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On the Management of Blue Marlin and White Marlin In the Atlantic: Implications for Foreign Longlining and Domestic Sportsfishing

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Submitted in partial requirement for the degree of Master of Marine Affairs, University of Rhode Island

by

Tundi M. Agardy

Preface

The following manuscript represents a compilation of the somewhat fragmentary and incomplete information available on the biologies of blue marlin and white marlin, and their respective responses to exploitation. From a policy perspective, the subject of managing these marlin species is a young one, and domestic management plans have quite a bit of growing to do. It was perhaps foolish to attempt an analysis of management options in a fishery so fraught with unknowns; on the other hand, the exercise has satisfied my personal curiosity to a great extent. In essence, my interest in this topic grew out of my fascination with sportsfishing. I, like many other anglers, wish to take a look beneath the politics of fisheries management, to the more fundamental issues concerning ecological responsivess of the species being exploited. All of us: managers, commercial and recreational fishermen, biologists, and government administrators, have an interest in maintaining fish stocks, if for different reasons. In the last analysis, the reasons may become unimportant if the goals are indeed met.

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INTRODUCTION

The twentieth century has witnessed the exponential growth of world-wide populations, and with it the over-exploitation of previously abundant resources. The limits inherent in terrestrial food production have necessitated increased utilization of world marine resources. Improved technology has enabled fishing fleets to harvest with a level of efficiency that in many cases has endangered the existence of commercial fish stocks. In the northwestern Atlantic, the price of ever-increasing harvesting has been the near decimation of several species. Haddock, herring and bluefin tuna are only a few stocks which have suffered from overfishing.

Blue marlin and white marlin are two species which have similarly been exploited with greater and greater frequency, but for very different reasons. Being large, predatory fish that are often found in association with yellowfin and other tunas, marlin are susceptible to being caught as by-catch in fisheries primarily directed at tuna. That the incidental by-catch of non-tuna species on longline is in high proportion to total catch is not news, but that this incidental catch might seriously affect fish stocks is only now becoming apparent. In fact, until J. Hoey presented his dissertation on the composition of longline by-catch, virtually nothing was known about how longlining activities in the north Atlantic might be affecting the ecology of the region.

Recently analyzed catch data show that captures of marlin on longline have decreased substantially since 1963, when exploitation was at an all-time peak. However, this statement is deceivingly optimistic. Although the by-catch of marlin has indeed decreased, it has not done so because of a

lessening of fishing pressure. A decrease in both size of individual fish and total catch of marlin suggests that the population cannot respond to historic levels of exploitation. In fact, some fisheries models predict the extirpation of marlin stocks in the Atlantic if longlining activities continue at their present pace.

Japanese fishing vessels have traditionally been the culprits in these longlining impacts. However, Japanese catches of marlin have decreased substantially, and other longlining nations are beginning to pick up where the Japanese left off. The U.S. longlining fleet, small as it is, carries at least some of the burden of responsibility. In addition, the increasing popularity of big game fishing and associated fishing tournaments has contributed to the exploitation of both blue and white marlin. The realization that stocks of marlin have declined has led recreational fishing organizations to cry out in warning. This alarm has been echoed by the domestic swordfishing industry, which has sought to decrease gear conflicts and competition at important coastal fishing grounds.

The response to these concerns, on the part of the U.S. government, has been the investigation of catch and effort in both longlining and recreational fishing activities. In 1978, having reviewed all the available information, a Preliminary Fisheries Management Plan for Billfishes and Sharks was presented by the U.S. Secretary of Commerce. Since then, the plan has been revised and expanded many times, and it is presently waiting to be put into force.

The management plan for billfishes includes estimates of maximum sustainable yield (MSY) and optimum yield (OY). These values are used for deciding whether the domestic harvestors and processors exploit the re-

source to capacity,and whether any surplus exists for foreign fishermen fishing within the U.S. Fishery Conservation Zone (or the 200-Mile Zone, as it is generically called). In this case, the National Marine Fisheries Service (within the Department of Commerce) has decided that the domestic recreational fishery consistently meets optimum yield levels. Thus, the management plan indicates that no marlin are available for taking by foreign fishermen.

Having decided that foreign fishing for marlin would only cause the decline of the marlin stocks, the Secretary of Commerce proposed regulations to decrease the incidental by-catch of billfishes on longline. These regulations include seasonal closures of coastal fishing grounds and area closures in sensitive areas. Of course, these regulations only extend to foreign longlining activities, and only within the 200-Mile Zone. In addition, foreign longliners must agree to a compensatory fee payment system, whereby any marlin caught on longline and killed would result in a$500 fine to be paid to the U.S. government. National Marine Fisheries Service Observers would be granted boarding privileges, as stipulated by the Fishery Conservation and Management Act of 1976.

The proposed regulations fall short of the mark of efficiently managing blue marlin and white marlin stocks for the following reasons. The models used to estimate MSY and OY are outdated and oversimplified, making predictions and derivations tenuous. Furthermore, the manipulation of MSY values to derive OY levels is inherently non-rigorous and thus open to question. Unfortunately, scientific management cannot be divorced from politics, and the traditional modes of estimating MSY and OY are the only methods that are not suspicious to untrained politicians.

Above and beyond political and sociological conflicts, the greatest problem facing fisheries managers is the paucity of information that exists about marlin distribution and abundance. Knowledge of migrations and seasonal distributions of the species are essential for population estimates, since we cannot know whether a local decline in population represents an overall decrease unless we know whether stocks are contiguous. Furthermore, if various isolated populations come together to spawn it may be crucial to prevent one stock from being more greatly exploited than another. This is where unilateral management of highly migratory species such as marlin becomes severely deficient. A multinational regulatory institution would indeed be desirable.

Until we expand our knowledge of stock identity, age, growth, survival, and reproduction in these species, an adequate management plan cannot be formulated. Despite the availability of increasingly more complex and realistic fisheries models, primitive methods must be used in lieu of the gaps in our scientific information. Thus, collection of data must be stressed in any domestic or international management plan. Ironically, longlining catch statistics remain the most useful source of such information. In the end, we may have to witness continued overexploitation of blue marlin and white marlin stocks before our knowledge is complete enough to prevent it.

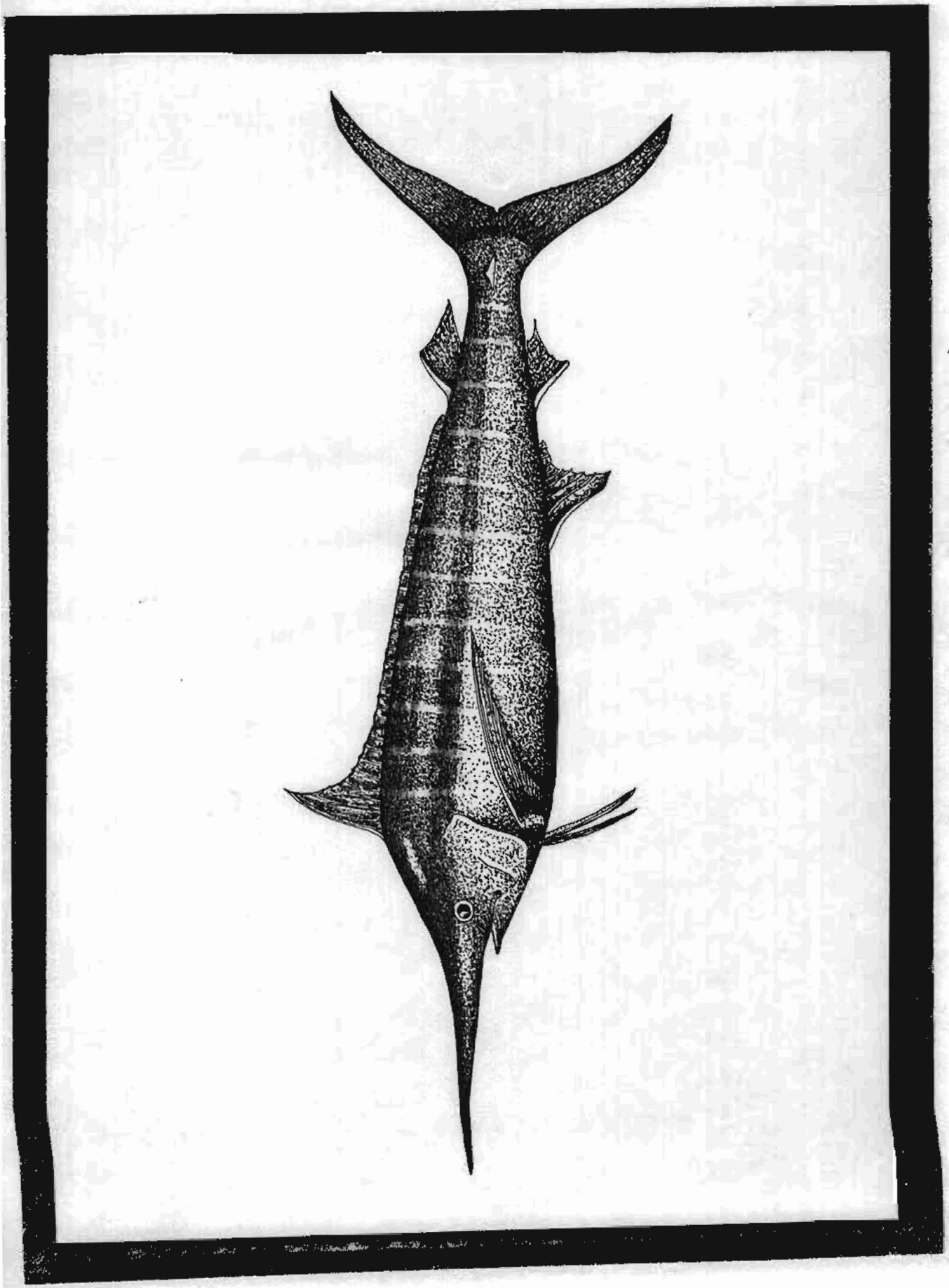


Figure 1. Blue marlin (Makaira nigricans)

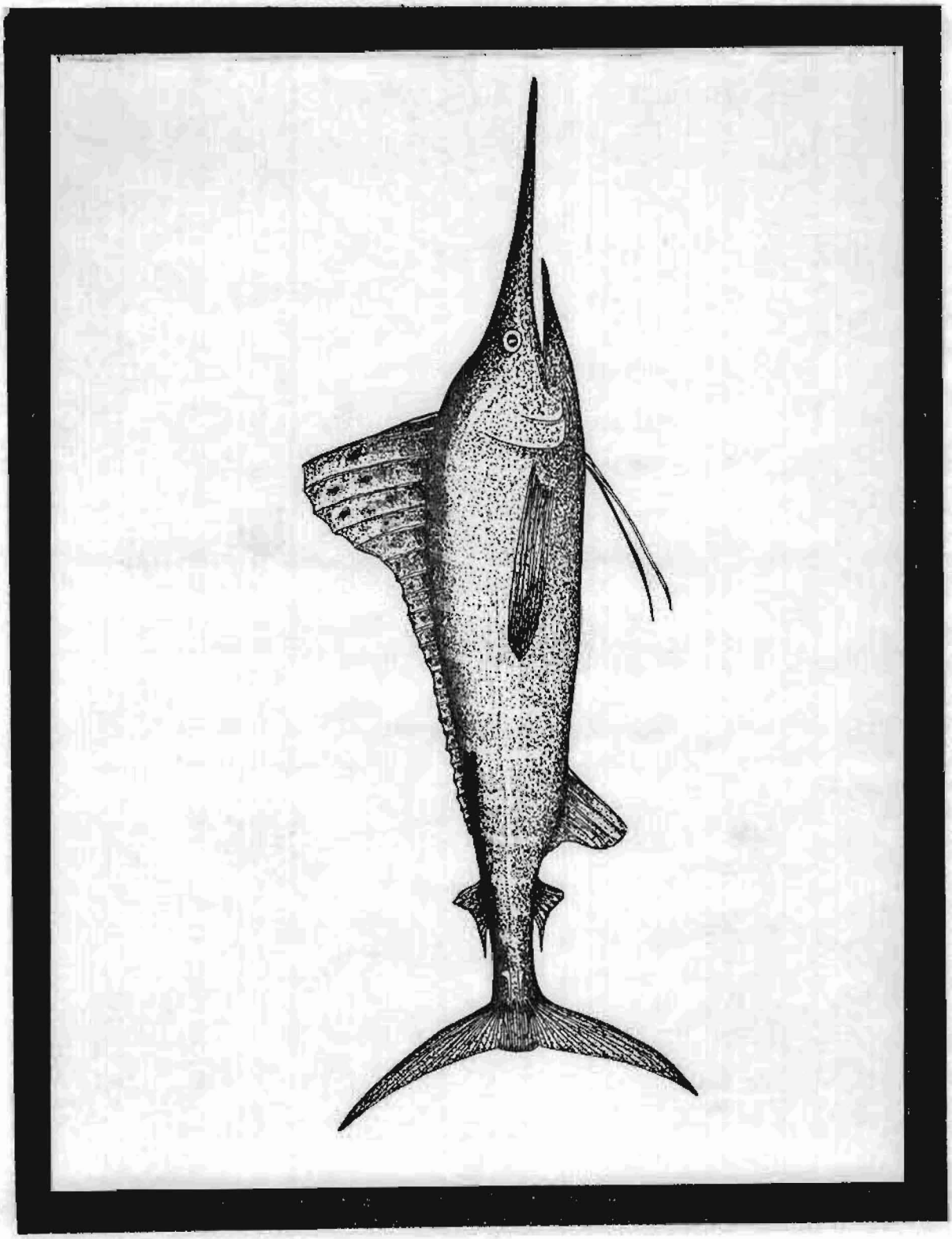


Figure 2. White marlin (Tetrapterus albidus)

THE FISHES

Distribution patterns

Blue marlin (Makaira nigricans) and white marlin (Tetrapterus albidus) are members of a morphologically unusual group of marine fishes collectively called billfishes. Included under this generic term are swordfish, sailfish, and spearfish, as well as the four species of marlin. Linking these rather diverse fishes is the presence of a long extension of the upper jaw; beyond this, members of the billfishes have few similarities. Even within the marlins, the species are phylogenetically distant so as to be related only at the family level (Istiophoridae). Ecologically, however, white and blue marlins have sufficiently similar patterns to warrant the following joint discussion.

Marlin are circumtropical in their distribution. Two of the four species known worldwide are found in the Atlantic Ocean, and in fact one of these (Tetrapterus) is found only in the Atlantic. Both blue marlin and white marlin are widespread in their occurrence, keeping within the latitudinal limits of 35°S to 45°N. They appear to be both coastal and oceanic, with seasonal concentrations along continental shelf margins. And because both species are found on both sides of the Atlantic Ocean, they are thought to be transoceanic as well[1]. There is a paucity of evidence supporting the theory of cross-Atlantic interchanges, however. Transoceanic longline data and two mid-ocean captures of white marlin made at 45°S/50°W and 40°S/15°E at least suggest that the white marlin's longitudinal range may in fact be continuous[2]. A similar argument may be made for blue marlin based on a tag recovery

that showed that a fish caught off the U.S. Virgin Islands was recaptured six months later off the coast of Angola[3]. Whether these migrations are anomalous cannot be ascertained without further tag and recapture data.

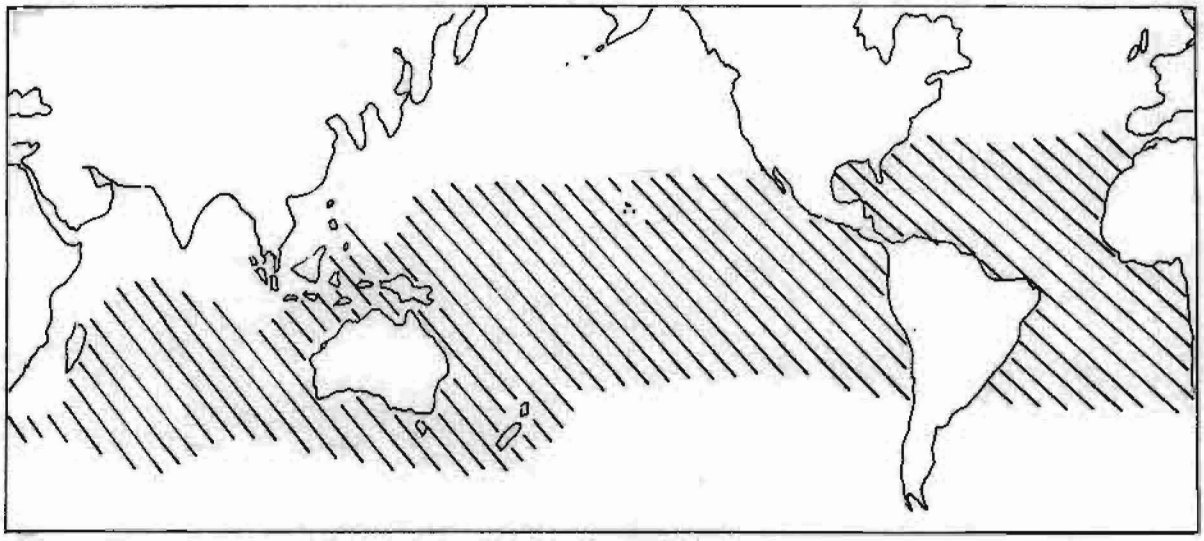
The degree to which geographically distant stocks intermingle is an important feature of the ecology of these species and a crucial question for their management. Even with complete information on stock size, recruitment, and mortality in a well-studied population, little confidence can be placed in models of that population without an estimate of its cohesiveness. The delineation of stocks into functionally isolated demes is fundamental to the science of population dynamics. Unfortunately, the issue of stock identity is usually addressed in a qualitative rather than quantitative manner[4]. Tagging or other mark and recapture methods are again important to the study of fish population dynamics. However, the lack of a direct commercial fishery for billfish severely limits the number of returns (J. Casey, per. comm.). Despite the widespread enthusiasm of recreational fishermen for tagging (and the minimal amount of tagging being done by observers in longlining vessels), tag returns remain around a meager one percent for blue marlin. Percentage returns of white marlin are significantly higher, but a wide majority of these were recaptured in the same area as release (see Mather 1960 and Buchanan et al 1977).

With respect to the stock issue, there exists a difference of opinion on whether the populations of white and blue marlin in the western Atlantic themselves are fragmented into subpopulations. As already indicated, the latitudinal range for Atlantic marlins falls

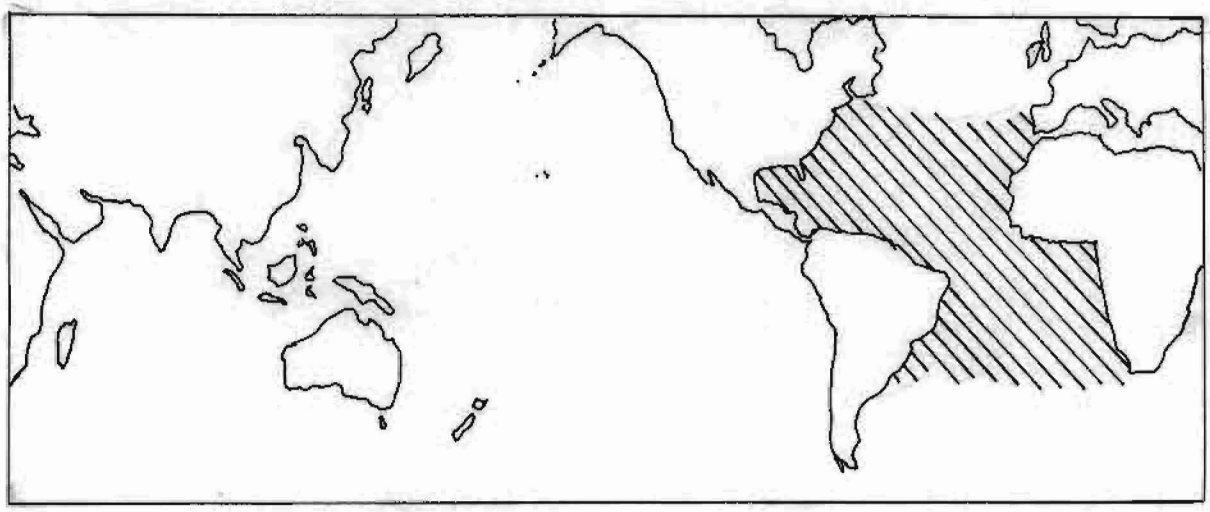
between 35°S and 45°N. However, marlin from waters north of the equator show differing migratory patterns as compared to fish from the south. The case with the white marlin is as follows: major concentration occur seasonally along the east coast of the U.S., in the Gulf of Mexico, and in the Caribbean sea. Once the fish leave the Gulf of Mexico during their annual migrations, there appears to be a divergent north / south movement. A portion of the population appears to move towards the Georges Bank region, while another group moves southward to the coast off LaGuaira, Venezuala[5]. The data from the Japanese longline fishery show that the two areas of concentration are separated by areas of low catch rates[6]. Mather and his colleagues interpreted this evidence as suggesting two separate spawning populations for white marlin in the western Atlantic[7]. On the other hand, others feel that considerable mixing of the north and south populations probably occurs in the southern Caribbean[8].

As in the case of the white marlin, blue marlin populations may be isolated in the western Atlantic. One group of fish appear to be confined within the limits of the Caribbean basin, while another appears to congregate off the Brazilian Coast[9]. Tag and recapture data have indicated no mixing between these subpopulations, but uneven sampling may be responsible for distorting the picture. Given their extraordinary swimming ability, it is difficult to believe that the northern and southern stocks are without at least occasional interchange. Generalized distribution patterns for both species are given in Figures 3 and 4.

The seasonal migration of these species follows increasing water



Blue Marlin



White Marlin

Figure 3. Worldwide distribution of blue marlin and white marlin

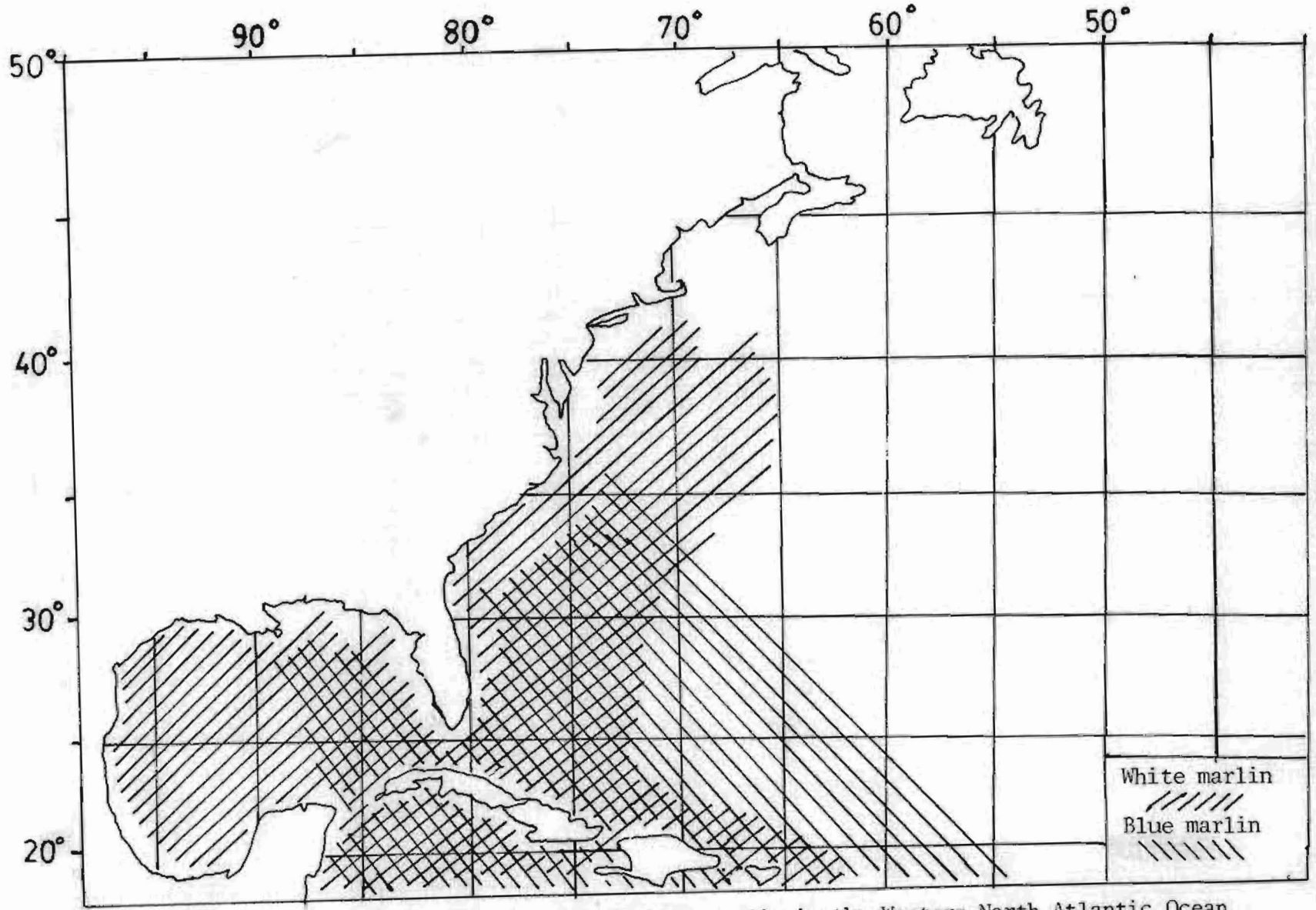


Figure 4. Areas of occurrence of blue marlin and white marlin in the Western North Atlantic Ocean.

temperature patterns in coastal areas. Marlin prefer a narrow range of surface temperatures[10]: 19°C - 27°C for white marlin and 22°C - 31°C for blue marlin.[11] Some authors suggest an even narrower range marked by temperature isotherms of 26 and 27 degrees Celcius for white marlin and 24°C - 28°C for blue marlin[12]. These temperature sensitivities were first described by Earle in 1940, who noted that white marlin appeared to vanish from the fishing grounds off Ocean City, Maryland, immediately after a drop in temperature; only to reappear a few days later. Recent data collected by National Marine Fisheries Service researchers suggest that temperature is indeed somehow correlated with marlin abundance, at least as far as exploratory longline catches indicate[13] (see Figure 5).

Both blue marlin and white marlin are thought to be holoepipelagic-that is, preferring the surface layers of the water in both coastal and oceanic regions. Some vertical migration possibly occurs in both species, to the extent that the prey on which they feed moves to varying depths. Overall, however, vertical movements by these marlin appear negligible relative to horizontal migrations. This latter large scale movement appears to be influenced by many physical parameters beyond thermal gradients. Both the blue marlin and white marlin adults are found more often in "blue water" than in "green water". This phenomenon has regularly been observed by sports fishermen and may be a result of variable amounts of particulate matter, oxygen content, or salinity of the seawater[14]. Salinity gradients have been specifically measured with respect to white marlin occurrence, and several authors have noted that white marlin

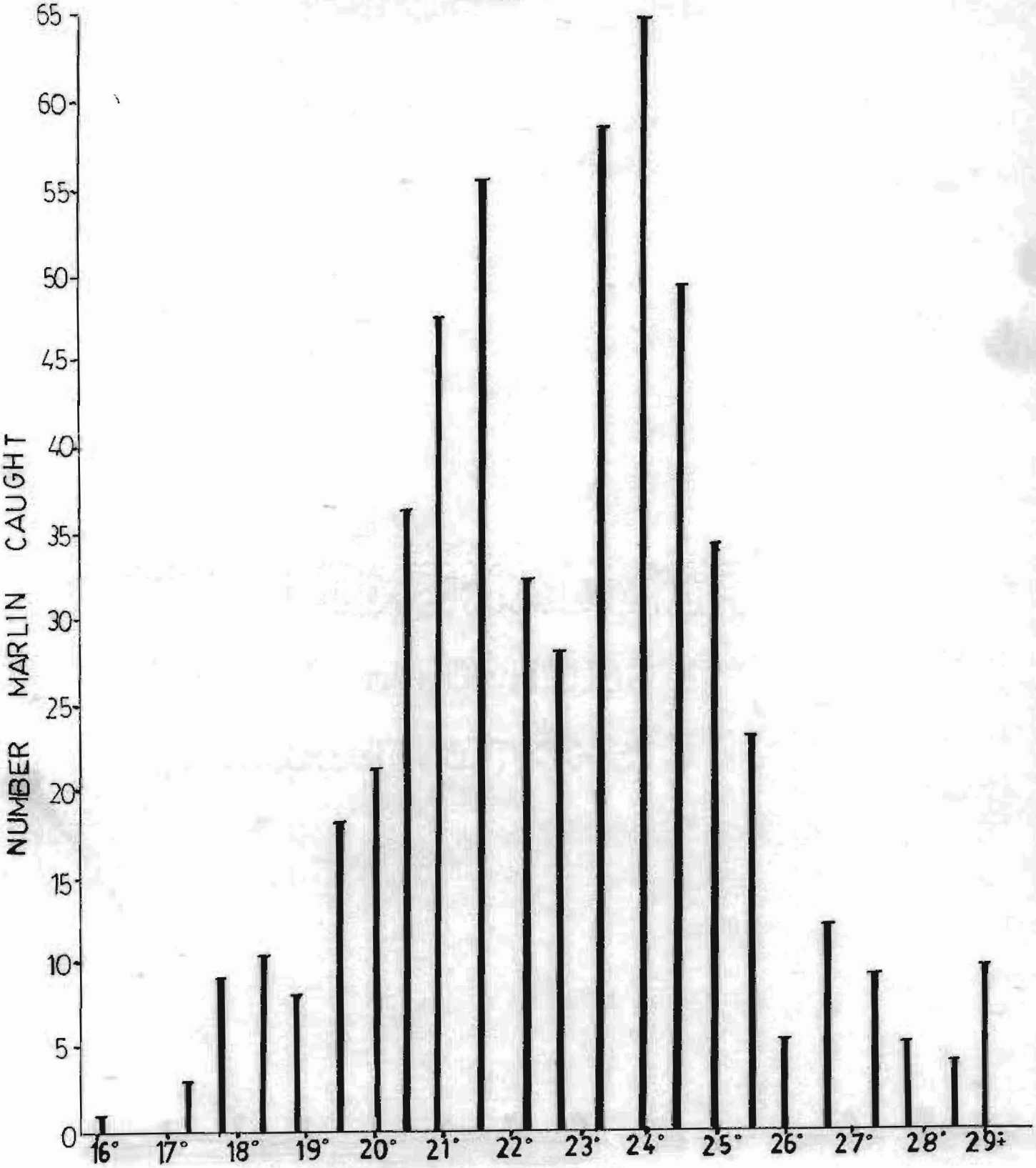


Figure 5. Frequency histogram of NMFS exploratory longline catches of marlin according to temperature (in degrees Celcius)

are common are common where abrupt changes in salinity occur, or in areas of mixing[15]. The preferred salinity range of the species, according to catch data, falls in the 35-37°/oo range. Oxygen content has also been measured in areas of high Tetrapterus albidus abundance, and the results indicate the white marlin prefer waters with low O_2 values surrounded by waters with high O_2 values - again suggesting a mixing region[16].

Water flow may play an important role in determining the distribution of marlin. Mather et al (1974) suggest white marlin prefer water which moves 0.5 - 2 knots. Major currents which may affect the patterns of occurrence for both species are the Florida Gulf Stream, the Atlantic Drift currents, the Atlantic North and South Equatorial Currents, the Venezuela current, the Atlantic Southern gyrals, and the "Loop Current" which extends from the Caribbean current into the Gulf of Mexico[17]. Bottom topography may also affect blue and white marlin distribution, despite the fact that the species tend to be found at the surface. Steep drop-offs and shoals often mark areas of high marlin occurence, as do submarine ridges. These features of the ocean floor may act either to depress the thermocline or deflect upwards, creating on upwelling area[18].

Clearly hydrographic factors such as ambient temperature, salinity, oxygen content, flow rate, and depth of thermocline are more likely to affect organisms at lower trophic levels than the marlins. Therefore it may be that food sources are being directly influenced by physical changes in the water, and that the marlin are merely following their food around the oceans. The precise way in which any of these factors

determine the distribution of prey items on which the marlin feed is not known. Nonetheless, it appears that all of these physical factors directly or in directly influence both white marlin and blue marlin distribution to some extent.

Ecological Interactions and Habitat Requirements

Little definitive information is available on the niche requirements of either marlin species. Correlative abundances of all species of fish taken by longline suggest that blue and white marlin are most similar to yellowfin tuna (Thunnus albacores) in their habitat preferences[19]. All three species are apex predators which rely on high speed swimming for prey capture[20], and all three are piscivorous. Marlin differ from tuna, however, in that they do not appear to feed in large schools. Thus although they may converge on the same aggregation of bait fish, they utilize differing strategies to capture their prey.

White marlin feed on a variety of fish and cephalopods, including primarily round herring (Etrumeus sadina) and the squid (Loligo pealei) in the northern end of their range. To the south, white marlin have been found to feed on squid, mackeral, octopods, doctorfish, tuna, jacks, and triggerfish[21]. The high diversity of prey items in the tropical latitudes suggests that these fish occur in smaller schools, reducing the electivity of the marlin. Blue marlin, like white, are daytime feeders. They exhibit considerably less variability in their diets than whites, feeding primarily on tuna and tuna-like fishes. These prey commonly include the mackeral, Auxis thazard, and tunas Thunnus atlanticus and Euthynnus pelamis[22]. It has been suggested

that areas of high marlin occurrences correspond with areas of high surface plankton concentrations, on which small bait fish such as the round herring feed. Illustrating a typical food chain, the marlin congregate where squid, tuna and other secondary consumers feed on concentrated plankton. The plankton in turn are influenced by upwelling, temperature, and oxygen gradients, reinterating the influence of physical oceanographic features on marlin distribution.

Competition for food may occur among all the apex predators whose ranges overlap, including sharks, tunas, swordfish, and other billfish[23]. The extent to which any of these species affect marlin abundance has not been studied[24], although quantifying competitive interactions is crucial to understanding the population dynamics of these species. Competition may indeed occur among billfish themselves, which require similar foods and habitats and which exhibit very similar behaviors. If food or space are limiting factors,competitive exclusiom may explain the lack of complete overlap in the ranges of the two marlin species. Mather et al (1974b) surmise that periodic fluctuations in blue marlin abundance probably occur due to ecological interactions with other marlin, supporting this idea.

Although both blue and white marlin are climax feeders and have few predators as adults, predation is probably severe on eggs, larvae and postlarvae. Little is known about predation at these early life stages[24], although natural selection to avoid juvenile predation is likely to be a strong driving force in the evolutionary adaptation of these species[25]. As adults, marlin may suffer occasional predation from sharks (especially the fast swimming mako shark Isurus oxyrhincus),

although no incidents of attacks on free swimming marlin have been reported in the literature. Rivas (1974) cites an observation of a broadbill swordfish being attacked by sharks, so presumably similar attacks on marlin are possible. Killer whales have also been observed to attack blue marlin[27].

A generalized model of hypothetical interspecific interactions is provided by Parin (Fis. 6). Clearly the extent to which any of these interactions produce a negative or positive effect has not been quantified. Energetic cost benefit analyses attempted on individuals are complicated enough, and extensions to other populations are even more difficult. Suffice it to say we can qualify interaction among species as well as within a single species, but the quantification of those interactions has not been adequately addressed.

Man has by far the greatest predatory effect on marlin adults. That this predation has occurred in enough evolutionary time to affect marlin distribution is doubtful, but the 100,000 tons/yr estimated catch of billfish worldwide likely has some effect[28]. Some claim that the sport fishery with its relatively ineffective gear has not harmed the population of big game fish. Nonetheless, a great deal of uncertainty lies in the estimation of detrimental effects caused by the combined incidental by-catch of marlin on longline and the directed sport fishery. It may be that simply man's presence on the seas, in the form of ship traffic and associated discharges and noise, have altered the normal distributions of the marlins.

Since schooling is not apparent in either white or blue marlin adults, group spawning is undoubtedly an extremely important intraspe-

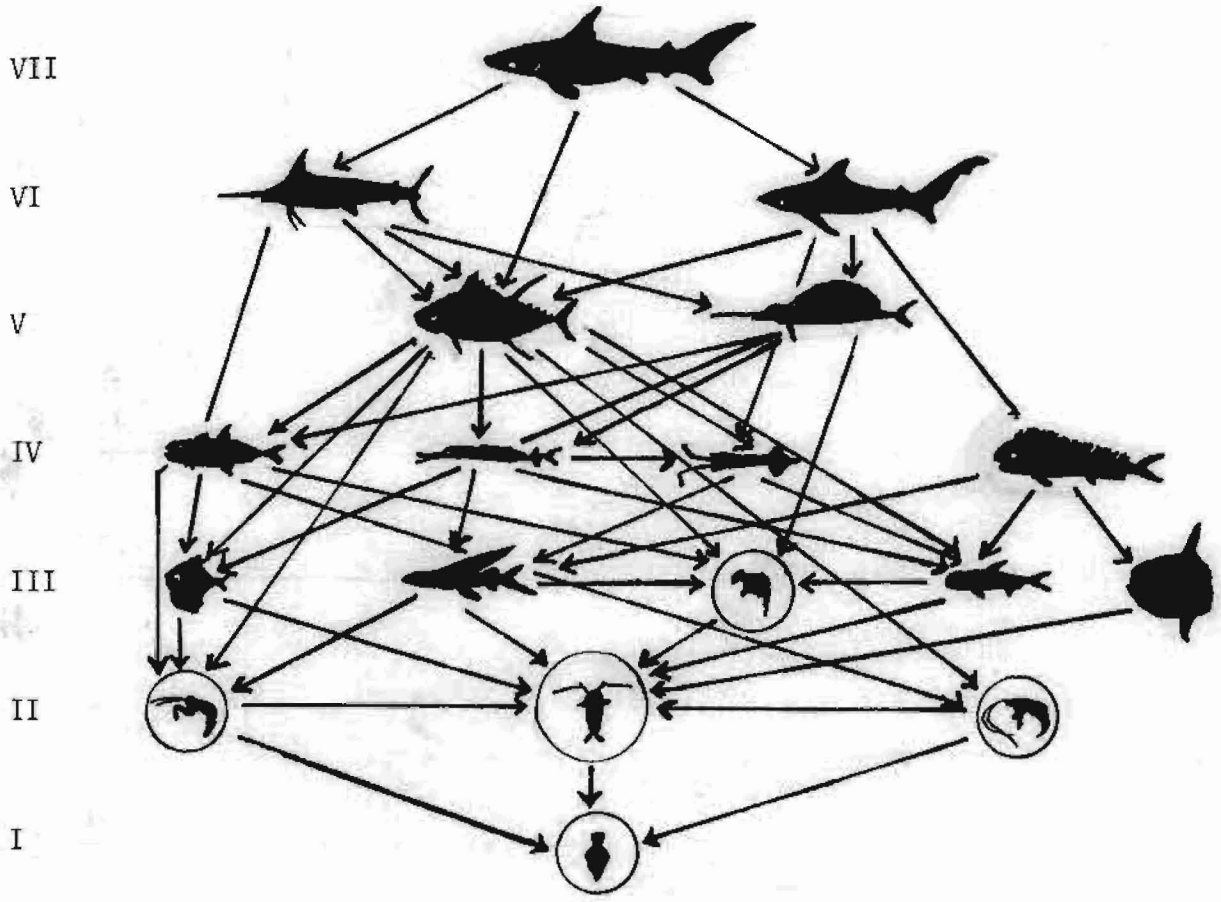


Figure 6. Schematic diagram of trophic links among subtropical and tropical epipelagic fishes (from Parin 1968)

Level I = phytoplankton
Level II = euphasids, copepods, and shrimp
Level III = deep sea fishes, flying fishes, hyperiids, lanternfishes, and moals
Level IV = ichthyophages, nyctoepipelagic predators, squid
Level V = tuna, lancetfishes
Level VI = marlins and medium-sized sharks
Level VII = large sharks

cific interaction. Spawning areas are difficult to locate in pelagic species, however. Theoretically, spawning regions should be marked by the presence of an even sex ratio in adult fish and larvae in close proximity. On the basis of this criteria, De Sylva hypothesized three separate spawning grounds for Tetrapterus albidus in the North Atlantic: northwest of Grand Bahama Island, Southwest of Bermuda, and northeast of Little Bahama Bank[29]. Generalized spawning requirements appear to be deep, blue water of high surface temperatures (20-29°C) and high surface salinities (> 35°/oo) ; areas where primary productivity is low[30]. DeSylva and Davis (1963) also report a high incidence of post-spawning females in the sport fishery out of Ocean City, Md. This suggests that north Atlantic white marlin spawn in areas somewhere between Bahamas and Cape Hatteras. Indeed, Baglin (1979) reports white marlin spawning off Florida in the spring.

The data on blue marlin spawning is similarly incomplete. Mather et al (1972) suggest that the two widely separated western Atlantic populations represent separate spawning stocks. Evidence indicates that northern populations spawn from July to September, while southern populations spawn in February and March[31]. Based on analyses of gonads of blue marlin caught by sport fishermen, it appears that a protracted spawning season occurs off the Lesser Antilles[32]. Because spawning is thought to occur far offshore, and because neither sport nor commercial fishermen generally recognize fish in spawning condition, a paucity of information on breeding exists.

It is clear that the highly migratory and non-schooling nature of both white and blue marlin has hindered acquisition of information

on their ecologies. From what little data are available, it appears that predation and interspecific interactions over food influence marlin distribution more than other habitat requirements. Factors influencing abundance, however, are even less well understood.

Life Histories

Not surprisingly, little information is available on growth and reproduction in T. albidus and M. nigricans. Additional tag returns, length-frequency data, and improved aging techniques are all needed before life history traits can be adequately understood. The limited information that follows is based on few samples and variable memodologies, so little confidence can be placed in the observations.

White marlin rarely attain a size greater than 80 kg (176 lbs), and the average adult weight is considerably less. According to International Game Fishing Association records, the largest white marlin caught to date on rod and reel weighed 79 kg. White marlin reach sexual maturity at about 20 kilograms and 130cm in eye-fork length[24]. However, there is a marked size dimorphism between male and female fish, such that females attain greater length and weight than males and at a faster rate. For example, the largest male taken in the sport fishery off Maryland weighed 29 kg, while the largest female in those samples weighed 52 kg [35]. Nothing is known about the ages of the measured specimens[36].

Our knowledge of blue marlin growth rates is slightly better off. A single tagged specimen, released at 90 kg and recaptured 30 months later at 163 kgs shows that blue marlins can double their weight in

less than 3 years. Since blue marlin are known to attain sizes of greater than 850 kg, this specimen was probably a young adult still in the rapid growth phase that characterizes most post-juvenile fish. Like the white marlin, blue marlin females grow bigger faster[37]. The smallest sexually mature males collected in the Atlantic weighed 35 and 44 kilograms, while the smallest sexually mature female weighed 61 kg[38]. Males seldom exceed 116 kg, averaging from 39-80 kg, according to Japanese longline statistics. Rivas (1974) claims that all blue marlin exceeding 136 kg are probably female.

Although estimates of longevity cannot be made with any certainty, blue marlin are thought to have long life spans. Tags have been recovered from individuals at liberty more than five years[39]. Furthermore, the enormous size of the fishes themselves suggest that growth must occur over many years[40].

Information on reproduction is again sorely lacking in both marlin species. Indices of maturity have been calculated from length and weight of gonads as percentage of total length or weight, but this information tells nothing about the reproductive potential of the fishes. Fecundity estimates for white marlin fall between 3.8 and 10.5 million eggs produced at a time[41], but it is not known how many times this egg production is possible in the lifetime of the fish. No fecundity data is available on the blue marlin, and again the frequency of spawning is unknown.

Abundances

The abundances of blue and white marlin occurring in the Atlantic are difficult to estimate, particularly due to two factors. First,

since no commercial fishery is directed at either species, catch data is limited. Second, the degree to which stocks exist as separate functional groups is unknown, thus changes in local density may or may not reflect absolute changes in population size. Despite this lack of knowledge, it is generally assumed that the stocks of marlin have decreased, and that they have done so due to overfishing.

Changes in the Japanese longline catches of white marlin were noticed as early as 1963, when catches dropped significantly. Catches continued to decline through 1970, resulting in a decrease from the maximum of 2.06 fish/1,000 hooks in 1962 to 0.80 fish/1000 hooks in 1970[42]. More recent data indicate that the white marlin catch from 1977-1979 averaged only one half the average in the previous ten years[43]. Although effort has decreased somewhat on the part of the Japanese, it has not declined as quickly as catch[44].

Blue marlin changes in abundance have been more abrupt. 1962 was a peak year for blue as well as white marlin catches in the Japanese longline fishery, but after 1962 the catch decreased dramatically. In 1965 the relative abundance of blue marlin caught was only one-fourth the peak level[45]. Rivas points out that this decrease began after fishing effort had extended over virtually the entire range of the species[46]. However, it has been suggested that blue marlin have recently recovered somewhat from the 1960's depletion, since fishing effort has declined substantially since 1977. Increases in total catches have been predicted following this decreasing effort, but thus far no such increase has occured. The only indication of a population recovery has come from a NMFS survey

on big game fishing, which shows that total catch has increased from 244 fish in 1977-79 to 299 in 1979-80[47].

The status of both blue marlin and white marlin stocks is unclear, yet fisheries biologists have repeatedly claimed the populations are overfished. The basis for this claim rests on theoretical predictions derived from fisheries models, where catch values have not met predicted levels. However, predictions based on models must be taken with a grain of salt. Even the best fisheries models[48], which are reasonably accurate in matching population fluctuations which have already occurred, encounter serious problems in predicting future trends (S. Saila, pers. comm.). And the NMFS and other fisheries biologists who utilize these models are the first to recognize those shortcomings (E. Anderson, pers. comm.). Nevertheless, all of the people involved in a fishery--be they biologists, fishermen, or administrators-- realize that we must work with what we have, or wait and suffer the risk of allowing the fishery to be depleted beyond recovery.

THE FISHERIES

Blue marlin and white marlin are taken by both commercial fishing operations and recreational fisheries in the Atlantic Ocean. The catch of marlins by the commercial fishery is incidental and undesirable; that is, the marlin take the bait accidentally. The commercial fisheries in which marlin are caught are generally directed towards yellowfin or bluefin tuna, or swordfish. Because of the low market value of marlin locally, any marlin that are caught by tuna-directed commercial gear are discarded. This is true for both domestic and foreign commercial fishing ventures.

The sport fishery, on the other hand, considers marlins a highly prized game fish. The capture of marlin on rod and reel is a relatively rare and thus somewhat prestigious event, and many anglers spend a considerable sum of money to try and gain membership into the elite group of successful marlin fishermen. Whereas the incidental by-catch of marlin on longline and other commercial gear is considered a nuisance, the directed catch of marlin on rod and reel is considered a worthwhile undertaking.

Longlining

The only commercial fishing venture which takes an appreciable quantity of marlin is the longline. Generally, marlin are either too sparsely distributed or too fast to become entrapped in purse seines, trawl nets, or other large scale fishing devices. Longline baits, on the other hand, are attractive to any large pelagic predator. Because marlin appear in association with the tunas at which longlining operations are directed, they are frequently caught.

The typical commercial longlining vessel ranges 50-70m in length with a hold capacity of 300-500 metric tons[49]. The vessels are generally well equipped with radio and navigational equipment as well as freezing facilities. The longline is set from the stern of the boat and the haulback and processing activities are carried out on the forward quarter deck.

The longline itself usually consists of a main line of cable with branched lines (ganglions) hanging from it. These ganglions are made of four separate sections connected by swivels. The last of the four sections is a four meter long steel leader with a hook attached to the end of it. Float lines attached to small buoys are used to suspend the main line in a horizontal fashion (see Fig. 7).

The longline is set at a speed of approximately 10 knots, usually just after midnight. Depending on the length of the main line (which may be as long as 135 kilometer), there is a rest interval between the set and retreval. During this period, the vessel drifts nearby the line, keeping it in constant visual contact. Haulback is usually begun at noon, at which time the red buoy marking the end of the longline is hauled aboard. The mainline is then fed into the automatic reeling and paying apparatus (ARP). The ganglion are unsnapped from the mainline, and any that carry fish are attached to a safety line. The fish is then handlined to the fish door while the vessel has stopped, and is winched aboard.

Longline setsare of variable dimensions, depending on the type of fish desired. Several authors have investigated the selectivity of longlining gear, in an effort to reduce waste and increase efficiency.

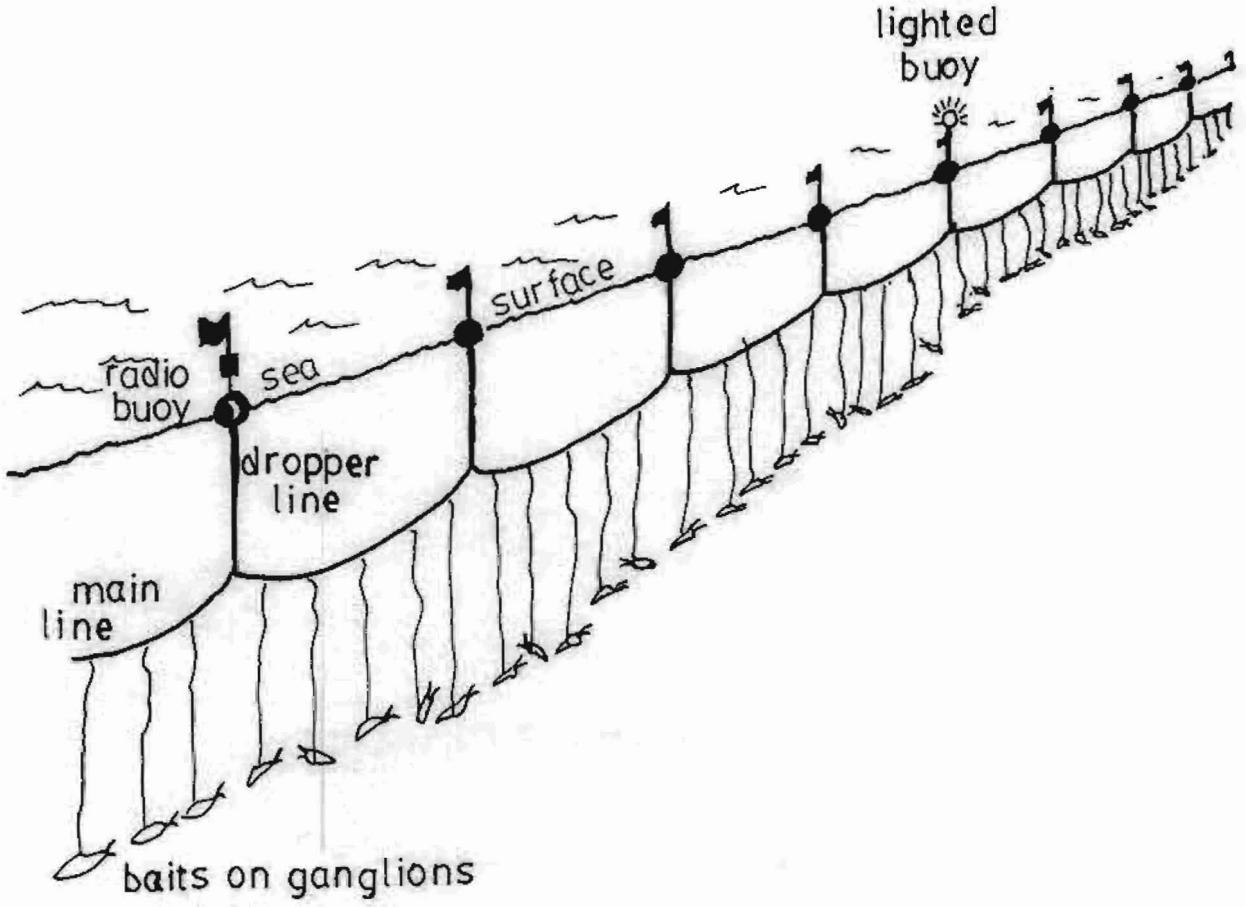


Figure 7. Diagram of a typical longline (from Gottschalk, 1972)

Parrish (1963) was the first to provide a broad summary of gear type and effectiveness; this was later expanded by Karlsen (1977) and Skud (1978). Size of gear parameters affecting catch rates was investigated by Hirayama (1969a, 1969b), and Honma (1974). Very few researchers, however, discuss how gear affects catch composition, which is important to the discussion of marlin by-catch. Depth control appears to be the primary mechanism regulating catch composition[50], aside from location. Depth is regulated by the length of the dropper lines, the distance between these ganglions, and the overall length of the mainline. The various gear dimensions employed in the western North Atlantic by various factions are summarized in Table 1.

It should be noted that the large scale commercial longlining activities alluded to here are not the only longlining operations fishing the North Atlantic. Exploratory longlining activities on a much reduced scale are being used by various state fish and wildlife agencies and by other researchers. Small longlining vessels (less than 10 meters in length) are also being utilized by private fishing companies[51]. Apparently, an unquantified amount of incidentally caught billfish is taken by domestic longline fisheries directed at swordfish and tuna. The swordfish longlining operations are likely to catch few marlin as by-catch by virtue of their temporal patterns (fished at night and during the season when marlin are not in abundance). The tuna longlining fleet, however, is a rapidly growing domestic fishery whose impact on billfish needs to be assessed.

For the most part, however, longlining in the Atlantic is dominated by the Japanese. The Japanese first began longlining for

Table 1. Longline gear dimensions for directed fisheries in the Western North Atlantic (reprinted from Hoey and Casey, 1984)

Fishery	Ganglions (m)	Float Lines (m)	Interhook Distance (m)	Hooks/Set	Main Line (km)
Shark					
NMFS*	5.5	5.5-7.3	15.2-18.3	100-300	8-9.6
Swordfish					
NE	5.5-6.1	6.1-12.2	18.3-27.4	2000	24-64
FLA	12.2-36.5	15.2	45.7-76.2	100-400	8-32
Tuna					
NMFS	9.2	9.2-54.8	21.9-27.4	400-600	unknown
Japanese	26.1	10-30	35-62.5	1900-2300	40-135

* NMFS longlining activities are exploratory; the other regional longlining operations are commercial

yellowfin tuna off Brazil in 1956, then spread both north and south in the years following[52]. The spectacular success of the fishing method, together with the lack of restrictions then imposed by coastal nations, drove the Japanese fishery to a peak in 1965. At that time, effort was estimated at nearly 100 million hooks[53]. Effort then decreased due to diminishing catches and displacement of Japanese vessels to other parts of the world. However, the decrease of Japanese effort was paralleled with an increase in effort by new nations, including US, Cuba, South Korea, and Taiwan. The total effort has remained around 100 million hooks in recent years[54]. Figure 8 shows these changes in effort by the Japanese within the U.S. 200 mile zone[55].

It is important for the purposes of this study to investigate how changes in effort have resulted in changes in the incidental by-catch of marlin. The most recent International Commission for the conservation of Atlantic Tuna (ICCAT) report on by-catch shows that although the international representation in the Atlantic longline fishery has undergone changes, the incidental catch of blue and white marlin remain high. Though this is not intuitively surprising, it may come as a shock to those who believe the by-catch of marlin diminishes proportionally to decreases in Japanese effort. The Japanese have become the target of many nationalistic campaigns to drive the foreigners out of the fishery conservation zone (FCZ) even though their catch has declined (see Table 2). The Japanese fishery only accounted for 19% of the marlin by-catch in 1980, compared to 100% in the late fifties. The U.S., Taiwan, Cuba, Korea, Venuzuela, Brazil, Panama, USSR and Grenada all presently contribute to the incidental by-catch of marlin

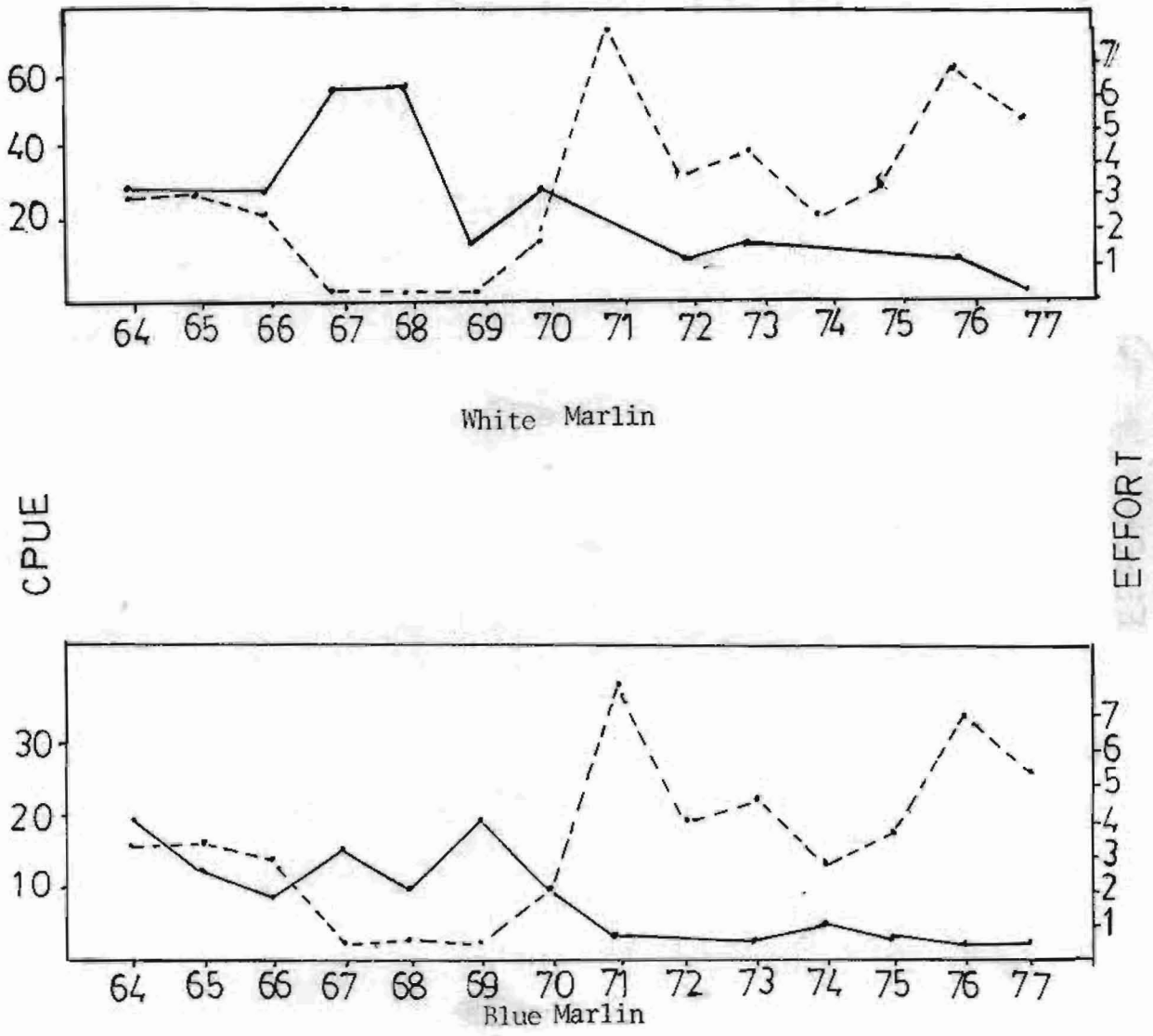


Figure 8. Catch per unit effort (CPUE) and nominal effort in the U.S. Fishery Conservation Zone by the Japanese longline fishery, 1964-1977 (from SAFMC Source Document)

Table 2. Effort in number of hooks, number of vessel days, and catch in number of fish from the Japanese longline fishery, 1964-1977 (from NMFS PFMP, 1983)

Year	Hooks	Vessel Days	Blue Marlin	White Marlin
		ATLANTIC		
1964	667,545	334	1,706	2,982
1965	1,905,372	953	1,031	5,478
1966	1,478,141	589	712	4,898
1967	238,278	199	76	257
1968	130,117	65	59	672
1969	153,119	77	340	220
1970	974,304	487	75	1,814
1971	6,180,180	3,090	1,203	10,667
1972	3,036,248	1,518	603	2,262
1973	3,751,083	1,876	592	4,104
1974	1,890,548	945	733	2,140
1975	1,335,924	668	341	1,227
1976	2,722,259	1,361	417	2,540
1977	873,004	437	107	339
		GULF OF MEXICO		
1964	410,336	205	1,103	2,512
1965	336,791	168	1,392	3,425
1966	-------	---	-----	-----
1967	103,976	52	135	561
1968	115,330	58	107	430
1969	41,201	21	28	153
1970	392,610	198	331	2,976
1971	1,053,745	529	488	4,983
1972	912,824	456	271	3,237
1973	658,876	329	271	3,675
1974	700,429	350	354	2,113
1975	2,100,629	1,050	449	3,746
1976	4,160,865	2,080	467	5,720
1977	4,390,028	2,195	272	1,498
		CARIBBEAN		
1964	2,124,430	1,062	3,199	5,155
1965	1,020,818	510	1,873	2,242
1966	1,368,522	684	1,499	3,466
1967	202,219	101	320	1,365
1968	170,205	85	246	1,502
1969	91,307	46	163	140
1970	567,896	284	1,437	1,455
1971	526,473	263	791	905
1972	-------	---	---	---
1973	5,760	3	6	1
1974	39,232	20	82	44
1975	------	--	--	--
1976	10,660	5	2	2
1977	2,423	1	0	0

on longline (see Tables 3 & 4). Furthermore, it should be noted that while the Japanese contribution to the marlin by-catch has plunged, the U.S. share has risen sharply (Figs 9 & 10). Kikawa and Honma (1983) and Kikawa and Nishikawa (1984) provide detailed summaries of fishing intensity over the past 25 years, with some surprising results.

Accurate information on longlining activities is available only through catch reports made to the ICCAT or the U.S. National Marine Fisheries Service (hereafter NMFS) for fishing activities within the FCZ. Data on by-catch in the open sea beyond the 200-mile limit is contributed voluntarily to nations with membership in the ICCAT. However since the primary objection of the ICCAT is conservation of tunas, the by-catch reports are not a high priority. Nations often report incidental by-catch in broad categories which overlook species distinctions (e.g. "billfish" or even "large fish"). Thus the data obtained through the requirements imposed on foreign nations fishing within the FCZ are perhaps the most useful.

The Japanese did not begin reporting information on by-catch until 1978. A preliminary fisheries management plan (PFMP) for billfish and sharks (implemented Jan. 27, 1978) provided a means by which US fishing biologists could evaluate the impact of longlining on non-target species. This reporting requirement was made possible by the 1976 Magnuson Fisheries Conservation and Management Act (hereafter FCMA). The FCMA established a regional council system which oversees the implementation of preliminary management act in problem fisheries (see Section III).

Historically, the Japanese longlining effort within the FCZ has

Table 3. Blue marlin landings in metric tons and indices of abundance in the total Atlantic Ocean, 1957-1980 (from ICCAT 1982 SCRS Species Report A)

Year	Japan Fishery	(%of total)	U.S. Fishery	(%of total)	Total*	IA
1957	764	100	-	-	764	28.3
1958	772	100	-	-	772	13.17
1959	841	100	-	-	841	6.37
1960	2,712	96	103	4	2,815	16.21
1961	3,768	92	116	3	4,077	23.02
1962	7,044	96	115	2	7,302	14.00
1963	8,600	95	128	1	9,034	13.14
1964	7,590	95	161	2	8,007	8.76
1965	5,751	93	163	3	6,153	8.11
1966	3,370	87	149	4	3,852	8.10
1967	1,073	48	197	9	2,234	5.57
1968	946	39	168	7	2,428	6.05
1969	960	31	207	7	3,085	4.94
1970	1,005	35	204	7	2,858	5.18
1971	1,395	44	179	6	3,197	3.64
1972	420	18	191	8	2,373	3.11
1973	346	11	209	7	3,180	3.81
1974	284	10	234	8	2,832	3.80
1975	608	20	241	8	3,030	3.13
1976	264	12	265	12	2,189	2.37
1977	135	7	295	14	2,057	2.33
1978	114	8	295	21	1,412	4.00
1979	336	12	295	22	1,347	4.19
1980	336	23	295	19	1,492	4.24

* Other countries contributing to total include Taiwan, Cuba, Korea, Venuzuela, Brazil, Panama, USSR, Brazil-Korea (joint venture), Brazil-Japan (joint venture), and Grenada.

Table 4. White marlin landings in metric tons and indices of abundance in the total Atlantic Ocean, 1957-1980 (from ICCAT 1982 SCRS Species Report A)

Year	Japan Fishery	(%of total)	U.S. Fishery	(%of total)	Total*	IA
1957	160	100	-	-	160	17.39
1958	161	100	-	-	161	5.31
1959	112	100	-	-	112	0.97
1960	253	81	60	19	313	2.26
1961	692	84	60	7	823	7.38
1962	1,915	93	74	4	2,059	4.88
1963	2,418	93	64	2	2,612	6.13
1964	3,495	94	70	2	3,731	3.63
1965	4,631	94	76	2	4,703	7.10
1966	3,002	86	76	2	3,501	6.50
1967	668	47	81	6	1,416	3.52
1968	1,088	53	87	4	2,036	5.07
1969	843	38	76	3	2,332	5.33
1970	703	34	104	5	2,085	3.14
1971	980	44	95	4	2,246	4.03
1972	440	19	99	4	2,331	3.33
1973	355	10	104	6	1,779	4.20
1974	390	22	108	6	1,747	5.25
1975	418	27	107	7	1,570	2.93
1976	543	30	109	6	1,810	4.90
1977	106	11	109	11	958	1.86
1978	129	13	109	11	1,002	3.32
1979	110	10	109	10	1,063	3.12
1980	125	13	109	11	960	1.61

* Other countries contributing to total catch include Taiwan, Cuba, Korea, Venuzuela, Brazil, Panama, USSR, Brazil-Korea (joint venture), Brazil-Japan (joint venture), and Grenada.

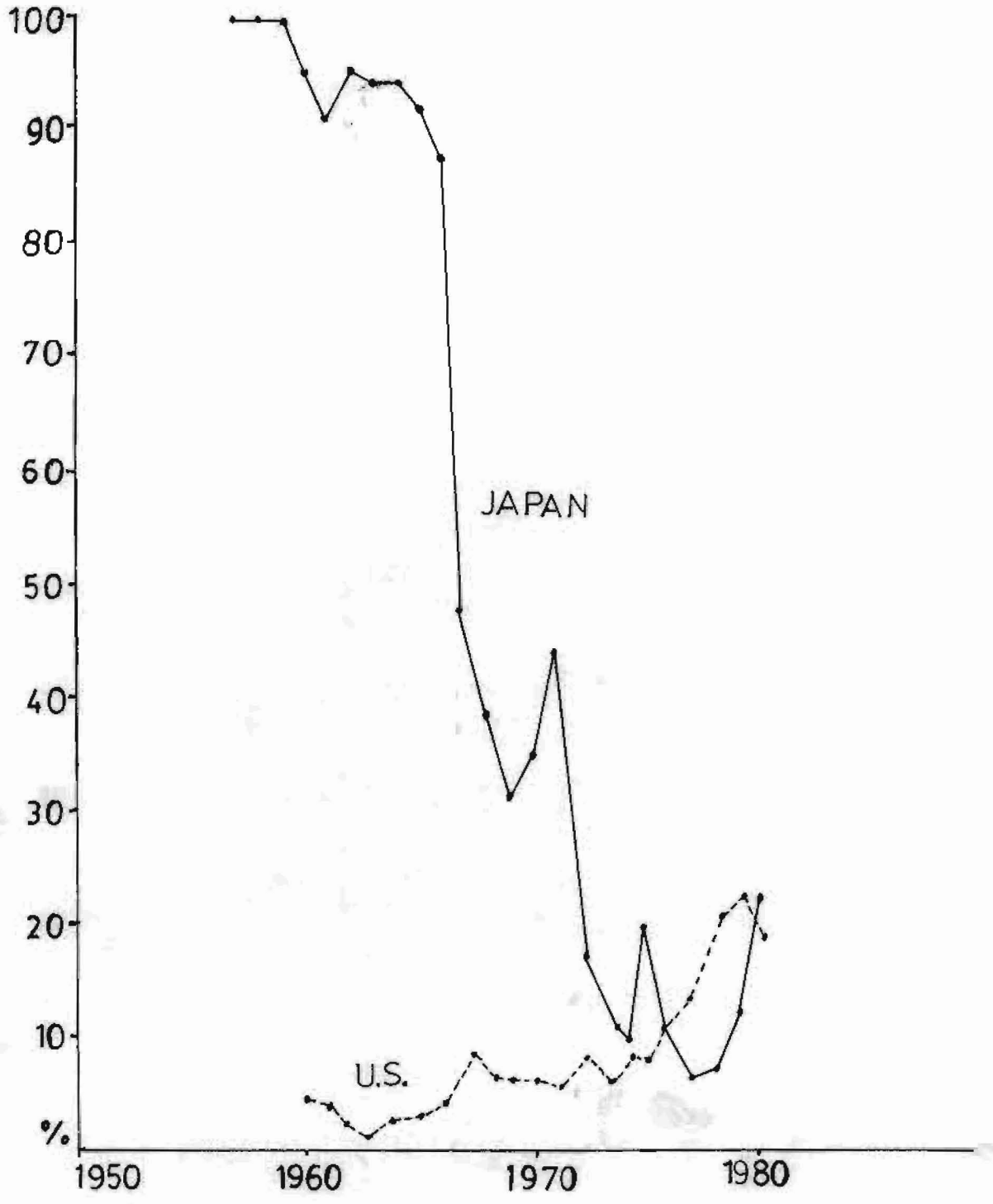


Figure 9. Catches of blue marlin by the U.S. and Japan from 1957-1980, expressed as a percentage of the total Atlantic catch

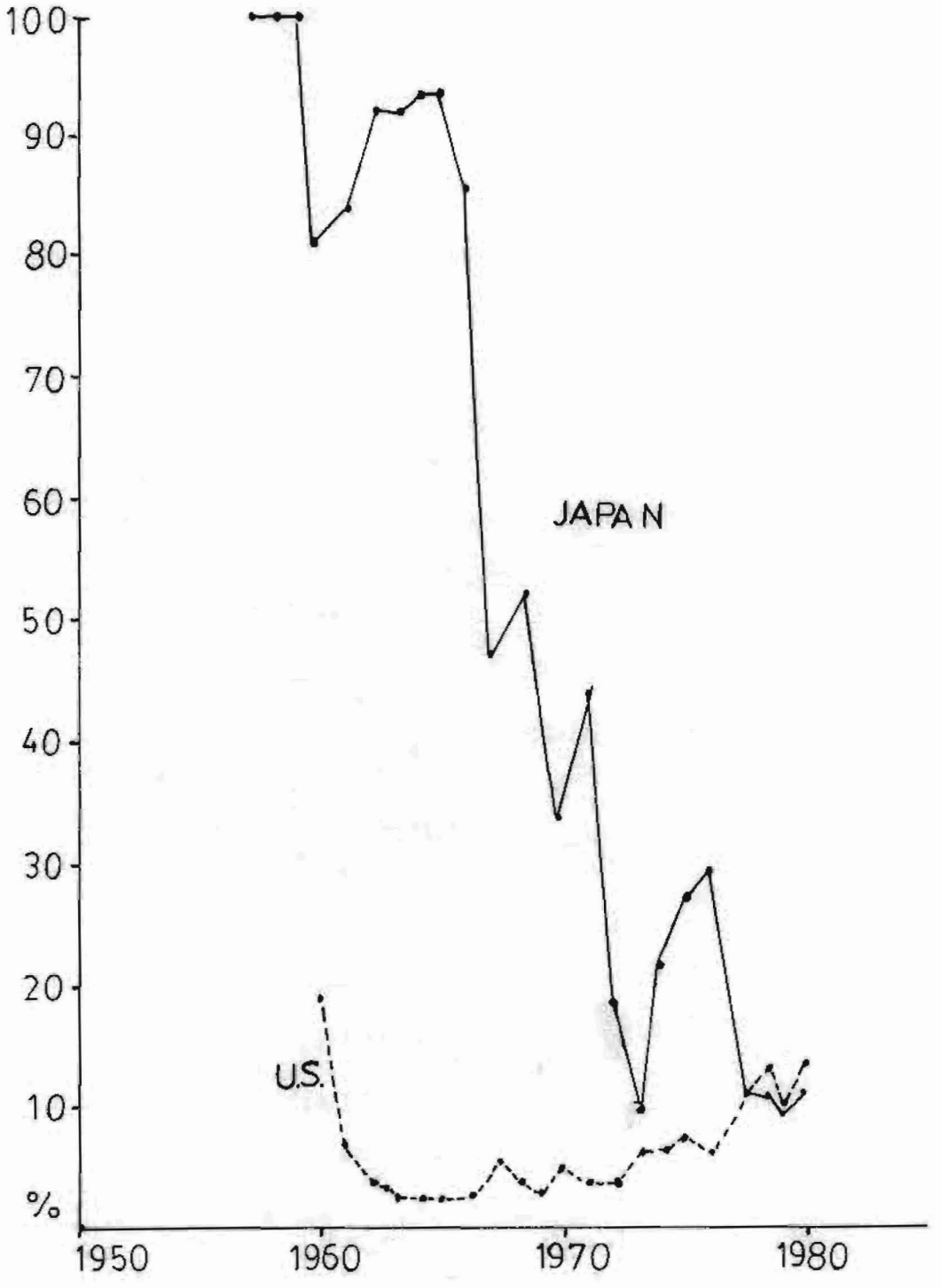


Figure 10. Catches of white marlin by the U.S. and Japan from 1957-1980, expressed as percentages of the total Atlantic catch

concentrated in the northern Gulf of Mexico in spring and summer and off the Eastern seaboard in late summer and fall[56]. The Gulf of Mexico fishery in particular has changed a great deal, according to Japanese reports. While early longline fishing in the Gulf was directed at yellowfin tuna,it switched to giant bluefin in 1973. In 1976 it became apparent that the optimal season for the bluefin tuna fishery was winter and spring, so the seasonal pattern of fishing was changed to increase yield. Most recently, however, the Japanese have volunteered to temporarily cease fishing in the Gulf of Mexico, due to a dramatic decrease in bluefin CPUE. The downfall of the bluefin may have thus contributed to the recovery of the blue and white marlin, if such a recovery is indeed taking place.

Effort in the overall Atlantic Ocean itself has not changed so dramatically. However, the Atlantic trend in catches has been following the North Atlantic in recent years. In the 1960's catches of both blue and white marlin in the north and south Atlantic were approximately equal. Statistics from the 1978 longline fisheries show that approximately 63% and 80% of total Atlantic catches of white marlin and blue marlin respectively were taken in the North Atlantic[57]. This emphasis on fishing grounds north of the equator may well change if restrictions on foreign fishermen by the US continue to increase, however.

It may appear from this discussion thus far that marlin are "trash fish", of no commercial worth. This is far from the case in the eyes of the Japanese. Billfishes, excluding the swordfish which is obviously of high value, command nearly as high a price as

tunas in some international markets. Veyangi (1974) has described the substitution of marlin in many traditional tuna products, such as fish balls, sausages, and smoked steaks. The price of white marlin in Japanese markets has increased more than 180% from 1961 to 1979, while the price of blue marlin has increased 350% in the same time period[58]. At 1979 prices of $1.31/lb. for blue marlin and $1.24/lb. for white marlin (called striped marlin in Japanese fish markets), marlin have ranked just under yellowfin tuna in market value[59].

Without more complete data on billfish age, growth, and recruitment, the impact of various changes in longlining intensity and temporal/spatial patterns cannot be ascertained. Nevertheless, it is clear that many metric tons of billfish are being wasted due to the nature of the fishery. As previously mentioned, longlining is not species - specific in attracting or hooking large fish[60]. Furthermore, peculiar permitting restrictions imposed on Japanese and other foreign longlining nations prevent the fishermen from retaining caught billfish or sharks. Even though many potentially valuable swordfish, marlin and prized sharks such as the mako are hooked, they may not be taken aboard and are thus released.

The release of billfish and other incidentally caught species might conjure up an image of happily faced fish swimming away from the longlining vessel off into the sunset. Unfortunately, this is not the case. Although reports concerning mortality in hooked billfish vary, it is generally agreed that some 50% of marlin caught on the longline are dead by the time haulback occurs. National Marine Fisheries Observer Program data show that of the marlin caught by longline from

June 30, 1982 to September 30, 1983, 45% of the blues and 76% of the whites were dead (P. Gerrior, pers. comm.). And of the fish that are pronounced alive at haulback, it is not known how many are strong enough to stay alive. It is likely that many are freed alive only to die or be attacked by sharks soon afterwards.

The Recreational Fishery

The domestic sportfishery for billfishes presents a whole new set of problems and objectives to fisheries managers. Big game fishing in the United States was historically an elitist hobby, and because of this it's participants were often viewed as the big game safari huntersof the high seas. The difficulty in attracting marlin to trolled baits or lures is thought to be an exciting challenge - one that is still met with great enthusiasm at great cost.

The U.S. sportfishery for billfishes operates all along the eastern coast of the US, from Florida to Massachusetts. Puerto Rico and Virgin Islands are also significant fishing centers from which vessels head northward into the Atlantic or southward into the Caribbean Sea. Generally the recreational fishery for blue and white marlin stays within the continental shelf margins and thus well within the U.S. FCZ. The actual distance travelled to fishing grounds varies according to the proximity of the shelf break (or canyons), or the Gulf Stream. Thus fishing vessels from the Virgin Islands need only travel 4 miles to reach marlin grounds, whereas vessels from New England often travel 50 miles or more to reach productive areas.

Various estimates of the size of the recreational billfish sector have been attempted in the past two decades. A recreational fishing survey questioning coastal residents from Texas to Massachusetts in 1968 showed close to 2500 billfishing vessels[61]. Eleven years later, the number of recreational vessels that participated in the sportfishery jumped to 19,737 vessels[62]. In addition, some three thousand charter vessels participated in commercial sportfishing for marlin and other billfish in 1977[63]. Clearly interest in sportfishing has grown in leaps and bounds to reach more than just the upper class sectors of the society[64].

Recent estimates indicate that the recreational fishery for marlin and other billfish generates over one million fishing days annually through some 66,400 anglers[65]. A survey conducted by the National Marine Fisheries Service in 1977-1978 provided this information, and is considered the best information to date on catch per unit effort in the recreational fishery, both charter and private. (A similar survey of the recreational fishery for marlin by Otto et al (1978) is considered less reliable because of sampling effort and data base[66].) Questionaires distributed to angling clubs and marinas along the eastern seaboard and in the Gulf and Caribbean provided information on location and size of catch and type of vessel used. (The questionaire used in this survey is provided in Appendix II). An estimated 5,761 blue marlin and 14,401 white marlin were caught within the FCZ by domestic recreational fishery in 1977/1978, based on this survey[67]. Catch per unit effort (CPUE) analyses of this data by region show that abundances[68] were greatest off Puerto Rico and the

V. I. (blue marlin) and off northern Florida - Cape Hatteras (white marlin)[69].

Sportfishing vessels which are directed primarily at marlin and other billfishes range from small center console outboards to larger diesel inboards (up to 65 in length). The SAFMC Source Document states that marlin fishing vessels, unlike those fishing for sailfish, require larger inboards because of the distances involved in getting out to the fishing grounds[70]. This statement may be misleading, because many well known marlin grounds lie only a few miles out of port, including the Virgin Islands South Drop, the Puerto Rico Trench, and the Dumping Grounds off Nantucket. In fact, any vessel with moderate fuel storage capacity and trolling gear can participate in the fishery.

All marlin fishing vessels have the same general equipment, be they charter or private boats. Marlin are caught on rod and reel, usually from trolled lines. Vessels differ in the pattern of bait trolled, the speed at which they troll, and the use of additional attractions such as "teasers". A typical vessel might use four baits or lures; two on the so-called flat lines running straight back from the cockpit and two on the outriggers. The outriggers have dual functions - one to spread out the width of the trolling pattern, the other to provide drop-back action. The latter increases the chances of securely hooking the fish, by making the bait drop back when the fish stikes and allowing it to be swallowed more deeply. Teasers looking like giant lures without hooks are often trailed just off the stern, in order to raise fish from the depths. With the advent of high speed plastic trolling lures, however, the use of teasers is decreasing.

Many successful charter boat captains and private angler boast about their winning troll patterns or favorite lures. The truth of the matter is that the ability to catch fish is primarily a function of the ability to find fish, especially in the case of widely distributed and seemingly elusive species like the marlins. Equipment such as Loran, Sat Nav, and depth finders/recorders are therefore at least as important as good quality outriggers, rods, reels, and lures. Because of this additional navigational equipment, fully equipped vessels involved in the billfishery are expensive to both buy and operate. Expenditures for the 1977-1978 billfish season totalled approximately $90 million, according to calculations of variable and annual fixed costs based on the NMFS angler survey[71].

It is difficult to estimate precisely the economic characteristics of the billfish sportfishery, for a number of reasons. First, many analyses of the recreational fisheries in the U.S. lump marlin with other billfish, including swordfish. The character of the swordfish fishery is so completely different from the marlin fishery that such a group treatment may distort the picture. Second, the economics of the private sportfishery vary greatly from that of the charter boat industry. Third, and perhaps most important, it is difficult to assess what the value of the recreational fishing experience is to the average angler. For, unlike the situation in commercial fisheries and in some sport fisheries, the value of a fishing trip cannot be estimated by the number of fish caught.

Marlin are not priced by anglers for their monetary worth, even though fish markets and restaurants are showing a slight but ever in-

creasing interest in buying marlin[72]. It is the thrill of the chase which makes fishing for billfishes worthwhile and in many cases it is unimportant to the angler whether or not he actually lands a fish. The fact that marlin are difficult to catch makes fishing for them all the more challenging. Their speed and grace in the water, the way in which they glow neon blue and erect their dorsal fins when striking a lure, and the spectacular acrobatics they display when caught make the marlins some of the most respected and sought after fish in the world[73].

How can one quantify the value inherent in such a non-priceable commodity? A number of economic evaluationshave been attempted, but as new variables are added to the models they become almost unmanageable[74]. The expenditure method may be the simplest standard by which to evaluate sportfishing benefits. However, as stated in the NMFS preliminary Management Plan for billfishes and sharks, what is crucial is the amount of money an angler would be willing to spend above and beyond the cost of the trip. And although "willingness to pay" is an expression of real economic value[75], the figure varies circumstantially.

Another way in which the economic value of a fishery is ascertained is the so-called travel-cost method. Demand curves generated by data on number of trips + cash per trip are used to assess values[76]. The National Marine Fisheries service has combined these two approaches to evaluate the sport fishery for billfish by using the travel cost curves to estimate willingness to pay. From this they conclude that a representative marine angler would be willing to pay $500 to catch one more marlin or sailfish[77]. This figure is then used to establish rates for a compensatory payment plan (see Section III)[78].

These measurements of billfish values rest on the assumption that the benefit of the resource to users is the amount that they would be willing to pay beyond what they already pay[79]. What must they already pay? The cost to participate in the billfish fishery varies greatly, depending on whether the vessel used is privately owned or chartered, how far the fishing grounds are, and the size of the vessel. Charter boats charge several hundred dollars to take anglers to marlin fishing grounds and provide them the opportunity to catch fish. This cost might be considered exorbitant due to the fact that the average number of days of fishing required to catch a billfish falls somewhere between 2 and 5[80]. At the 1980 average of 3.57 trips/billfish, as calculated for the Gulf of Mexico Fishery, it might cost the angler many hundreds of dollars to get his fish.

The cost of big game fishing is relatively high for two important reasons. The first is sociological: the benefits derived from a fishing trip far exceed the value of the billfish caught, as already noted. These benefits include being outdoors and away from crowds, noise, etc.,establishing a comraderie with the fishing crew or having the opportunity to fish with friends, building self-confidence, getting exercise, and of course having the opportunity to catch fish other than marlin. One could write an endless list of the benefits accrued from deep-sea fishing, but one would be hard-pressed to try and estimate the relationship between these benefits and the overall value of the fishery.

The second point to be made with regard to the high costs of billfish fishing is that the cost of operation must be passed on to the consumer. Therefore although participants in the billfish fishery generally

pay more than participants in other fisheries, they do so to cover the costs of running and maintaining the vessel and it's gear. Variable expenses to the boatowner include maintenance, fuel, wages for labor, bait and tackle, and ice; while fixed costs include depreciation, insurance advertising, dockage and taxes[81]. Given all these operating costs, the charterboat captains make surprisingly little profit. In a selected sample of charter vessels in Texas, Florida, Georgia, South Carolina, and North Carolina, the net revenues per vessel averaged only $8530 before taxes[82].

Naturally the profitability of charter operations is influenced by frequency of trips and length of the season, as well as additional sources of revenue from trips such as fish mounting fees and fish sales[83]. Although the charterboat captain has no control over external parameters such as seasonal availability of fish, he can increase the number of trips by advertising. Because of the elusive nature of billfishes, the best advertising a captain can generate is the promotion of his reputation for finding and catching fish. What is most important to the seasoned angler is not cost but effectiveness; veterans would rather pay more to have a better shot at getting a fish. The best captains thus need only rely on word-of-mouth publicity to get all the business they need.

Reputation in sportfishing circles is most important at tournament time. Tournaments are where the real monies lie-- in the form of cash awards and internal betting. The contests are usually run by fishing clubs or corporate sponsors, who sometimes recoup their investments by charging substantial entry fees. Tournament regulations governing entrants, methods and times of fishing, and eligible catch vary with

with each specific contest. Because tournaments are periods of intense localized fishing, effort is greatly increased and catches tend to rise proportionally. Given the higher probability of catching a billfish and the promise of fame and fortune if that fish is of winning size, the popularity of the tournament is not surprising. The most recent calender of tournaments published by the International Game Fishing Associations illustrates this popularity worldwide (Appendix III).

Before the advent of the era of environmentalism tournaments were held on a "take" basis only. Billfish would be hung from platforms and weighed in (see photograph in Appendix IV), then thrown away[84]. However, with the newly installed conservation ethic in angling clubs and sport fishing organizations[85], tournaments are becoming more tag and release oriented. Marlin are thus hooked and brought alongside the boat, estimated for length, and allowed to swim free. This technique has such widespread popularity that many private individuals and charterboat captains allow only tag and release of caught fish, unless a fish appears to be a world record. The enthusiasm for tagging not only prevents the waste of fish but also helps to increase the data pool for fishery biologists[86].

The economic impact of both the regular charter fishing industry and the tournaments is difficult to quantify[87]. These operations, however, may substantially impact resort communities which provide support industries. These multiplier effects included additional revenue to marina owners, hotel and restaurant businesses, and the travel industries. This is especially true for the tournament hosting businesses, which benefit from the fact that most billfish tournaments last for several days (see Appendix III). According to a New York Times article on the tournament

businesses, the inclusive cost to an angler for the catch of one blue marlin averages around $10,000![88] An additional facet of the economics of the tournaments is the prevalent captains betting pool, in which the vessel operators place bets among themselves as to who will win the tournament. These wagers commonly exceed many thousands of dollars, however the impacts on the communities cannot be estimated because the betting is unofficial[89].

In summary, the economics of the recreational fishery for billfishes are complex. The cost to a private boat owner may be similar to the variable and fixed costs to charterboat operators,but it is impossible to precisely quantify the portion of those costs being spent specifically for marlin fishing. Similarly, it is difficult to estimate the total costs and total revenues generated by the charter vessel industry because of the complications involved in quantifying the impacts of alternative fishing activities. It is clear that the benefits derived from sportfishing for billfish far exceed the costs, when one looks at the widespread participation in both the private and commercial recreational fishery. However, how far benefits exceed costs remain uncertain.

THE FISHERIES MANAGEMENT ISSUES

Management Problems

The previous pages have attempted to present the myriad of biological, economic, and sociological elements inherent in the Atlantic blue marlin and white marlin fisheries. From this rather random assemblage of facts and figures it should at least be clear that marlin represent very different things to different groups of people. For instance, the species pose a distinct set of questions to the fisheries scientist which may contrast those perceived by foreign fishermen. Likewise, a charter vessel captain may view marlin differently from a sportsfisherman. Designs for managing the fishery must take into account all these rather divergent vantage points and aim for compromise between all interested parties.

Fundamentally, a national fisheries management plan attempts to do two things: protect its fish and protect its fishermen. Although this is undeniably elementary thinking, all management strategies have these goals at their core. Management becomes necessary when either a) stocks become depleted to unproductive or even endangered levels, b) gear conflicts impede effective fishing, or c) foreign competition becomes so great as to interfere with the domestic industry. Apparently all three of these events have taken place in the billfish fishery, to some extent.

The draft fishery management plan for the Atlantic billfishes cites the following four problems in the fishery:

A. Available data indicate that the North Atlantic stock of blue marlin is overfished and suggest that white marlin may be overfished also.

B. At present, there is no international program to manage and conserve billfish stocks. Because the U.S. accounts for less than 25% of the removals from the marlin stocks, an international program to complement U.S. management measures is desirable.

C. There is intense competition for the available resource between the recreational fishery for billfish and other fisheries that have a by-catch of billfish.

D. The current statistical and scientific data base is insufficient to develop a long-term regime for conservation and management of the stocks[90].

The management objectives proposed in the draft plan address these problems in a very general way. They support conservation of the stocks, organization of social and economic benefits to the nation, maintenance of billfish availability to fishermen, and the increased understanding of the condition of the stocks and the fishery[91].

A number of questions arise from this very broad view of billfish management measures. What jurisdictional rights does the U.S. have to control both domestic and international participation in the fishery? What actions have been proposed to meet the management objections? And finally, what options are available for future management of the billfish fishery? The following sections will address these questions.

Jurisdictional Limits of the U.S.

Fisheries management is a relatively young science, a science born out of the need to control the ever-increasing exploitation of coastal fish stocks. In the U.S., the need for such control was not realized until 1945 - the year of the Truman proclamation announcing a 200 mile fishery conservation zone (FCZ). While the Truman Proclomation

may have instilled nationalistic ideas in the minds of U.S. citizens, it did little else in the way of expanding the nation's control over its marine resources. In effect, the Truman Proclamation of 1945 rang out in warning of things to come.

It was not until foreign fishermen dominated the productive fishing areas off both coasts of the U.S. that actual jurisdictional expansion was initiated. In the early 1970s, many domestic fishing vessels were forced to retire from certain fisheries due to foreign competition. The competitors, made superior through cheap labor and advanced technologies, enjoyed an expontentially growing capitalization of continental shelf. In some cases, foreign fishing pressure led to the demise of previously expansive stocks[92]. Thus, the rapid proliferation of the distant water fleets within the FCZ caused U.S. fishermen to cry out in alarm.

The answer to these cries arrived the form of the Magnuson Fishery Conservation and Management Act of 1976. The FCMA provided a framework through which to regulate foreign fishing competition. It was hoped that by giving domestic fishermen more of an opportunity to increase catch, trade deficits with other fishing nations could be decreased as well. The legislation showed a radical departure from any earlier attempts to formulate a national fisheries management plan. It called for the establishment of eight regional councils to review fisheries conflicts and proposed management plans. In doing so, it recognized the need to promote cooperation among states, while at the same time recongizing the fact that most fisheries problems could not be adequately handled on a national level.

The regional councils are composed of state fisheries directors,

appointees from the Department of Commerce, at-large members from recreational, academic, and commercial fishery sectors, and the regional director of NMFS. Public meetings provide a forum for exchange, and the council utilizes this public input to prioritize fisheries issues. When a fishery shows signs of trouble, biologists working for the councils calculate the maximum sustainable yield (MSY) for that fishery. The councils then set an optimum yield (OY) value for the fishery, based on economic and sociological fishes in addition to biological ones. If the harvesting capacity of domestic fishermen cannot meet the OY level, the surplus is granted away to foreign fishermen.

The participation of a foreign fleet in harvesting a fishery thus becomes a function of the ability of U.S. fisheries to meet the optimum yield. The eligibility of foreign nations in fisheries within the U.S. FCZ depends on the presence of a Governing International Fisheries Agreement (GIFA). Requirements under these agreements include the reporting of catch statistics and participation in the Observer Program. In this program, NMFS observers spend time on foreign fishing vessels recording catch, gathering morphometric data, reveiwing techniques,and tagging fish. The Observer Program is financially supported by the GIFA nations.

It may become clear that the FCMA makes more of an attempt to control foreign fishing than to promote actual conservation of the fish stocks. This is particularly true because derivations of MSY are not rigorous, and catch per unit effort data used to make MSY estimates can be interpreted in any number of ways. Furthermore, the limits set by the OY, although required to be less than MSY, are achieved in a some-

what unscientific fashion. Thus, the FCMA has been viewed more often as a political tool than a useful conservation measure, at least in some application[93]. NMFS director William Gordon epitomized national philosophy when addressing commercial fishermen last month: "The world is changing. Your competitors are global. You have to think on a wider scale, and on a national level as well. It's your future to decide, both economically and biologically".[94] It may be significant that the economic future precedes the biological future in his statement.

The FCMA was enacted to strengthen control over local stocks of fish historically fished by U.S. fishermen. Highly migratory species, however, pose some unique problems for national fishing management. Species which do not perceive political boundaries and roam freely from the jurisdictional limits of one country to that of another complicate unilateral management plans. And although some authors contend that the vast majority of nations believe extension of jurisdiction over such species is compatible with customary law[95], many recent events suggest international cooperation is needed. Several multinational options for managing these types of fisheries exist, including membership in an international management body (such as the ICCAT) as proposed in the Law of the Sea Treaty (LOS).[96] Another option involves the use of bilateral agreements between the nations utilizing the fishery (See Carroz and Savini, 1979, on the prevalence of bilateral agreements in international fisheries). However, because the U.S. has failed to ratify the LOS Treaty, and because in this case bilateral agreements would not be comprehensive enough, the U.S. has adopted a unilateral measure for managing billfish.

Proposed Management Plans

Alarmed by reports of decreasing catch and increasing gear conflicts in the recreational fishery for billfish, the U.S. Department of Commerce implemented a Preliminary Management Plan (PMP) for Atlantic Billfishes and Sharks on January 27, 1978. The PMP stated that no available surplus of billfishes existed for the foreign fleet fishing within the U.S. Fishery Conservation Zone (FCZ). It did so by maintaining that the optimum yield, as determined by the regional councils, was being consistently met by the domestic fishery. In addition, the PMP required that all billfishes caught incidentally on foreign longline be released unharmed. Although these two management measures are still in effect today, the PMP has been repeatedly revised and expanded since 1978.

In general, the PMPs undertake a number of tasks. First, they establish the maximum sustainable yields (MSY) for various stocks using conventional fisheries models (see Gulland, 1974,1983, and Ricker 1975 for a review of fisheries models and their applications). In the case of blue marlin, the logistic model was applied to catch and effort data under a variety of assumptions about year class structure. The estimation of these parameters resulted in a calculation of MSY at 2,366-2,610 metric tons.[98] However, the high signal to noise ratio in the graph showing observed data points and the theoretical equilibrium curve is evidence that the model does not really fit the data well (see Figure 11). Nonetheless, this logistic is commonly used when information is limited, and appears to be commonly accepted.

The PMPs show that the MSY value for white marlin has been calculat-

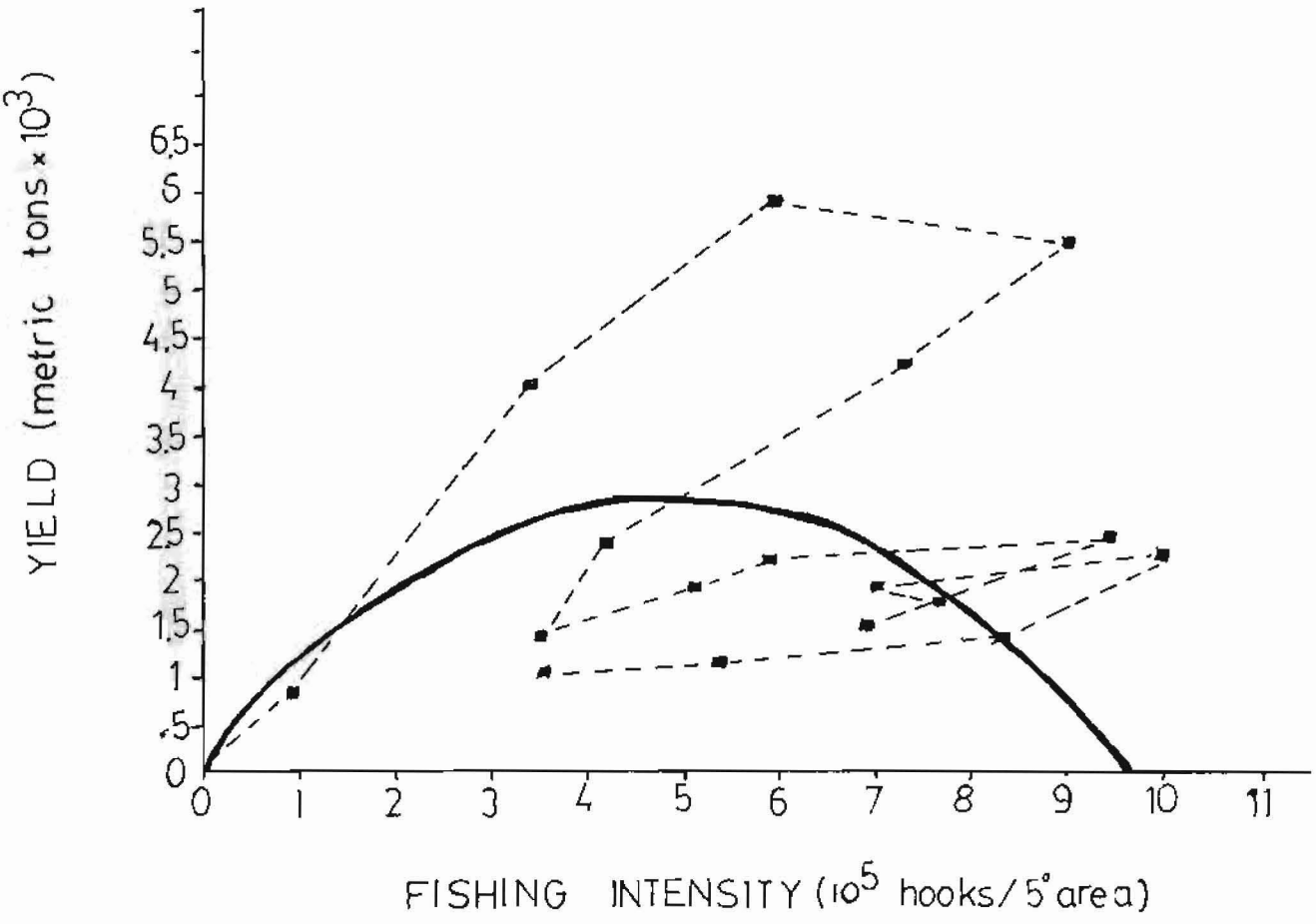


Figure 11. Equilibrium catch curve and observed data points for blue marlin in the Atlantic Ocean, assuming two stocks and five significant year classes (from Farber, as cited in the SAFMC Source Document, 1983)

ed in a somewhat different manner. Using the Schaefer model, it relies on several assumptions about the fishery, which in reality may or may not be true. These assumptions include that 1) a negative relationship exists between CPUE and effort such that effort is correlated with abundance, and 2) equilibrium of the North Atlantic fishery occurred at two distinct times in the period from 1961 to 1979. Using CPUE values at these theoretical equilibrium points, the Schaefer equilibrium curve was generated to estimate MSY. This value fell at 1,435 metric tons, however the same criticisms may be made of the curve fit (see Figure 12).

Once MSY values have been calculated, the PMP defines a preliminary optimum yield value for each fishery. The optimum yield (OY) is defined as "the amount of fish which will provide the greatest overall benefit to the Nation, with particular reference to food production and recreational opportunities; and which is presented on the basis of MSY from the fishery as modified by any relevant economic, social, or ecological fact".[99] The preliminary OY addresses only foreign fishing within the FCZ, and is thus only an interim measure.

Optimum yield estimates for the marlin fisheries were made by evaluating a representative annual catch by domestic fishermen as some percentage of the all-nation fishing mortality in that year. Using this method, the PMP sets the blue marlin preliminary OY at 256 metric tons, based on the 1980 catch showing 94.5% landings in the FCZ were made by the U.S.. Similarly, the preliminary OY for white marlin was set at 100 metric tons, or 87.2% of total FCZ fishing mortality for 1980.

The PMP next attempts to evulate the domestic harvesting and proces-

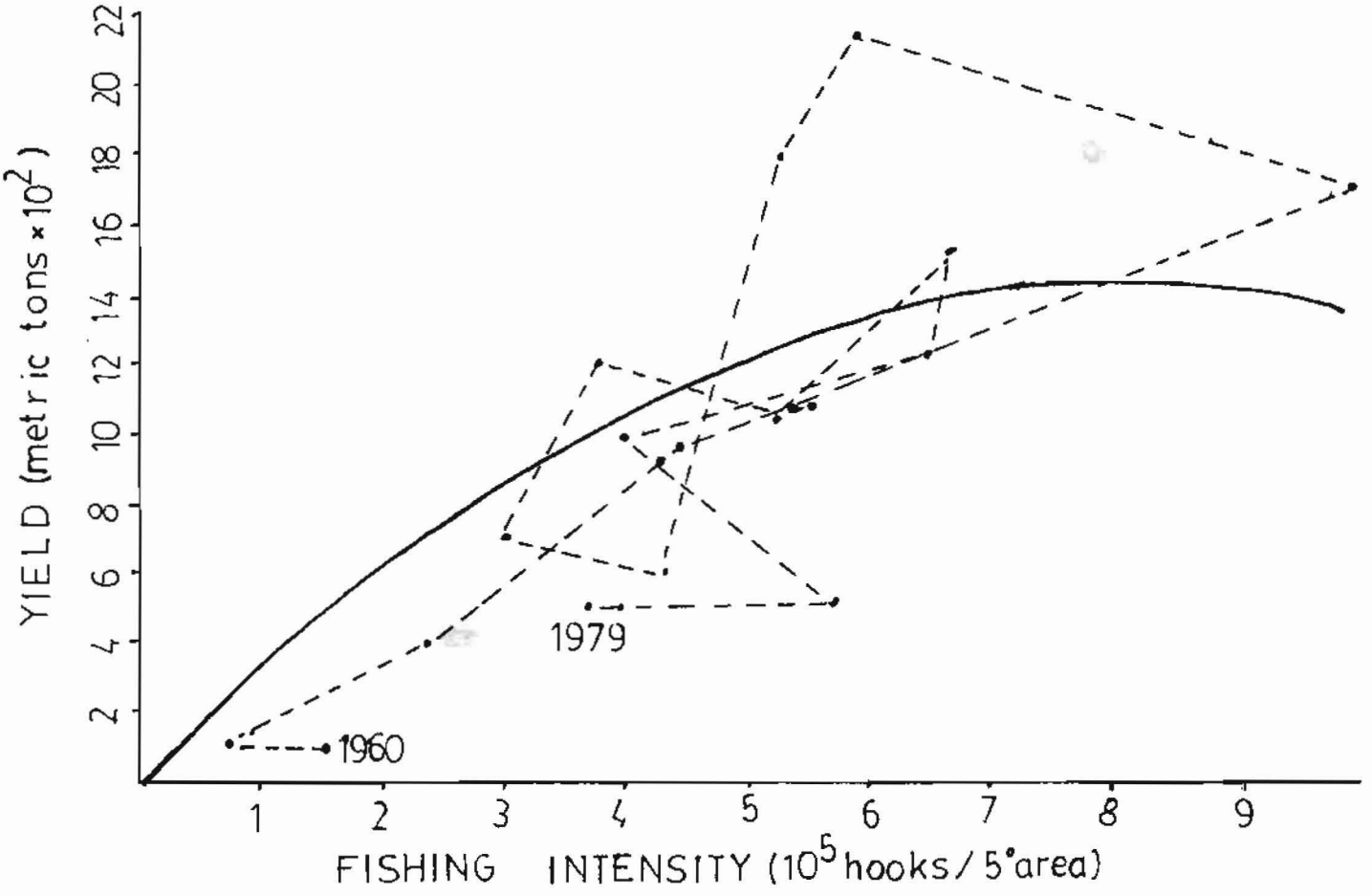


Figure 12. Schaefer equilibrium curve and observed data for white marlin in the North Atlantic (from Farber, as cited in the SAFMC Source Document)

sing capabilities for the fisheries in question, based on the OY values. Utilizing NMFS survey data on the U.S. recreational fishery for billfishes, the estimated domestic harvesting capacity fell at 2,123 metric tons per year.[100] Domestic processing capacity was not really an issue in the billfish FMP, since marlin, spearfish, and sailfish are chiefly non-processed fishes. Thus, U.S. processing capacity is by default expected to meet the U.S. harvesting capacity. Because the recreational fishing sector that harvests marlin can be expected to meet optimum yield, and because processing is not required, the total allowable levels of foreign fishing (TALFF) were set at zero (see Table 5).

The FMP presents any data relevent to the case for managing a fishery. However, its more important function is to elucidate measures which will be used for management, as well as alternative measures which were examined and rejected. The most recent determination made by the Secretary of Commerce indicates that the following measures are necessary to achieve optimum yield in the domestic sector:

> 1. Each foreign vessel fishing longline gear in the FCZ is required to maintain a daily fishing log that includes number, weight, and condition of each billfish caught.
>
> 2. Each foreign nation fishing within the FCZ under a permit that allows the taking of billfishes and sharks must submit quarterly reports.
>
> 3. An area of approximately 10,000 square nautical miles off the Dry Tortugas will be closed to fishing throughout the year; and fishing with longline gear on the bottom is prohibited in the East and West Flower Garden Banks. Otherwise, the incidental hooking of billfishes is allowed in the Gulf of Mexico from January 1 to April 30.
>
> 4. Incidental hooking of billfish by foreign longliners is allowed from January 1 to December 31 in the Atlantic except for two seasonal closings: Area I

Table 5. Maximum sustainable yield, optimum yield, domestic annual harvest, total allowable level of foreign fishing, and domestic annual processing estimates for the Atlantic marlin fisheries (from NMFS PFMP 1983)

	Blue marlin	White marlin
MSY	2,488	1,435
OY	256	100
DAH	256	100
TALFF	0	0
DAP	256	100

closed June 1 - September 30; Area II closed June 1 - November 30 (see Figure 13).

5. Any nation operating pelagic longline vessels in the FCZ in 1982 would be charged $500 for each blue or white marlin hooked and killed in the FCZ. The compensatory payment system would be applied to all billfishes determined to be dead on release.

6. Each foreign fishing vessel in the FCZ must have a valid permit issued by the Secretary of Commerce; and each vessel entering the FCZ to engage in fishing must check in by radio or port call and check out upon leaving. U.S. observers have boarding privileges, and any prohibited species observed aboard a foreign fishing vessel will be presumed to have been caught in the FCZ, unless arrangements with the U.S. enforcement authorities have been made.

7. No vessel many intentionally discard gear; nor may any foreign fishing vessel conduct longline fishing in any fixed gear area, the location of which is broadcast by the U.S. Coast Guard.[101]

If fully implemented, such management measures would cost the U.S. government a projected $629,804 annually.

The most recent revision of the management plan for billfishes and sharks is considerably better than previous plans, but is still wholly inadequate. The most fundamental weakness of the PMP is that it's objectives appear to be more protectionist than managerial. Not only are the management measures designed to limit fishing by foreigners, the very values on which the management is based are tenuous and biased towards the domestic fleet. Of course, one might argue that the whole purpose of the FCMA is to protect national fisheries from foreign depletion. However, the true problems inherent in the marlin fisheries are neither gear conflicts nor foreign competition in the FCZ. More important are the serious gaps in our knowledge of the fishes and their capacities for withstanding increasing fishing pressures through-

KEY

----- Limits of the U.S. FCZ
Prohibited Incidental Billfish Catch Area I (June-Sept.)
Prohibited Incidental Billfish Catch Area II (June-Nov.)
Tortugas Area : Prohibited Incidental Billfish Catch Area (January through April)
Disputed Area of U.S. and Canada : No Foreign Fishing

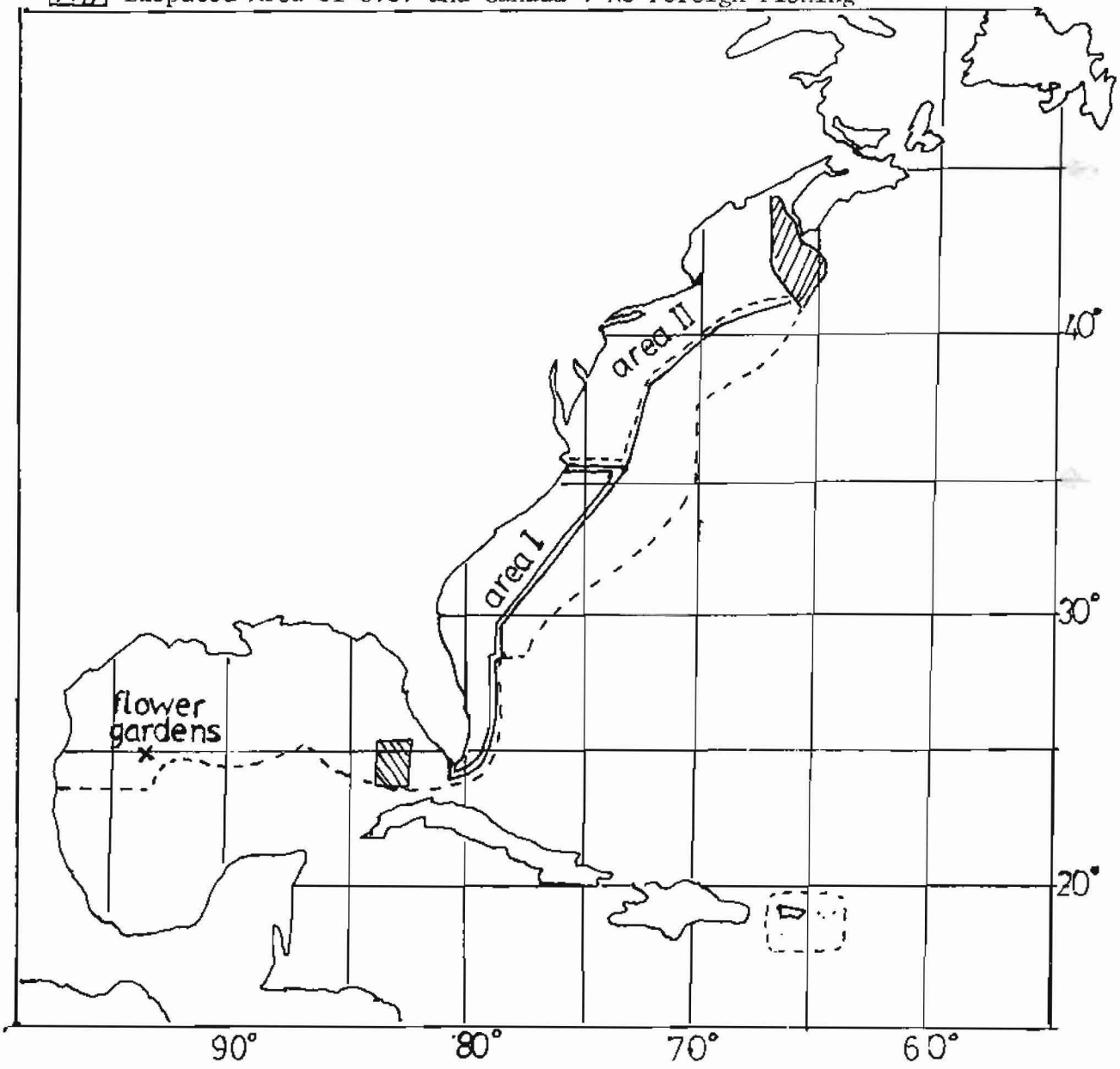


Figure 13. Proposed areas of restriction for foreign longlining operations within the U.S. FCZ (from NMFS PFMP, 1983)

out their ranges.

One need only to look at the basis for limiting effort in the billfish fishery to realize how unfocused the proposed management measures may in fact be. As already mentioned, the derivations of MSY for the blue marlin and white marlin fisheries are fraught with problems. The use of such simplistic and archaic fisheries models such as the Schaefer stock production model are only justified when the curve bears some resemblance to the data point spread. Even then, the models based on CPUE versus effort may be deceiving due to the redundancy in the relationship. The fisheries scientists, however, are left with few choices due to the inadequacy of information on the species. For without age, growth, and recruitment data, primitive models are the only tools available.

Given the somewhat imprecise nature of the MSY estimates, the derivation of optimum yield levels must also be questioned. Then again, the OY values derived for other fisheries have traditionally tasted a little of magic, so the billfish OYs may not be at all unusual. Remember, in the words of the FCMA, OY is presented on the basis of MSY as modified by any relevant social, economic, or ecological factors. Since social and economic considerations really only add up to politics, one might say the OY is a political version of the biological MSY. And when the MSY derivation itself is troubled by uncertainties, the OY becomes even less credible.

Let us assume that the MSY and OY values are the best estimates available. Do the management measures themselves address the important issues? The answer to that question must be purely subjective, since

the billfish fishery means different things to different people. In my opinion, the proposed management measures, while adequately addressing the secondarily important issue of gear conflicts, do little to achieve the goal of effective resource management. Area closures prevent or reduce recreational/longlining vessel coincidence, instead of reducing fishing pressure on spawning or other crucial stocks. The compensatory fee payment system imposes somewhat arbitrarily derived[102] taxes on longliners. These are aimed at covering the costs of implementing the management plan, rather than reducing the incidental by-catch of billfish. It is difficult to see the rationale behind charging foreign nations for abiding to a rather ineffective and somewhat biased national plan. Were it implemented, the fee system would still remain largely unenforceable anyway, since foreign longliners have a history of inaccurate reporting practices.[103]

Alternative Management Options

The PMP as it stands also contains alternative management measures which were considered and rejected. In essence, the inclusion of unacceptable measures gives credibility to the proposed plan. However, many crucial objectives are overlooked.

The first management option that was rejected was the most extreme alternative to any fishery management: closure of the entire Atlantic FCZ to foreign longliners. This obviously drastic measure was not feasible because it precluded the foreign tuna fishery, and it is not within the limits of the FCMA to limit tuna fishing itself. Limited entry is

a management practice that is rarely used except as a last resort, since it is essentially discriminatory in principle.[104]

Other management alternatives reviewed in the PMP include restricting gear dimensions (main line length and hook number), limiting effort as according to number of vessels, and imposing a penalty on foreign operations exceeding some threshold level of by-catch. These measures were differentially rejected as being either ineffective or too costly. In addition, the PMP looked over and rejected a foreign voluntary agreement to limit by-catch; one that had been agreed to by the Japanese in 1981. The only viable management option that was rejected was one which focused on the reduction of by-catch through alternative tuna fishing methods. However, as stated in the PMP, this option was dismissed because "the feasibility and cost of different tuna fishing practices that would reduce the incidental catches of billfishes cannot be determined at this time".[105] This is unfortunate, since the true culprit in the marlin issue is the longlining methodology with its non-species-specific attractiveness to large fishes.

At the present time the PMP for Billfishes and Sharks is sitting on the back burner. Recently , the recreational catch of marlin has fluctuated, causing alarm at some moments, relief at other moments (see Figure 14). The management councils seem to waiting for a substantial downturn in catch per unit effort, enough at least to get the PMP into the limelight. But in the meantime, the size of individual billfish caught incidentally on longline continues to decline, to the point that the average size of a swordfish caught on longline this past year was only 31 pounds (J. Hoey, pers. comm.). Whether this trend is applicable to catches of

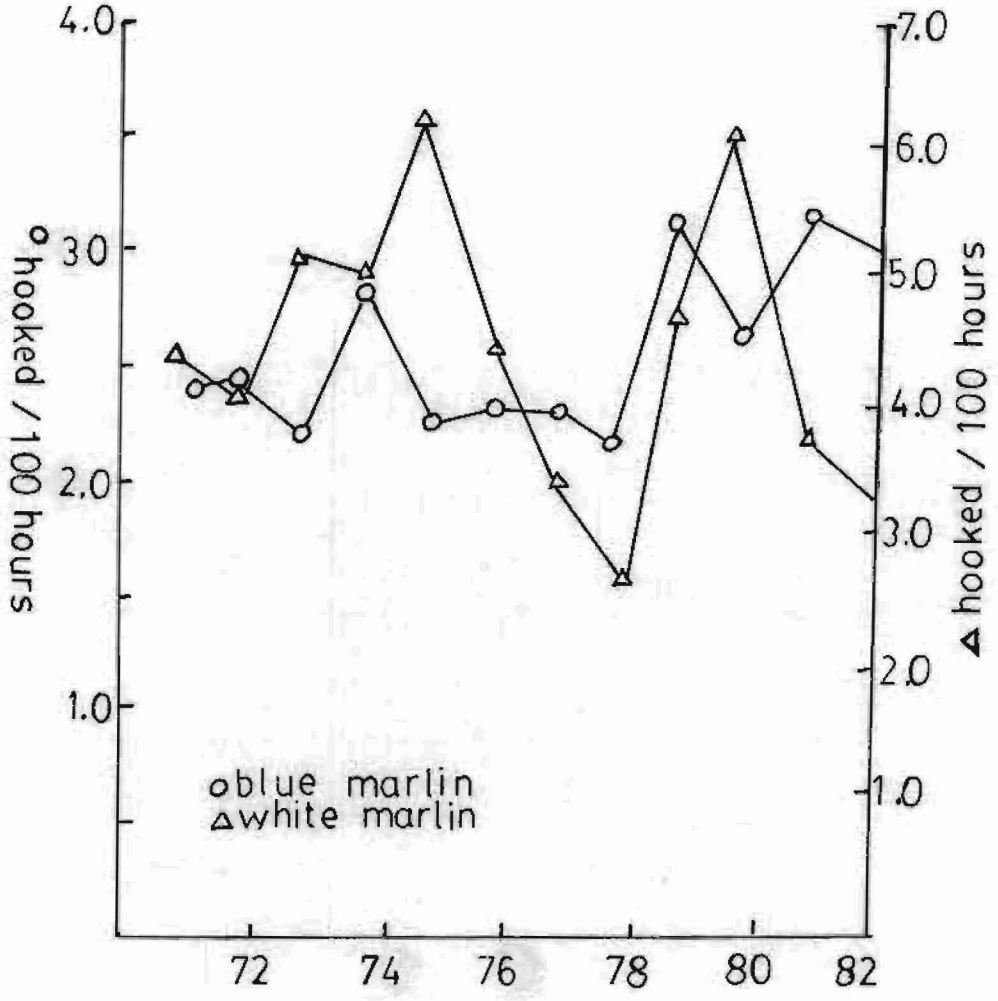


Figure 14. Catch of marlin in the U.S. recreational fishery: Gulf of Mexico only (from Farber and Conser, 1983)

blue marlin and white marlin is subject to debate, since the fishery has undergone major temporal and spatial changes of late.[106] In any case, what is sorely needed at this time is a set of management objectives that concentrate on conservation rather than blind nationalism.

What is most crucial to the management of the marlin fisheries is an integrated international approach. Obviously the U.S. will be most effective in implementing management plans within its jurisdictional limits, and less effective in convincing foreign nationals of the need for management. However, highly migratory species perceive no boundaries, and cannot be managed effectively unless managed in the same way throughout their ranges. For if fisheries regulations in the FCZ begin to impose too much of a burden on foreign fleets, they will simply move out of the 200-mile zone and deplete stocks there. No amount of bumper sticker diplomacy and lobbying by the fisheries industries will be able to prevent potential decimation of blue marlin and white marlin stocks then.

THE FUTURE

If the picture painted thus far shows a dark and uncertain future for the blue marlin and white marlin, remember all is not lost. Every day we increase our knowledge of ecology, even if in only minute increments. Fisheries science is growing perhaps more quickly than any other, and new models with introduced stochasticity and more realistic parameters allow predictions to be made with ever-increasing confidence.[107] As biologists gather more data and expand their knowledge, managers are offerred more to work with and make their cases more credible.

As previously stressed, a crucial part of any management scheme is continued data collection. This is especially true in situations such as that which exist in the marlin fishery, where virtually nothing is known yet the politial push for restrictions necessitate management. What is desperatly needed is a program aided at gathering morphometric and meristic data , in order to successfully estimate age and growth. Furthermore, recruitment needs to be qualified and quantified, such that restrictions may be imposed in areas where marlin spawn. This is especially crucial in recreational fisheries where the goal is to land a fish as large as possible. Since large marlins are inevitably female, it is likely that recruitment is being more adversely affected than previously thought.

Clearly, the case for increasing our knowledge of these species cannot be stressed enough. However, our knowledge is not only deficient with regard to the internal aspects of the species (age, growth, recruitment, etc.) but the external aspects as well. We cannot even begin to

understand how changing the population size of one species will impact another sympatric species, with the exception of straightforward predator/prey relationships. For instance, reductions in the stock of yellowfin tuna that occur with the marlin may reduce competition and thus enhance the marlin's survivorship. On the other hand, releasing sharks caught in directed fisheries may act to cause an ecological imbalance to the detriment of the shark's prey species (i.e. marlin and tuna). All these various types of ecologcial interactions need to be studied and quantified.

One aspect of ecological modelling which has been sadly neglected is the impact of environmental changes on populations. We have witnessed the general degredation of the coastal seas, but have yet to assess the far-reaching effects of such perturbations. It is however, becoming increasingly more apparent that pollution and habitat alteration cause widespread and longlived changes in the marine environment. In this case, marlin may be affected by contaminants in areas critical to their survival (such as the hypothesized spawning grounds in the Gulf of Mexico). Factors affecting population size and recruitment are multiple and varied, and thus far models have been qualitative rather than quantitative in nature (see Figure 15).

Unilateral measures, though lacking in their ability to manage the resource effectively, can provide the necessary data for understanding all these impacts. Traditionally, recreational fishermen have had an active interest in fisheries conservation, but have been given few guidelines. The need to collect information on size, tag recaptures, and spawning conditions must be stressed. The proposed saltwater angling

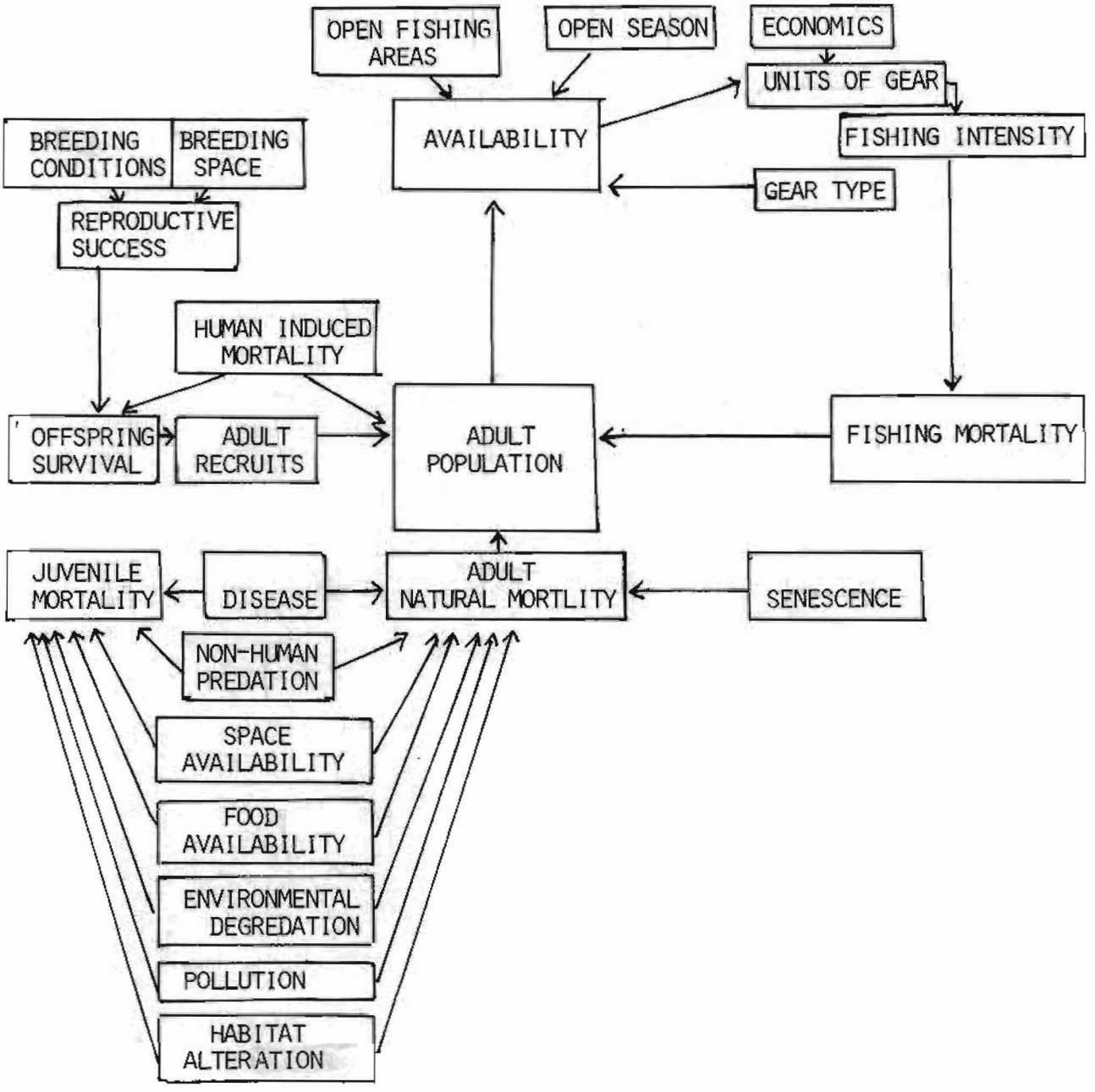


Figure 15. Schematic diagram of natural and fishing mortality effects on fish populations (apapted from Rousenfell 1975)

license presently being discussed on Capitol Hill may provide the necessary incentive for fishermen to accurately and consistently report catch data. Furthermore, the license scheme provides a means by which revenues can be generated for further scientific assessment.

In the last analysis, what is needed more than anything else is for all the participants in the billfish fishery to sit down and openly outline their objectives. An international discussion of such goals can be formalized through multiobjective programming analyses, which can provide a rigorous and unbiased appraisal of the best management compromise available.[108] An international institution which would provide a forum for such multinational planning is sorely needed, especially since the only existing organizations which consider the marlin problem are primarily concerned with tuna fisheries. In the words of the SAFMC Source Document, "in the absence of an international fishing regime, further increases in the level of effort for billfishes...could result in recruitment overfishing and depletion of the stocks". One only hopes that the stocks can maintain themselves while the slow-moving political machinery gets geared up to face the issue.

Acknowledgements

I would like to extend my thanks to John Hoey of the South Atlantic Fishery Management Council for providing invaluable data and helpful comments, and to Jack Casey of the NMFS Narragansett Lab for the same. Thanks also to the numerous NMFS researchers and administrators who have voluntered information, and to Mary Martin for typing the manuscript. Finally, special thanks to Saula Saila for sharing his infinite wisdom, and to Dennis Nixon for his eternal humor.

Endnotes

1 Much of the general information on marlin comes from two synopses on the biology of the species written for the international Billfish Symposium in Honolulu (1972). The review of white marlin work was done by F.J. Mather, III, J.M. Mason, and H.L. Clark, while the blue marlin review was provided by L.R. Rivas.

2 Ueyangi et al (1970).

3 NMFS tagging newsletters provide information on recaptures to all fishermen participating in the tag and release program.

4 Tag and recapture data is valuable in addressing the stock question butlimited by inevitably small sample sizes. One method which should also be utilized in the analysis of population dynamics of these species is electrophoretic research. I am using this technique to answer a similar question about the demography of the leatherback turtle, using small blood samples obtained from both adults and hatchlings. Mary Fabrizio of the URI Oceanography Department is presently working on electrophoctic analyses of eye lens proteins inthe striped bass to address the stock problem. Electophoretic identification of enzymes is rapidly becoming a relatively simple and straightforward technique.

5 Gibbs (1957) and Wise and Davis (1973).

6 South Atlantic Fishery Management Council (SAFMC) Source Document: 5-9

7 This hypothesis is supported by the lack of tranequatorial movements of tagged marlin (Mather et al 1972). However, as noted in the SAFMC Source Document, the recreational fishery, which accounts for the bulk of the recovery information on tagged billfish, is scarce in the Southern Atlantic. Because effort is unequal, tag and release data are difficult to interpret.

8 Wise and Davis (1973)

9 Rivas (1974)

10 I choose to stress "surface" water when discussing the temperature range of marlins because nothing is known of their vertical migrations - which may actually expose them to greater temperature ranges than presently measured.

11 SAFMC Source document: 5-10, 5-15.

12 Temperature ranges for white marlin have been suggested by Gibbs (1957), DeSylva and Davis (1963),and Ovchinnikov (1970). Ranges for blue marlin are provided by Mather et al (1974), and Squire (1962).

13 National Marine Fisheries Service unpublished data

14 Nakamura and Rivas (1972)

15 DeSylva and Davis (1963) and Ovchinnikov (1970)

16 DeSylva and Davis (1963)

17 Mather et al (1974) and Rivas (1974)

18 The effect of bottom topography on marlin distribution has been discussed at length in Desylva and Davis 1963, and mentioned in Nakamura's papers. By way of anecdotal information, the occurence of M. nigricans follows the same pattern as T. albidus with respect to the sea floor, at least in the Virgin Islands. These islands, like the other lesser Antilles, lie on the edge of the Caribbean plate. Within a few miles of land the depth of the water may drop off to more than 60,000 feet. Off St. Thomas (a major sportfishing center) the north drop-off occurs 17 miles offshore and forms an underwater cliff. Local lore claims that the blue marlin are found in great abundance in that area because the marlin chase their prey into the cliff walls and trap them there. Although this is all fancy, no reasonable alternative has been proposed as to why that particular area houses one of the largest seasonal concentrations of blue marlin in the U.S.

19 Fox (1971) has analysed the temporal and spatial relationships between tuna and billfishes based on Japanese longline data collected from 1956 to 1965.

20 Both marlin and tuna exhibit hydrodynamic morphological adaption which enhance speed of movement through the water. These include torpedo-shaped bodies for speed and long, thin pectoral fins to enable high speed turns. During short, straight bursts of swimming, the fins fold into the body to reduce drag. Marlins have additional adaptations for agility in swimming: a large dorsal fin that can be erected during turns and stops, and a long bill which "pierces" the water ahead of the fish to reduce turbulent drag. The bill is also thought to be useful in stunning and spearing prey (Ovchinnikov, 1970).

21 Stomach analysis and field observation data provided by DeSylva and Davis (1963) and Nakamura (1971).

22 DeSylva (1963), (1974a)

23 Casey and Hoenig (1977)

24 Speculative competitors with marlin for food have been proposed, however. These include Thunnus albacores (Fox, 1971) and Istiophorus platypterus (Wise and Davis, 1973) for the white marlin, and Tetraptrus fluegeri, T. augustirostris, Thunnus thunnus, Thunnus obesus and Thunnus albacores (Mather et al, 1974). Generally, any large sympatric species which feeds on schooling fishes in epipelagic waters can negatively interact with marlin.

25 A study by Volley cited in the S.A. FMC Source Document indicates school dolphin feed on billfish, although most were identified as sailfish.

26 Such juvenile predation may have shaped the seasonal distribution of summer and winter flounder in Narragansett Bay (P. Jeffries, pers. comm.).

27 Maeda (1967)

28 Ueyangi (1974)

29 Stephens (1965)

30 Mather et al (1974)

31 Mather et al (1972)

32 Erdman (1968)

33 Size of fecund fish is provided by Ueyangi et al (1970) and Baglin (1979).

34 Catch data is usually in length of fish but Lenarz and Nakamura (1974) have figured out a conversion formula for length to weight so that all data may be standardized.

35 SAFMC. Source Document 5:11

36 However two specimens tagged as adult were recaptured six years later, suggesting the life span of the fish probably exceeds 8 years (F. Mather, pers. comm.).

37 An interesting phenomena which occurs in other fish and may occur in both Makaira nigricans and Tetrapterus albidus should be noted here. Protandry, the situation where an organism spends the early part of its life as a male, then later undergoes a sex reversal having reached an optimal size, is sometimes found in fish which exhibit pronounced sexual size dimorphism. DeSylva (1963) sug-

gests this is the case with the blue marlin, and it may very well hold in the case of the white marlin. The mode of attaining sexual maturity is an often overlooked but crucial feature of the life history of any organism that is in need of management.

38 Data from Erdman (1968) and DeSylva (1963).

39 Buchanan et al (1973).

40 SAFMC Source Document: S-41

41 SAFMC Source Document: 5-10.

42 Mather et (1972), citing Ueyangi et al (1970) and J.P. Wise (pers. comm.).

43 Changes in relative abundance of species in a longline haul and overall number of fish caught per year remain the best indicator of species abundance available. Japanese longline catch is used because the Japanese have maintained the greatest historical effort. Japanese longliners fishing within the FCZ of the U.S. report their catch statistics to NMFS, which has provided this data in turn to the SAFMC.

44 Basing abundance on trends in catch-per-unit-effort (CPUE) can be difficult because of varying efficiency of gear. Although CPUE attempts to standardize fishing, it does so by dividing catch by either the number of hooks used or the number of standardized vessel days. It should be noted that despite this common denominator not all effort is equal. In particular, more effective hooks, better fish finding electronics (see Forbes and Nakker, 1972) and other such gear improvements help to improve catch without increasing either hook number or days at sea.

45 Ueyangi et al (1970)

46 Rivas (1974)

47 One should be extremely careful in interpreting this data and other recreational fishing catch statistics. Whereas the evolution of longlining gear is slow, sportfishing gear has changed drastically in the last ten years. Years ago sportfishermen hunted for marlin using trolled baits (ballyhoo, mullet, mackerel, squid, etc), but a recent and dramatic revolution changed all that. With the advent of plastic, high-speed trolling lures an angler can cover more area in a day of fishing. Furthermore, the "artificials" as they are called, are many times more efficient at attracting and hooking fish. (see Appendix I).

48 Farber (1982) reviewed the data basis on both white and blue marlin and then assessed the Atlantic stocks for the ICCAT.

In 1983, Farber and Conner revised these "best estimates" using the Pella-Tomlinson stock production model fitted by the PRODFIT program. Although this particular model is the best of its kind available to fisheries scientists, it nonetheless must be used with caution because it in no way accounts for stochasticity in the system. (See also assessments by Lopez (1981), Murphy (1960) and Otto et al (1977)).

49 This data has been provided by Lopez et al (1979), summarizing information on Japanese longlining efforts in the Gulf of Mexico.

50 An unpublished manuscript by J. Hoey and J. Casey provided invaluable data on incidental by-catch composition on longline and a summary of longlining metrodology. It is the first study to evaluate catch composition and rates in varying longlining fisheries.

51 One such company operates out of St. John, USVI , and is able to supply fresh fish to nearly all the restaurants in the Virgin Islands each trip.

52 SAFMC Source Document: 8-19

53 Ueyangi et al (1974)

54 SAFMC Source Document: 8-19

55 More information on the history of the Japanese longlining fleet, see Shapiro (1950) and Shingu and Hisada (1977).

56 SAFMC Source Document: 8-22

57 Ibid: 8-24

58 Ibid: 8-23

59 Ibid: 8-23

60 See Brock (1962), Forster (1973), Saetersdal (1963), and Shomura (1955) on varying selectivity of longline through use of different baits and set patterns.

61 Austin et al (1976); see also Duel (1973) for historic estimates of the size of the recreational billfish fishery.

62 Hamm and Slater(1979)

63 NMFS Preliminary Fishery Management Plan (1983)

64 The growth of the sportfishing industry may best be described by the anecdotal description of the Virgin Islands fishery with which I am most familiar. When the new legendary charter boat captain Johnny Horns was sent down to the Virgin Islands by the Rockfeller family in the early 60s, his was the only charter boat in the V.I.. By 1981 (the year in which I was lucky enough to win the annual V.I. billfish tournament), approximately 180 charter and company-owned boats participated in the fishing. The 1977 World Record Blue Marlin (all-tackle) which weighed 582kg (1282 lbs) surely helped promote this extraordinarily rapid growth in the charter boat business.

65 Austin et al (1976) provided the formula by which to calculate angler days based on an average of 3.5 participants/vessel/day.

66 SAFMC Source Document: 8-1

67 Ibid: 8-11

68 One must use the term "abundance" with caution here. The CPUE values, as derived from the recreational fishery catch statistics, are probably more influenced by where the fishing is than where the marlin are. For instance, fishing effort may be greater off the Virgin Islands where boats are easily serviced and where tourists are easily accomodated than, for instance the Andros Islands which are remote. The marlin fishing grounds off these remote islands may in fact be more productive than elsewhere and are yet to be discovered. (For a thorough, if somewhat outdated discussion of the terms abundance and relative abundance in fisheries, see Mather, 1951).

69 The NMFS angler survey was prompted in part by a 1977 report to the working group in billfish amendment in the Southwest Fisheries Center by Beardsley (1977). He and Conser (1981) later worked up the catch and effort data generated by the survey.

70 SAFMC Source Document: 8-6.

71 Ibid: 9-1

72 This reflects the current American trend in gastronomic courage where even the staunchest supporters of meat and potato cooking are willing to experiment with novel tastes like fish, shark, goosefish, and smoked anything.

73 Of course, the sportfishery for marlin is not limited to the Atlantic. Black marlin (Makaira indira) exceeding 700kg (1500 lbs) have been caught off the Pacific coast of Peru and in Australia, while striped marlin (Tetrapterus audas) are actively pursued off Pacific, Mexico and New Zealand. A substantial fishery for

Pacific blue marlin is also well known in Hawaii. For more information see DeSylva (1974-6), who provides a brief outline of the sportfishery for billfishes around the world.

74 For instance, assume that certain values are derived for a simple cost-benefit analysis, as described by Dwyer and Bowes (1978). If one attempts valuation of the "challenge" inherentin finding, hooking, and landing/tagging a marlin can one predict how that value changes as the process if facilitated by newer and more sophisticated equipment? The derivation of a value for the challenge of fishing has not as yet been addressed in sportfishing economic analyses I have come across. Neither has the question of the cost of crowding at a fishing site been given enough attention (see Lopes and Knetsch, 1981).

75 Lopes and Knetsch (1981)

76 McConnel and Norton (1976) discuss the options available in economic analyses of this kind; later McConnell and Sutiner (1979) expand their models to include not only sport fisheries but combined recreational and commercial fisheries.

77 NMFS Preliminary Management Plan for Billfishes and Sharks (1983): Appendix XIII.

78 I have several problems with the approach taken by the analysts working on this valuation, but these may be due more to my ignorance than anything else. The main shortcoming of their marginal analysis of the value of yet another marlin is that not all consumers have the same fishing background, so they ought not to be treated as a homogeneous group. The analysis also ignores many other important considerations that influence the value of a fishing trip, as mentioned in this paper.

79 McConnell and Norton (1976)

80 See Pristas (1981) on effort and catch in the Gulf of Mexico recreational billfish fishery.

81 SAFMC Source Document: Table 9-2

82 Ibid: Table 9-2

83 Taxidermy fees run about $4.37/inch, according to the SAFMC Source Document (9-8). From this, the captain gets a sizable commission from the fish mounting company (usually 30%). This commission is incentive enough for the captain to do his best to persuade the angler that the fish would look great over the fireplace, in the den, etc.. After about two trips one learns to say no (having already retired the other dusty trophies to the attic...).

84 The-more open-minded marina owners could either sell the fish locally if a market existed, or set up a fish-smoking operation on site. Johnny Harms did the latter at Red Hook, St. Thomas, and his smoked blue marlin was for years a sought-after delicacy. Since most marlin are now tagged and released, his smoking business has fallen off.

85 Recreational fishing organizations such as the International Game Fish Association (IGFA), The International Women's Fishing Association (IWFA), the Sport Fishing Institute (SFI), the American Fishing Tackle Manufacturer's Association (AFTMA), and the National Coalition for Marine Conservation (NCMC) spend an enormous sum of money annually to stress conservation. They do so through newsletters, annual publications, and symposia.

86 And, in fact, angler participation in the Cooperative Tagging Program, is essential to continue study of the stock question, age and growth, and fishing mortality. Without it the minimal information derived from exploratory longline and observer programs could not begin to address these questions (see Casey et al 1978).

87 The difficulty is again in separating the billfish charter operations from the other recreational fisheries. Because of the seasonality of marlin fishing, most vessels target other species in the off-season.

88 SAFMC Source Doucement: 10-4

89 It should be noted that the anglerentering the tournament never sees these behind - the-scenes transactions, and of course gets no percentage of the winning bet unless he is the owner and operator at the same time.

90 Draft Fishery Management Plan for billfishes (FFMP) prepared by two South Atlantic Fishing Management Council: 7

91 IBid: 7-8

92 An example of such overexploitation is the herring fishery which at one time enjoyed a thriving but limited exploitation. The appearance of Soviet travelers on Georges Bank and Browns' Ledge marked the near extirpation of the species. It is now almost impossible to find a herring in the western North Atlantic - a sad fact considering the fish was once ubiquitous in the area. (Stephen M. Clark, pers. comm.).

93 Warner et al (1981) discuss the FCMA with regard to its conservation aspects and elucidate how the FCMA was designed primarily for conservation, even though it's goals as such may not be stressed. See also Burke (1982a) and Knight (1978)for enlightning discussion of the FCMA.

94 Commercial Fisheries News, March 1984 : 4

95 See especially Burke (1982)

96 For extensive discussions on the Law of the Sea Treaty and what it might have meant to U.S. Fishery Management, see Burke (1982b) and Copes (1981). In addition, articles by Joseph (1973, 1977) and King (1979), and the informative book by Joseph and Greenough (1979) provide insight into the complexity involved in managing highly migratory species.

97 As stated in the NMFS Preliminary Fishery Management Plan (revised June 1983), "The allowable level of foreign fishing for blue and white marlin, sailfish, spearfish, and swordfish is zero because domestic fishermen are expected to land the preliminary OY."

98 NMFS PMP (1983) Appendix B

99 Magnuson Fishery Conservation and Management Act of 1976, Section 3 (18)

100 Hamm and Slater (1979) provide data as follows: 18,976 vessels fished an average of 15.3 days for billfish, with an average catch rate of 0.28 billfishes per boat day (at an estimated 110 days/season) yield 81,293 billfishes/season. Given the average billfish size of .026 metric tons (57.5 lbs), the capacity for domestic harvest is 2,123 mt annually. Note that this calculation is based on values for all billfish, including sailfish and spearfish.

101 Taken directly from the NMFS PFMP June 1983.

102 The compensatory fee system is based on the estimated price that a recreational fisherman would pay to catch yet another marlin. As previousily mentioned, this derivation may not be valid.

103 Thompson (1982) provides an in-depth look how different observer records are from ship's logs submitted to NMFS. Invariably the Japanese longliners report substantially less in by-catch than were actually caught.

104 See Knight and Lambert (1975) for a discussion of the constitutionality of limited entry schemes.

105 NMFS PFMP 1983: 34

106 As in Powers (1983) versus Conser (1979).

107 Sissenwine (1978) discusses the inadequacy of MSY as a basis for OY, and proposes more realistic and useful models to derive OY.

108 See Cohon (1978)

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APPENDICES

APPENDIX I: The following is an article which I wrote for Salt Water Sportsman in 1979, but never sent in for publication. It is a true account and is included here in an effort to describe the excitement inherent in big game fishing.

It was a morning not unlike many others, sleepiness giving way to the anticipation of good fishing. The day promised sunshine, with a slight NE wind to keep the baits working well. One of those royal blue days of late summer, when the sea is dark and deep and alive with the dancing of bright whitecaps.

Leaving Montauk light behind, the chop became a little heavy from the action of the rip current coupled with the wind. Not enough to dim our prospects, however, only causing the spilling of some already cold coffee. We became all the more enthused when the few boats around us seemed to be heading for the Tuna Hole, leaving us pointing 185° at a clear horizon. By 9 o'clock we had reached the spot: inland from the dropoff by several miles and in a good 40 fathoms of water. Since we had spent the previous evening rigging baits in the kitchen (despite cries of protest from unenthusiastic wives), we needed only to plan our line of attack.

It was merely because of the optimistic quality of the day and the fact that we had gotten out early enough to make use of it all that we tried something new. Bob, our captain and fearless leader who was the cause of inspiration for all eight of us on board, was in an especially bright mood. Setting convention aside, he agreed to a half-hour test run of some artificials I had been given by an old friend from the Caribbean. Instead of the usual squid-eel combination on the outriggers, ballyhoo on the flats, we put out a Ferro Jet lure and a Kona

head on the riggers and set the inside with yellow feathers. The set-up looked a little gaudy, to be sure; bright colors in bright sunshine and bright blue water. "Half-an hour, that's it" Bob grumbled as he sat back on the bait box and gazed at the wake, adjusting the well-worn cap on his head.

Half an hour was plenty. We had started on our usual trolling speed, but it just didn't look right. So (more grumbles from the captain) we sped up to 10 knots, as my friend had suggested. At this speed the lures torpedoed in and out of the chop, leaving jet-like trails of wake behind. The lures themselves looked so exciting and filled with action that we nearly missed the strike. Only a split-second of that neon blue glow up behind the Jet lure, then bang! the reel started buzzing and we were off.

Bob grabbed the 50 lb. rod, set the hook, and handed it over to his brother, whose Bertram 31 we were using for the expedition. Dick, not naturally obsessed with sportsfishing but caught up in the contagious atmosphere of the occaison, leaned back and let his weight fight the fish. The drag was fairly loose but the fish was sounding fast and promised to be big. The first run straight down nearly stripped the reel, so before the fish got a second wind Dick tightened up the drag and got to work. Fifteen minutes. Twenty-five. Dick sat down in the fighting chair and Bob reached for the day's first beer. Despite the marlin-like glow we had glimpsed at the hit, the fish acted like a big bluefin, and we were ready for the fight.

We weren't at all ready for what happened next. Slowly, the tension let up on the line. Dick was reeling hard and starting to

doubt whether the fish was still on. Suddenly, an explosion of water twenty yards off the stern and out sailed a huge, powerful billfish. Bob, having just cracked a second beer with the comment that it looked like it was going to be a two-beer fish, lost his calm altogether. We were all feverish- laughing and screaming and breathless.

Dick pumped the reel hard. A few more soundings, more jumps, and the sun moved overhead and inched towards West. Two hours passed, three- Bob's wife Adrienne at the controls, backing down whenever the opportunity arose. At four hours Dick's hands started to bleed and needed bandaging. Still the fish was strong- diving towards bottom, turning, and rocketing out the surface. We had witnessed eight jumps.

Five hours passed since the strike. Dick was tired but determined, asking only for an occaisonal drink and rebandaging. We put a shoulder harness on him, and talked on the flying bridge of a release. The fish looked healthy and didn't seem to be foul-hooked; marlin have no commercial value so we'd let it go anyway. Feelings were mixed: we had never once gotten the billfish up along side the boat and could only guess as to its size. We finally decided to tighten up the drag a little bit, and fight it hard so we could get a look and set it free.

Eleven clean jumps. Our stomachs remained tied in knots and we still shouted at every spectacular hurdle. Both the fish and Dick seemed undaunted and equally determined. After six hours neither seemed to want to give in. A half hour later, the fish jumped yet another time, but didn't clear the water and started to show signs of strain. We had another conference on the bridge, and got ready to release the fish before it suffered any real harm. Dick tightened the drag one more time

and gave it all he had.

Within twenty minutes the fish was alongside the boat. As we watched from the bridge, Bob grabbed the leader wire and bent over the side to cut it. Instantly, we all silently realized what only one of us could chokingly say out loud. "That's a broadbill"---It shocked us all.

The boat burst into action. Bob threw down the fishing pliers and reached for a gaff. Those of us with free hands grabbed all the gaffs that we could, since we were in want of a flying gaff and had to make do with the hand-held gaffs we had. With the gaffs set and fish still thrashing, Bob grabbed the bill and commanded us to heave. As the six of us gave it all the strength we could muster we pulled the swordfish into the back of the boat. Larger than we had expected (or even foolishly hoped), the swordfish lay across the transom with bill and tail high in the air. Over twelve feet in total length, we guessed it to be near 400 pounds (an official weighing in Montauk that night revealed 405 pounds, only 23 off the world record for the class).

Dusk fell and we all grew quiet, tired from all the excitement. Heading back towards the flashing beacon that marked Montuck, Dick sat with his bandaged hands in his lap, smiling. Bob still sat in the stern facing the fish, shaking his head at the pile of empty beer cans in the bucket. A two-beer fish.

When one looks at the history of trolling for big game fish, billfish in particular, the evolution of bright, high speed lures is not a surprise. Natural baits such as eels, mullet and ballyhoo have been in use for years, becoming increasingly more ornate with the addition

of feathers and the like. As experimentation led to specialization, ballyhoo and especially eels were rigged with plastic dressings: skirts in bright and even phosphorescent colors. Despite these improvements however, natural baits have never been able to withstand high speed trolling at length. Not only do artificial lures stand up to hours of trolling and repeated strikes, they can be used throughout the season and year to year. (Any seasoned billfisherman wonders whether he can refreeze those thawed and unused baits yet one more time). Another advantage to trolling lures is their relatively dependent and constant performance. Variables inherent to natural baits, such as length and thickness of the bait used, freshness, and rigging techniques are avoided.

Only recently, however, have all-plastic lures dominated the billfishing scene. Sportsfisherman are finding these lures surprisingly successful, given the fish are there and hungry. The optimum trolling speed seems to be somewhere in the vicinity of 9-12 knots. Clones, jet lures and kona heads are the most popular of the artificial marlin lures with conical heads of hard plastic or metal and flexible plastic streamers. Often the heads are concave for better hydrodynamic design. Many types have a string of colored heads as the body. Bright colors seem to work well: the most popular being green and blue with other accents.

As for catching huge swordfish: no guarentees. Broadbills are known to be finicky; even we have spent hours trying to "force feed" swordfish squid to seeming interested fish. Having a swordfish up in the baits is an exciting but often frustrating experience, and fishing techniques are badly in need of improvement. As far as we know, no other swordfish have been caught on an artificail high-speed trolling' lure. But this may be the start of a new trend...

APPENDIX II : Form used by the National Marine Fisheries Service Angler Survey

BILLFISH SURVEY

1. DURING THE 12 MONTH PERIOD FROM MAY 1, 1977 THROUGH APRIL 30, 1978, DID YOU OR ANYONE ELSE USE YOUR BOAT TO FISH FOR BLUE MARLIN, WHITE MARLIN, SAILFISH, SPEARFISH, SWORDFISH, OR LARGE SHARKS? ☐ YES ☐ NO
(IF NO GO TO 4)

2. PLEASE INDICATE ON THE TABLE BELOW THE NUMBER OF FISH BY SPECIES AND AREA THAT WERE CAUGHT (CAUGHT=BOATED+RELEASED) FROM YOUR BOAT DURING THE TIME PERIOD ABOVE ALSO, PLEASE INDICATE DAYS FISHED WHETHER SUCCESSFUL OR NOT

FISHING AREA	BLUE MARLIN		WHITE MARLIN		SAILFISH		SPEARFISH		SWORDFISH		SHARKS OVER 20 LB *		INDICATE NUMBER OF DAYS FISHED BY AREA FOR	
	NUMBER CAUGHT	NUMBER RELEASED	NUMBER CAUGHT	NUMBER RELEASED	NUMBER CAUGHT	NUMBER RELEASED	NUMBER CAUGHT	NUMBER RELEASED	NUMBER CAUGHT	NUMBER RELEASED	NUMBER CAUGHT	NUMBER RELEASED	BILLFISHES	SHARKS
U.S. WATERS — VIRGINIA & NORTHWARD														
N. CAROLINA TO FLORIDA														
FLA. EAST COAST & FLA. KEYS														
GULF OF MEXICO														
PUERTO RICO & U.S. VIRGIN ISLANDS														
OTHER WATERS														

*IF ABLE TO IDENTIFY SPECIES OF SHARKS, PLEASE ESTIMATE NUMBER CAUGHT BY SPECIES: _____

3. PLEASE INDICATE THE FOLLOWING:

A. BOAT LENGTH_____FEET

B. WAS YOUR BOAT USED PRIMARILY FOR CHARTERING DURING THE LAST 12 MONTHS? ☐ YES ☐ NO

C. NUMBER OF FISH LISTED ABOVE THAT WERE CAUGHT IN A TOURNAMENT: BILLFISH_____SHARKS_____

4. THANK YOU VERY MUCH FOR YOUR PARTICIPATION IN THIS SURVEY. PLEASE RETURN THIS QUESTIONNAIRE TO US IN THE ENCLOSED ENVELOPE EVEN THOUGH YOU MAY NOT HAVE USED YOUR BOAT FOR BILLFISHING DURING THAT PERIOD. PLEASE INDICATE IF YOU WOULD LIKE TO RECEIVE A COPY OF THE FINAL RESULTS OF THIS SURVEY WHEN AVAILABLE ☐ YES ☐ NO

APPENDIX III (Black dots indicate marlin tournaments)

International Tournament Calendar

JANUARY-FEBRUARY 1984 ISSUE

PUBLISHED BY THE INTERNATIONAL GAME FISH ASSOCIATION • 3000 EAST LAS OLAS BOULEVARD • FORT LAUDERDALE, FLORIDA 33316-1616 USA

This calendar is a service to members and lists forthcoming tournaments as they have been reported to IGFA. Sponsors of international, national or large regional fishing tournaments wishing to be listed should advise IGFA of the name of the tournament, date, location, and the address where anglers can obtain more information. IGFA is not responsible for erroneous dates, cancellations, changes, etc., and anglers should confirm events with tournament officials.

Publication of these tournament names and dates does not indicate endorsement by IGFA, and any tournament which claims such endorsement is doing so falsely. Neither is IGFA in any way responsible for the manner in which these tournaments are run or in any decisions affecting their outcome. While all tournaments are encouraged to use IGFA International Angling Rules in their events, such use does not indicate endorsement, sponsorship or involvement by IGFA.

The following tournaments began earlier but will be continuing through the coming months.

JULY 1, 1983-JUNE 30, 1984, NEW ZEALAND: Westpac Trophy, Bay of Islands. Contact Birke Lovett, Secy.-Mgr., Bay of Islands Swordfish Club, P.O. Box 31, Russell.

NOVEMBER 6, 1983-JUNE 30, 1984, NEW ZEALAND: Striped Marlin Stakes, Bay of Islands. Contact Birke Lovett, Secy.-Mgr., Bay of Islands Swordfish Club, P.O. Box 31, Russell.

DECEMBER 3, 1983-APRIL 14, 1984, FLORIDA, USA: 49th Annual Metropolitan South Florida Fishing Tournament, Miami. Contact Grayson Smith, Exec. Sec., Met Tournament, 1431 N. Bayshore Drive, Miami, FL 33132.

JANUARY 1-DECEMBER 31, 1984, BAHAMAS: Members Tournament, Bimini. Contact Raul Miranda, Bimini Big Game Fishing Club & Hotel, P.O. Box 523238, Miami, FL 33152.

1984

- **MARCH 2-11, NEW ZEALAND:** International Billfish Tournament, Bay of Islands. Contact Bay of Islands Billfish Tournament, P.O. Box 1770, Auckland 1.
- **MARCH 3-5, AUSTRALIA:** Fremantle Sailing Club Blue Marlin Classic, Fremantle. Contact Perth Game Fishing Club, E.J. Clugson, Secy., 149 West Coast Highway, North Beach 6020, W.A.

MARCH 4, NETHERLANDS: Estuari Sea Boat Angling Tournament, Den Oever. Contact H.V. Leonen, EFSA-Nederland, Van Ostadelaan 8, 1231 AK Loosdrecht.

MARCH 4-8, ZAMBIA: Zambia National Fishing Competition, Lake Tanganyika. Contact Reg. Hughes, Chairman, P.O. Box 90069, Luanshya, Zambia, Africa.

- **MARCH 4-9 BAHAMAS:** Bimini Benefit Billfish Tournament (formerly Frankie Brown). Contact Blue Water, Ltd., Frank Hinzey, Gen. Mgr., P.O. Box 627, Bimini
- **MARCH 4-11, MAURITIUS:** International Marlin Competition. Contact Mauritius Travel & Tourist Bureau, Ltd., Sir William Newton Rd., Port Louis.
- **MARCH 10-11, AUSTRALIA:** Fremantle Sailing Club Blue Marlin Classic, Fremantle. Contact Secy., Perth Game Fishing Club, 149 West Coast Hwy., North Beach 6020, W.A.

MARCH 12-17, NEW ZEALAND: Annual One Base Contest, Tutukaka. Contact Mrs. B.M. Brown, Secy., Whangarei Deep Sea Anglers' Club, P.O. Box 401, Whangarei.

- **MARCH 17-18, AUSTRALIA:** Perth Game Fishing Club Western Australia Open. Contact Secy., Perth Game Fishing Club, 149 West Coast Hwy., North Beach 6020, W.A.
- **MARCH 17-19, NEW ZEALAND:** Marlin Tournament, Whakatane. Contact R. Gildon, Tournaments Officer, Whakatane Big Game Fishing Club, P.O. Box 105, Whakatane.
- **MARCH 19-24, BAHAMAS:** 5th Annual Bacardi Billfish Tournament, Bimini. Contact Raul Miranda, Tournament Director, P.O. Box 523238, Miami, FL 33152.
- **MARCH 24, AUSTRALIA:** Perth Game Fishing Club Western Australia Open. Contact Secy., Perth Game Fishing Club, 149 West Coast Hwy., North Beach 6020, W.A.
- **MARCH 24-APRIL 1, HAWAII, USA:** Hawaiian Blue Marlin Tournament, Kailua-Kona. Contact Clint Allen, (617) 451-0900.

MARCH 26-31, AUSTRALIA: The Naturaliste Blue Water Classic, Busselton, Western Australia. Contact Cliff Fraser, Secy., Naturaliste Game Fishing Assn., P.O. Box 441, Busselton, W.A. 6280.

- **MARCH 27-31, BAHAMAS:** Marlin International's "Showdown" Blue Marlin Tournament, Walker's Cay. Contact "SHOWDOWN" c/o Marlin International, P.O. Box 12902, Pensacola, FL 32576.

MARCH 28-30, GEORGIA, USA: Georgia Invitational/East League, Lanier Islands. Contact Tournament Dept., B.A.S.S., P.O. Box 17900, Montgomery, AL 36141.

- **APRIL 1-7, AUSTRALIA:** 4th Annual Australian & International Billfish Tournament, Tangalooma. Contact Bill Stoddart Pres. Moreton Bay Game Fish Club, P.O. Box 420, Sunnybank 4109, Queensland.

APRIL 2-6, BAHAMAS: His & Hers Tournament, Chub Cay. Contact Warren Miedke, Gen. Mgr., Chub Cay Club, P.O. Box 661067, Miami Springs, FL 33166 USA.

- **APRIL 4-6 BAHAMAS:** Walker's Cay Gran Prix (1st leg of IBL Gran Prix Series). Contact International Billfish League, 4201 N. Federal Hwy., Suite B, Pompano Beach, FL 33064 USA, (800) 338-3815.
- **APRIL 6-8, FLORIDA, USA:** The Greater Miami Annual Billfish Tournament. Contact The Greater Miami Billfish Tournament, 18201 N.W. 68th Ave., Suite 6, Miami, FL 33051.

APRIL 6-8, MEXICO: 14th Annual Sailfish Release Tournament, Cozumel. Contact Torneo de Pesca de Cozumel, Hotel Meson San Miguel, Cozumel, Quintana Roo, Mexico 77600.

APRIL 7-8, SWEDEN: EFSA'S Spring Festival, Verberg. Contact Kent Andersson, EFSA, Box 178, 401 23 Göteborg.

- **APRIL 8-13, BAHAMAS:** Walker's Cay Billfish Tournament, Abaco. Contact Walker's Cay Hotel & Marina, 700 S.W. 34th St., Fort Lauderdale, FL 33315 USA, (800) 327-3714.

APRIL 8-14, AUSTRALIA: 11th Annual Tangalooma Game Fish Classic, Tangalooma. Contact Bill Stoddart, Pres., Moreton Bay Game Fish Club, P.O. Box 420, Sunnybank 4109, Queensland.

- **APRIL 9-13, BAHAMAS:** Members Tournament, Chub Cay. Contact Warren Miedke, Gen. Mgr., Chub Cay Club, P.O. Box 661067, Miami Springs, FL 33166 USA
- **APRIL 9-13, BAHAMAS:** Annual Walker's Cay Billfish Tournament. Contact Ms. Mary Pritz, Walker's Cay, 700 S.W. 34th St., Fort Lauderdale, FL 33315 USA.
- **APRIL 11-14, BELIZE:** 3rd Annual Belize International Billfish Tournament, San Pedro. Contact Jerry McDermott, c/o Paradise Hotel, Box 888, Belize City.
- **APRIL 11-14, MEXICO:** Cozumel International Marlin Tournament. Contact Marlin Int'l. Assn., P.O. Box 12902, Pensacola, FL 32576 USA.

APRIL 12-13, FLORIDA, USA: Florida Invitational, Lake Okeechobee. Contact Bass'n Gal HQ, P.O. Box 13925, Arlington, TX 76013.

APRIL 13-15, MICHIGAN: Annual World Record Steelhead Tournament, Clare. Contact Dick Swan, 3230 Oakland Dr., Clare, MI 48617.

APRIL 15, SWEDEN: EFSA's Spring Festival, Bohuslän. Contact Kent Andersson, EFSA, Box 178, 401 23 Göteborg.

- **APRIL 15-20, BAHAMAS:** Hemingway Billfish Tournament (1st leg of the Bahamas Billfish Championship), Bimini. Contact Blue Water, Ltd., Attn. Frank Hinzey, Gen. Mgr., P.O. Box 627, Bimini.

APRIL 16-22, COSTA RICA: Snook-Tarpon Tournament, Casa Mar. Contact Ms. Cathy Williams, International Women's Fishing Assn., P.O. Box 2025, Palm Beach, FL 33480.

APRIL 21-24, AUSTRALIA: Mercury South Eastern Invitation Tournament, Bermagui. Contact Secy., Victoria Game Fishing Club, 186 Station St., Aspendale 3195, Victoria.

APRIL 25-28, FLORIDA, USA: Super B.A.S.S. Tournament, Palatka. Contact Tournament Dept., B.A.S.S., P.O. Box 17900, Montgomery, AL 36141.

APRIL 25-28, NEW ZEALAND: International Trout Fishing Tournament, Lake Taupo. Contact Tournament Director, P.O. Box 865, Taupo.

APRIL 26-29, NEW YORK, USA: Empire State/Lake Ontario Trout & Salmon Derby, Lake Ontario. Contact ESLO Derby, Inc., P.O. Box 220, Pittsford, NY 14534.

APRIL 26-29, MEXICO: Golden Snook Tournament, Tampico. Contact Jesus Holguera, Club Internacional de Yates Tampico, Avenida Hidalgo 3705-Desp. 203, 89120 Tampico, Tam.

- **APRIL 27-29, FLORIDA, USA:** Ft. Lauderdale Semi-Annual Billfish Tournament. Contact Skip Field, President, P.O. Box 22218, Fort Lauderdale, FL 33335.

APRIL 27-29, MEXICO: Swordfish Tournament, Cozumel. Contact Torneo de Pesca de Cozumel, Hotel Meson San Miguel, Cozumel, Quintana Roo, Mexico 77600.

- **APRIL 29-MAY 4, BAHAMAS:** Walker's Cay Billfish Tournament (2nd leg of Bahamas Billfish Championship). Contact Ms. Mary Pritz, Walker's Cay Hotel & Marina, 700 S.W. 34th St., Fort Lauderdale, FL 33315 USA, (800) 327-3714.
- **APRIL 30-MAY 2, HAWAII, USA:** Kona A'Lure Annual Hawaiian Wahine Fishing Tournament, Kailua-Kona. Contact Tournament Director, P.O. Box 2097, Kailua-Kona, HI 96740.

APRIL 30-JULY 31, NEW YORK, USA: Empire State/Lake Ontario "Brown Derby," Lake Ontario. Contact ESLO Derby, Inc., P.O. Box 220, Pittsford, NY 14534.

MAY 1-5, MEXICO: Sea of Cortez Panga Tournament, San Jose, Baja California Sur. Contact Bill Gallagher, Dir., Hotel El Presidente, San Jose, Baja California Sur.

MAY 1-OCTOBER 31, FLORIDA, USA: Summer Fishing Contest, West Palm Beach. Contact Ms. Frances Doucet, West Palm Beach Fishing Club, Box 468, West Palm Beach, FL 33402.

MAY 1-3, FLORIDA: Bonefish Tournament, Islamorada. Contact Intl. Women's Fishing Assn., P.O. Box 2025, Palm Beach, FL 33480

MAY 2-5, FLORIDA, USA: Marathon Intl. Tarpon Tournament, Marathon. Contact Ms. Karen Farley, P.O. Box 891, Marathon, FL 33050.

MAY 3-5, NEW ZEALAND: Duke of Marlborough South Pacific Tournament, Bay of Islands. Contact B.O.I.S.C., Game Fishing Charters, Maritime Bldg., Paihia.

MAY 3-5, FLORIDA, USA: Florida Invitational/East League, Clewiston. Contact Tournament Dept., B.A.S.S., P.O. Box 17900, Montgomery, AL 36141.

MAY 3-6, SOUTH CAROLINA, USA: Hilton Head Billfish Tournament (1st leg of S.C. Billfish Triple Crown). Contact Dave Harris, Hilton Head Billfish Tournament, Shelter Cove Marina, P.O. Box 5628, Hilton Head Island, SC 29938.

MAY 3-6, MEXICO: Marlin Tournament, Cozumel. Contact Torneo de Pesca de Cozumel, Hotel Meson San Miguel, Cozumel, Quintana Roo, Mexico 77600.

MAY 5-6, FLORIDA, USA: West Palm Beach Fishing Club Small Boat Tournament. Contact Ms. Frances Doucet, West Palm Beach Fishing Club, Box 468, West Palm Beach, FL 33402.

MAY 5-6, DENMARK: Scandinavian Sea Angling Championship, Hirtshals. Contact Kent Andersson, Box 178, 401 23 Göteborg, Sweden.

MAY 6, FRANCE: First Fly Fishing European Tournament, Dreux. Contact Chairman, Fly Country Club, La Mouche et La Poudre, 31 rue Parisis, 28100 Dreux.

MAY 6, NETHERLANDS: North Sea Boat Angling Tournament, Scheveningen. Contact H.V. Loenen, EFSA Nederland, Van Ostadelaan 8, 1231 AK Lousdrecht.

MAY 7-10, NEW ZEALAND: Bay of Islands South Pacific Championship. Contact Game Fishing Charters, Maritime Bldg., Paihia.

MAY 10-13, SOUTH CAROLINA, USA: Bohicket Seabrook Billfish Tournament (2nd leg of S.C. Billfish Triple Crown), Charleston. Contact Damien Zanetti, 1830 Andell Bluff Blvd., Johns Island, SC 29455.

MAY 11-12, SWEDEN: Sea Cat Festival, Varberg. Contact Kent Andersson, EFSA, Box 178, 401 23 Göteborg.

MAY 13-18, BAHAMAS: 2nd Annual Angler's Invitational Tournament, Chub Cay. Contact Jerry Isan, 550 Arvida Pkwy., Coral Gables, FL 33156 USA.

MAY 14-19, BAHAMAS: 8th Annual Light Tackle Billfish Tournament, Bimini. Contact Raul Miranda, Tournament Director, P.O. Box 523238, Miami, FL 33152.

MAY 14-19, BAHAMAS: Bluefin Tuna Tournament, Bimini. Contact Raul Miranda, Tournament Director, P.O. Box 523238, Miami, FL 33152

MAY 15-20, JAMAICA: Jamaica International Blue Marlin Tournament, Ocho Rios. Contact Ocho Rios Angler Assn., Minister Robt. Marsh, P.O. Box 54, Ocho Rios.

MAY 18-19, SOUTH CAROLINA, USA: 8th Annual Blue Marlin Open, Seabrook Island. Contact Atlantic Billfish Club, P.O. Box 308, Johns Island, SC 29455.

MAY 18-20, FLORIDA, USA: Pompano Beach Fishing Rodeo. Contact Wade Horn III, P.O. Box 5584, Lighthouse Point, FL 33064.

MAY 19-JULY 28, FLORIDA, USA: Suncoast Tarpon Roundup, Clearwater. Contact Suncoast Tarpon Roundup, 1467 Southridge Drive, Clearwater, FL 33516.

MAY 19-27, TEXAS: Annual Texas Saltwater Fishing Hall of Fame Tournament, Galveston. Contact Southeast Texas Sportfishing Assn., c/o Sportsman's Paradise, 2001 - 61st St., Galveston, TX 77551

MAY 20-26, BAHAMAS: Cat Cay Tuna Tournament. Contact Robert Noyes, Gen. Mgr., Cat Cay Club, Ltd., P.O. Box 530950, Miami Shores, FL 33153 USA.

MAY 20-25, MEXICO: Classic Billfish Tournament, Cabo San Lucas, Baja California. Contact Tournament Dir., Classic Billfish Tournament, P.O. Box 383, Pacific Palisades, CA 90272 USA.

MAY 24-25, ILLINOIS, USA: Illinois Invitational, Clinton Lake. Contact Bass'n Gal HQ, P.O. Box 13925, Arlington, TX 76013

MAY 24-27, SOUTH CAROLINA, USA: Georgetown Blue Marlin Tournament (3rd leg of S.C. Billfish Triple Crown), Georgetown. Contact Marshall Truluck, P.O. Box 1704, Georgetown, SC 29440.

MAY 24-28, FLORIDA, USA: 8th Annual Striking Fish Tournament, South Daytona. Contact Judith Augustine, Publicity Committee, Greater Daytona Beach Striking Fish Tournament, P.O. Box 4688, South Daytona, FL 32021.

MAY 25-28, FLORIDA, USA: Greater Suncoast Shark Tournament III, Clearwater. Contact Earl Levy, Bonnie's Bait & Tackle, 1253 So. Ft. Harrison Ave., Clearwater, FL 33516.

MAY 26-27, JAPAN: Tokyo Marinpic Billfish Tournament, Tokyo. Contact H. Onishi, Japan Game Fish Assn., T108 c/o Sadakata Bldg. 2F 202, 5-13-13 Shiba Minato-ku, Tokyo.

MAY 26-27, OHIO: Annual Pro-Am Walleye Tournament, Port Clinton. Contact Lake Erie Charter Boat Assn., P.O. Box 5278, Toledo, OH 43611.

MAY 26-27, SCOTLAND: European Cod Festival, Pittenween. Contact D.S. Dallas, EFSA, 11 Park Circus, Ayr.

MAY 28-JUNE 2, BAHAMAS: Blue Water Tuna Tournament, Bimini. Contact Fred Hinzey, Gen. Mgr., Blue Water Resort, Ltd., Bimini.

MAY 30-JUNE 1, WISCONSIN, USA: La Crosse Invitational West League. Contact Tournment Dept., B.A.S.S., P.O. Box 17900, Montgomery, AL 36141.

MAY 31-JUNE 3, MEXICO: 1st Sailfish Tournament, Tampico. Contact Jesus Holguera, Club Internacional de Yates Tampico, Avenida 3705-Desp. 203, 89120 Tampico, Tam.

MAY 31-JUNE 3, SOUTH CAROLINA: Annual Pabst Blue Ribbon Billfish Tournament, Georgetown. Contact Ed Brainard, Belle Isle Marina, Georgetown, SC 29440

JUNE, SWEDEN: Swedish Line Class Championship, Västkusten. Contact Kent Andersson, EFSA, Box 178, 401 23 Göteborg.

JUNE 1-3, CAYMAN ISLANDS: 4th Annual Cayman Airways Pilots Open Tournament. Contact Capt. Robert Hamaty, c/o Cayman Airways, P.O. Box 1101, Grand Cayman, BWI.

JUNE 1-30, CAYMAN ISLANDS: Million Dollar Month. Contact Bill Rewalt, Chairman, West Wind Bldg., P.O. Box 878, Grand Cayman, BWI.

JUNE 1-DECEMBER 31, MASSACHUSETTS to SOUTH CAROLINA: Capt. Nappi's Annual Fluke Tournament, Martha's Vineyard to Edisto. Contact Capt. C. Nappi, 106 West John St., Hicksville, NY 11801.

JUNE 3-8, FLORIDA, USA: Florida Keys Invitational Tarpon Classic. Contact Fishing International, P.O. Box 2132, Santa Rosa., CA 95405.

JUNE 4-9, NORTH CAROLINA: World Championship Big Rock Blue Marlin Tournament, Morehead City. Contact Bill O'Brien, P.O. Box 1673, Morehead City, NC 28557.

JUNE 5-8, BAHAMAS: Green Turtle Yacht Club Annual Memorial Fishing Tournament, Green Turtle Cay, Abaco. Contact Crispin McKelvey, Green Turtle Cay Club & Marina, Box 270, Green Turtle Cay, Abaco.

JUNE 5-9, BAHAMAS: Cat Cay Billfish Tournament (3rd leg of Bahamas Billfish Championship). Contact Robert Noyes, Gen. Mgr., Cat Cay Club, Ltd., P.O. Box 530950, Miami Shores, FL 33153.

JUNE 6-10, CAYMAN ISLANDS: Mor-Son Sportfishing International Festival, Grand Cayman, BWI. Contact John Moreton, Chairman, 15 Compton Ave., Mannamead, Plymouth PL3 5DA, England, UK.

JUNE 6-10, MEXICO: Vista del Mar Angler's Invitational Derby, Twin Dolphins Hotel, Cabo San Lucas, Baja California Sur. Contact Ira M. Goldberg, (213) 272-0851

JUNE 9-11, AUSTRALIA: Victorian Open Invitation Game Fishing Tournament, Portland. Contact Secretary, Victorian Game Fishing Club, 186 Station St., Aspendale 3195, Victoria.

JUNE 9-15, NEW ZEALAND: The Light Tackle Tournament, Bay of Islands. Contact Birke Lovett, Secy.-Mgr., Bay of Islands Swordfish Club, P.O. Box 31, Russell.

JUNE 10, SWEDEN: Knalle-Cupen, Varberg. Contact Kent Andersson, EFSA, Box 178, 401 23 Göteborg.

JUNE 11-16, CAYMAN ISLANDS: Cayman Islands Angling Club Invitational Team Tournament, Contact Clarence Flowers, Jr., Chairman, P.O. Box 311, Grand Cayman, BWI

JUNE 12-17, DOMINICAN REPUBLIC: 44th International Light Tackle Tournament, Santo Domingo. Contact Ms. Helen Smith, ILTTA, 2044 Federal Ave., Costa Mesa, CA 92627 USA.

JUNE 12-17, DOMINICAN REPUBLIC: 44th Intl. Light Tackle Tournament, Santo Domingo. Contact Helen Smith, ILTTA, 2044 Federal Ave., Costa Mesa, CA 92627 USA.

JUNE 14-17, NEW JERSEY, USA: 4th Annual Shark Tournament, Cape May. Contact Dick Weber or Walt McDonald, South Jersey Marina, P.O. Box 641, Cape May, NJ 08204.

JUNE 14-16, VIRGINIA: First Annual Reedville Bluefish Derby. Contact President, Smith Point Sea Rescue, P.O. Box 203, Reedville, VA 22539.

JUNE 15-17, LOUISIANA, USA: Deep South Fishing Rodeo, Empire. Contact Deep South Louisiana Fishing Assn., P.O. Box 4250, New Orleans, LA 70178

JUNE 16-17, NEW YORK, USA: Hudson Anglers 12th Annual Shark Tournament, Freeport. Contact Ronnie Bauer, 301 Hudson Ave., Freeport, NY 11520.

JUNE 16-22, MEXICO: Lucky Trojans Billfish Tournament, Baja California. Contact Michael J. Garris, Lucky Trojans, 2115 Beverly Blvd., 2nd Floor, Los Angeles, CA 90057 USA.

JUNE 17-24, AUSTRALIA: Barramundi Classic, Perth. Contact E.J. Clugson, Secy., Perth Game Fishing Club, 149 West Coast Hwy., North Beach 6020, W.A.

JUNE 18-23, AUSTRALIA: 3rd Annual Barramundi Classic, Corroboree Billabong, Northern Territory. Contact Secy., No. Territory Game Fishing Assn., P.O. Box 128, Darwin, N.T., 5793.

JUNE 19-23, BAHAMAS: Championship Billfish Tournament, Bimini (4th Leg of Bahamas Billfish Championship). Contact Raul Miranda, Tournament Director, P.O. Box 523238, Miami, FL 33152.

JUNE 21-23, NORTH CAROLINA: Morehead City's Gran Prix (2nd leg of IBL Grand Prix Series). Contact International Billfish League, 4201 N. Federal Hwy., Suite B, Pompano Beach, FL 33064.

JUNE 22-24, SENEGAL: Championship of Senegal (12 lb. class), Dakar. Contact Mr. Gaby Manint, B.P. 3132, Dakar.

JUNE 22-24, CAYMAN ISLANDS: The Pflueger Tournament (Open). Contact Capt. Harrison Bothwell, Chairman, P.O. Box 311, George Town, Grand Cayman, BWI.

JUNE 23, OHIO, USA: 4th Annual League of Ohio Sportsmen's Lake Erie Walleye Tournament, Ft. Clinton. Contact Tournament Chairman, 12900 Triskett Rd., Cleveland, OH 44111.

JUNE 23, NEW JERSEY: Nick Miraglilo Memorial Mako Shark Tournament, Margate. Contact Charley Zaimes, Angler's Roost, 9401 Amherst Ave., Margate, NJ 08402.

JUNE 23-24, FLORIDA: Annual Offshore Striking Fish Tournament, Daytona Beach. Contact Halifax Sport Fishing Club, P.O. Box 4421, South Daytona, FL 32021.

JUNE 29-JULY 1, FLORIDA, USA: Fort Pierce Open. Contact Fort Pierce Sportfishing Club, P.O. Box 3688, Fort Pierce, FL 33454.

JUNE 29-JULY 4, FLORIDA: Annual U.S. Open 4th of July Shark Tournament, Jacksonville. Contact Florida Shark Club, P.O. Box 11005, Jacksonville, FL 32211.

JUNE 30, FLORIDA: Annual Billfish Tournament, Port Canaveral. Contact Cape Marina, 800 Scallop Drive, Port Canaveral, FL 32920.

JULY, WALES: European Tope Festival, Tenby. Contact European Federation of Sea Anglers, 14 Wadham Rd., Liskeard, Cornwall, ENGLAND.

JULY 5-8, FLORIDA: Pensacola International Billfish Tournament. Contact Ron Thomas, Chairman, P.O. Box 1510, Pensacola, FL 32597.

JULY 6-8, MEXICO: VIII Kino Bay International Sportfishing Tournament, Hermosilla. Contact Club Deportivo Bahia Kino, APDO 857 Kino Bay, Hermosillo, Sonora.

JULY 7-8, NEW YORK: Annual Charity Shark Tournament, Montauk Point, Long Island. Contact Capt. Gloria Hayn, Montauk Captains Assn., 99-52 66th Rd., Forest Hills, NY 11375.

JULY 8-14, BERMUDA: International Light Tackle Tournament, Hamilton. Contact Andrew Down, Pres., Bermuda Anglers Club, P.O. Box 754, Hamilton 5.

- **JULY 9-13, BAHAMAS:** Chub Cay Blue Marlin Tournament (5th leg of Bahamas Billfish Championship). Contact Warren Miedke, Gen. Mgr., Chub Cay Club, P.O. Box 661067, Miami Springs, FL 33166 USA.
- **JULY 11-15, NEW JERSEY, USA:** 7th Annual White Marlin Open, Cape May. Contact Dick Weber or Walt McDonald, South Jersey Marina, P.O. Box 641, Cape May, NJ 08204.

  JULY 11-15, MEXICO: 6th Intl. Tarpon Fishing Tournament, Tampico. Contact Club de Yates Tampico, Ave. Hidalgo 3705-203, 89120 Tampico, Tam.

  JULY 12-13, TEXAS, USA: Tournament of Champions-Four Gal Team Championship, Hemphill. Contact Bass'n Gal HQ, P.O. Box 13925, Arlington, TX 76013.

  JULY 14, OHIO: Annual Walleye Scholarship Derby (Lake Erie), Port Clinton. Contact WOSE, P.O. Box P, Port Clinton, OH 43452.
- **JULY 15-20, BAHAMAS:** Bimini Blue Water All Fun Tournament. Contact Frank Hinzey, Gen. Mgr., Blue Water, Ltd., P.O. Box 627, Bimini.

  JULY 21-22, NEW YORK: Annual Shark Tag Tournament, Montauk, Long Island. Contact Rusty Akkala, Montauk Marine Basin, West Lake Drive, Montauk, NY 11954.
- **JULY 23-28, BAHAMAS:** Summer Blue Marlin Tournament, Bimini. Contact Raul Miranda, Tournament Director, P.O. Box 523238, Miami, FL 33152.
- **JULY 23-27, MASSACHUSETTS:** Nantucket Billfish Tournament. Contact Nantucket Ship Chandlery Corp., Old South Wharf, Nantucket, MA 02554.
- **JULY 25-28, TEXAS:** South Padre Island Invitational Billfish Tournament. Contact Paul Veale, Jr., P.O. Box 3499, South Padre Island, TX 78597.
- **JULY 26-29, JAPAN:** Tokyo Billfish Tournament. Contact H. Onishi, Japan Game Fish Assn., T108 c/o Sadakata Bldg. 2F 202, 5-13-13 Shiba Minato-Ku, Tokyo.
- **JULY 28-AUGUST 4, FIJI ISLANDS:** 4th Annual Fiji Intl. Game Fishing Tournament, Pacific Harbour. Contact Albert A. W. Threadingham, Tournament Dir., GPO Box 395, Suva.

  JULY 29-AUGUST 1, AUSTRALIA: King Bay Game Fishing Club Light Tackle Classic. Contact E.J. Clugson, Secy., 149 West Coast Hwy., North Beach 6020, Western Australia.

  AUGUST, SWEDEN: GHFK-Cupen, Smogen. Contact Kent Andersson, EFSA, Box 178, 401 23 Goteborg.
- **AUGUST 1-5, TEXAS, USA:** 46th Texas International Fishing Tournament, South Padre Island. Contact Texas International Fishing Tournament, P.O. Box 2715, South Padre Island, TX 78597.
- **AUGUST 2-4, NEW JERSEY, USA:** 15th Annual White Marlin Invitational Tournament, Beach Haven. Contact Don Leek, Beach Haven Marlin and Tuna Club, Box 216, Beach Haven, NJ 08008.

  AUGUST 5-10, BAHAMAS: Native Tournament, Bimini. Contact Frank Hinzey, Gen. Mgr., Blue Water, Ltd., P.O. Box 627, Bimini.

  AUGUST 7-10, NORWAY: European Sea Angling Championships, Stavanger. Contact Kent Andersson, EFSA, Box 178, 401 23 Goteborg.
- **AUGUST 8-10, NEW JERSEY:** Annual Overnight Swordfish & Marlin Tournament, Ocean City. Contact Carl A. Posse, Tournament Dir., P.O. Box 1104, Blue Bell, PA 19422.
- **AUGUST 8-11, TEXAS:** South Padre Island's Grand Prix (3rd leg of IBL Gran Prix Series). Contact International Billfish League, 4201 N. Federal Hwy., Suite B, Pompano Beach, FL 33064.

  AUGUST 8-12, MEXICO: Tarpon International Tournament, Tampico. Contact Secretary, Club de Regatas Corona, A.C., Aptdo. Postal 612, C.P. 89230 Tampico, Tam.
- **AUGUST 9-12, NEW JERSEY, USA:** Manufacturers Marlin Round-up, Cape May. Contact Dick Weber or Walt McDonald, South Jersey Marina, P.O. Box 641, Cape May, NJ 08204.
- **AUGUST 10-17, HAWAII, USA:** 8th Annual Kona Hawaiian Billfish Tournament, Kailua-Kona. Contact Jim Sutherland, Executive Director, Hawaiian International Billfish Association, 2923 Makalei Place, Honolulu, HI 96815.

  AUGUST 12-15, MEXICO: Snook International Tournament, Tampico. Contact Secretary, Club de Regatas Corona, A.C., Aptdo. Postal 612, C.P. 89230, Tampico, Tam.
- **AUGUST 13-17, MARYLAND:** Annual White Marlin Open, Ocean City. Contact Jim Motsko, Pres., White Marlin Open, P.O. Box 737, Ocean City, MD 21842.
- **AUGUST 15-29, MEXICO:** 5th Marlin Intl. Tournament, Tampico. Contact Club de Yates Tampico, Ave. Hidalgo 3705-203, 89120 Tampico, Tam.

  AUGUST 16-18, NEW YORK, USA: Bass Masters Classic, Niagara Falls. Contact Tournament Dept., B.A.S.S., P.O. Box 17900, Montgomery, AL 36161.

  AUGUST 16-18, SWEDEN: Fladenfestivalen, Varberg. Contact Kent Andersson, EFSA, Box 178, 401 23 Göteborg.
- **AUGUST 16-18, MEXICO:** Billfish Tournament, Tampico. Contact Secy., Club de Regatas Corona, A.C., Aptdo. Postal 612, C.P. 89230, Tampico, Tam.
- **AUGUST 17-26, HAWAII, USA:** 26th Annual Hawaiian International Billfish Tournament. Kailua-Kona. Contact Peter Fithian, Chairman, Hawaiian International Billfish Association, 2923 Makalei Place, Honolulu, HI 96815.
- **AUGUST 18-24, CALIFORNIA, USA:** The Channel Islands 13th Billfish Tournament, Oxnard. Contact Secy., Channel Islands Invitational Broadbill Tournament Assn., P.O. Box 5164, Oxnard, CA 93031.
- **AUGUST 21-26, NEW JERSEY, USA:** Marlin Mardi Gras, Cape May. Contact Dick Weber or Walt McDonald, South Jersey Marina, P.O. Box 641, Cape May, NJ 08204.

  AUGUST 23-24, KENTUCKY, USA: U.S. Invitational, Barkley Lakes. Contact Bass'n Gal HQ, P.O. Box 13925, Arlington, TX 76013.

  AUGUST 25-SEPTEMBER 3, NEW YORK, USA: Empire State Lake Ontario King Salmon Derby, Lake Ontario. Contact ESLO Derby, Inc., P.O. Box 220, Pittsford, NY 14534.
- **AUGUST 30-SEPTEMBER 3, VIRGINIA:** Annual Virginia Beach Marlin Tournament. Contact Cape Henry Billfish Club, c/o W. Jeffrey Dyckman, Pres., 830 Carolina Ave., Virginia Beach, VA 23451.

  SEPTEMBER 3-8, SENEGAL: International Team Tournament, Dakar. Contact Mr. Gaby Manint, B.P. 3132, Dakar.
- **SEPTEMBER 4-9, PUERTO RICO:** International Billfish Tournament, San Juan. Contact Chairman, Intl. Billfish Tournament, Club Nautico de San Juan, P.O. Box 1113, San Juan, PR 00902.
- **SEPTEMBER 5-9, VIRGINIA, USA:** 3rd Annual Ocean View Open Billfish Tournament, Norfolk. Contact Rip Walters, Chairman, 325 E. Bayview Blvd., Norfolk, VA 23503.
- **SEPTEMBER 6-8, BAHAMAS:** Small Bimini Open Angling Tournament, Bimini. Contact Raul Miranda, Tournament Director, P.O. Box 523238, Miami, FL 33152.
- **SEPTEMBER 6-8, MARYLAND:** Ocean City's Gran Prix (4th leg of IBL Gran Prix Series). Contact Intl. Billfish League, 4201 N. Federal Hwy., Suite B, Pompano Beach, FL 33064.
- **SEPTEMBER 7-12, NEW JERSEY, USA:** Tournament of Champions, Cape May. Contact Dick Weber or Walt McDonald, South Jersey Marina, P.O. Box 641, Cape May, NJ 08204.

  SEPTEMBER 13-14, MASSACHUSETTS, USA: 39th Annual Martha's Vineyard Striped Bass & Bluefish Derby. Contact Ed Jerome, Chairman, Box 1698, Vineyard Haven, MA 02568.

  SEPTEMBER 15-16, SWEDEN: EFSA's Fall Festival, Bohuslän. Contact Kent Andersson, EFSA, Box 178, 401 23 Göteborg.

  SEPTEMBER 19-21 SOUTH CAROLINA, USA: 11th Annual Coastal Carolina Invitational Intercollegiate Fishing Match & Seminar, Conway. Contact Dr. Donald Millus, Coastal Carolina College, P.O. Box 1954, Conway, SC 29526.
- **SEPTEMBER 19-22, CALIFORNIA:** Los Angeles Billfish Club Avalon Invitational Tournament, Catalina Island. Contact Dr. Jordan J. Weitzman, Los Angeles Billfish Club, 13135 Addison St., Sherman Oaks, CA 91423.
- **SEPTEMBER 21-24, HAWAII:** Annual Chuck Machado's Luau Jackpot Fishing Tournament, Honolulu. Contact Chuck Machado's Luau, P.O. Box 29133, Honolulu, HI 96820.
- **OCTOBER 4-6, ALABAMA:** Orange Beach's Gran Prix (5th leg of IBL Gran Prix Series). Contact International Billfish League, 4201 N. Federal Hwy., Suite B, Pompano Beach, FL 33064.

  OCTOBER 5-8, NEW YORK: Annual Full Moon Bass Tournament, Montauk, Long Island. Contact Rusty Akkala, Montauk Marine Basin, West Lake Drive, Montauk, NY 11954.
- **OCTOBER 10-14, PUERTO RICO:** International Fishing Tournament, Mona Island. Contact Enrique Gómez, Public Relations Fishing Tournament, Club Deportivo del Oeste, P.O. Box 3450, Mayaquez, PR 00709.

  OCTOBER 20, SWEDEN: Herring Festival, Helsingborg. Contact Kent Andersson, EFSA, Box 178, 401 23 Göteborg.

  OCTOBER 21, SWEDEN: EFSA's Fall Festival, Bohuslän. Contact Kent Andersson, EFSA, Box 178, 401 23 Göteborg.

  OCTOBER 22, MEXICO: Sea of Cortez Shoot-Out, Rancho Buena Vista, Baja California. Contact Rancho Buena Vista, Box 673, Monrovia, CA 91016 USA.

  OCTOBER 23-29, MEXICO: World Festival of Fishing, Rancho Buena Vista, Baja California. Contact Bill Gallagher, Rancho Buena Vista, Box 673, Monrovia, CA 91016 USA.
- **OCTOBER 23-25, FLORIDA:** Key West's Gran Prix (6th leg of IBL Gran Prix Series). Contact International Billfish League, 4201 N. Federal Hwy., Suite B, Pompano Beach, FL 33064.
- **OCTOBER 26-28, FLORIDA, USA:** Fort Lauderdale Semi-Annual Billfish Tournament. Contact John Gerbino, Pres., P.O. Box 22218, Fort Lauderdale, FL 33335.

  OCTOBER 27-28, JAPAN: Tokai Asian Yellow-Tail Contest, Tokyo. Contact H. Onish, Japan Game Fish Assn., T108 c/o Sadakata Bldg. 2F 202, 5-13-13 Shiba Minato-ku, Tokyo.

  OCTOBER 29-NOVEMBER 6, AUSTRALIA: Exmouth CFC-GAMEX. Contact E.J. Clugson, Secy., 149 West Coast Hwy., North Beach 6020, Western Australia.

  NOVEMBER 4, NETHERLANDS: Easter Schelde Boat Angling Tournament, Tholen. Contact H.V. Loenen, EFSA-Nederland, Van Ostadelaan 8, 1231 AK Loosdrecht.

  NOVEMBER 25, NETHERLANDS: North Sea Boat Angling Tournament, Scheveningen. Contact H.V. Loenen, EFSA-Nederland, Van Ostadelaan 8, 1231 AK Loosdrecht.

  NOVEMBER 28-DECEMBER 1, BAHAMAS: Adam Clayton Powell Memorial Wahoo Tournament, Bimini. Contact Frank Hinzey, Gen. Mgr., Blue Water, Ltd., P.O. Box 627, Bimini.

International Game Fish Association
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Ft. Lauderdale, FL 33316

APPENDIX IV : A catch from a typical marlin "take" tournament