and the

U.S. sport fishing industry. These negotiations resulted in an informal understanding between the two parties that Japanese vessels would restrict their fishing to areas other than those where U.S. sport fishermen fished for billfishes, and that U.S. fishermen would be discouraged from destroying Japanese longline gear.

In addition to the conflicts between Japanese longliners and U.S. sport fishermen, there are problems with U.S. longline fishermen. U.S. longline fishermen are unable to detect Japanese longlines because of the ineffective radar reflectors employed by the Japanese. Japanese fishermen rarely use their radars while on the fishing grounds; thus, they frequently do not detect longlines set by U.S. fishermen and marked with radar reflectors. Thus, tangled lines, lost time and lost or damaged gear are frequent. On several occasions U.S. fishermen have left the fishing grounds to the Japanese after sustaining significant gear damage. This issue is more fully considered in the Swordfish FMP. Again, the greatly reduced Japanese effort in the EEZ has eliminated most gear conflicts.

7.5 Description of the Economic Characteristics of the Fishery

7.5.1 Domestic Harvesting Sector

Expenditures by the participants in the recreational billfish fishery are estimated to have been approximately $100 million in 1977-1978. The total economic value of the fishery is even larger, and has certainly increased since then. Expenditures by billfish fishermen increase the buying and spending power of those sectors of local and regional economies which supply goods and services to the recreational fishing community. This increased buying power has indirect impacts on wages and profits both within and outside of the communities in which the original expenditures occurred.

Although a comparable figure of total economic value of the commercial fishery is not available, the present (1986) ex-vessel value of billfish to the commercial longline fishery is estimated to be $134,716. Thus, billfish represent far less than one percent of the catch by value for longliners (Table 4). While these figures do not reflect a common denominator and thus cannot be directly compared, they provide some indication of the considerable difference in relative value of these species to the two user groups.

7.5.2 Domestic Processing Sector

Domestic interest in billfishes is recreational and many of the fish hooked are released back into the ocean without being boated. However, some billfish caught in the recreational fishery occasionally enter commercial channels in the U.S. mainland. As demand has increased, this practice has presumably become more widespread.

Some billfish have historically entered commercial markets as smoked fish. A relatively small harpoon fishery for white marlin has historically taken several hundred fish annually in the southern New England area. These fish are often sold as smoked product. Recreationally caught

marlin have often entered commercial markets in Florida as well, where they are sold as a smoked product. Recently fresh marlin has become increasingly popular. Marlin for this market are believed to come primarily from the longline bycatch, although some recreationally caught fish are also sold.

In Puerto Rico and to a lesser extent in the Virgin Islands, billfishes are utilized as food and frequently command a high price. Consequently, billfish caught both by recreational and small-scale fishermen in the Caribbean are sold in local markets. In 1978, approximately 7,500 pounds of blue marlin were landed and processed by fishermen in Puerto Rico. In 1985 11,000 pounds were reported landed, however, this is known to be an underestimate of actual landings. The ex-vessel value in 1985 was approximately $1.50 per pound (Figure 1). Additional fish are processed (often by smoking) in the Virgin Islands. However, there is no separate processing industry in the islands.

One additional commercial trade in billfishes is the mounting and sale of bills, tails, and whole fishes by taxidermy facilities. The number of billfishes being processed each year by taxidermists is unknown. The three largest taxidermists reportedly mount a total of approximately 1,000 sailfish per year.

7.6 Social Characteristics of the Fishery

The social benefits generated as a result of the billfish fishery are difficult to quantify. However, it is clear that the value of the fishery to the nation is, to a large extent, dependent on the esthetic benefits derived from the recreational experience. Participants in this fishery are willing to spend large sums of money (per boat day of fishing and per fish caught) and time in the fishery even though the catch per unit of effort is extremely low in comparison with that in other marine recreational fisheries.

Data from the NMFS survey indicate that, except in the Caribbean, 1 blue marlin is caught for every 10-30 boat days, depending on the area, 1 white marlin for every 3 to 17 boat days and 1 sailfish for every 5-6 boat days (on the Florida east coast). Even so, the recreational fishery devoted nearly 291,000 boat days to the fishery in 1977 at an average cost estimated at $350 per boat day. Approximately $1,300 (or $22 per pound) was spent for every billfish landed. In 1983, in the Mid-Atlantic region alone, 2,552 boats fished for marlin and tuna on 21,276 boat days. Total expenditures for marlin and tuna fishing for these trips was over $40 million. Approximately $7,400 was spent for each billfish landed.

It appears that participation in the billfish fishery is dependent not only on catching a fish, but also on the expectations of catching a fish. Any increase in the availability of these fishes in times and areas when recreational fishing occurs should enhance these expectations and consequently, the social benefits derived from the fishery. Presumably, this would also apply to the Caribbean small-scale fishermen.

While it is extremely difficult to determine the actual value of catching a billfish to a recreational fisherman, it is clear that their recreational value far exceeds their commercial value. At $1.00 per pound, the average white marlin is worth less than $50 commercially. Regardless of how one calculates the recreational value of that same fish, its value will be many times higher than this (based on 1981 dollars and 1979 data, the compensation value cited in the PMP was $500).

8.0 CAPACITY DESCRIPTORS

8.1 Optimum Yield (OY)

8.1.1 Specification of Optimum Yield

Optimum yield for billfishes is the greatest number of billfish that can be caught by the recreational fishery in the EEZ, consistent with the provisions of this fishery management plan, considering the biological limitations of the stock and the unavoidable incidental catches in other fisheries.

Optimum yield in this fishery cannot be quantified. The optimum yield is the greatest number of billfish that the recreational fishery can catch at the maximum population level that can be established. Even then, the term "yield" is inappropriate because the maximum benefits to society from this fishery are derived from the experience of catching a billfish, not from their harvest. The present population levels are unknown, the present level of catch is not known, the stock size is unknown, the stock structure is not known, and the maximum potential population size is not known. Thus it is impossible to define a numerical OY.

8.1.2 Economic, Social and Ecological Considerations

The billfish fishery is essentially unique among U.S. fisheries in that the recreational experience is the basis of the value, not the food value or a combination of food and recreational value as would be the case in more typical fisheries. In fact a large proportion of the anglers seem to enhance the value of the recreational experience by releasing rather than retaining their catches. Therefore OY actually would be more meaningfully expressed in terms of high population density of fish rather than in the more conventional terms of yield from the stocks. It is the intent of this FMP to encourage the release of the maximum number of billfishes so that the population density is maintained at the highest possible level. It is the intent of the FMP to minimize the harvest, thereby maximizing population density while still allowing traditional, competitive fishing tournaments to be held.

The higher the availability of billfishes within the EEZ, the greater the likelihood that U.S. anglers will catch a billfish. Any increase in the likelihood of success should have a substantial, positive impact on the socio-economic values of the fishery. Thus, the optimum yield will result from reserving to the U.S. recreational fishery the most billfish possible occurring in the EEZ at any given time.