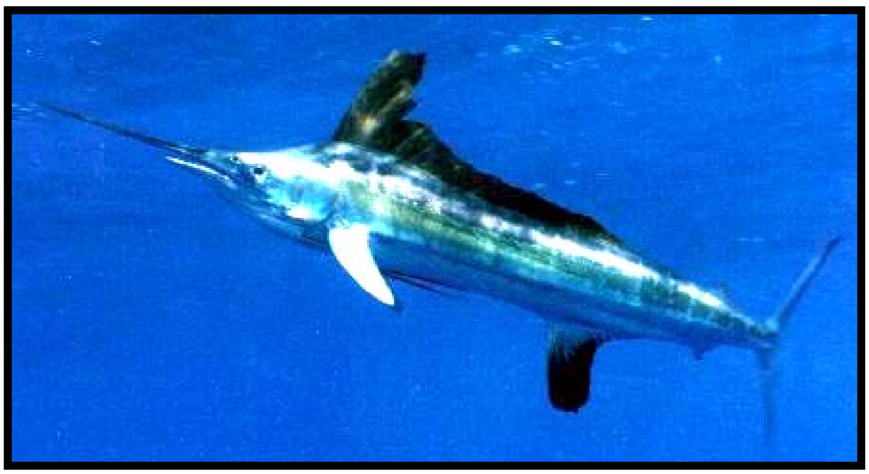
Atlantic White Marlin Status Review

December 10, 2007



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Biological Review Team
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Acknowledgements

The status review for the Atlantic white marlin was conducted by a team of biologists from NOAA's National Marine Fisheries Service (NMFS). The members of the biological review team (BRT) contributed a significant amount of time and effort to this process. The BRT included Dr. Stephania Bolden (NMFS/Southeast Regional Office), Mr. Randy Blankinship (NMFS/Highly Migratory Species), Mrs. Kim Damon-Randall (NMFS/Northeast Regional Office), Dr. John Hoolihan (NMFS/Southeast Fishery Science Center), and Dr. Scott Nichols (NMFS/SEFSC). Their review was dependent on information from scientific literature and proceedings of the International Commission for the Conservation of Atlantic Tunas (ICCAT) in addition to additional data provided by members of the ICCAT U.S. Delegation. Further information was kindly provided in the form of presentations and a round-table discussion by Dr. John Graves, Dr. Phil Goodyear, Dr. Mauricio Ortiz, Dr. Clay Porch, Dr. Eric Prince, Dr. David Die, Dr. Beth Babcock, Dr. Mahmood Shivji, Dr. Bob Cowen, Mr. Larry Beerkircher, and Mr. David Richards. Additional information provided by Ms. Arietta Venizelos (SEFSC) and Dr. Beth Babcock (Rosenstiel School of Marine and Atmospheric Science) is appreciated. We appreciate all who responded to and provided information in response to the December 2006 Federal Register Notice. Permission to use figures from ICCAT report was graciously provided by Dr. Victor Restrepo. For assistance in coordinating and assisting the status review process in numerous ways, the BRT wishes to thank Ms. Calusa Horn and Ms. Maria Holliday. Finally, the BRT wishes to thank NMFS/SEFSC, NMFS/NEFSC and Dr. John Graves for their peer review of the status review.

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List of Abbreviations

AFA/AFH	Distance between anal opening and first anal fin divided by the first anal fin
AFS	American Fisheries Society
ATCA	Atlantic Tunas Convention Act
B	Stock biomass
B/K	Ratio of current biomass to unfished biomass
BRT	2007 Biological Review Team
Bmsy	Biomass achieved at constant fishing mortality
BSP	Bayesian surplus production
C	Catch
CBD	Center for Biological Diversity
CITES	Convention on International Trade in Endangered Species
CFR	Code of Federal Regulations
COSEWIC	Committee in the Status of Endangered Wildlife in Canada
CPUE	Catch Per Unit Effort
CTC	Cooperative Tagging Center
CZMA	Coastal Zone Management Act
DB	Decibel
dB/dt	Rate of change in biomass over time
DNA	Deoxyribonucleic Acid
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
ESA	Endangered Species Act
ETP	Eastern Tropical Pacific
F	Fishing mortality rate
FAD	Fish Aggregating Device
FCZ	Fishery Conservation Zone
FEIS	Final Environmental Impact Statement
Fmsy	Fishing mortality rate that produces greatest yield
FMP	Fishery Management Plan
FR	Federal Register
GLM	General Linear Models
GPS	Global Positioning System
HBS	Habitat based standardization
HMS	Highly Migratory Species
ICCAT	International Commission for Conservation of Atlantic Tunas
IGFA	International Game and Fish Association
IUCN	The World Conservation Union
IUU	Illegal, unreported and Unregulated
K	Carrying capacity
Kg	Kilogram
LFA	Low Frequency Active

LJFL	Lower Jaw Fork Length
LPS	Large Pelagic Survey
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MDMF	Massachusetts Division of Marine Fisheries
MMPA	Marine Mammal Protection Act
MSY	Maximum Sustainable Yield
mt	Metric Ton
MRFFS	Marine Recreational Fisheries Statistics Survey
NMFS	National Marine Fisheries Service
NED	Northeast Distant Statistical Sampling Area
NERO	Northeast Regional Office
Nm	Nautical mile
NOAA	National Oceanic and Atmospheric Administration
NEPA	National Environmental Policy Act
OY	Optimum Yield
PECE	Policy for Evaluation of Conservation Efforts
PLL	Pelagic longline
PMP	Preliminary Fishery Management Plan
POP	Pelagic Observer Program
PSAT	Pop-up Satellite Archival Tags
RBS	Recreational Billfish Survey
PVA	Population Variability Analysis
Q	Constant catchability
r	Intrinsic rate of population growth
RSMAS	Rosenstiel School of Marine and Atmospheric Science
SAFMC	South Atlantic Fishery Management Council
SARA	Species at Risk Act
SCRS	Standing Committee for Research and Statistics
SEIS	Supplemental Environmental Impact Statement
SERO	Southeast Regional Office
SEFSC	Southeast Fishery Science Center
SR	Status Review
SRT	2002 Status Review Team
TAC	Total allowable catch
TIRN	Turtle Island Restoration Network
TL	Total length
UNCLOS	United Nations Convention of the Law of the Sea
U.S.	United States
USFWS	United States Fish and Wildlife Service
U.S.V.I.	United States Virgin Islands
VIMS	Virginia Institute of marine Science
VMS	Vessel Monitoring System
WG	Working Group

Executive Summary

In 2001, NOAA's National Marine Fisheries Service (NMFS) received a petition from the Biodiversity Legal Foundation and James R. Chambers requesting NMFS to list the Atlantic white marlin (*Tetrapturus albidus*) as a threatened or endangered species under the Endangered Species Act (ESA). NMFS subsequently convened a status review team (SRT) to assess the species status and the degree of threat to the species with regard to section 4(a)(1) factors in the ESA. The 2002 status review (SR) determined that two of the five ESA factors listed in Section 4 (a)(1) were of concern for white marlin: overutilization and the inadequacy of existing regulatory mechanisms. While the 2002 SR concluded that the white marlin stock had not declined to levels to which it was in danger of extinction, it noted that the stock could decline to a level that would warrant ESA protection if fishing mortality was not reduced significantly and relatively quickly.

Subsequent to the 2002 finding that the petitioned action was "not warranted" (67 FR 57204), a settlement agreement was reached between NMFS, the Center for Biological Diversity (CBD), and the Turtle Island Restoration Network (TIRN) wherein it was agreed that NMFS would revisit the status of the white marlin following the 2006 stock assessment by the International Commission for the Conservation of Atlantic Tunas (ICCAT). The lawsuit filed by CBD and TIRN alleged that NMFS decision to not list the white marlin under the ESA was arbitrary, capricious, and contrary to law in violation of the ESA and the Administrative Procedure Act, and enjoined NMFS to make a new and lawful determination as to whether the white marlin warrants listing as threatened or endangered under the ESA. Specifically, it was claimed that NMFS: 1) ignored the clear population trend line that showed white marlin were in danger of becoming functionally extinct in less than 5 years; 2) NMFS relied on speculative regulatory measures that its own SRT characterized as insufficient; and 3) NMFS also ignored the SRT's warning that ICCAT lacks the resolve to adopt further, effective management measures for white marlin. The settlement agreement between the plaintiffs and NMFS stipulated that NMFS would: 1) submit for publishing in the Federal Register a notice of intent to commence a review of the white marlin, including solicitation of scientific and commercial data regarding the status of and threats to the species within 30 days of ICCAT's formal adoption in Plenary Session of a new stock assessment; 2) within 60 days of ICCAT's formal adoption in Plenary Session of the new white marlin stock assessment, NMFS will commence a new review of the status of the white marlin; 3) within 18 months of the commencement of the new status review, but in no case later than December 31, 2007, NMFS will make and submit for publication one of the findings described in ESA section 4(b)(3)(B); and 4) noted that nothing in the Agreement shall restrict the rights of Plaintiffs or any other person to challenge or seek judicial review.

In December 2006, NMFS announced that a status review of the Atlantic white marlin was initiated and solicited information regarding the status of and threats to the species (71 FR 76639). A new biological review team (BRT) was then convened to commence a new status review pursuant to terms of the aforementioned settlement agreement.

The 2007 BRT reviewed current journal articles, papers prepared at workshops and symposia to assist in the new stock assessment, the 2006 ICCAT stock assessment, reports from the 2004 billfish grant program, information submitted in response to a Federal Register Notice (71 FR

76639), and existing management of the fisheries in order to determine the status of and threats to the white marlin. Next, the 2007 BRT examined the five factors specified in section 4(a)(1) of the ESA relevant to a decision to list white marlin: 1) the present of threatened destruction, modification, or curtailment of its habitat or range; 2) overutilization for commercial, recreational, scientific, or educational purposes, 3) disease or predation, 4) the inadequacy of existing regulatory mechanisms; and 5) other natural or manmade factors affecting its continued existence. The two ESA factors of concern for white marlin are overutilization and the adequacy of existing regulatory mechanisms. While white marlin are almost certainly overfished as evidenced by a long history of exploitation that has probably depleted the population below the management target, overfishing may not be occurring today as current F/Fmsy estimates are reported as both greater and less than one depending on the index. If overfishing has ended for white marlin, it may take several years before the stock will no longer be considered overfished. Recent population abundances indicate that the number of white marlin in the size range vulnerable to the fishery is between 100,000 – 2,000,000, likely around 200,000. Catches have been reduced since 1996, and F has decreased annually since 2002. Although there are issues regarding compliance with ICCAT recommendations, and the extent of illegal, unreported, and unregulated fishing, the BRT concludes that the best available information indicates that the current regulatory mechanisms are sufficient to prevent continued stock decline of white marlin. Further, the BRT concludes that existing non-regulatory mechanisms are beneficial to the long-term persistence of the species and should be continued. Finally, the BRT established and adapted listing thresholds for white marlin and deliberated to determine if white marlin met standards for either threatened or endangered throughout all or a significant portion of its range. Based on the best available information, the BRT determined that neither the threatened or endangered metric was met, and concluded that an ESA listing for white marlin was not warranted.

I. Introduction

A. ESA Background

The purposes of the Endangered Species Act (ESA) are to provide a means to conserve ecosystems upon which endangered species and threatened species depend, to provide a program for the conservation of endangered and threatened species, and to take appropriate steps to recover a species. The U.S. Fish and Wildlife Service (USFWS) and NOAA's National Marine Fisheries Service (NMFS) share responsibility for administering the ESA; NMFS is responsible for determining whether marine, estuarine or anadromous species, subspecies, or distinct population segments of vertebrate species are threatened or endangered under the ESA. To be considered for listing under the ESA, a group of organisms must constitute a "species."

The ESA provides the following relevant definitions:

"the term species includes any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature."

"endangered species" is defined as "any species which is in danger of extinction throughout all or a significant portion of its range."

"threatened species" is defined as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

Additional guidance regarding entities appropriate for listing under the ESA is available. A vertebrate population segment can be identified and listed as a "distinct population segement," if criteria are met to identify them as discrete and significant (61 FR 4722).

Determination of whether a species (as defined above) should be listed as threatened or endangered is based upon the best available scientific and commercial information. The status is determined based on the definitions of threatened and endangered as analyzed in an extinction risk analysis. An assessment of factors specified in section 4 (a)(1) of the ESA are examined to determine if they may have or may be contributing to decline, including:

A. The present or threatened destruction, modification, or curtailment of its habitat or range;
B. Overutilization for commercial, recreational, scientific, or educational purposes;
C. Disease or predation;
D. Inadequacy of existing regulatory mechanisms; or
E. Other natural or manmade factors affecting the continued existence of the species.

Within this status review (SR) document, the BRT also summarized ongoing protective efforts to determine if they abate any risks to the white marlin.

B. Approach

Given the recent 2002 NMFS SR, the 2007 BRT first considered utilizing the 2002 report as an outline for the 2007 status review. The BRT decided to adopt the format of the 2002 status review with some modification: they melded section V of the 2002 report that separately discussed population dynamic indicators into the discussion investigating overutilization as a ESA factor (chapter V of 2007 report).

This 2007 status review of the white marlin is divided into eight sections:
I. Introduction
II. Natural History
III. Description of the Fisheries and Fishery Management
IV. ICCAT Stock Assessments
V. Analysis of Listing Factors
VI. Evaluation of Conservation Efforts and Non-Regulatory Measures
VII. Extinction Risk Analysis
VIII. Literature Cited

Realizing that the definitions and approaches of population dynamics are conventional, the 2007 team utilized the 2002 SR as a summary of previous stock assessments (e.g., the 2000 stock assessment) and history of the fishery. While the 2007 BRT relied on the 2002 report as a starting point, they did not automatically adopt all results and conclusions of the 2002 SRT. The 2007 team carefully examined a series of stock assessments put forward by the Standing Committee for Research and Statistics (SCRS) of ICCAT since the 2002 report to assess current status of the stock. The previous 2002 SRT had available the final documents from the 2000 assessment, and draft documents from the 2002 assessment. The 2007 BRT reexamined the 2000 and 2002 assessments (now final), and results from the new 2006 assessment. In addition, papers from workshops and symposia held to prepare for the 2006 assessment were analyzed: ICCAT's 2006 assessment meeting, held in May 2006, where a working group of about 20 scientists from ICCAT member nations participated in developing the 2006 assessment; information from a May 2005 data preparatory meeting in Natal; and an international billfish symposium held in November 2005 at Catalina Island. Further, the 2007 BRT reviewed and utilized recent peer-reviewed journal articles, a series of reports from grants funded for Atlantic billfish research in 2004 (via Gulf States Marine Fisheries Commission), information submitted in response to a Federal Register Notice (71 FR 76639; December 21, 2006), and management actions subsequent to the 2002 report. Additional information was gained from invited experts through presentations and participation in subsequent round-table discussions.

The BRT noted a special effort was made by ICCAT prior to the 2006 meeting to obtain catches from countries not previously reporting. Controversy continued about interpretation and standardization of Catch per Unit Effort (CPUE) time series, attracting a considerable amount of analysis and simulation effort by the ICCAT participants. Those efforts were largely unsuccessful in making new progress toward international consensus on CPUE. As a result, the assessment working group elected not to reevaluate population benchmarks from the previous assessment. Instead, the 2006 assessment concentrated on evaluating recent population trends, and looking for possible impacts of the new ICCAT catch restrictions. Population status and trend estimates were extended to the start of 2006.

The BRT then examined the five statutory ESA factors listed above and clearly determined contribution of each factor relative to the white marlin. The BRT: 1) agreed with the ICCAT determination that the species consists of a single stock; 2) considered impacts of the congener roundscale spearfish; and 3) could not identify any discrete spawning or nursery area. ~~Finally,~~ The BRT established and adapted listing thresholds for the white marlin and deliberated to determine if the white marlin met standards for either threatened or endangered throughout all or a significant portion of its range.

II. Natural History of White marlin

A. Description of the Species

1. Taxonomy

Family: Istiophoridae
Order: Perciformes
Class: Actiopterygii

Species: *Tetrapturus albidus* Poey, 1860

Synonymy: *Tetrapturus lessonae* Canestrini, 1861; *Makaira lessonae* Jordan and Everman, 1926; *Makaira albida* Jordan and Evermann, 1926; *Lamontella albida* Smith, 1956.

Recently, Collette et al. (2006) presented genetic evidence to propose a taxonomic reclassification of white marlin and Indo-Pacific striped marlin *Tetrapturus audux* into a separate genus, *Kajikia*. The status review team acknowledges this evidence, but defers to the usage of *Tetrapturus* until such time as *Kajikia* is officially recognized by the American Fisheries Society (AFS).

2. Physical Appearance

(excerpted from Nakamura, 1985; modified with Shivji et al., 2006).

Diagnostic Features: Body elongate and fairly compressed. Bill stout and long, round in cross section; nape fairly elevated; right and left branchiostegal membranes completely united to each other, but free from isthmus; no gillrakers; both jaws and palatines with small, file-like teeth. Two dorsal fins, the first with 38-46 rays, usually with a rounded anterior lobe, higher than body depth anteriorly, then abruptly decreasing in height to about the 12th dorsal fin ray and gently decreasing further backward; first dorsal fin base long, extending from posterior margin of preopercle to near second dorsal fin origin; second dorsal fin with 5-6 rays, its position slightly backward with respect to the second anal fin; two anal fins, the first with 12-17 rays, the second with 5-6 rays and very similar in size and shape to the second dorsal; pectoral fins long and wide, round-tipped, adpressible against sides of body with 18-21 rays; pelvic fins slender and almost equal to or slightly shorter than the pectorals. Relationship of the distance between the anus to the first anal fin, and the height of the first anal fin ranges from 0.18 to 0.37 (Shivji et al., 2006). Caudal peduncle well compressed (laterally) and slightly depressed (dorsoventrally), with strong double keels on each side and a shallow notch on both the dorsal and ventral surfaces; anus situated just in front of first anal fin origin. Lateral line single and obvious, curving above base of first pectoral fin and then continuing in a straight line above the caudal fin base. Body densely covered with elongate bony scales, each with 1-2 posterior points. Vertebrae 24 (12 precaudal, 12 caudal). Color: Body blue-black dorsally, silvery white splattered with brown laterally, and silvery white ventrally; usually no marks or blotches on body, but sometimes more than 15 rows of obscure whitish stripes. First dorsal fin dark blue with many black dots; second dorsal fin dark blue; pectorals blackish brown, sometimes tinged with silvery white; pelvic fins blue-black with a black fin membrane; caudal fin blackish brown. Maximum size: 280.0 cm TL and 82 kg.

B. Distribution and Habitat

The geographical range for white marlin is restricted to the tropical and temperate waters of the Atlantic Ocean and adjacent seas (Fig. 1). This differs from the blue marlin (*Makaira nigricans*) and sailfish (*Istiophorus platypterus*), that range throughout both the Atlantic and Indo-Pacific regions. White marlin movements extend to the higher temperate latitudes of its range only during the warmer months of the year. They may occur in small, same-age schools; however, they are generally solitary compared to the Scombrids (tunas).

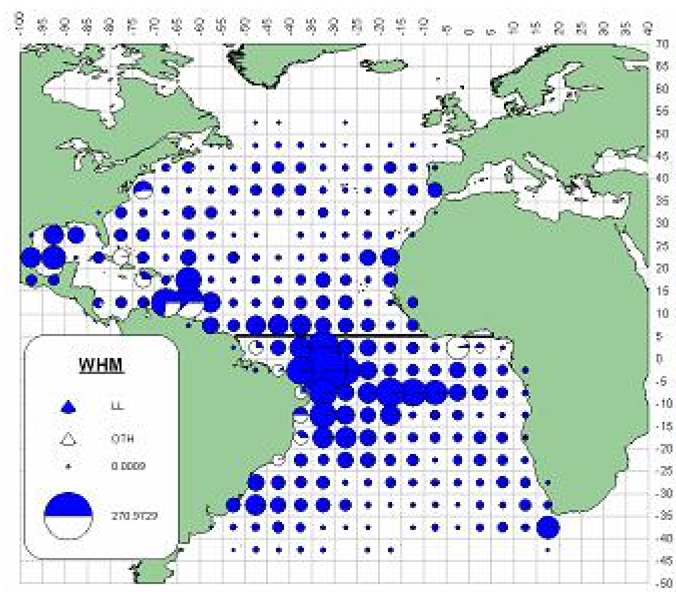


Figure 1. Geographic distribution of white marlin catches by major tuna fisheries for the period 2000-2004 (dark shading represents longline catches and white represents other gears). Reproduced from ICCAT Biennial Report (2007).

Large post-spawning aggregations of white marlin are reported off the Mid-Atlantic states during the summer period (Earle, 1940; deSylva and Davis, 1963; Baglin, 1977). A large recreational fleet targets white marlin in a largely catch and release fishery that extends up to 148 km offshore from Cape Cod, Maine to Cape Hatteras, North Carolina. White marlin usually can be found where large numbers of prey items are available. This can occur at weed lines (fronts), current lines, and around marked bathymetric features (e.g., drop-offs, canyons, and shoals). For example, white marlin are present in offshore submarine canyons extending from the Norfolk Canyon in the Mid-Atlantic to Block Canyon off eastern Long Island. Recreational fishing for white marlin also occurs in the Straits of Florida, southeast Florida, the Bahamas, off the north coasts of Puerto Rico and USVI, and in the Mona Passage east of the Dominican Republic. White marlin in the Gulf of Mexico tend to exhibit peak numbers off the Mississippi River Delta in July, and at DeSoto Canyon in August. Adult white marlin in the Gulf of Mexico appear to associate themselves more with blue waters of low productivity, and are found less frequently in the more productive green waters (NMFS, 2006).

Conventional mark-recapture data collected by the Cooperative Tagging Center (CTC) constituent-based tagging program (NOAA/NMFS/SEFSC) has revealed spatial and temporal characteristics of white marlin movement (Ortiz et al., 2003). From 1954 through 2005, a total of 49,543 white marlin were marked and released in the Atlantic basin, resulting in 961 recaptures (1.94%; CTC, unpubl. data). The majority of releases took place in the months of July through September, in the western North Atlantic off the eastern coast of the United States; and, to a lesser extent, off Venezuela, the Gulf of Mexico, and the western central Atlantic. The longest distance traveled was 6,523 km (4,053 miles), while the maximum number of days at-liberty was 5,488 (15 yrs). Trans-Atlantic crossing have been recorded for several individuals. However, only two reports of trans-equatorial crossings have been documented (Orbesen et al. [in review]). Recaptures indicate a substantial number of individuals moving between the Mid-Atlantic coast of the United States and the northeast coast of South America.

Horodysky et al. (2007) examined vertical movement and habitat use via 47 pop-up satellite archival tags (PSATs) attached to white marlin released from recreational and commercial vessels (Horodysky and Graves, 2005; Kerstetter and Graves, 2006a). Most of these PSATs were high resolution tags, collecting data points every 90 seconds. During at-liberty periods ranging from five (n=4) to ten (n=43) days, these white marlin spent nearly half their time near the surface (< 10 m). All made frequent short duration dives to depths averaging 51 m, suggesting that a great deal of foraging effort takes place well below the surface waters. Horodysky et al. (2007) suggest this behavior may explain the relatively high catch rates of white marlin on some deep-set pelagic longline gears. In a study supporting this suggestion, Junior et al. (2004) reported no obvious depth layer preference for white marlin captured with pelagic longline gear off northeastern Brazil in depths ranging from 50 to 230 m (164-754 feet). An analysis of high resolution (≤ 60 seconds) archival data from two white marlin PSATs showed time engaged in vertical movement ranged from 29.4% to 54.4%, with most of this activity taking place during daylight hours (Hoolihan, unpubl. data). Maximum depths recorded for these individuals were 188 m and 260 m. While dive events were frequent, the majority of time (55.9 and 86.1%) was spent at depths less than 75 m. Prince and Goodyear (2006) used PSAT data from sailfish and blue marlin to show how vertical movement could be restricted by a hypoxic barrier formed during upwelling. One implication of this condition is that billfish movements are constrained to near-surface depths where adequate levels of dissolved oxygen are available. Another is that their susceptibility to capture by surface fishing gears would increase. Given the same conditions, white marlin could be expected to behave similarly.

1. Biological Characteristics

White marlin exhibit sexually dimorphic growth patterns with females growing larger than males. Size at harvest generally ranges from 20 to 30 kg (44-66 lb). They grow quickly and can reach an age of at least 18 years, based on tag recapture data (SCRS, 2004). Adult white marlin can grow to over 280 cm (110 inches) TL and weigh up to 82 kg (184 lb).

White marlin are primarily general piscivores, but also feed on squid and other prey items. In the Gulf of Mexico and along the U.S. Atlantic coast important prey items for adult white marlin include herring, dolphinfish (*Coryphaena* spp.), hardtail jacks (*Caranx crysos)*, and squid (Nakamura, 1985). In the northeastern Gulf of Mexico, off the coasts of Florida and Mississippi, Davies and Bortone (1976) found the most common prey items were Scrombrids (*Euthynnus* sp. and *Auxis* sp.), squid, and moonfish (*Selene setapinnis*. In turn, Atlantic pomfret (*Brama brama*) and squid (*Ornithoteuthis antillarum*) were the most abundant food items sampled from stomachs of white marlin collected off the coast of Brazil in the southwestern Atlantic Ocean (Junior et al., 2004). The number of food items per stomach ranged from 1-12, while the largest sized prey items were snake mackerel (*Gempylus serpens*) ranging in length from 40 to 73 cm (15.7-28.7 inches; Junior et al., 2004). Likely predators of adult white marlin include sharks and killer whales (Mather et al., 1975).

Female white marlin are about 20 kg (44 lb) in mass and 130 cm (51.2 inches) in length at sexual maturity. Spawning activity occurs during the spring (March through June) in northwestern Atlantic tropical and sub-tropical waters marked by relatively high surface temperatures (20-29°C) and salinities (> 35 ppt). White marlin move to higher latitudes during summer, when waters warm. White marlin sampled during the summer at these higher latitudes (Mid-Atlantic states) were in a post-spawning state (deSylva and Davis, 1963). Arocha et al. (2006) reported females exhibiting high gonad index values (associated with mature gonads) present in the western North Atlantic from April to July between 18°N and 22°N. Spawning seems to take place further offshore than sailfish, although white marlin larvae are not found as far offshore as blue marlin. Females may spawn up to four times per spawning season (deSylva and Breder, 1997). It is believed there are at least five spawning areas in the western north Atlantic: northeast of Little Bahama Bank off the Abaco Islands; northwest of Grand Bahama Island; southwest of Bermuda; the Mona Passage, east of the Dominican Republic; and the Gulf of Mexico. Prince et al. (2005) collected eight white marlin larvae in neuston tows in April/May off the coast of Punta Cana, Dominican Republic indicating that there had been recent spawning activity in this general area. Further, Luthy et al. (2005) identified 27 white marlin larvae (4.5-20.3 mm SL), using morphometric and genetic analyses, which were captured in the Florida Straits during the period March – June. More recently, nine white marlin larvae were collected during May-June near the Bahamas in the Florida Straits (D. Richardson, RSMAS, unpubl. data). Lastly, white marlin larvae (n = 15) have been genetically identified from the Gulf of Mexico, confirming spawning activity in that region (J. Rooker, Texas A&M University, unpubl. data).

There is a paucity of information regarding the age and growth of white marlin. Efforts to accurately determine the incremental growth annuli from fin spines have been hindered by enlargement of the spine's vascular core. This enlargement results in erosion (i.e., obliteration) of early annuli. This problem has been well documented for other istiophorid billfishes (Jolley, 1974; Jolley, 1977; Hedgepeth and Jolley, 1983; Hill et al., 1989; Freire et al, 1998; Hoolihan, 2006). Comparing fin spine radius with incremental growth of annuli has allowed some researchers to back-calculate the number of annuli eroded in sailfish fin spines (Alvarado-Castillo and Félix-Uraga, 1996; Chiang et al., 2004). A preliminary study has been undertaken to age white marlin using anal fin spines (Drew et al., 2006b). These researchers reported a value of two annuli for both the median and mode from white marlin anal fin spines collected from two Venezuelan fisheries. However, these counts still require correction for annuli loss due to vascularization (Drew et al., 2006a). Validation of annuli counts is necessary prior to interpreting ages. Preliminary analysis of the marginal increment growth suggested one annulus was formed each year. Unfortunately, sample specimens did not include the full size range of white marlin, lacking both very small and very large individuals. In addition, samples were absent from several months when spawning occurs (April-June), hindering the validation of this ageing technique (Drew et al., 2006b); spawning may influence annuli formation, so obtaining additional samples is necessary.

C. Definition of the Stock/Stock Structure

In 2000 the ICCAT SCRS adopted a single Atlantic-wide stock approach for the white marlin stock assessment (Restrepo et al., 2003). Prior to this, the 1992 and 1996 assessments considered both separate North and South Atlantic stocks (delineated by a boundary at 5º N - a line selected primarily because it coincided with ICCAT statistical areas) as well as an Atlantic-wide stock. The two-stock model reflected the international pelagic longline effort in the 1970s that was directed to the north and south of 5º N (Uozumi and Nakano, 1994). In addition, analyses of adult gonadal condition and sporadic catches of putative white marlin larvae indicated that spawning occurred in the North and South Atlantic in each hemisphere's respective spring and summer, and it was considered unlikely that an individual would spawn in both areas. The relative independence of the two putative stocks was supported by preliminary results of tag/recapture studies that provided no evidence of movements of tagged white marlin across 5º N.

Support for the currently accepted single stock model is based on an increased spatial distribution of longline fishing effort showing the presence of white marlin across 5º N during all four quarters of the year (SCRS, 2001). In addition, further recoveries of conventional tags have revealed several trans-Atlantic and transequatorial movements (Ortiz et al., 2003; Orbesen et al., [in review]). While a relatively small fraction of reported recoveries account for the long distance movements, the number of white marlin undertaking such movements is likely to be considerably greater since the likelihood of receiving a tag recovered in a distant water fishery is low. In all, the tagging data suggest a substantial connectivity between white marlin in the North and South Atlantic.

Previous investigations of the genetic stock structure for white marlin have demonstrated haplotype variability within populations, but lacked any significant heterogeneity between regions to suggest multiple stocks (Graves and McDowell, 1995; Graves and McDowell, 1998; Graves and McDowell, 2001; Graves and McDowell, 2003). More recently, analyses of mitochondrial DNA control region sequences (n = 99) and five tetranucleotide repeat microsatellite loci (n = 214) from four geographic regions in the Atlantic Ocean revealed considerable genetic variation for the markers tested (Graves and McDowell, 2006). Pairwise comparisons of microsatellite data between the four regions showed a significant difference between groups from the western North Atlantic and western South Atlantic; and, a significant difference in mitochondrial DNA between the western North Atlantic and Caribbean regions, indicating a trend for increased genetic divergence with increased geographic separation. Graves and McDowell (2006) stated that the significant heterogeneity between regions warrants further analysis. This suggests that multiple stocks may be revealed by using additional molecular markers and increasing spatial sampling. Nevertheless, their results indicated a high rate of gene flow throughout the range of white marlin, suggesting the single stock management approach is appropriate at this time. Relative to the ESA terminology, the BRT adopts the term "stock" to be synonymous with "species" and therefore concludes that the white marlin consists of a single species throughout its range.

There is no indication that the geographic range of white marlin has decreased, based on the distribution of catch reported from major tuna fisheries during 2000-2004 (Fig. 1). Further, there are no indications that separate stocks or spawning groups are likely to develop as a result of geographic isolation. This is also supported by genetic analyses.

D. Congener[1] species

The NOAA Fisheries pelagic observer program (POP) began collecting skin patches and morphometric information from spearfishes and white marlin in 1992 on a very small scale and in conjunction with other data collection. This practice continues to the present. In 1998, the POP initiated, for all observers, identification protocols for spearfish and white marlin using the anus location (i.e., the distance between anal opening and first anal fin divided by the first anal fin, aka AFA/AFH relationship) and scale morphology, but did not require or request observers to submit the measurements or scale samples (although a certain percentage did); only a lower jaw fork length measurement was required. During 2003, the POP encouraged observers to collect skin patches and take photographs for morphometric evaluation. In January 2006, the POP began to require observers to collect a skin patch from all dead spearfishes or white marlin brought on deck, and also to measure, to the nearest centimeter, the distance between the anal opening and the anal fin, and the height of the anal fin, as well as lower jaw fork length. Observers were still encouraged (but not required) to photograph the fish as well. To date, the POP has collected AFA/AFH relationship and matching scale morphology data for 81 roundscale spearfish (*Tetrapturus georgii* Lowe, 1840), 38 white marlin (*T. albidus*), and 15 longbill spearfish (*T. pfluegeri* Robins and de Sylva, 1963).

Validity of the roundscale spearfish (*T. georgii*) has recently been reported by Shivji et al. (2006) using genetic and morphometric analyses. Roundscale spearfish are not hybrids, but rather a clearly different genetic lineage to sympatric billfish species. To an untrained observer, the roundscale spearfish and white marlin are morphologically similar. Characteristics that differentiate the roundscale spearfish from the white marlin include: mid-lateral scales that are rounded anteriorly; a greater distance between the anus and insertion of the first anal fin; branchiostegal rays extending to posterior edge of the operculum; and, unique mitochondrial

[1] Congeners are organisms within the same genus.

ND4L-ND4 nucleotide sequences (Shivji et al., 2006). Further, Collette et al. (2006) report sequence differences in several other mitochondrial gene regions, and importantly (to dismiss hydridization), an anonymous nuclear gene region.

Confusion in identification of these congeners has occurred. In gutted and finned commercial landings throughout the range, roundscale spearfish may be misidentified as longbilled spearfish (Anon. peer reviewer). It is likely that most recreational roundscale spearfish captures have been classified as white marlin. The proportions of roundscale spearfish classified as white marlin in the fishery catches is not known. Further, it is unknown whether the proportion has changed over time. No information is available describing interspecific competition, or potential geographic overlap/separation, between the roundscale spearfish and white marlin. Further, it is not possible to separate roundscale spearfish from white marlin in the historical catch records. A genetic re-analysis of specimens identified as "white marlin", landed in New Jersey recreational fishing tournaments over the last few years, confirmed 17.5% were actually roundscale spearfish (J. Graves, VIMS, unpubl. data). This has raised the possibility that the abundance of the white marlin may be overestimated as the estimates likely include roundscale spearfish. The POP data suggests the roundscale spearfish is widely distributed in the western North Atlantic, and abundant in the Sargasso Sea area during the winter period (Beerkircher et al., in press). Further, POP observers have reported roundscale spearfish in mid-July off the Grand Banks at 43°42´N, 47°37´W (L. Beerkircher, SEFSC, pers. com.).

The so-called "hatchet marlin" (*Tetrapturus* sp.), another putative congener, exhibits truncated dorsal and anal fins. This morphometric condition has been known to occur in both roundscale spearfish and white marlin. The genetic identify of hatchet marlin is detailed in Collette et al. (2006), with inference that hatchet marlin and roundscale spearfish may be conspecific. Thus, the shortened fins suggests a phenotype variable only, not a separate species (J. Graves, VIMS, pers. com).

III. Description of Fisheries and Fishery Management and Conservation Mechanisms

In order to understand the status of the white marlin stock, the 2007 BRT thought it was appropriate to describe the fisheries and fisheries management measures affecting white marlin. Following is a summary of domestic and international fisheries, both commercial and recreational, as determined by a variety of data collection methods and management measures affecting them.

A. Fisheries Data Collection Programs

Fisheries dependent data are collected in several different programs targeting various fisheries with white marlin interactions. Following is a brief description of these programs.

1. Marine Recreational Fishery Statistics Survey

The Marine Recreational Fishery Statistics Survey (MRFSS) consists of dockside interviews of anglers and a phone based survey. MRFSS collects data for the Atlantic and Gulf of Mexico coastal states except Texas that conducts its own fishery dependent monitoring program. While MRFSS collects data on Atlantic billfish, it was not specifically designed for such a rare event fishery. For this reason, the MRFSS data are not considered to be highly accurate in determining the exact number of landings or releases of Atlantic Highly Migratory Species (HMS), but it does provide useful additional data for purposes of comparison with other data sets.

2. Recreational Billfish Survey

The Recreational Billfish Survey (RBS) captures tournament landings from the Atlantic, Gulf of Mexico, and Caribbean Sea. RBS data represent the majority of verifiable domestic Atlantic billfish landings, but are still a subset of aggregate U.S. landings. The data are self-reported by tournaments selected for reporting from all registered Atlantic billfish tournaments.

3. Non-tournament Recreational Reporting

This program is a key element in complying with Phase I of the ICCAT marlin rebuilding plan and began in March 2003. With the exception of billfish or swordfish landed in the states of North Carolina and Maryland, anglers landing Atlantic billfish or swordfish outside of tournaments are required to report those landings to NMFS within 24 hours of landing. The states of North Carolina and Maryland have landing card programs and provide their landings data to NMFS.

4. Large Pelagic Survey

The Large Pelagic Survey (LPS) is designed to intercept bluefin tuna and operates only from Virginia to Maine on the Eastern seaboard from June through October. LPS landings are known to be a subset of aggregate U.S. Atlantic landings. Both the MRFSS and LPS can overlap with the RBS data which must be accounted for when attempting to quantify aggregate landings.

5. Pelagic Longline Logbooks

Mandatory reporting to NMFS on catch and effort data is self-reported via logbooks in the pelagic longline fishery. These data are collected on a per set basis and fishermen are required to report number of each species caught, number retained, number discarded alive, number discarded dead, location of the set, type of gear, size of gear, and duration of the set.

6. Pelagic Observer Program

The POP monitors a mobile U.S. pelagic longline fleet ranging from the Grand Banks to the Atlantic off of Brazil and in the Gulf of Mexico. Vessels range in size from 35-90 feet and trips typically last 2-45 days. During an average year, the observer corps will spend about 900 days at sea encompassing 70-75 vessel trips and about 500 longline sets. The distance of a longline set can range from 10-40 miles fishing between 200-1,000 baited hooks about 100 yards apart. The POP targets 8% coverage of the vessels based on the fishing effort of the fleet. Observer personnel record fish species, length, weight, sex, location, and other environmental information.

The information collected is used to evaluate the harvest and status of the pelagic fish stocks and is important in evaluating the effectiveness of management measures to control harvest levels.

B. Description of the Fisheries

1. Overall Fishery and Its International Nature

Atlantic billfish, including white marlin, have historically been landed as incidental catch of foreign and domestic commercial pelagic longline vessels, or in directed recreational and artisanal fisheries (NMFS, 1999). Because the majority of billfish fishing mortality in the Atlantic Ocean is part of international commercial pelagic fisheries, billfish catch estimates have risen and fallen with the overall catch estimates for pelagic fisheries. White marlin landings in the Atlantic (Fig. 2) have followed a fluctuating pattern. Total reported landings for white marlin peaked in 1965 at 4,906 metric tons (mt), declining to 610 mt in 2004 (ICCAT, 2006). Over the past 25 years, the landings numbers have fluctuated between 610-1,966 mt. Since 2000, landings have declined from 1,242 mt to 610 mt Atlantic-wide. By comparison, the mean reported U.S. catch (landings plus dead discards) was 5% of the mean reported total Atlantic catch (83 mt and 1640 mt for mean U.S. and Atlantic totals respectively) and from 2000-2004 the mean reported U.S. catch was 3% of the mean reported total Atlantic catch (29 mt and 861 mt for mean U.S. and Atlantic totals respectively).

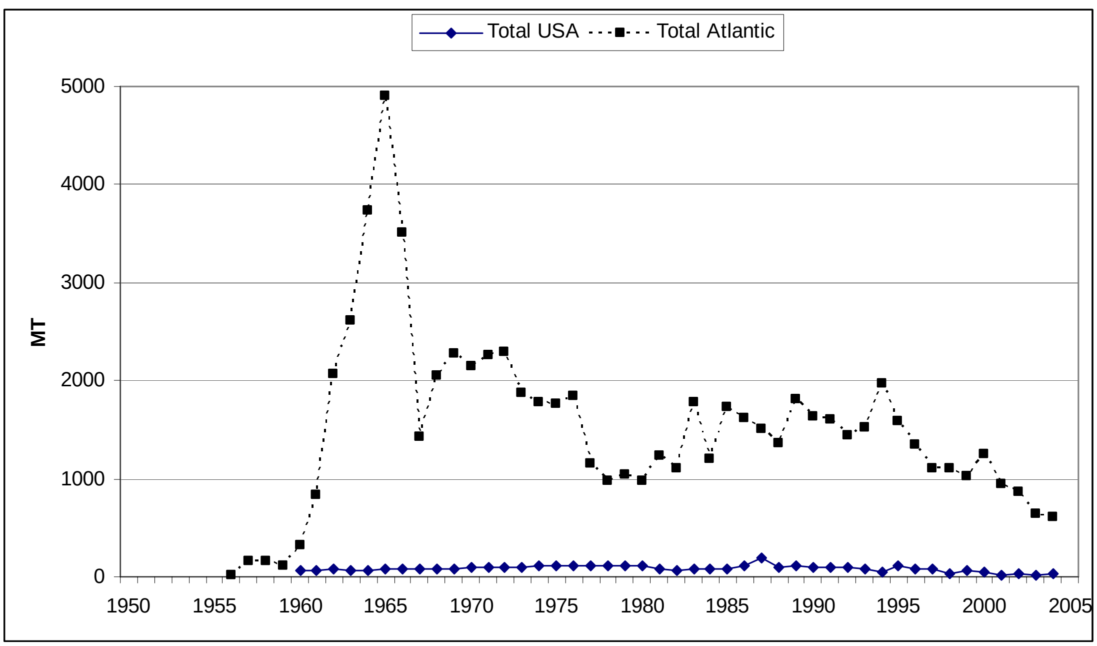


Figure 2. White marlin catches from 1955 - 2004 in metric tons (MT) separated into total Atlantic (squares) and total U.S. (diamonds) landings. Source: ICCAT, 2006.

Atlantic blue marlin, white marlin and sailfish are highly-prized recreational species in the U.S., Venezuela, Bahamas, Brazil and many countries in the Caribbean Sea and west coast of Africa. Several countries also land them for consumption from incidental catches to directed commercial longline fisheries (NMFS, 1999). While the directed effort is principally targeted toward tuna species and swordfish, billfish occur in the same area as these other pelagic species making them susceptible to the gear. Billfish tend to be associated more with tuna catches than swordfish because they are largely daylight feeders (NMFS, 1999).

a) International Catch

White marlin catches have been reported by 34 countries in the Atlantic since 1956 (ICCAT 2006). Traditionally, ICCAT has collected data by ocean area because of differing exploitation patterns in the North (north of 5° N. lat.) and South Atlantic Oceans. The combined reported catches of white marlin from the Atlantic are shown in Figure 2. It is important to note that, with the exception of those from the U.S., current total Atlantic landings estimates do not include dead discards. During the 1960s, Japan was responsible for 80% of all white marlin caught in the Atlantic Ocean with a peak white marlin catch of 4,631 mt in 1965 (1,913 mt in the North Atlantic and 2,718 mt in the South Atlantic). In the 1970s and 1980s, 21 countries reported catches of white marlin from the North Atlantic, with Chinese Taipei, Japan, Cuba, Venezuela, Korea and the U.S. reporting the highest catches. In the 1990s, Chinese Taipei, Venezuela, Spain, Japan, Barbados, and the U.S. provided the greatest catch of white marlin in the North Atlantic. From 2000-2004, Venezuela (24%), Chinese Taipei (16%), EC-Spain (14%), U.S. (11%), Japan (10%), and Mexico (9%) reported the highest catches of white marlin in the North Atlantic.

In the South Atlantic, 22 countries have reported catches of white marlin, with Japan, Korea, Chinese Taipei, Brazil, and Cuba reporting the highest catches during the 1970s and 1980s. After Japan reduced catches of white marlin in the South Atlantic in 1973, Korea, Chinese Taipei and Cuba were responsible for nearly 90% of the reported landings. In the 1990s, Brazil, Chinese Taipei, Japan, Korea, and the EC-France/Spain accounted for most white marlin landings in the South Atlantic. From 2000 to 2004, Brazil (46%), Chinese Taipei (37%), and EC-Spain (6%) landed the most white marlin in the South Atlantic. Recently, total Atlantic catches of white marlin from 2000 to 2004 were highest for Chinese Taipei (35%), followed by Brazil (29%), EC-Spain (9%), and Venezuela (9%). The 2006 ICCAT Billfish Stock Assessment (SCI-012/2006) recognized an increase in artisanal landings reported from several developing countries.

b) U.S. Commercial Fisheries

Since the early 1900s, the traditional use of Atlantic billfish resources in the waters off the continental U.S. has been in recreational fisheries, with a significant increase in participation after World War II (NMFS, 1999). Until the early 1950s, the fishery was concentrated in only a few areas along the Atlantic and Gulf Coasts. Fisheries in waters off Puerto Rico traditionally included a small-scale, handline subsistence fishery, in addition to a recreational fishery. There have been no directed commercial activities for white marlin, with the exception of a small harpoon fishery that once existed in the waters off southern New England. However, white marlin and other billfishes caught incidentally in commercial fisheries were marketed prior to the late 1980s, and were usually processed and sold as smoked fish product.

In 1988, the South Atlantic Fishery Management Council (SAFMC), in cooperation with the Caribbean, Mid-Atlantic, New England, and Gulf of Mexico Fishery Management Councils, prepared a Fishery Management Plan (FMP) for Atlantic billfish, that prohibited retention, landing, or sale of billfish (including white marlin) caught by commercial fishing vessels in U.S. waters, thereby reserving this resource for recreational anglers. The 1988 SAFMC FMP required that all Atlantic billfish caught on commercial gear shoreward of the outer boundary of the Exclusive Economic Zone (EEZ) must be released "in a manner that will ensure maximum probability of survival," by cutting the line near the hook without removing the fish from the water. This measure was changed in 1999 with Amendment One to the Atlantic Billfish Fishery Management Plan that allowed for removal of the hook from Atlantic billfish.

(1) Pelagic Longlines

The U.S. pelagic longline fishery for Atlantic HMS primarily targets swordfish, yellowfin tuna, and bigeye tuna in various areas and seasons. Secondary target species include dolphin, albacore tuna, and pelagic sharks (including mako, thresher, and porbeagle sharks) as well as several species of large coastal sharks. Although this gear can be modified (i.e., depth of set, hook type, etc.) to specifically target swordfish, tunas, or sharks, it is generally a multi-species fishery. These vessel operators are opportunistic, switching gear style and making subtle changes to target the best available economic opportunity of each individual trip. Pelagic longline gear sometimes attracts and hooks non-target finfish with little or no commercial value, as well as species that cannot be retained by commercial fishermen due to regulations, such as billfish. Pelagic longlines may also interact with protected species such as marine mammals, sea turtles and sea birds. Thus this gear has been classified as a Category I fishery with respect to the Marine Mammal Protection Act (MMPA). Any species (or undersized animal of permitted species) that cannot be landed due to fishery regulations is required to be released, whether dead or alive. Pelagic longline gear is composed of several parts (Fig. 3) (NMFS, 1999).

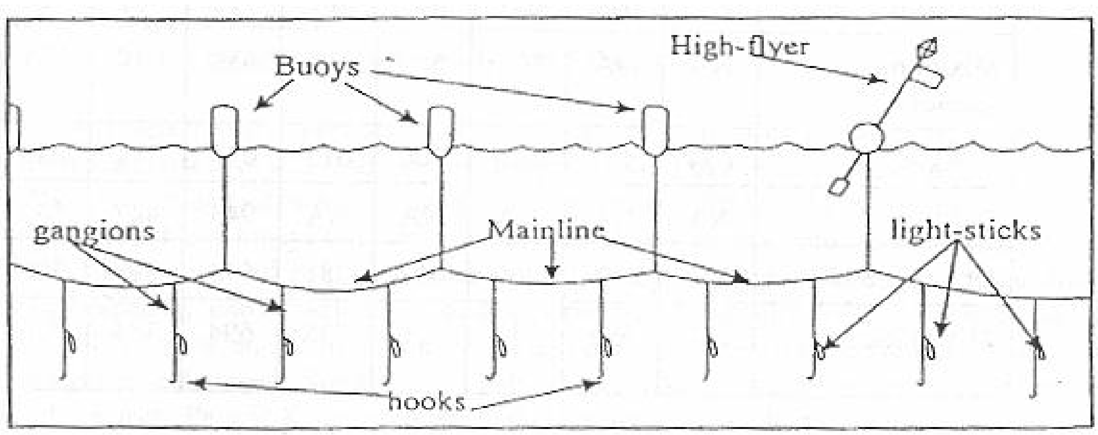


Figure 3. Typical U.S. Pelagic Longline Gear. Source: Arocha, 1996.

The primary fishing line, or mainline of the longline system, can vary from 5 - 40 miles in length, with approximately 20 - 30 hooks per mile when fishing for swordfish and 40 - 80 hooks per mile when fishing for tuna. The depth of the mainline is determined by ocean currents and the length of the floatline, which connects the mainline to several buoys, and periodic markers which can have radar reflectors or radio beacons attached. Each individual hook is connected by a leader, or gangion, to the mainline. Lightsticks, which contain chemicals that emit a glowing light, are often used, particularly when targeting swordfish. When attached to the hook and suspended at a certain depth, lightsticks attract baitfish, which may, in turn, attract pelagic predators (NMFS, 1999).

When targeting swordfish, pelagic longline gear is generally deployed at sunset and hauled at sunrise to take advantage of swordfish nocturnal near-surface feeding habits (NMFS, 1999). In general, longlines targeting tunas are set in the morning, deeper in the water column, and hauled in the evening. Except for vessels of the distant water fleet, which undertake extended trips, fishing vessels preferentially target swordfish during periods when the moon is full to take advantage of increased densities of pelagic species near the surface. The number of hooks deployed in each set varies with line configuration and target species (Table 1) (NMFS, 1999).

Green-stick fishing gear, which under one configuration currently falls within the definition of longline gear, may also be deployed as a trolling gear to target surface feeding tunas. Under this configuration, the mainline and gangions are elevated and actively trolled so that the baits fish on or above the water's surface. This style of fishing is reported to be extremely efficient compared to conventional fishing techniques.

Table 1. Average number of hooks per pelagic longline set by year and target species 1999-2004. Source: 2006 Consolidated HMS FMP.

Target Species	1999	2000	2001	2002	2003	2004
Swordfish	521	550	625	695	712	701
bigeye tuna	768	454	671	755	967	400
yellowfin tuna	741	772	731	715	723	696
mix of tuna species	NA	638	719	767	764	779
Shark	613	621	571	640	970	1,046
Dolphin	NA	943	447	542	692	1,033
other species	781	504	318	300	865	270
mix of species	738	694	754	756	750	777

Figure 4 illustrates basic differences between swordfish (shallow) sets and tuna (deep) longline sets. Swordfish sets are buoyed to the surface, have few hooks between floats, and are relatively shallow. This same type of gear arrangement is used for mixed target sets. Tuna sets use a different type of float placed much further apart. Compared with swordfish sets, tuna sets have more hooks between the floats and the hooks are set much deeper in the water column. It is believed that because of the difference in fishing depth, tuna sets hook fewer turtles than the swordfish sets. In addition, tuna sets use bait only, while swordfish fishing uses a combination of bait and lightsticks. Compared with vessels targeting swordfish or mixed species, vessels specifically targeting tuna are typically smaller and fish different grounds.

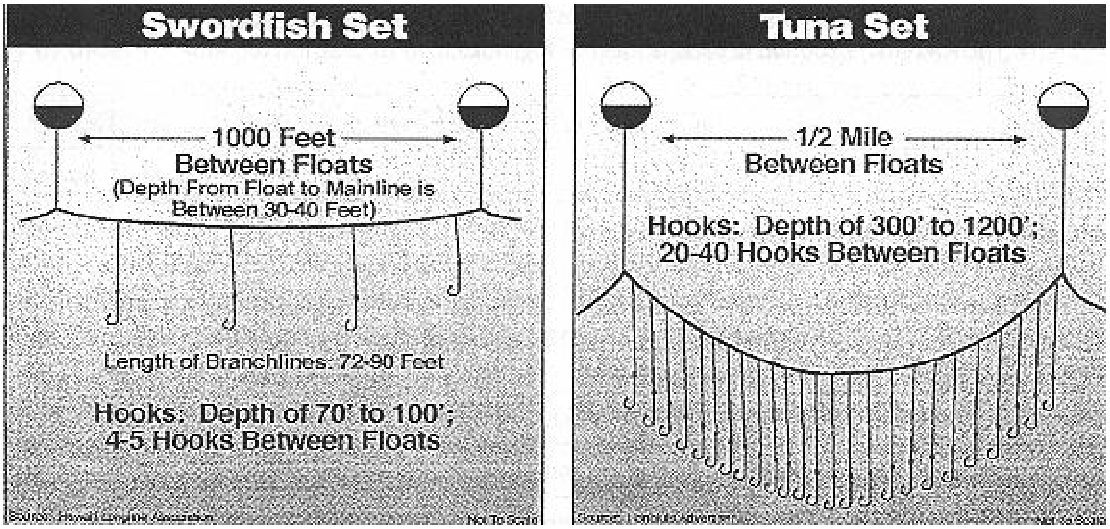


Figure 4. Different Pelagic Longline Gear Deployment Techniques. Source: Hawaii Longline Association and Honolulu Advertiser. NOTE: This figure is only included to show basic differences in pelagic longline gear configuration and to illustrate that this gear may be altered to target different species.

(2) Regional U.S. Pelagic Longline Fisheries Description

The U.S. pelagic longline fishery sector has historically been comprised of five relatively distinct segments with different fishing practices and strategies, including the Gulf of Mexico yellowfin tuna fishery, the South Atlantic-Florida East Coast to Cape Hatteras swordfish fishery, the Mid-Atlantic and New England swordfish and bigeye tuna fishery, the U.S. distant water swordfish fishery, and the Caribbean Islands tuna and swordfish fishery. Each vessel type has different range capabilities due to fuel capacity, hold capacity, size, and construction. In addition to geographical area, these segments have historically differed by percentage of various target and non-target species, gear characteristics, and deployment techniques. Some vessels fish in more than one fishery segment during the course of the year (NMFS, 1999). Due to the many changes in the regulations since 1999 (e.g., time/area closures and gear restrictions), the fishing practices and strategies of these different segments may have changed.

(3) The Gulf of Mexico Yellowfin Tuna Fishery

Longline vessels fishing in the Gulf of Mexico primarily target yellowfin tuna year-round; however, each port has one to three vessels that directly target swordfish, either seasonally or year-round. Longline fishing vessels that target yellowfin tuna in the Gulf of Mexico also catch and sell dolphin, swordfish, other tunas, and sharks. While fishing for yellowfin tuna, few swordfish are captured incidentally likely due to fishing period. Many of these vessels participate in other Gulf of Mexico fisheries (targeting shrimp, shark, and snapper/grouper) during allowed seasons. Home ports for this fishery include Madiera Beach, Florida; Panama City, Florida; Dulac, Louisiana; and Venice, Louisiana (NMFS, 1999).

Longline gear targeting tuna is configured similar to swordfish longline gear but is deployed differently. The gear is typically set out at dawn (between 2 a.m. and noon) and retrieved at sunset (4 p.m. to midnight). The water temperature at hook location varies based on the location of fishing. However, yellowfin tuna are targeted in the western Gulf of Mexico during the summer when water temperatures are high. In the past, fishermen have used live bait, however, in 2000 NMFS prohibited the use of live bait in an effort to decrease bycatch and bycatch mortality of billfish (65 FR 47214). This rule also closed the Desoto Canyon area (year-round closure) to pelagic longline gear. In the Gulf of Mexico, and all other areas, except the Northeast Distant Statistical Sampling Area (NED), specific circle hooks (16/0 or larger non-offset and 18/0 or larger with an offset not to exceed 10 degrees) are currently required, as are whole finfish and squid baits.

(4) The South Atlantic – Florida East Coast to Cape Hatteras Swordfish Fishery

Historically, South Atlantic pelagic longline vessels targeted swordfish year-round, although yellowfin tuna and dolphin fish were other important marketable components of the catch. In 2001 (65 FR 47214), the Florida East Coast closed area (year-round closure) and the Charleston Bump closed area (February through April closure) became effective.

Prior to these closures, smaller vessels used to fish short trips from the Florida Straits north to the bend in the Gulf Stream off Charleston, South Carolina (Charleston Bump). Mid-sized and larger vessels migrate seasonally on longer trips from the Yucatan Peninsula throughout the West Indies and Caribbean Sea, and some trips range as far north as the Mid-Atlantic coast of the United States to target bigeye tuna and swordfish during the late summer and fall. Fishing trips in this fishery average 9 sets over 12 days. Home ports (including seasonal ports) for this fishery include Georgetown, South Carolina; Charleston, South Carolina; Fort Pierce, Florida; Pompano Beach, Florida; and Key West, Florida. This sector of the fishery consists of small to mid-size vessels, which typically sell fresh swordfish to local high-quality markets (NMFS, 1999).

(5) The Mid-Atlantic and New England Swordfish and Bigeye Tuna Fishery

Fishing in this area has evolved during recent years to focus almost year-round on directed tuna trips, with substantial numbers of swordfish trips as well. Some vessels participate in directed bigeye/yellowfin tuna fishing during the summer and fall months and then switch to bottom longline and/or shark fishing during the winter when the large coastal shark season is open. In 1999, NMFS closed the Northeastern U.S. area in June to pelagic longline gear to reduce bluefin tuna discards (64 FR 29090). Fishing trips in this fishery sector average 12 sets over 18 days. During the season, vessels primarily offload in the ports of New Bedford, Massachusetts; Barnegat Light, New Jersey; Ocean City, Maryland; and Wanchese, North Carolina (NMFS, 1999).

(6) The U.S. Atlantic Distant Water Swordfish Fishery

This U.S. fishing ground covers virtually the entire span of the western north Atlantic to as far east as the Azores and the Mid-Atlantic Ridge. Approximately 12 large fishing vessels that fish in the distant water operate out of Mid-Atlantic and New England ports during the summer and fall months targeting swordfish and tunas, and then move to Caribbean ports during the winter and spring months. Many of the current distant water operations were among the early participants in the U.S. directed Atlantic commercial swordfish fishery. These larger vessels, with greater ranges and capacities than the coastal fishing vessels, enabled the United States to become a significant participant in the north Atlantic fishery. They also fish for swordfish in the south Atlantic. The distant water vessels traditionally have been larger than their southeast counterparts because of the distances required to travel to the fishing grounds. Fishing trips in this fishery tend to be longer than in other fisheries, averaging 30 days and 16 sets. Ports for this fishery range from San Juan, Puerto Rico through Portland, Maine, and include New Bedford, Massachusetts, and Barnegat Light, New Jersey (NMFS, 1999). This segment of the fleet was directly affected by the L-shaped closure in 2000 and the NED closure implemented in 2001. A number of vessels have recently returned to this fishery with the issuance of the July 6, 2004, rule (69 FR 40734) to reduce sea turtle bycatch and bycatch mortality. Unlike in other areas, vessels fishing in the NED are required to use 18/0 or larger circle hooks with an offset not to exceed 10 degrees and whole mackerel or squid baits.

(7) The Caribbean Tuna and Swordfish Fishery

This fleet is similar to the southeast coastal fishing fleet in that both are comprised primarily of smaller vessels that make short trips relatively near-shore, producing high quality fresh product. Both fleets also encounter relatively high numbers of undersized swordfish at certain times of the year. Longline vessels targeting HMS in the Caribbean use fewer hooks per set, on average, fishing deeper in the water column than the distant water fleet off New England, the northeast coastal fleet, and the Gulf of Mexico yellowfin tuna fleet. This fishery is typical of most pelagic fisheries, being truly a multi-species fishery, with swordfish as a substantial portion of the total catch. Yellowfin tuna, dolphin and, to a lesser extent, bigeye tuna, are other important components of the landed catch. Ports for this fishery include St. Croix, U.S.V.I.; and San Juan, Puerto Rico. Many of these high quality fresh fish are sold to local markets to support the tourist trade in the Caribbean (NMFS, 1999).

(8) Management of the U.S. Pelagic Longline Fishery

The U.S. Atlantic pelagic longline fishery is restricted by a limited swordfish quota, divided between the North and South Atlantic (separated at 5°N). Other regulations include minimum sizes for swordfish, yellowfin, bigeye, and bluefin tuna, limited access permitting, bluefin tuna catch requirements, shark quotas, protected species incidental take limits, reporting requirements (including logbooks), and gear and bait requirements. Current billfish regulations prohibit the retention of billfish by pelagic longline vessels, or the sale of billfish from the Atlantic Ocean. As a result, all billfish hooked on pelagic longlines must be discarded, and are considered bycatch. This is a heavily managed gear type and, as such, is strictly monitored. Because it is difficult for pelagic longline fishermen to avoid billfish and other non-target species in some areas, NMFS has closed areas in the Gulf of Mexico and along the East Coast and implemented a live bait prohibition in the Gulf of Mexico due to the large number of interactions with Atlantic billfish. The intent of these measures is to decrease bycatch in the pelagic longline fishery in areas with the highest rates of bycatch. There are also time/area closures for pelagic longline fishermen designed to reduce the incidental catch of bluefin tuna and sea turtles. In order to enforce time/area closures and to monitor the fishery, NMFS requires all pelagic longline vessels to report positions on an approved vessel monitoring system (VMS).

(9) Recent Catch and Landings

U.S. pelagic longline catch (including bycatch, incidental catch, and target catch) is largely related to these vessel and gear characteristics, but is summarized for the whole fishery in Table 2.

Table 2. Reported Catch of Species Caught by U.S. Atlantic Pelagic Longlines, in Number of Fish, for 1999-2004. Source: Pelagic Longline Logbook Data, SEFSC.

Species	1999	2000	2001	2002	2003	2004
Swordfish Kept	67,120	62,978	47,560	49,320	51,835	46,440
Swordfish Discarded	20,558	17,074	13,993	13,035	11,829	10,675
Blue Marlin Discarded	1,253	1,443	635	1,175	595	712
White Marlin Discarded	1,969	1,261	848	1,438	809	1,053
Sailfish Discarded	1,407	1,091	356	379	277	424
Spearfish Discarded	151	78	137	148	108	172
Bluefin Tuna Kept	263	235	177	178	273	475
Bluefin Tuna Discarded	604	737	348	585	881	1,031
Bigeye, Albacore, Yellowfin, Skipjack Tunas Kept	114,438	94,136	80,466	79,917	63,321	76,962
Pelagic Sharks Kept	2,894	3,065	3,460	2,987	3,037	3,440
Pelagic Sharks Discarded	28,967	28,046	23,813	22,828	21,705	25,355
Large Coastal Sharks Kept	6,382	7,896	6,478	4,077	5,326	2,292
Large Coastal Sharks Discarded	5,442	6,973	4,836	3,815	4,813	5,230
Dolphin Kept	31,536	29,125	27,586	30,384	29,372	38,769
Wahoo Kept	5,136	4,193	3,068	4,188	3,919	4,633
Turtles Discarded	631	271	424	465	399	369
Number of Hooks (X 1,000)	7,902	7,976	7,564	7,150	7,008	7,276

(10) International Issues and Catch

Pelagic longline fisheries for Atlantic HMS primarily target swordfish and tunas. Directed pelagic longline fisheries in the Atlantic have been operated by Spain, the U.S., and Canada since the late 1950s or early 1960s. The Japanese pelagic longline tuna fishery started in 1956 and has operated throughout the Atlantic since then (NMFS, 1999). Most of the 35 other ICCAT nations now also operate pelagic longline vessels.

The U.S. pelagic longline fleet represents a small fraction of the international pelagic longline fleet that competes on the high seas for catches of tunas and swordfish. In recent years, the proportion of U.S. pelagic longline landings of HMS, for the fisheries in which the United States participates, has remained relatively stable in proportion to international landings (Table 3). The U.S. fleet accounts for less than 0.5 percent of the landings of swordfish and tuna from the Atlantic Ocean south of 5°N, and does not operate at all in the Mediterranean Sea. Tuna and swordfish landings by foreign fleets operating in the tropical Atlantic and Mediterranean are greater than the catches from the north Atlantic area where the U.S. fleet operates. Even within the area where the U.S. fleet operates, the U.S. portion of fishing effort (in numbers of hooks fished) is less than 10 percent of the entire international fleet's effort, and likely less than that due to differences in reporting effort between ICCAT countries (NMFS, 2001).

Table 3. Estimated International Longline Landings of HMS, Other than Sharks, for All Countries in the Atlantic: 1999-2004 in metric ton wet weight. Source: SCRS, 2005.

Species	1999	2000	2001	2002	2003	2004
Swordfish (N. Atl + S. Atl)	25,268	25,091	22,702	22,278	21,746	23,872
Yellowfin Tuna (W. Atl)[2]	11,596	11,638	12,740	11,605	9,996	15,008
Bigeye Tuna	76,527	71,194	55,265	46,584	51,065	43,620
Bluefin Tuna (W. Atl.)[2]	914	859	610	727	228	542
Albacore Tuna (N. Atl + S. Atl)	27,209	28,896	29,722	27,798	27,893	20,940
Skipjack Tuna (W. Atl)[2]	58	23	60	143	95	231
Blue Marlin (N. Atl. + S. Atl.)[3]	2,359	2,209	1,638	1,331	1,690	1,376
White Marlin (N. Atl. + S. Atl.)[3]	981	893	592	725	582	528
Sailfish (W. Atl.)[4]	524	815	812	1,271	860	657
Total	145,436	141,618	124,141	112,462	114,155	106,774
U.S. Longline Landings (from 2003, 2004, and 2005 U.S. Natl. Reports)[5]	8,331.1	7,253.5	5,694.9	6,193.7	5,442.3	5649.1
U.S. Longline Landings as a Percent of Total Longline Landings	5.7	5.1	4.6	5.5	4.8	5.3

[1]Landings include those classified by the SCRS as longline landings for all areas
[2]Note that the United States has not reported participation in the Eastern Atlantic yellowfin tuna fishery since 1983 and has not participated in the Eastern Atlantic bluefin or the Eastern Atlantic skipjack tuna fishery since 1982.
[3]Includes U.S. dead discards and Brazilian live discards.
[4]Includes U.S. dead discards.
[5]Includes swordfish, blue marlin, white marlin, and sailfish longline discards.

c) U.S. Recreational Fisheries

Billfish angling has a long history in the U.S., and the first marlin landed was reported in 1903 (Gillis and Ditton, 1998). Billfish anglers are a small constituency compared to other marine or freshwater angler groups (Ditton and Stoll, 1998). Ditton (1996) described typical participants in billfish angling as white males in their forties, highly educated, with high annual household incomes; billfish anglers tend to fish twice as frequently as those targeting other saltwater species. These results are similar to those found by Maiolo (1990) from a survey of U.S. billfish anglers participating in tournaments along the East Coast, Gulf of Mexico and Caribbean (Puerto Rico and Bahamas). Most recreational anglers consider themselves to be strong advocates for conservation of Atlantic billfish resources.

Conservation of Atlantic billfish resources was a primary objective of the 1988 Atlantic Billfish FMP in order to maintain the highest availability of billfish to the U.S. recreational fishery. The FMP set minimum size limits for the recreational retention of Atlantic billfish species including a 62 inch lower jaw fork length (LJFL) limit for white marlin. A March 24, 1998 (63 FR 14030) interim rule increased the minimum sizes for billfish, including an increase to 66 inches LJFL for white marlin. The interim rule was extended September 29, 1998, (63 FR 51859). Complete current billfish regulations may be found at 50 CFR 635. There is currently no bag limit for white marlin in the recreational fishery. In the U.S., Atlantic blue marlin, white marlin, and Atlantic sailfish can be landed only by recreational fishermen fishing from either private vessels or charterboats; longbill spearfish are not allowed to be retained; and there is no minimum size for roundscale spearfish.

(1) Recreational Fishing Gear

Sport fishing for Atlantic billfish on private recreational and charterboats utilizes rod and reel, often with multiple rigs trolled simultaneously. The sportfishing gear used for billfishes is generally more expensive than that used for other recreational marine species. The white marlin fishing season generally begins in May, although tournaments in warmer-water areas (e.g., Bahamas) will start in March. Due to timing of catches, it may appear that white marlin move up the coast in the spring; however, it is also possible that they move west from the central gyre. Then in the fall, tagging data indicate that the fish move to the east when the waters cool. Regardless of origin, marlins are most often found along the coast of the U.S. as waters warm during the summer, with relatively more white marlin traveling farther north to be caught off the Mid-Atlantic and southern New England during July to September. The Atlantic marlin season generally ends by October for the continental U.S., but fish are still caught in the warm Caribbean waters off Puerto Rico and the U.S.V.I.

The 1988 Atlantic Billfish FMP noted that boats used in the U.S. sport fishery for billfishes range from 16 feet to more than 65 feet in length, powered with outboard engines to large diesels. Lucy et al. (1990), describing the fleet characteristics in Virginia's recreational marlin-tuna fishery, found that boats averaged 28 feet in length; charter vessels average 37 feet, and private boats average 26 feet in length. Jesien et al. (2006) described fleet characteristics off Maryland and New Jersey as having an average boat size of 44 feet. Fishing for blue marlin and white marlin generally requires a larger vessel with inboard engines because of the distance needed to travel to reach the fishing grounds. Trips in excess of 100 miles from the shore may be required to reach primary fishing areas. In some geographical areas, where deep waters are closer to shore, vessels of all sizes targeting white marlin can be found. This is particularly evident off the southeast coast of Florida, northern Gulf of Mexico, and the Caribbean (Puerto Rico and U.S.V.I.). The development of more reliable engines, electronic devices (e.g., GPS, cellular phones, and satellite-based communications), and new vessel designs has made offshore fishing grounds accessible to more anglers in a greater variety of vessel sizes.

In 2003, Ditton and Stoll published a paper that surveyed the literature regarding what is currently known about the social and economic aspects of recreational billfish fisheries. It was estimated that 230,000 anglers in the United States spent 2,136,899 days fishing for billfish in 1991. This is approximately 3.6 percent of all saltwater anglers over age 16. The states with the highest number of billfish anglers are Florida, California, North Carolina, Hawaii, and Texas in descending order. Billfish anglers studied in the U.S. Atlantic, Puerto Rico, and Costa Rica fished between 39 and 43 days per year.

Billfish recreational anglers tend to spend a great deal of money on trips. Ditton and Stoll (2003) report that a 1990 study of U.S. total trip costs for a typical billfish angler estimated a mean expenditure of $2,105 per trip for the Atlantic and $1,052 per trip for Puerto Rico. The aggregate economic impact of billfish fishing trips in the U.S. Atlantic is conservatively estimated to be $22.7 million annually.

In addition to the economic impact of recreational billfish angling, Ditton and Stoll (2003) report that using a contingent valuation method they estimated consumer's surplus or net economic benefit to maintain current billfish populations in the U.S. Atlantic to be $497 per billfish angler per year in the U.S. Atlantic and $480 in Puerto Rico. They also estimate that the number of annual billfish anglers in the U.S. Atlantic to be 7,915 and 1,627 in Puerto Rico. The aggregate willingness-to-pay for maintaining current billfish populations is $3.93 million in the U.S. Atlantic and 0.78 million in Puerto Rico. The aggregate direct impact of billfish expenditures is estimated to be $15.13 million for the U.S. Atlantic and $32.40 million for Puerto Rico. Thus, the total aggregate economic value of billfish angler fishing is $19.06 million per year for the U.S. Atlantic and $33.18 million per year for Puerto Rico.

Generally, HMS tournaments last from three to seven days, but lengths can range from one day to an entire fishing season. Similarly, average entry fees can range from approximately $0 to $5,000 per boat (average approximately $500/boat - $1,000/boat), depending largely upon the magnitude of the prize money that is being awarded. The entry fee would pay for a maximum of two to six anglers per team during the course of the tournament. Additional anglers can, in some tournaments, join the team at a reduced rate of between $50 and $450. The team entry fee did not appear to be directly proportional to the number of anglers per team, but rather with the amount of money available for prizes and, possibly, the species being targeted. Prizes may include citations, T-shirts, trophies, fishing tackle, automobiles, boats, or other similar items, but most often consists of cash awards. In general, it appears that billfish and tuna tournaments charge higher entry fees and award more prize money than shark and swordfish tournaments; however, there is a wide range in entry fees.

Cash awards distributed in HMS tournaments can be quite substantial. Several of the largest tournaments, some of which are described below, are part of the World Billfish Series Tournament Trail whereby regional winners are invited to compete in the World Billfish Series Grand Championship for a new automobile and a bronze sculpture. Other tournament series include the International Game Fish Association (IGFA) Rolex Tournament of Champions, and the South Carolina Governor's Cup. White marlin is a top billfish species from Cape Hatteras, North Carolina to the eastern tip of Georges Bank from June through October each year. The White Marlin Open in Ocean City, Maryland, which is billed as the "world's richest fishing tournament," established a new world record payout for catching a fish when it awarded $1.32 million in 2004 to the vessel catching the largest white marlin. The 21st Annual Pirates Cove Billfish Tournament in North Carolina awarded over $1 million in prizes in 2004, with the top boat garnering over $400,000 for winning in six categories. Total prize money awarded in the Big Rock Tournament in North Carolina has exceeded $1 million since 1998.

Blue marlin, sailfish, and tunas are also often targeted in fishing tournaments including those discussed above. Forty-five teams participated in the 2004 Emerald Coast Blue Marlin Classic at Sandestin, Florida, with over $482,000 in cash prizes and the top boat receiving over $58,000. The 34th Annual Pensacola (Florida) International Billfish Tournament indicated that it awarded over $325,000 in cash and prizes in 2004. The World Sailfish Championship in Key West, Florida had a $100,000 guaranteed first prize for 2005. In South Carolina, the Megadock Billfishing Tournament offers a $1,000,000 prize for any boat exceeding the current blue marlin state record. The 2004 Florida Billfish Masters Tournament in Miami, Florida awarded over $123,000 in prize money, with the top boat receiving over $74,000. Sixty-two boats competed in the 2003 Babylon Tuna Club Invitational in Babylon, New York for over $75,000 in cash prizes, and the Mid-Atlantic $500,000 Tuna Tournament sponsored by the South Jersey Marina in Cape May, New Jersey has had an annual payout of greater than $1,000,000 for several years (including calcuttas).

In addition to official prize money, many fishing tournaments may also conduct a “calcutta” whereby anglers pay from $200 to $5,000 to win more money than the advertised tournament prizes for a particular fish. Tournament participants do not have to enter calcuttas. Tournaments with calcuttas generally offer different levels depending upon the amount of money an angler is willing to put down. Calcutta prize money is distributed based on the percentage of the total amount entered into that calcutta. Therefore, first place winner of a low level calcutta (entry fee ~$200) could win less than a last place winner in a high level calcutta (entry fee ~$1000). On the tournament websites, it was not always clear if the total amount of prizes distributed by the tournament included prize money from the calcuttas or the estimated price of any equipment. As such, the range of prizes discussed above could be a combination of fish prize money, calcutta prize money, and equipment/trophies.

Fishing tournaments can sometimes generate a substantial amount of money for surrounding communities and local businesses. Besides the entry fee to the tournament and possibly the calcutta, anglers may also pay for marina space and gas (if they have their own vessel), vessel rental (if they do not have their own vessel), meals and awards dinners (if not covered by the entry fee), hotel, fishing equipment, travel costs to and from the tournament, camera equipment, and other miscellaneous expenses. Fisher and Ditton (1992) found that the average angler who attended a billfish tournament spent $2,147 per trip (2.59 days), and that billfish tournament anglers spent an estimated $180 million (tournament and non-tournament trips) in 1989. Ditton and Clark (1994) estimated annual expenditures for billfish fishing trips in Puerto Rico (tournaments and non-tournaments) at $21.5 million. More recently, Ditton et al., (2000) estimated that the total expenditure (direct economic impact) associated with the 1999 Pirates Cove Billfish Tournament, not including registration fees, was approximately $2,072,518. The total expenditure (direct economic impact) associated with the 2000 Virginia Beach Red, White, and Blue Tournament was estimated at approximately $450,359 (Thailing et al., 2001). These estimated direct expenditures do not include economic effects that may ripple through the local economy leading to a total impact exceeding that of the original purchases by anglers (i.e., the multiplier effect). Less direct, but equally important, fishing tournaments may serve to generally promote the local tourist industry in coastal communities. In a survey of participants in the 1999 Pirates Cove Billfish Tournament, Ditton et al., (2000) found that almost 80 percent of tournament anglers were from outside of the tournament’s county. For this reason, tourism bureaus, chambers of commerce, resorts, and state and local governments often sponsor fishing tournaments.

Sport fishing for white marlin and other billfishes on private recreational and chartered vessels is conducted in nearly all warm and deep tropical and subtropical ocean areas. The recreational U.S. Atlantic billfish fishery is concentrated from Massachusetts to North Carolina, southeast Florida, the northern Gulf of Mexico and the Caribbean (including Puerto Rico and the U.S.V.I.), depending upon the species and season. White marlin are available to the recreational sport fisheries in the Gulf of Mexico from June into October, with peak abundance in the northern Gulf in July and August (Browder and Prince, 1990). The northeastern limit of the summer coastal occurrence of white marlin is off Nantucket and Martha's Vineyard Islands, south of Cape Cod, Maine. Spring is the peak season for sport fishing for white marlin in the Straits of Florida, Bahamas, Puerto Rico and the U.S.V.I. Most of the recreational fishing effort for billfish along the U.S. Atlantic coast, Gulf of Mexico, and in the Caribbean Sea is concentrated either around key ports, fishing centers, or billfish tournaments (Prince et al., 1990), in relatively deep waters from 120 ft to 6,000 ft (Lucy et al., 1990).

(2) Recreational Catches and Landings

Due to the rare nature of billfish encounters and the difficulty of monitoring landings outside of tournament events, reports of recreational billfish landings are sparse. However, the RBS provides a preliminary source for analyzing recreational billfish landings. Table 4 documents the number of billfish landed in 1999 – 2006, as reported by the RBS.

Table 4. Recreational billfish tournament landings in numbers of fish by calendar year. Source: NMFS Recreational Billfish Survey (RBS).

Species	1999	2000	2001	2002	2003	2004	2005	2006
Blue Marlin	107	79	49	57	71	52	53	59
White Marlin	36	8	22	33	20	25	26	37
Sailfish	30	17	11	14	24	9	4	4

The BRT realizes potential value of the RBS to provide an understanding of the frequency of recreational encounters with white marlin. Figure 5 shows that recreational CPUE shows that overall encounters with white marlin are not decreasing.

There is a requirement for all permit-holders, both private and charter, to report recreational, non-tournament landings of billfish, including swordfish, within 24 hours of landing to NMFS. An exception is Maryland and North Carolina, wherein vessel owners are required to report billfish landings at state-operated landings stations. A landed fish means a fish that is kept and brought to shore. Due to large-scale non-compliance with the call-in requirement, the landings in Table 5 are considered a minimum estimate of the non-tournament landings of billfish.

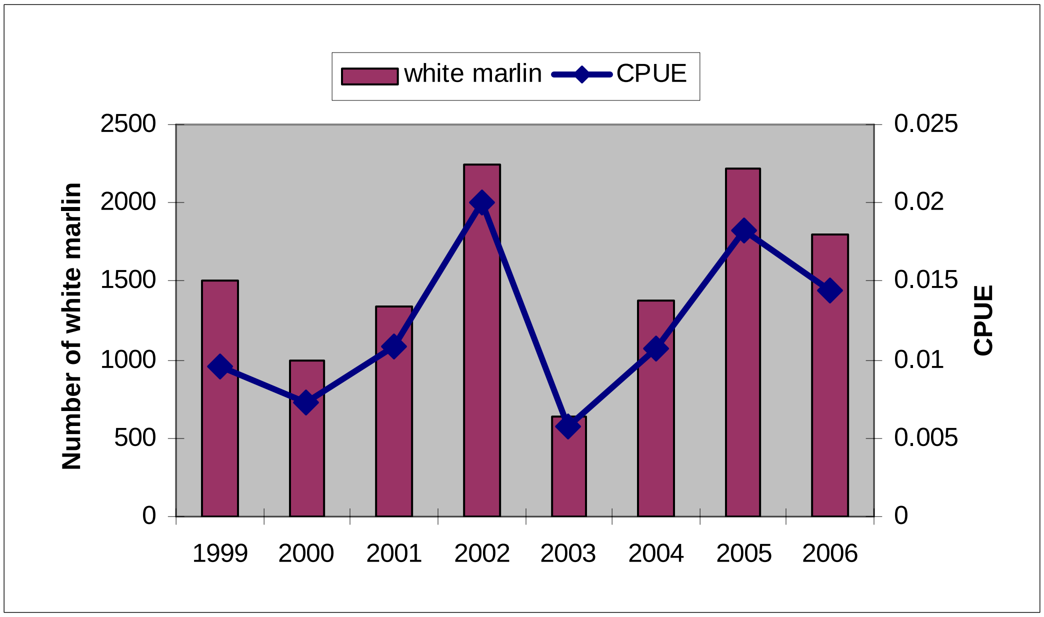


Figure 5. Number of white marlin and catch per unit effort (CPUE) from 1999 - 2006 as reported in the Recreational Billfish Survey, SEFSC. Effort is recorded as boat hours in the recreational fishing tournaments.

Table 5. Number of non-tournament billfish reported to NMFS via call-in system by fishing year, 2002-2005. Fishing years are for period of June 1 – May 31. Source: NMFS HMS Non-Tournament Recreational Billfish and Swordfish Landing Phone Reporting.

Species	2002*	2003	2004	2005**	2006**
Blue Marlin	0	7	2	5	1
White Marlin	0	1	0	2	0
Sailfish	3	16	57	58	24

* Reporting requirement became effective March 1, 2003
** 2006 Fishing Year June 1, 2006 – December 31, 2006

(3) Post-Release Mortality

Following the 2002 NMFS SR, valuable information on billfish post-release hooking mortality in commercial and recreational fisheries by hook type has been gathered in investigations using PSATs. The principal source of adult mortality for white marlin occurs as incidental bycatch on commercial pelagic longline gears (Serafy et al., 2004). Kerstetter and Graves (2006a) examined post-release mortality of 28 PSAT monitored white marlin caught on longline gears targeting swordfish and tunas. A high survival rate for these individuals suggested that live release could effectively reduce bycatch mortality for white marlin caught with longline gears. Further studies suggested that using non-offset circle hooks increased the survival of bycatch species at haulback of pelagic longline gears, with minimal effect on the catch rate of target species (Kerstetter and Graves, 2006b).

Circle hooks were required in the U.S. pelagic longline fishery following the 2004 ESA section 7 consultation. This requirement was implemented to protect all listed sea turtles, but primarily endangered leatherback sea turtles; however, conservation efforts also benefit other species such as white marlin.

Horodysky and Graves (2005) examined post-release mortality in the recreational Atlantic white marlin fishery using short duration PSATs (n=41) and found that mortality levels using traditional J-hooks was 35%, higher than previously assumed. This number was higher than post-release mortality rates for blue marlin at 11% (Graves et al., 2002, n=9) and striped marlin at 29% (Domeier et al., 2003, n=80). Given sample sizes of the studies examined, there is no statistical difference between the Horodsyky and Graves 35% post-release mortality rate for Atlantic white marlin and the 29% estimate identified for Pacific striped marlin. Previous post-release survival estimates for billfish were thought to be in excess of 90% (NMFS, 2006). The recent white marlin post-release mortality statistics, when combined with estimates for the number of Atlantic blue and white marlin released by U.S. anglers, form the basis for NMFS' conclusion that the mortality contribution of the recreational billfish fishery is higher than previously estimated. The rationale for this conclusion is described below.

NMFS regulations since 1999 require the release of all white marlin and other billfishes by commercial fishermen. In addition, minimum sizes have been imposed on the recreational fishing community, which is estimated to release over 90% of the white marlin caught in recent years. These regulations coupled with a strong conservation ethic result in the release of thousands of white marlin annually by domestic fisheries. Moreover, recent ICCAT resolutions and recommendations call for the reduction of white marlin landings and the release of live white marlin by Contracting Parties (ICCAT 96-9, 97-9, 98-10, 00-13, 06-09). If compliance is attained, these measures will result in high numbers of white marlin being released by international fisheries as well.

As previously described, the primary domestic source of Atlantic billfish mortality is the Atlantic pelagic longline fishery; second is the directed recreational billfish fishery. As seen in Figure 6 and Table 6, data reported to ICCAT for the period 1999 - 2005 shows a noticeable overall decrease in dead discarded Atlantic white marlin in the domestic pelagic longline fishery, with noticeable inter-annual fluctuation. Trends in recreational landings of Atlantic white marlin also show an overall decrease for the period 1999 - 2005, with substantial inter-year fluctuations, as shown in Figure 6 and Table 6; also clearly showing that during the period 1999 - 2005, dead discards of Atlantic white marlin from pelagic longline fishing substantially exceeded recreational landings of white marlin every year.

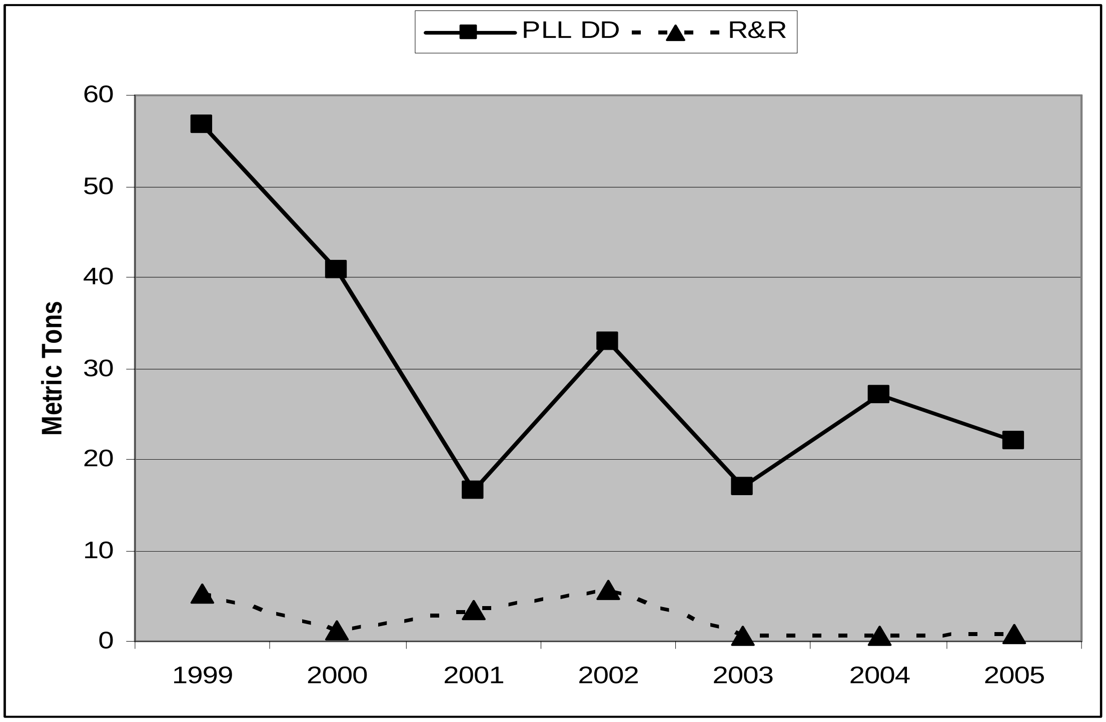


Figure 6. U.S. pelagic longline dead discards (PLL DD) and rod & reel (R & R) landings of Atlantic white marlin in metric tons. Source: U.S. National Report to ICCAT 2006.

Table 6. U.S. pelagic longline dead discards (PLL DD) and rod & reel (R&R) landings of Atlantic white marlin in metric tons. Source: U.S. National Reports to ICCAT 2006.

Year	PLL DD	R&R
1999	56.7	5.2
2000	40.8	1.3
2001	16.5	3.4
2002	33.0	5.6
2003	17.0	0.6
2004	27.0	0.7
2005	22.0	0.8

Minimum size limits are the primary management measure currently in effect to limit landings and potentially limit total fishing mortality in the directed fishery for Atlantic billfish. The current minimum size limits can reduce the number of fish that qualify for landing. Current minimum size limits were implemented to decrease domestic landings in an effort to comply with ICCAT Recommendation 97-09. In addition to limiting fishing mortality by potentially reducing the number of fish landed, if set appropriately, minimum sizes can also ensure some level of reproductive potential remains in the fishery by allowing fish to reach the size at sexual maturity before recruiting into the fishery. Current domestic minimum sizes are set above the size at maturity for Atlantic white marlin, and as such, assure that some level of reproductive potential is maintained in the fishery. Minimum size limits do not, in and of themselves, guarantee that landings will remain at any given level or have a direct impact on post-release mortality of billfish. Billfish that are released in the recreational fishery are not considered as bycatch because of the catch-and-release fishery management program that was established in Amendment 1 to the Atlantic Billfish FMP (NMFS, 1999).

Known recreational landings of Atlantic billfish have remained at relatively low levels since 1999 due to minimum size requirements and a strong voluntary adherence to the practice of catch and release fishing. Recent recreational landings, as reported to ICCAT in metric tons, can be seen in Table 6 above. The number of recreationally landed Atlantic blue and white marlin, as reported to ICCAT, since adoption of the annual 250 recreationally caught marlin landing limit (Recommendation 00-13), can be seen in Table 7. In 2002, the United States exceeded its combined annual limit of 250 recreationally landed blue and white marlin, but carried forward underharvest from 2001, per ICCAT Recommendation 00-14. ICCAT Recommendation 00-14 allows for the carryover of underharvest and mandates carryover of overharvest from a previous fishing year to a subsequent fishing year for any species under quota or catch limit management. It should be noted that the accounting methodology upon which the 2003 numbers reported to ICCAT were based differs from the methodology used to generate the 2002 and 2001 numbers that were reported to ICCAT. The methodology used to generate the 2001 and 2002 landings shown in Table 7 resulted in higher landings being reported to ICCAT for those years than would have been reported if the 2003 methodology had been applied. For additional information on this methodological issue, please see Van Voorhees et al., 2004.

Table 7. U.S. landings of Atlantic marlin (BUM = blue marlin; WHM = white marlin) and annual harvest relative to the 250 fish limit as reported to ICCAT in numbers of fish. Source: U.S. National Reports to ICCAT 2006; and E. Carlsen, NMFS, pers. comm.

Year	BUM	WHM	Total	Annual Over/Underharvest
2001	77	116	193	57
2002	191	88	279	-29
2003	113	23	136	114
2004	118	31	149	101
2005	62	26	88	162
Total	561	284	845	

It is estimated that between 74% and 99% of all billfish are released by billfish anglers. RBS data, as presented in Table 8, indicate Atlantic HMS tournament release rates of 96.8% to 99.2% for white marlin for the period 1999 - 2006. For the same period, MRFSS data (Table 9) indicate release rates of 99.6% to 100% and LPS data (Table 10) indicate release rates of 89.4% to 99.4% for white marlin. The available data indicate a strong adherence by Atlantic billfish anglers, whose activities are captured by these data collection systems, to catch and release fishing, both within and outside of tournaments.

Table 8. White marlin tournament landings and releases 1999-2006 in number of fish. Source: NMFS Recreational Billfish Survey (based primarily on catch and release), updated from NMFS, 2006.

Year	Retained	Released	Live Release Rate
1999	36	1,464	0.976
2000	8	990	0.992
2001	22	1,317	0.984
2002	33	2,218	0.985
2003	20	615	0.968
2004	25	1,351	0.982
2005	26	2,189	0.988
2006	37	1,757	0.979

Table 9. Estimated white marlin aggregate landings and releases 1999-2006 in number of fish (includes Puerto Rico, excludes Texas). N/A indicates data are not available. Source: MRFSS Database, updated from NMFS, 2006.

Year	Landings	Releases	Live Release Rate
1999	58	3,591	0.984
2000	26	6,620	0.996
2001	0	10,582	1.0
2002	0	4,633	N/A
2003	0	883	N/A
2004	0	7,292	N/A
2005	0	7,967	N/A
2006	0	4,833	N/A

Table 10. White marlin estimated aggregate landings and releases (from Virginia to Maine) 1999-2006 in number of fish. Source: NMFS LPS Database, updated from NMFS, 2006.

Year	Retained	Released	Dead Discard	Live Release Rate
1999	6	156	0	0.963
2000	4	705	0	0.994
2001	4	703	0	0.994
2002	218	5,616	0	0.963
2003	365	3,071	0	0.894
2004	69	5,610	0	0.988
2005	91	6,518	0	0.986
2006	150	3,205	0	0.955

Despite the widespread practice of catch and release fishing in the Atlantic billfish fishery, as discussed above, recent data on post-release mortality rates of recreationally caught billfish indicate that the adverse ecological impacts of recreational activities on billfish resources may be greater than previously recognized. Post-release survival of recreationally caught and released Atlantic billfish was previously estimated to be 90 percent or greater (NMFS, 1999). Conversely, this means that post-release mortality of recreationally caught and released billfish was previously estimated to be ten percent or lower. This estimate was derived from a review of the relevant literature at the time, which consisted primarily of studies examining catch and release mortality of bluefin tuna and sharks and Gulf of Mexico longline post-release survivorship. Since that time, there have been a number of pertinent studies examining both J-hook and circle performance and effects on billfishes.

Table 11 presents the estimated number of white marlin mortalities resulting from catch and release fishing activities based on NMFS' RBS, MRFSS, and LPS databases. In deriving these estimates, an assumption was made that all billfish anglers use J-hooks. NMFS acknowledges that some unquantified portion of billfish anglers currently use circle hooks, and, as such, this assumption could bias the estimates to higher than actual levels. NMFS currently does not have an estimate of the proportion of billfish anglers that regularly use circle hooks. However, uncertainty in billfish landings stemming from under-reporting, as well as additional uncertainty stemming from landings estimates in the Commonwealth of Puerto Rico and the U.S.V.I., may result in underestimates of recreational mortality. Mortality estimates were derived by applying a post-release mortality rate of 0.35 (Horodysky and Graves, 2005) to the reported number of releases (e.g., 100 releases * 0.35 post-release mortality rate = 35 mortalities). Using this methodology, estimated release mortalities of Atlantic white marlin range from 215 to 776 based on RBS data (1999 - 2006), 309 to 3,704 based on MRFSS data (1999 – 2006), and 55 to 2,281 for LPS data (1999 - 2006). The range of these estimates is a result of sampling design of the independent data collection programs: see page 18 for additional detail. For the reasons discussed above, actual post-release mortalities of white marlin likely fall somewhere between these estimates. As previously discussed, each of these databases has particular limitations; however, taken in combination, the data provide some indication of the magnitude of U.S. induced recreational white marlin mortalities.

Table 11. Estimated post-release mortality of white marlin in numbers of fish by year and database based on J-hooks and 35% post-release mortality rate from the Recreational Billfish Survey (RBS), Marine Recreational Fishery Statistics Survey (MRFSS), and Large Pelagic Survey (LPS). Modified from NMFS, 2006.

Year	RBS		MRFSS		LPS	
	Live Releases	Estimated Post-Release Mortalities	Live Releases	Estimated Post-Release Mortalities	Live Releases	Estimated Post-Release Mortalities
1999	1,464	512	3,591	1,257	156	55
2000	990	347	6,620	2,317	705	247
2001	1,317	461	10,582	3,704	703	246
2002	2,218	776	4,633	1,622	5,616	1,966
2003	615	215	883	309	3,071	1,075
2004	1,351	473	7,292	2,552	5,610	1,964
2005	2,189	766	7,967	2,788	6,518	2,281
2006	1,757	615	4,833	1,692	3,205	1,122

(4) Time/Area Closures Potentially Affecting White Marlin

At present, the Atlantic pelagic longline fishery of the United States is subject to several discrete time/area closures that are designed to reduce bycatch in the pelagic longline fishery by prohibiting pelagic longline fishing for ICCAT managed species in those areas during specified times. These closures, developed to reduce bycatch, bycatch mortality, and incidental catch of undersized swordfish, billfish and other overfished and protected species from pelagic longline gear utilized by U.S. flagged vessels, affect fishing areas up to 200 nm from shore (Fig. 7) (NMFS, 2000). These closures are as follows: 1) Florida East Coast: 50,720 nm2 year-round; 2) Charleston Bump: 49,090 nm2 from February through April each year; 3) DeSoto Canyon: 32,860 nm2 year-round; and 4) the Northeastern U.S. 21,600 nm2 during the month of June each year.

Additional closures in the shark bottom longline fishery and the reef fish fishery may have ancillary benefits of reduced white marlin bycatch even though white marlin are not frequently caught with these gears. Effective January 1, 2005, the U.S. implemented a Mid-Atlantic shark closed area for bottom longline gear from January through July of each year to protect dusky shark and juvenile sandbar sharks in pupping and nursery areas. In addition, all HMS gear types are prohibited year-round, except for surface trolling only from May through October, in the Madison Swanson and Steamboat Lumps Marine Reserves (Fig. 8). These closures were implemented for the protection of spawning aggregations of gag grouper. The HMS management measures will expire on June 16, 2010, consistent with Gulf of Mexico Fishery Management Council recommendations. Both of these reserves are located shoreward of the Desoto Canyon Closed Area (Fig. 8). The Madison-Swanson Marine Reserve is 115 nm2 in size, and the Steamboat Lumps marine reserve is 104 nm2 in size. Finally, on March 29, 2006, NMFS published a proposed rule (71 FR 15680) to complement regulations that the Caribbean Fishery Management Council implemented on October 28, 2005 (70 FR 62073) that would close six small distinct areas off of Puerto Rico and the U.S.V.I. to bottom longline gear, year-round. The purpose of these closed areas is to protect essential fish habitat of reef-dwelling species. A final rule implementing these closed areas is anticipated in the fall of 2006. These areas are defined in § 50 Part 622.33 (a) of the CFR.

The Northeast Distant Statistical Sampling Area (NED) (2,631,000 nm2), which had been closed year-round (per regulations at 50 CFR part 223 and 635) for the period 2001 through July of 2004, has since been reclassified as a gear restricted area leading to benefits for white marlin by reducing bycatch and PRM in the northern portions of its range. Pelagic longline vessels may only fish for highly migratory species in this area if they observe strict circle hook and bait restrictions and use approved sea turtle release gear in accordance with the release and handling protocols. Outside of the NED, the U. S. HMS PLL fishery is required to use circle hooks with certain bait combinations, depending on the region, as well as the required, approved sea turtle release gear and release and handling protocols. NMFS published a proposed rule on March 26, 2006 (71 FR 15680) that would require participants in the Atlantic shark bottom longline fishery to possess, maintain, and utilize the same equipment and follow the same protocols for the safe handling and release of sea turtles and other protected species as required in the pelagic longline fishery. A final rule implementing these measures is expected in the fall of 2006.

The goals of these time/area closures are varied; their effectiveness in reducing white marlin bycatch has not yet been assessed. However, the removal of longline fishing pressure from these areas may have resulted in ancillary benefits to many bycatch species such as white marlin.

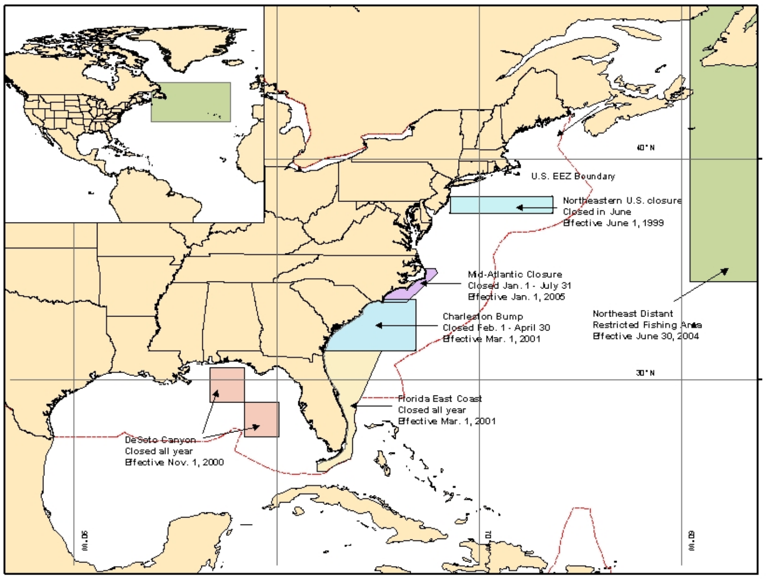


Figure 7. Current time/area closures in highly migratory species fisheries. Inset shows extent of the Northeast Distant (NED) restricted fishing area. All closures except the Mid-Atlantic are applicable to pelagic longline gear only. The Mid-Atlantic Closure is applicable to bottom longline gear only. Note: the NED was a closed area to all vessels beginning in 2001, it later became the NED Restricted Fishing Area on June 30, 2004 when it was opened to pelagic longline vessels limited at all times to possessing and/or using only 18/0 or larger circle hooks with an offset not to exceed 10 degrees.

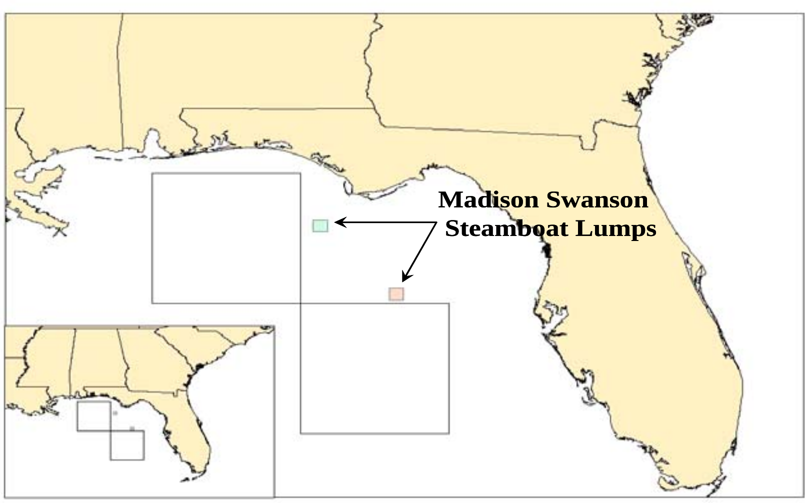


Figure 8. Location of the Madison-Swanson (upper left) and Steamboat Lumps (lower right) marine reserves in the northern Gulf of Mexico. The Desoto Canyon closure (larger box outlines) is also shown for reference.

d) Unreported Fishing

Illegal, unreported, and unregulated (IUU) fishing activities affecting tunas and tuna-like fishes, including marlins, in the ICCAT convention area have been a source of concern within ICCAT for many years. The Commission has adopted several Recommendations to attempt to combat this activity and continues to seek ways to eliminate this fishing. Although direct estimates of IUU catches are seldom available, monitoring of import and export statistics has been used to identify IUU catches for certain species of Atlantic tunas. As species such as white marlin are taken as bycatch in fisheries harvesting bigeye, there are likely IUU catches of white marlin (and other species).

IV. ICCAT Stock Assessments

This BRT examined a series of stock assessments put forward by the Standing Committee for Research and Statistics (SCRS) of ICCAT. The previous SRT had available the final documents from the 2000 assessment, and draft documents from the 2002 assessment. The current BRT reexamined the 2000 and 2002 assessments (now final), and examined the results from the 2006 assessment. ICCAT's 2006 assessment meeting was held in May 2006. A working group of about 20 scientists from ICCAT member nations participated in developing the assessment. Prior to the 2006 assessment, there was a data preparatory meeting in May 2005 (Natal, RN Brazil) and an international billfish symposium in November 2005 (Catalina Island, CA United States) that set up many of the recent findings for use at the 2006 assessment (SCRS/2005/10; Bulletin of Marine Science Volume 79). Papers from these workshops, symposia and other ICCAT papers from between assessments were also examined by the BRT.

A special effort was made by ICCAT prior to the 2006 meeting to obtain catches from countries not previously reporting. Controversy continued about interpretation and standardization of Catch per Unit Effort (CPUE) time series, attracting a considerable amount of analysis and simulation effort by the ICCAT participants. Those efforts were largely unsuccessful in making new progress toward international consensus on CPUE. As a result, the assessment working group elected not to reevaluate population benchmarks from the previous assessment. Instead, the 2006 assessment concentrated on evaluating recent population trends (~post-1996), and looking for possible impacts of the new ICCAT catch restrictions. Population status and trend estimates were extended to the start of 2006.

A. Available Data

ICCAT compiles data from the fishing nations on catch, effort, and catch rates. The SCRS scientists examine those compilations, perform any calculations needed to fill gaps, and from that work form a set of data believed to be the best available. Like its predecessor, this BRT accepts the SCRS workshops' decisions about catch data as the best available at the time of each assessment. For the 2006 assessment, data were available from 1956-2005, although 2005 was considered preliminary, and possibly incomplete. The catch data are collected in extensive tables in the ICCAT billfish report (SCRS/2006/12).

There are clear limitations on the accuracy of the catch data base. Not all nations have reported white marlin catches every year. Therefore, for many entries in the final catch estimates, catches were computed from ratios of white marlin to target landings, or from ratios of white marlin in unclassified landings taken from other sources. Catches from several west African countries have been newly added to the catch tables; others have yet to report, but that there is some catch is almost certain. As stated previously, misidentification of species also occurs. There are no appreciable data to separate catches of roundscale spearfish from white marlin. Additionally, some fish classified as white marlin in the field, were actually genetically identified as blue marlin (presentation to BRT by M. Shivji). There seems to be some lingering concern in SCRS that Portugal's marlin catch reports may include swordfish. Some of the high seas longline nations have ceased to record billfish released alive in their logbooks. As a substantial fraction of individuals might die post-release, this creates a new data gap, and ICCAT has called for corrective action in reporting, preferably by increased observer coverage.

CPUE time series are available from a number of fisheries in the Atlantic. Seven of them (from 5 different countries) are considered by SCRS to be of sufficient spatial and temporal extent to warrant bringing them into the stock assessment analysis. There seems to be little controversy about the reliability of the nominal data, but serious controversy exists among the different nations about proper analysis and interpretation to infer population trends from the CPUE data. No single series covers all relevant years, at least without substantial analytical adjustment. Clearly, the different fisheries have changed over the years with respect to the spatial distribution of effort and the specific fishing techniques used. As a highly migratory species, no doubt the spatial and season patterns of white marlin distribution have changed over time as well. Recent regulations have also probably affected CPUEs. The target species have changed in some fisheries for which marlin are largely a bycatch. All this makes for a very complex 'standardization' problem, to extract an index from one or more CPUE series that may have a realistic chance of varying in proportion to actual abundance (i.e. that has a constant catchability, usually denoted as 'q', over time).

Analytical approaches for standardizing CPUE are often based on General Linear Models (GLMs), and most of the ICCAT efforts for white marlin are based on GLM or some variant thereof. There are numerous ICCAT documents addressing individual CPUE time series, and analyses to derive combined indexes from multiple time series. Some of the analyses combine separate series within a country to extract a standard series for that country. Other analyses attempt to combine indexes across countries. The idea is to extract a common signal from multiple indexes, presumably tracking abundance, separating that signal from local effects and noise. Over the years, the analyses considered have varied the factors included, but most have been consistent in showing a generally declining trend over years. Japan has had a different perspective, arguing that most of the CPUE decline for white marlin in high seas longlining is in fact due to changes in fishing practices that have reduced the 'efficiency' of the gear as an agent for white marlin removals. They have developed a standardization approach referred to as 'habitat based standardization' (HBS). This approach largely focuses on the vertical distributions of marlin and the longline hooks, with the marlin distribution predicted from vertical profiles of temperature and archival tag data, and longline hook distribution predicted from characteristics of the gear.

ICCAT works by developing international consensus, and consensus has not been reached on the CPUE analyses. Work continues, including a major workshop addressing longline CPUE in February 2007 (Hawaii), for which a draft report was made available to the BRT. This workshop was Pacific-sponsored and featured mostly Pacific species, but many of the issues and discussions also apply to the Atlantic fishery. All issues and decisions needed for CPUE analyses were on the table, but the overriding issue in the Pacific was the same as in the Atlantic: virtually all the analytical variants returned similar population trends and led to similar management advice, except for the Japanese HBS analysis.

One approach to addressing the differences between Japan and everyone else has been to develop simulated data series (i.e. with known abundance trends, distributions, and efficiencies similar to what is believed for real stocks), and test the ability of the different analytical techniques to return the known abundance sequence (Goodyear, 2006). To date, neither the non-HBS GLM approaches nor the HBS approach have been very successful. Work continues, but at least part of the problem appears to stem from efficiency assumptions provided by the Japanese and built into the simulation, where nominally identical gear has large efficiency differences in adjacent years. Not surprisingly, none of the models can resolve that inconsistency.

In order to initiate an age-structured assessment model, some progress has been made since 2002 toward age determination capability (Drew et al., 2006b). However, the research has not yet resulted in a reliable age determination procedure. Even when and if that research succeeds, it may take many years to build a data set of catch at age samples of the several fisheries.

There are no data available from fishery-independent sampling programs with which to characterize the abundance or demography of white marlin. Given the geographic range of marlin, it is most unlikely that developing a fishery-independent program for abundance trends would be productive.

B. Modeling Approach for the 2006 Assessment

The ICCAT assessment group concluded that no real progress had been made on the longline CPUE controversy, and decided to consider only a shortened data stream and a restricted scope of analysis in 2006. In effect, the longer term assessment from 2002 was allowed to stand, and the benchmarks from that assessment remained the basis for comparing 2006 population status with potential standing stock and production. As the CPUE controversy is largely related to assessing trends from the 1960s through the 1970s, the CPUE inputs to the shortened time series examined in 2006 are not as controversial.

Without time series data on catch by age or life stage, the quantitative modeling techniques available to estimate absolute biomass and fishing mortality rate trends fall under the heading ‘production models.’ The underlying structure of a production model (shown here is the Schaefer or ‘logistic’ formulation) is:

$$dB/dt = rB(1-B/K)-C$$

where K is the carrying capacity, r is the intrinsic rate of population growth, C is catch, B is stock biomass, and dB/dt is the rate of change in B with time. All variables are expressed as weight. Most models also translate catch and biomass results into a fishing mortality rate estimate, denoted by F. Three variants were considered in 2002, but for 2006 the assessment group settled on the Bayesian Surplus Production (BSP) approach originally introduced to ICCAT by McAllister & Babcock (2003). That model was modified for 2006 so that it could accept either a single composite CPUE, or several indexes simultaneously, with options for weighting. Babcock submitted a paper to the 2006 session (SCRS/2006/064) exploring the effects of using multiple indexes (with three weighting techniques), and of using each index individually. To separate the effects of the methods changes from data changes, she used data from 1959-2000 in this exploration (i.e., the data available for the 2002 assessment). Results are shown in Table 12. With the increased flexibility added to the Bayesian model, the capabilities of the other two models used previously were deemed no longer needed.

At the ICCAT assessment workshop, the BSP model was fitted to catches and CPUEs from 1990-2005. [Biomass in 1990]/K was constrained to have a similar median and variance as the 2002 assessment. The prior on the intrinsic rate of increase (r) was the same as used in 2002. The prior on K was uniform on the log scale.

The analyses variants investigated included different choices of prior distributions to check sensitivity inclusion of CPUE indexes individually, and inclusion of seven indexes simultaneously. For cases with seven indexes simultaneously, a decision about relative weighting among the indexes is required. The assessment considers equal weighting and weighting by catch. In addition, Babcock (2006) outlined weighting by precision, but the assessment workshop appears not to have considered it.

Table 12. Abridged results from Babcock Table 2 (SCRS/2006/064) for new version of Bayesian surplus production model to fit data available in 2002. Entries are central tendency with associated coefficient of variance in parentheses. Biomass (B) and fishing mortality rate (F) are 2000 values. Index designators refer to weighting technique: MLE is based on precision, C is based on catch, and EQ is equal weighting. JAP LL hooks refers to Japanese data not subjected to their HBS analysis. One set of three runs was done omitting Japanese data ("no" set). Interestingly, K values are all similar. The r values estimated depend on the choices of weighting among the indexes. B/K and F/Fmsy likewise are quite sensitive to the choice of weighting among the indexes. Modeling the population by including the Japanese HBS index suggests the fishery has had minimal impact on the stock. Somewhat surprisingly, with each index entered separately, the model returned a stock in much better shape in terms of B/K, and more productive in terms of r, than when all the indexes are used together.

	B/K	r	K	F/Fmsy
With multiple indexes				
MLE JAP LL hooks	0.14 (0.21)	0.07 (0.29)	52584 (0.13)	5.03 (0.26)
C JAP LL hooks	0.67 (0.51)	0.33 (0.78)	54823 (0.37)	1.53 (2.51)
EQ JAP LL hooks	0.13 (0.30)	0.07 (0.30)	51260 (0.15)	5.46 (0.35)
MLE no JAP LL	0.15 (0.22)	0.07 (0.29)	50698 (0.15)	4.50 (0.26)
C no JAP LL	0.91 (0.09)	0.49 (0.52)	53578 (0.41)	0.16 (2.36)
EQ no JAP LL	0.17 (0.27)	0.07 (0.31)	52105 (0.15)	4.05 (0.30)
MLE JAP LL HBS	0.16 (0.32)	0.07 (0.46)	54810 (0.15)	4.39 (0.28)
C JAP LL HBS	0.94 (0.04)	0.50 (0.51)	63751 (0.32)	0.10 (0.58)
EQ JAP LL HBS	0.96 (0.03)	0.58 (0.46)	68681 (0.28)	0.08 (0.64)
With single indexes				
JAP hooks	0.51 (0.74)	0.28 (0.82)	47379 (0.39)	3.63 (2.08)
JAP HBS	0.94 (0.04)	0.51 (0.49)	59431 (0.37)	4.39 (0.28)
TAI LL	0.85 (0.27)	0.48 (0.60)	57610 (0.36)	0.39 (2.66)
VEN rec	0.93 (0.06)	0.50 (0.49)	54933 (0.39)	0.13 (0.96)
USA rec	0.89 (0.17)	0.48 (0.53)	50450 (0.44)	0.27 (3.65)
USA LL	0.44 (0.83)	0.28 (0.73)	39503 (0.41)	2.03 (0.88)

C. Results from the 2006 Assessment

Figure 9 shows the raw 'Task 1' data summed over all countries reporting, along with the results of catch adjustments made by the assessment working group. Figure 10 shows only the most recent catches, broken out by country. Reported catches of industrial fisheries have been reduced since ICCAT called for reduction. Reduction has not reached the target of 33% of late 1990s level. In 2004 (the most recent data available to BRT), total catches were reduced to 45% of 1996 values (ICCAT 2006 Table 5).

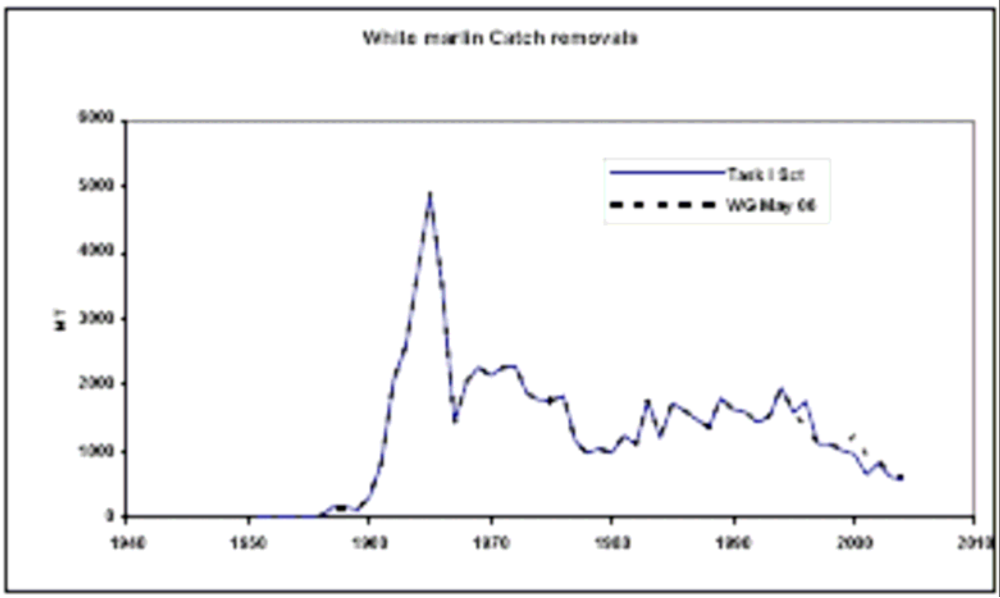


Figure 9. Results of the white marlin Task 1 catches, and WG adjusted catches. Source: ICCAT 2006, Figure 4.

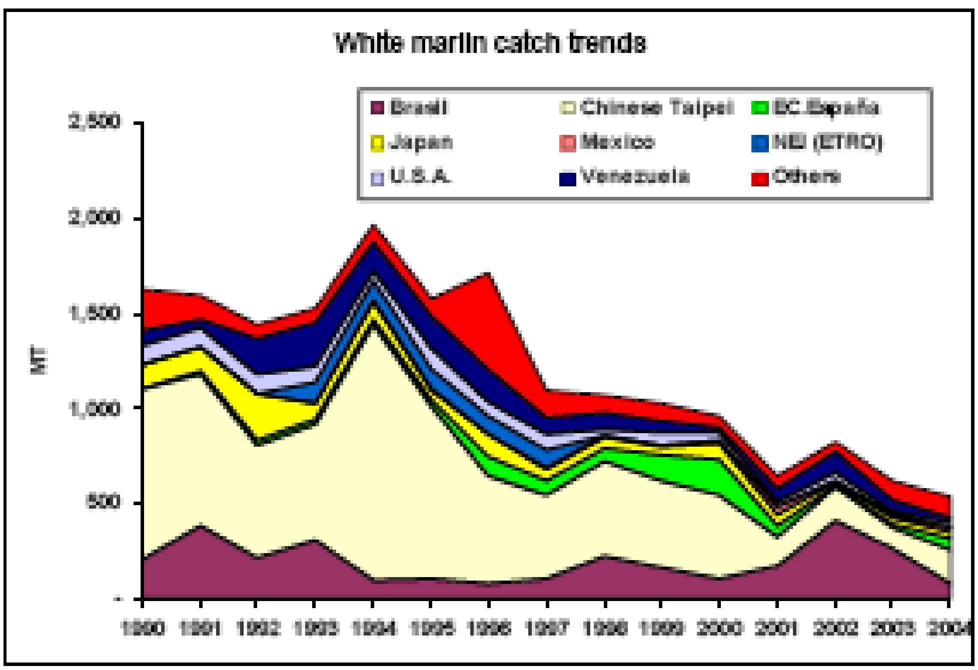


Figure 10. Recent white marlin catches, by country. Source: ICCAT 2006, Figure 1.

Seven CPUE indexes for separate fisheries were featured by the working group, and ultimately used in the production model. Of these seven, two show an increase from 2001-2005, the other five are fairly flat (Fig. 11). Participants from the U.S. delegation told the BRT that the summary report corrected some small errors found after preparation of the full report, so the graph from the summary report is used here. Appendix 6 of ICCAT SCI-12/2006 has results of several different CPUE standardization models for combining data from (up to) four longline fleets into single indexes. Some of the figure legends do not describe all the curves included, so the results were not clear in every case. However, most of the analyses tended to agree qualitatively on an upturn in composite CPUEs in the most recent years; the indices differed in how much, and the extent of the confidence intervals. The indexes central tendency only for three analytical treatments selected by the assessment working group of the four longline data sets are shown in Figure 12.

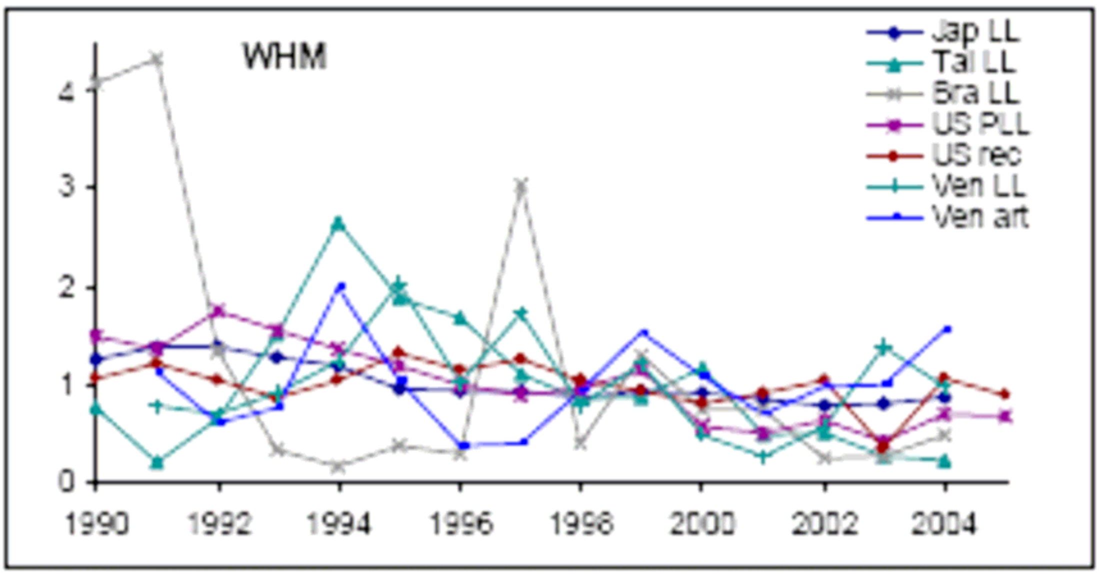


Figure 11. Catch per unit effort indexes by individual fishery from 1990 – 2004 for white marlin. Source: ICCAT 2006, Figure 3.

The ICCAT assessment working group did not specify a single base case, but it appears to have selected the equal weighting case and a non-HBS version of Japanese longline CPUE for its main figure, shown here in Figure 13. Figure 14 compares the results from the base case of the 2002 that was updated in 2006. The estimated track of the population for the last few years no longer follows the downward trend seen in the 2002 assessment. An abridged version of the tabled results from the several analytical cases is shown here as Table 13. The new data lead to population status estimates more favorable than the 2002 assessment suggested. Innate productivity (r) comes out slightly higher, but well within the range of expected variability. B/K is more favorable across the board, and F/Fmsy comes out on both sides of 1, depending on analytical choice.

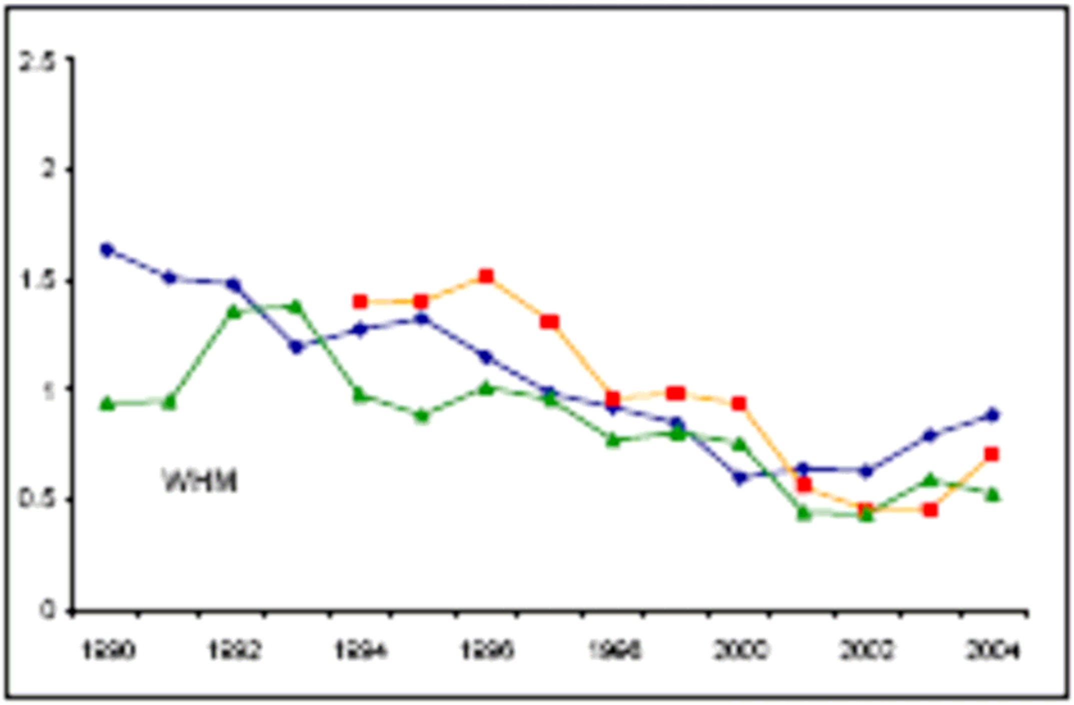


Figure 12. Composite catch per unit effort (CPUE) indexes for white marlin from three analytical treatments of longline CPUE data from 1990-2004. Source: ICCAT 2006, Figure 4. Notably, the ICCAT figure did not identify which line was treatment.

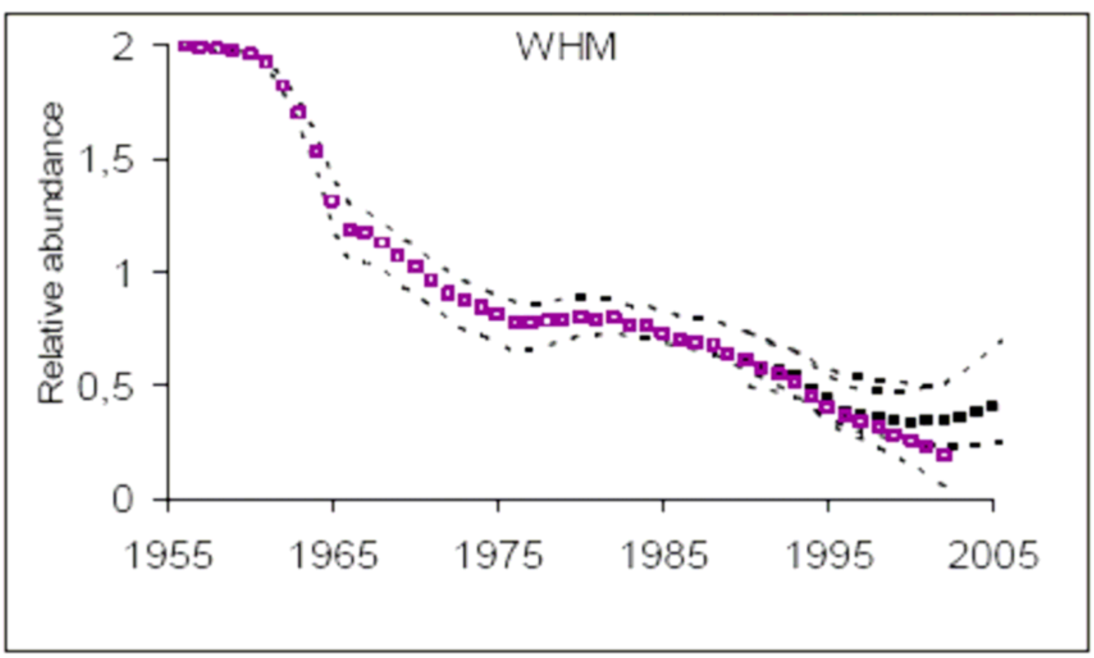


Figure 13. Comparison of population trend from 2006 ICCAT assessment with 2002. Solid squares are 2006 assessment; open are 2002. Dotted lines are 80% confidence intervals. Source: ICCAT 2006, Figure 5.

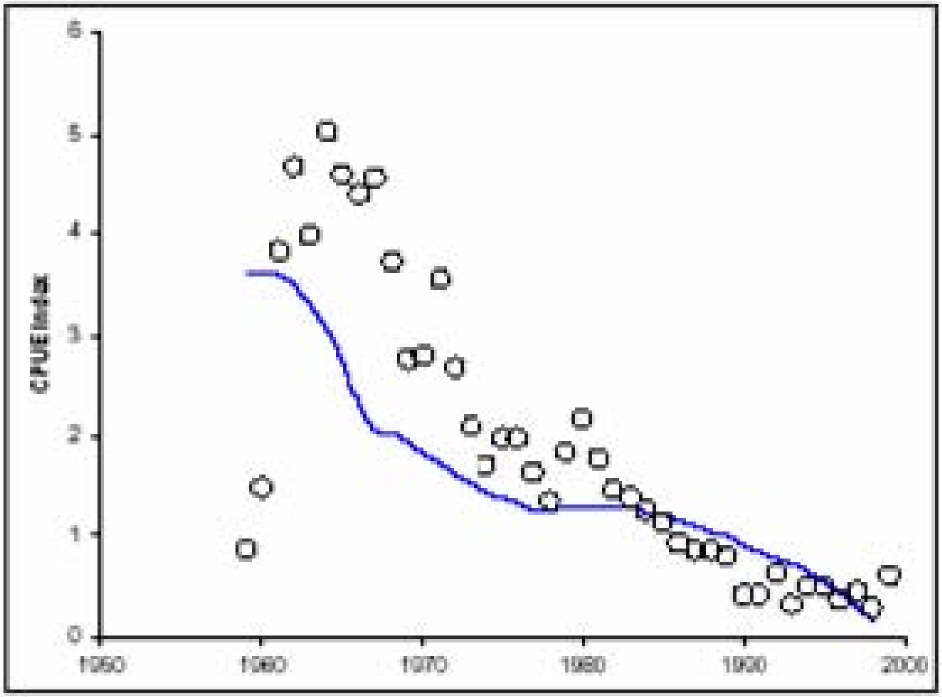


Figure 14. Fit of the biomass dynamic model to the combined catch per unit effort (CPUE) index for Atlantic white marlin 1960-2000. Source: White Marlin Status Review Team. 2002. Figure 6.

Table 13. Abridged results from the full 2006 ICCAT assessment of white marlin. Entries are central tendencies and (coefficient of variation). B/K and F/Fmsy refer to 2006, except for the 2002 assessment line, which is based on 2002. Original and Working Group (WG) catches refer to Task 1 data and the WG re-estimations of some of the catches, respectively. Only equal and catch weightings were presented - precision weighting was not presented or discussed. Source: SCI-012/2006; Tables 12 and 13. Notably, there were no entries comparing the C WG catch runs with the 2002 benchmarks.

	B/K	r	K	F/Fmsy	B/K-02	F/Fmsy-02
2002 Assessment	0.12 (0.65)	0.15 (0.31)	36210 (0.17)	5.83 (0.85)		
EQ Orig catch	0.23 (0.47)	0.22 (0.53)	30834 (0.36)	0.98 (0.54)	0.35	1.44
EQ WG catch	0.20 (0.31)	0.19 (0.42)	32338 (0.32)	1.07 (0.37)	0.35	1.38
C WG catch	0.85 (0.27)	0.50 (0.55)	47057 (0.51)	0.26 (4.07)		
C WG catch alt r prior	0.42 (0.58)	0.15 (0.31)	55574 (0.35)	1.27 (2.17)	1.43	1.25

ICCAT's assessment working group expressed a cautious optimism that the downward trend in abundance has ended, and that this stabilization or reversal may be due to the ICCAT catch restrictions. The ICCAT assessment team stated that at least an additional 4-5 years of data are necessary to confirm an upward trend. In addition they recommended that, as a minimum, existing management measures be continued, and believe that white marlin can rebuild to MSY under existing restrictions.

D. Review of Previous Assessment Results

Because the assessment working group elected to keep the benchmarks from the 2002 assessment, and because not all analyses discussed in the 2002 SR were updated in 2006, this BRT decided to include a brief recapitulation of the evidence relevant to population status in 2002.

The CPUE controversy (Japan vs. others) dominated discussion at ICCAT in 2002, but a Japanese assessment document based on an earlier version of HBS did not produce a credible assessment. The other nations acknowledged and carried forward the Japanese results, but largely ignored them in establishing a best case for the entire history of the fishery. The 2002 SRT accepted this interpretation, and noted that CPUE overall had fallen to less than 10% of its initial value.

The base case scenario did give some credence to the Japanese position of change in efficiency in the longline fishery over time, however. Figure 13 shows the fit between the composite CPUE and population size estimated in 2002. Clearly, the two series do not parallel each other, indicating a possible change in efficiency of fishing effort.

Sensitivity to analytical approach was also highlighted in 2002. Figure 15 shows the range of B/K estimates obtained in some 33 formulations of production models in 2002. The highest values come from the discounted HBS-type analysis. The accepted values clustered around B/K (B in 2000) just above 0.1.

The 2002 SRT paid careful note to the apparent downward turn in biomass, but not CPUE at the end of the time series as shown in Figure 15. This by necessity coincided with a sharp upturn in fishing mortality rate (F). The 2002 SRT concluded these features were probably analytical artifact, because the presumed spike in F did not parallel available fishing effort statistics, and the biomass estimates did not track short term CPUE variation very closely, either. The 2006 results are consistent with the 2002 SRT interpretation.

Porch did not update his 2002 ‘first cut’ at age structured modeling. The 2002 SRT treated the results as ‘secondary’ information, based on the limitations to the approach as Porch explained them. As the full time series of CPUE was not revisited in 2006, Goodyear’s B/Bmsy estimates were not revisted either. Nothing has arisen since to contradict the general pictures extracted from these reports.

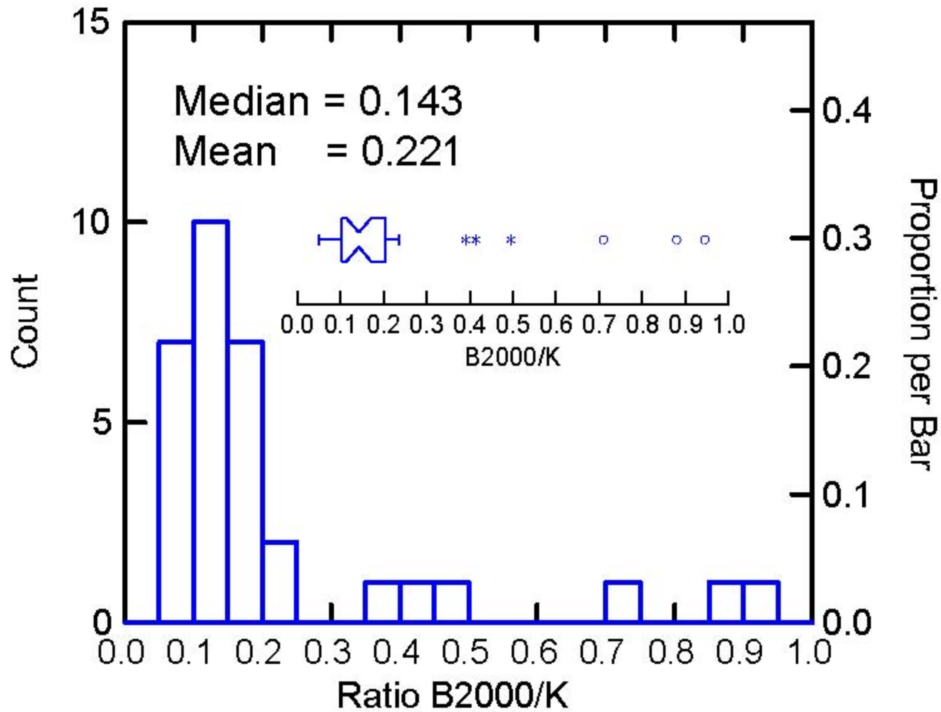


Figure 15. Ratios of biomass in 2000 to K in 33 alternative formulations of production models used for white marlin in the 2002 SCRS stock assessment. Note that the model runs did not provide an unbiased set of model simulations with respect to likely B2000/K ratios. Rather, these results document the range of model outcomes examined and the frequency of occurrence of particular outcomes. Source: White Marlin Status Review Team. 2002, Figure 12.

E. BRT Evaluation of white marlin stock assessment

The BRT notes that many of the limitations cited about catch data accuracy could operate on stock status in either direction. Moreover, the existence of inaccurate catches does not imply that the true exploitation rate is proportionally higher or lower than the rates estimated (e.g., added catches may cause an increase in the estimated population size in some assessment models). On the whole, the BRT believes that unless the four or five top nations have significantly misreported, the catch data limitations are unlikely to cause qualitative inaccuracy in assessment.

White marlin catches have not been separated from any roundscale spearfish mixed in, and it is very unlikely that separations could ever be made in the historical data even if a program began immediately to separate the species in future catches. Realistically, all ICCAT white marlin stock assessments have included the roundscale spearfish, and identifying differences in the species' spatial distributions will probably be the main factor in determining population abundance of each species. There is no indication that the proportion and distribution of roundscale spearfish in the white marlin commercial catch reports have changed over time; therefore, the BRT adopts the interpretation and conclusions of the 2006 stock assessment.

The BRT understands the need to continue work on reducing the controversy over longline CPUE analysis, but believes that the HBS line of inquiry may prove unproductive, and should largely be ignored for BRT purposes. HBS requires extensive data, and the mismatches in scales (and durations) of data available appear to be serious impediments to ever reaching a meaningful application of the method. We also took note of the frequent searches to depth performed by white marlin tagged with depth-recording tags as described by Prince et al. (2005) and Horodosky et al. 2007. Although spending most time at or near the surface, the individual fish clearly explore large depth ranges in the water column, and thus the presumed properties addressed via depth-driven HBS may not actually be very relevant. We suspect that changing the line of inquiry toward investigating changes in geographic distribution over time might be more productive in improving CPUE standardization. On the other hand, certainly the change in fishing practices roughly coinciding with a change in primary interest from yellowfin to bigeye in the 1970s could have been very significant in changing white marlin catchability, and the western-style standardization analyses may not be capturing all of that change; see also Serafy et al., 2004. Figure 6 in the 2002 SR (reproduced here as Fig. 14) shows as much, with the mismatch between CPUE and production model-estimated biomass very consistent with a 'changing q' picture. Figure 14 also implies that the production model, by estimating a biomass track different than the CPUE track is actually accounting for at least some of the change. One might also take note of the qualitative similarity between Figure 14 in the 2007 SR (reproduced from Fig. 6 in 2002 SR) document and Figure 13 in Ortiz, 2006. In any case, by excluding the HBS results, the BRT is being conservative regarding possible risk to the stock – we are setting aside only the most optimistic scenarios of a stock little impacted by fisheries.

Initially, the BRT was concerned about comparing F and B from the shorter time series with benchmarks from the longer series of 2002. One usually uses ratios from the same analysis in belief that these are often more stable to data and analytical changes than the individual values are. However, both the internal and external ratios are reported from at least some of the model runs, and there do not appear to be any problems. The degree of sensitivity to weighting choice was a bit surprising, in that reasonable cases can be made for any of the three weightings suggested. However, the real source of the sensitivity is the differences among the indexes. The weightings are simply favoring some indexes over others in extracting a common trend.

The BRT agrees with the cautious optimism expressed in the ICCAT reports. Real catch reductions appear in the data. Regulations have been and are being implemented. Combined CPUEs are now largely stable or increasing. The new regulatory measures may well be having some success. We are uncertain that the new measures are the principal cause of the stabilization. It may be that either a large number of year classes in the population and/or surprisingly stable recruitment from year to year occurred concurrently for the CPUEs to respond to this extent in such a short time period. Nevertheless, it seems clear that the long-term downward trend seen in the 2002 results did not continue. The analytical treatment that appears to be favored by the ICCAT working group is the least optimistic in terms of B/K, but still above the 2002 estimate. The other analytical treatments lead to more optimistic values, so there seems to be a minimal chance of a hidden, elevated risk to the population due to analytical choices. The BRT concludes that it is likely that under the current management regimes, that it likely that the white marlin stock will remain stable or continue to increase.

V. Analysis of the ESA section 4(a)(1) Factors

The ESA requires us to determine whether any species is an endangered or threatened species because of any of the factors specified in section 4(a)(1). The following is an analysis of these five factors as they relate to the current status of the white marlin.

A. Present or threatened destruction, modification, or curtailment of its habitat or range.

1. Curtailment of range

a) Atlantic Ocean

Annual ICCAT white marlin catch distributions (1950s-2000s) show no evidence of range contraction (Fig. 16). This is further substantiated by the historical distribution of ICCAT longline fishing effort resulting in the catch of white marlin (Fig.17).

b) Western North Atlantic

The Massachusetts Division of Marine Fisheries (MDMF) has collected catch and effort information at all recreational fishing tournaments that target highly migratory species. Figure 18 shows the number of white marlin caught and the CPUE by recreational tournament fishermen in the waters off southern New England from 1987 to 2005 (G. Skomal, MDMF, pers. comm.). Inter-annual fluctuations in white marlin abundance are likely related to environmental, biological, and ecological factors in this region. According to the MDMF (G. Skomal, MDMF, pers. comm.), in general, CPUE for white marlin in southern New England has been low throughout the time series (with the exception of five years: 1987, 1988, 1994, 1995, and 1998) ranging from 0.1-1.0 white marlin/100 boat hours. In recent years, CPUE fluctuated between 0.3 to 0.9 fish/100 boat hours; however, in 2005, the CPUE increased to 1.7 fish/100 boat hours. This represents a five fold increase from 2004, is the highest CPUE since 1998, approaches the 19-year time series average of 2.1 fish /100 boat hours, and approaches the 23-year average reported by NMFS in 1995 for the Northwest Atlantic, Gulf of Mexico, and Caribbean Sea (1.9 fish/100 boat hours) (G. Skomal, MDMF, 2007 pers. comm.). According to fishing reports and program observations, white marlin were caught in the offshore canyons in 2005. This is in contrast to the other years with high marlin catches in which the fish typically moved onto the shelf.

Conclusion: There is no evidence of range contraction for the white marlin.

Figure 16. Average annual catch distributions of white marlin by 5° by 5° block, by period noted above. Source: Reproduced from ICCAT Biennial Report (2007).

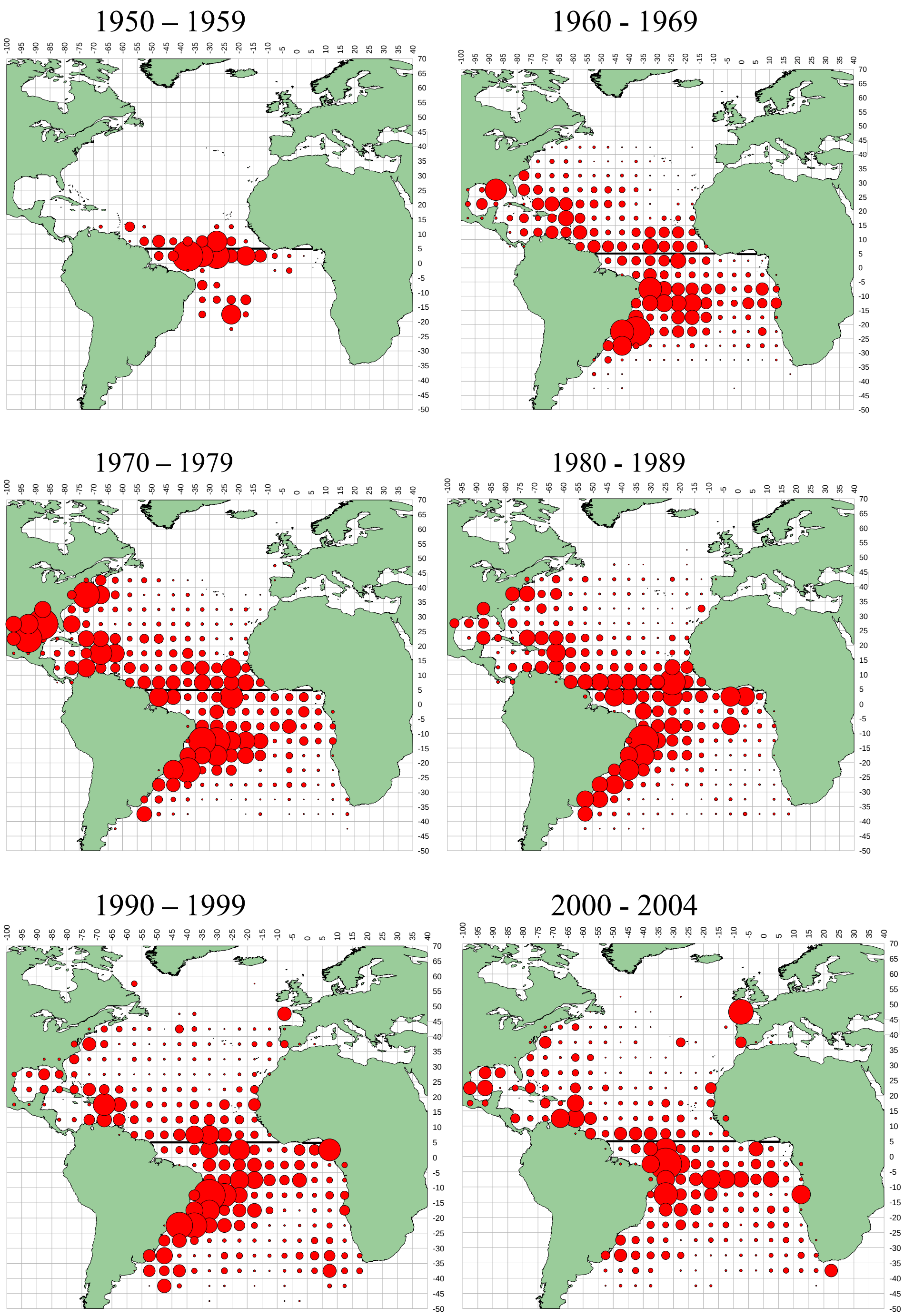


Figure 17. Distribution, by 5° by 5° block, of longline fishing effort that resulted in white marlin catch by decade note above. Source: Reproduced from ICCAT Biennial Report (2007).

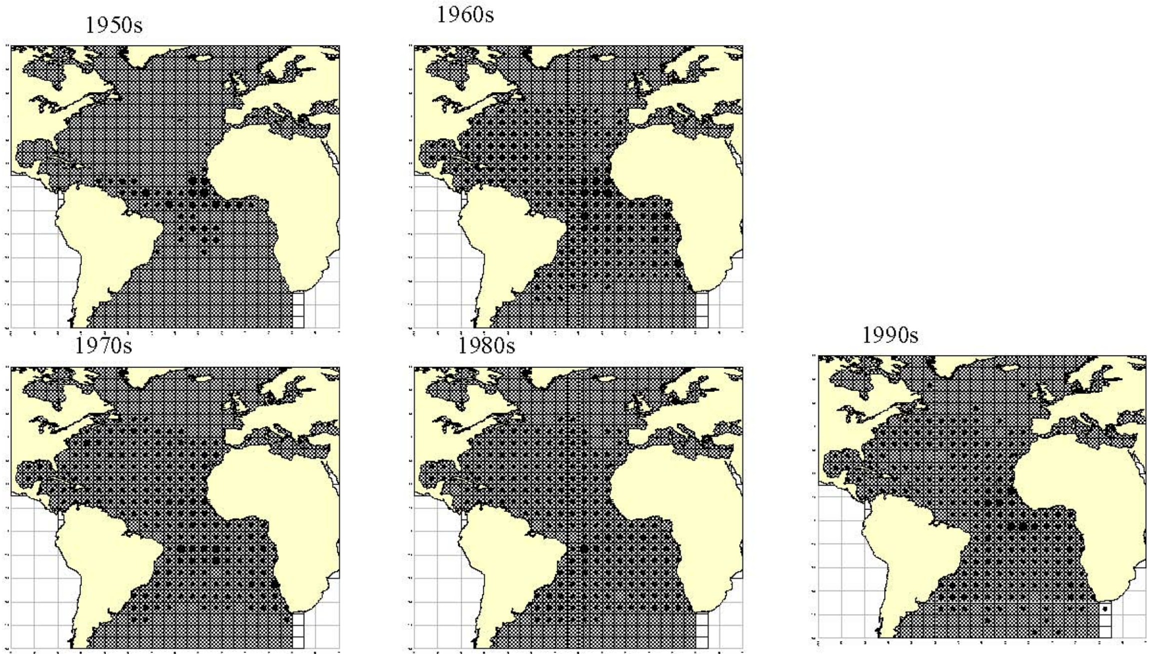
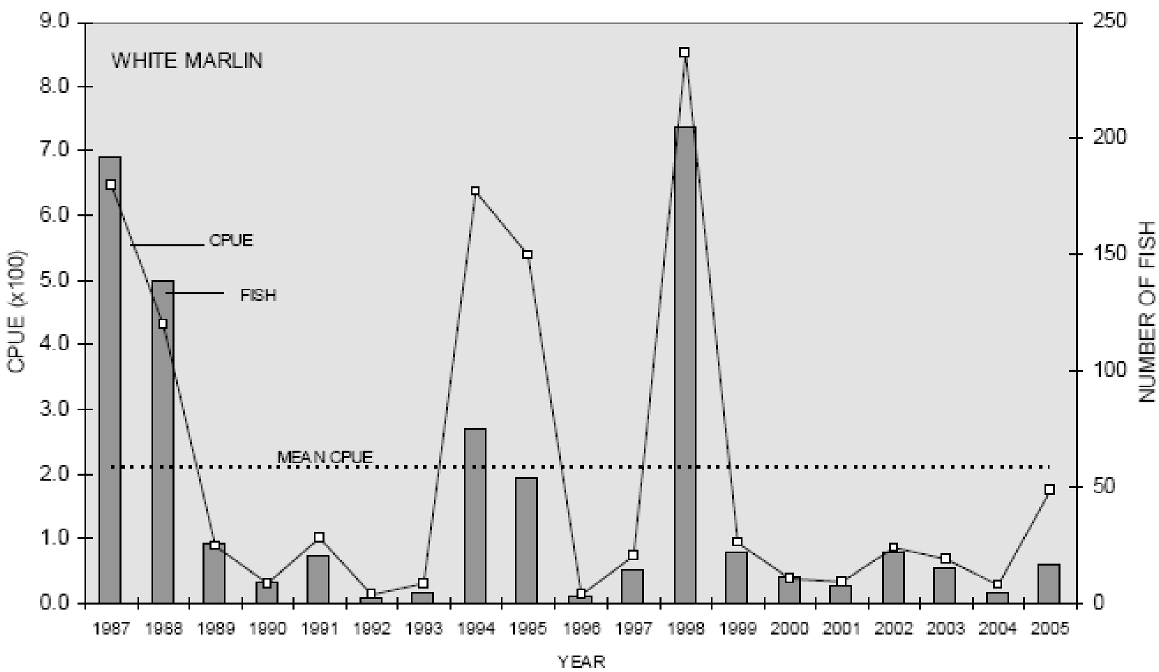


Figure 18. Annual recreational tournament white marlin catch from the waters off southern New England 1987 – 2005. Catch per unit effort (CPUE) is indicated by the solid line, bars indicate number of fish.



2. Destruction or Modification of Habitat

In the U.S., the Final Consolidated Atlantic HMS FMP describes and delineates essential fish habitat for white marlin and discusses fishing and non-fishing activities that may adversely affect that habitat. Based on an initial assessment, NMFS indicates that no evidence exists to indicate that fishing methods for billfish have any impact on billfish habitat. It is unlikely that other fishing activities affect marlin habitat but there are no data to indicate such. The FMP suggests that *Sargassum* sp. may provide important refuge habitat particularly for early life stages of white marlin (NMFS, 2006). However, more information is needed before *Sargassum* sp. can be delineated as essential fish habitat (EFH) for this species. It is important to note that commercial harvest of *Sargassum* sp. in the U.S. is restricted by the final SAFMC FMP (NMFS, 2006), which may provide ancillary benefits to white marlin.

The EFH regulations require that FMPs identify non-fishing related activities that may adversely affect EFH of managed species, either quantitatively or qualitatively, or both (NMFS, 2006). Potential effects of anthropogenic activities on billfishes were discussed in de Sylva et al., 2000. Broad categories of activities that may adversely affect HMS EFH include, but are not limited to: 1) actions that physically alter structural components or substrate (e.g., dredging, filling, excavations, water diversions, impoundments and other hydrologic modifications); 2) actions that result in changes in habitat quality (e.g., point source discharges); 3) activities that contribute to non-point source pollution and increased sedimentation; 4) introduction of potentially hazardous materials; or 5) activities that diminish or disrupt the functions of EFH. For white marlin, water quality degradation is possible as a result of mining and offshore oil and gas operations in the Gulf of Mexico, as well as industrial coastal development. Billfish are known to congregate over submarine canyons whose features may provide for redistribution of contaminants from nearshore areas to offshore habitats (NMFS, 1999). We have found no data, and are aware of no data that indicate what effects offshore activities may have on the status of this species.

In a study conducted by Prince and Goodyear (2006), depth distributions of tropical pelagic marlins, sailfish, and tunas in the eastern tropical Pacific (ETP) and the western North Atlantic are compared. There is intense nutrient upwelling in the ETP study area, and as such, the area is characterized by a cool, shallow thermocline, high surface chlorophyll concentrations, and hypoxic conditions below the thermocline (Prince and Goodyear, 2006). In contrast, the western North Atlantic area is characterized by a large, warm surface layer, deep thermocline, low surface chlorophyll concentrations, and dissolved oxygen concentrations exceeding 4 parts per million for depths less than 300 meters (Prince and Goodyear, 2006). According to Prince and Goodyear (2006), the most significant difference between the two study areas is with the dissolved oxygen profiles. The researchers found that the cumulative depth frequencies indicated Atlantic white marlin and sailfish utilized the deeper areas of the water column for longer periods of time than their counterparts in the Pacific. In both study areas, billfish spent approximately 70% of their time in depths less than 50 m; however, Pacific fish spent significantly more time (greater than 90%) in this stratum as compared to fish in the Atlantic study area (70-75%) (Prince and Goodyear, 2006). They also found that most Atlantic billfish (80-85%) dove below 50 m at least once during each 6-hour period while only 35-47% of the Pacific billfish dove beyond this depth. The marlins were restricted to much shallower areas in the Pacific than in the Atlantic and this persisted over the study duration (Prince and Goodyear, 2006). The authors concluded that the cold hypoxic environment present in the ETP constitutes a lower habitat boundary and restricts fish to a shallow band near the surface; thus, potentially making them more vulnerable to over-exploitation by surface gears (Prince and Goodyear, 2006). Information from this study indicates that white marlin habitat in portions of the western North Atlantic is not restricted due to dissolved oxygen concentrations and that appropriate habitat is available, which allows the species to disperse throughout the water column.

Conclusion: The BRT concludes that the geographic range of white marlin has not been curtailed. Further, the BRT has found no evidence of white marlin habitat destruction or modification.

B. Overutilization for commercial, recreational, scientific or educational purposes.

The ESA contains no guidance on how to assess overutilization. Further, the statute does not outline levels of population decline relative to an endangered or threatened status. This makes sense, as it unlikely that any single set of criteria would fit all circumstances, even for marine fish alone. The 2002 SRT examined the literature, and invited presentations from experts (American Fisheries Society [AFS] and USFWS) on criteria for status evaluation, with the intent of extracting extinction risk considerations specifically for white marlin. They developed a set of criteria based on six population dynamics considerations they felt could be considered:

1. Decline in population
2. Absolute population size
3. Recruitment: trends and variability
4. Spatial focusing
5. Depensation considerations
6. Formal modeling of probability of extinction.

Further, the 2002 SRT discussed more specific criteria for each item. Herein, the current BRT reviews and incorporates the 2002 criteria. For the purpose of the 2007 status review, the BRT considered total removals as estimated by the SCRS in this overutilization section; that is we did not separate overutilization by user group. Notably, for the purpose of these estimates, recreational and scientific removals are small relative to the commercial fishery wherein landings and discards are frequently bycatch.

In this section, the BRT evaluated the results from the ICCAT assessments and subsequent analyses, stepping through the BRT's list of population dynamic considerations for evaluating overutilization of white marlin. See earlier sections for details on fishing activities and their impacts on the population (stock status). For the first two criteria (decline in population and absolute abundance), some results are summarized in Table 14. Here and through the remainder of the document, the BRT has chosen to express population decline as the ratio of current biomass to unfished biomass (B/K), rather than B/BMSY which is the usual benchmark in fishery stock assessments, because the extinction risk literature focuses on reductions from unexploited levels.

Table 14. Summary of white marlin population estimates from various sources.

Source	Stock Size as % of K	Absolute Abundance
Available to 2002 SRT:		
2000 ICCAT Assessment	6-11%	100,000-300,000
Babcock & McAllister (2002)	6-12%	200,000
Goodyear (2002)	6-11%	N/A
Porch (2002)	8-18%	200,000-700,000
2002 ICCAT draft Assessment	3-12%	100,000-300,000
Available after the 2002 SRR:		
2002 Final assessment	12%	200,000
Equal weighting of CPUE indexes	20-23%	300,000-400,000
CPUE Indexes weighted by catch	42-85%	1,000,000-2,000,000

The ranges from the 2002 status review were based on the central tendencies from the cases presented by the authors as the primary cases. They do not include analyses added later for more specialized sensitivity considerations, nor (except for Goodyear, 2002), development of confidence intervals. For those production model-based papers reporting recent biomass as a fraction of Bmsy, Bmsy was assumed to be 0.5*Bunfished (results from Porch 2002 were estimated from graphs). The population sizes were based on the papers' estimates of recent biomass, assuming an average weight of 20 kg per fish, and rounded to one significant digit. Goodyear specifies recent biomasses as starting point cases in his analysis, and his work does not contain estimated recent population sizes. For the more recent analyses (all from the ICCAT SCRS assessment report), we have created the two result lines by combining runs within each of the index weighting choices from Table 14, highlighting the strong sensitivity to analytical choices.

1. Population Trends

The full history of population decline was not reinvestigated in the ICCAT 2006 assessment, so the declines estimated in the 2002 assessment and used in the 2002 SR are incorporated herein. The declines estimated were generally consistent with 'vulnerable' status under AFS criteria if white marlin are assumed to have low productivity, and 'not at risk' if white marlin are assumed to have medium productivity. The limited age and growth information for white marlin makes the assessment of white marlin productivity difficult: white marlin would probably be characterized as low productivity by maximum age based on tag-recapture and probably as medium or high productivity, based on growth rate of blue marlin (Prince et al., 1991). Estimates of r from production models range from low to high productivity. The most plausible estimates of r range between 0.1 and 0.2 (Babcock and McAllister, 2002 and Babcock, RSMAS, pers. comm.). The estimates straddle the border between low and medium productivity using AFS standards. There is no evidence supporting classification of white marlin as having 'extremely low productivity' by AFS standards. The current BRT concurs with the 2002 SRT interpretation: the long term declines in white marlin are on the borderline between 'vulnerable' and 'not at risk' status under AFS criterion 4. This borderline situation certainly justified the examination of white marlin's status in 2002, but did not support a finding of significant danger of extinction. We note that the 2006 assessment suggests the decline has stopped.

2. Absolute Population Size

The more conservative analyses presented in Table 14 are consistent with recent population sizes of about 200,000 individuals in the size range vulnerable to the fishery. Other analytical choices result in much higher values up to 2 million (Table 14). Even the smallest estimates are not consistent with imminent species decline. .

3. Recruitment: Trends and Variability

No new evidence specific to recruitment has been developed since 2002. Even then, evidence specific to recruitment was very sparse. None of the CPUE time series can be identified as specific to newly recruited fish. Small fish appear intermittently in some of the CPUE series (Goodyear et al., 2002), but that result can at present be interpreted as chance encounter with small fish as readily as with evidence for stronger year classes. Porch's (2002) model allowed estimation of recruitment and its trends, which he provided to the 2002 SRT separate from his ICCAT paper (results for a single case were plotted in the 2002 status review as Figure 10), but the data limitations led to very smoothed estimates of recruitment. A decline was evident, but the magnitude was not out of line with what could be expected based on declines of biomass evident in the less structured production models. Porch reported that the data did not allow reliable estimation of a stock recruitment steepness parameter; and the 2002 SRT agreed. To date, the Porch 2002 model has not been updated.

4. Spatial Focusing

There is no evidence for major changes in distribution of white marlin. Maps of catch (Figs. 16 and 17) indicate a broad geographic range for the species, persisting throughout the history of significant fishing. The longline fisheries may have become more tropical in recent years, but given the white marlin distribution, there is little likelihood that a unit of effort has become or is becoming far more effective, beyond that already accounted for in the CPUE standardization analyses. Further, because white marlin is a bycatch species, one would not expect that fishing effort would become more efficient at targeting them. Large aggregations of white marlin have not been reported. Spawning appears to occur throughout much of the range. In short, there remains no evidence to suggest special vulnerability of white marlin to spatial focusing of fishing effort.

5. Depensation Considerations

Nothing in the biological knowledge base for white marlin suggests special vulnerability to depensatory effects. There are no signals in the population models or their underlying data to suggest that depensatory effects are beginning. With population size estimates on the order of 200,000 or higher, white marlin are unlikely to be in or about to be in a range where one might expect depensatory effects.

6. Formal Modeling of Probability of Extinction

No formal Population Variability Analysis (PVA) models for white marlin are available. Population projections were updated in 2006 from the 2002 stock assessment, however, to assess the chances of the stock dropping to levels where ESA protection would be warranted in the future. These results are presented in section VI as the projections evaluate the population response to various management scenarios.

Discussion

It is hard to conceive of revisions to the catch data sufficient to change our general conclusions about absolute population size. The CPUE signal is qualitatively very strong, and is derived from multiple sources. The estimates of extent of decline do not vary greatly among the analyses currently accepted by the U.S. scientific delegation to ICCAT. The only competing analyses on the table (from Japan) argue for less decline than this BRT is accepting. The amount of sensitivity to choice of CPUE weighting was a bit surprising, but really only affects evaluation of the extent of overfishing, and does not leave open any question about the appropriateness of threatened or endangered status.

A concept used in fishery management seems worth injecting here: the distinction between overfished and overfishing. Overfished is a property of a population, reflecting the history of exploitation, rather than the current removal rates. A stock is considered overfished if its biomass is less than the management target selected. Overfishing is more a property of the fishery (although one does say "a population is experiencing overfishing"). If the fishing mortality rate is higher than the management target, then overfishing is occurring. The distinction implies that one term may apply without the other. White marlin are almost certainly overfished (although one of the analyses in Table 14 suggests not) – a long history of exploitation has probably depleted the population below the management target (MSY) level. If overfished, then overfishing clearly occurred in the past to get the population to an overfished state. However, overfishing may or may not be occurring today. Analytical choices in 2006 resulted in estimates of current F/Fmsy both greater and less than one. The point is that overfishing can end abruptly, whereas an overfished state takes time to rebuild. If overfishing has ended for white marlin (or does so in the near future), it may still take several years before the stock will no longer be considered overfished.

While white marlin may continue to be overfished, and are likely not undergoing overfishing, these terms differ from the ESA term of overutilization. Overfishing, as described above, is when harvesting is at a rate greater than the management goal. A population can be considered to be overfished without undergoing overfishing (i.e., there is a lag effect as the population recovers from overfishing). Overutilization, on the other hand, can be applied to an exploitation to the point of diminishing returns. This is not the case with white marlin as population abundances, as shown in Figure 12, no longer exhibits a downward trend and population estimates (Table 14) indicate both an increase in number and B/K.

We also should point out that overutilization in itself does not imply a continuing downward spiral for a population. A population may equilibrate at an abundance lower than desired, but can be quite stable at that level if fishing effort is stable. Some of the concern about white marlin in 2002 arose largely because fishing effort had been steadily increasing, and thus the population showed an extended decline without sign of equilibrating at any particular level. The 2002 assessment did not support endangered or threatened status, but without a stabilization, some readers retained doubts. That situation has changed with the 2006 assessment. Catch reduction has occurred, and CPUE appears to be stabilizing.

Conclusion: White marlin are likely overfished, and some overfishing may or may not continue. The BRT concludes that overutilization of this species has occurred, but is not currently occurring.

C. Competition, Disease or Predation

1. Competition

The ESA requires an evaluation of competition, predation, and disease factors as they affect white marlin. It is not likely that under "balanced" circumstances white marlin lose in the competition for food because they are generalized piscivores and cover large areas of ocean when foraging (NMFS, 1999). In the Gulf of Mexico and perhaps in other portions of the species range, important prey items of adult white marlin include squid, dolphinfishes (*Coryphaena* spp.*)* and hardtail jack (*Caranx crysos*), followed by mackerels, flyingfishes, and bonitos (NMFS, 2006). Other potential food items include cutlassfishes, puffers, herrings, barracudas, moonfishes, triggerfishes, remoras, hammerhead sharks, and crabs (NMFS, 2006). Along the central Atlantic coast food items include round herring (*Etrumerus teres*) and squid (*Loligo pealei*). Carangids and other fishes are consumed as well (Nakamura, 1985 cited in NMFS, 2006). It is clear that levels of some prey species have declined due to fishing and other factors; however, no information exists to indicate that depressed populations of some prey species are negatively affecting white marlin in the Atlantic Ocean.

As mentioned previously, new genetic information has been compiled which provides evidence that there is a fifth species of Istiophoridae in the western North Atlantic – the roundscale spearfish (*T. georgii*) (Shivji et al., 2006). The roundscale spearfish closely resembles the white marlin and the two may often be confused. Evidence indicates that the roundscale spearfish is distributed widely in the western North Atlantic and is particularly abundant in the Sargasso Sea. Little is known about the life history of the roundscale spearfish and thus, it is possible that this congener could compete for similar resources as the white marlin. However, additional research on the distribution and life history of the roundscale spearfish is needed before any conclusions can be made.

2. Predation

Not much is known regarding predation of white marlin. This species is a part of a productive pelagic ecosystem and as such, white marlin experience high levels of mortality from a wide range of predators. The most significant predator on white marlin is likely to be humans. Killer and pilot whales are known to prey upon marlin hooked on longlines (D. Kerstetter, pers. comm.). Other species pursue marlin, including sharks (Pepperell and Davis, 1999; Block et al., 1992) and possibly killer whales (Mather et al., 1975), and young white marlin are likely eaten by a broad range of other species, including adult white marlins. Several large shark species both in the large coastal shark complex and the pelagic complex have experienced declines in the Northwest Atlantic over the last several decades. Some of these species are considered overfished and are managed under the Final Consolidated Atlantic HMS FMP (NMFS, 2006). Declines in these potential white marlin predators may have had some ancillary benefit on white marlin stock status but the extent is not known. Also, management measures are being considered and implemented to curb the declines in shark populations and begin to rebuild the stocks. Thus, any benefits to white marlin from the declines are not expected to continue as shark populations are rebuilt.

3. Disease

We have found no information to indicate that disease is a factor in white marlin abundance. These animals likely carry a range of parasites that do not have any known population effects (Barse and Hocutt, 1990).

Conclusion: The BRT concludes that there is no evidence that competition, predation, or disease are affecting the white marlin.

D. Evaluation of Adequacy of Existing Regulatory Mechanisms

1. International Authorities

a) ICCAT

White marlin are managed in the Atlantic Ocean by the member nations of the ICCAT. By consensus, this group adopts binding recommendations to manage for maximum sustainable catch of the fish populations under its purview. The conservation and management recommendations of ICCAT include, but are not limited to, total allowable catches, sharing arrangements for member countries, minimum size limits, effort controls, time/area closures, trade measures, and monitoring and inspection programs. Meetings are held annually and the U.S. negotiating platform is developed by NMFS and the State Department, in conjunction with ICCAT Commissioners that represent recreational and commercial industries. In addition, the ICCAT Advisory Committee, comprised of interested U.S. citizens, provides advice to NMFS on matters regarding international management of these species. The U.S. platform at ICCAT is finally established through discussions between NMFS, U.S. Dept. of State, and the ICCAT Commissioners and does not include public input at that stage. As with all foreign policy negotiating, U.S. negotiators have the latitude to identify priorities among species while still pursuing U.S. conservation goals.

In 1995, ICCAT adopted a non-binding resolution (95-12) that encouraged member nations to improve billfish research, update historical catch and effort data, increase participation in tag and release programs, and promote voluntary release of live billfish. The following year ICCAT adopted another resolution (96-9) that encouraged member nations to promote the use of monofilament leaders (gangions) to reduce billfish mortality, and to report on the costs and benefits of the use of monofilament leaders. The resolution also encouraged member nations to improve catch statistics and investigate the post-release mortality of billfish released live from commercial and recreational gears, information necessary to develop a rebuilding plan for billfish stocks.

ICCAT made its first-ever binding recommendation for Atlantic blue and white marlin in 1997. ICCAT Recommendation 97-09 required all member nations and cooperating parties to reduce landings of white marlin and blue marlin by at least 25% from landings reported in 1996 starting in 1998 with the full reduction to be accomplished by the end of 1999. The recommendation also encouraged parties to promote voluntary release of live billfish, and mandated the SCRS to conduct stock assessments in 1999.

ICCAT adopted its second binding recommendation regarding billfish in November 1998. ICCAT Recommendation 98-10 built upon the previously discussed ICCAT Recommendation 97-09 by limiting landings of Atlantic blue and white marlin in the year 2000 to no more than levels required to be achieved by the end of 1999. This Recommendation also postponed the SCRS assessments to 2000.

The results of the 2000 billfish assessments indicated a continued reduction in white marlin biomass, and the Commission adopted another binding recommendation to establish a rebuilding plan for blue marlin and white marlin at the 2000 meeting (00-13). The recommendation provided for a two-phase program to rebuild overfished billfish stocks. In Phase 1, Contracting Parties were to reduce landings of blue marlin by 50% from 1999 levels, and landings of white marlin by 67% from 1999 levels. Observer estimates of the percentage of white marlin alive at the time of longline gear retrieval range from 44% (Jackson and Farber, 1998) to 69% (NMFS, 1999). ICCAT adopted the marlin rebuilding strategy based on the SCRS' most recent stock assessments that indicated that marlin stocks continued to be severely overfished. Animals alive at the time of capture in the pelagic longline and purse seine fisheries were to be released in a manner to maximize survival. There were also provisions in Phase 1 to record catch composition and the number of live and dead releases, to improve catch and catch-at-size reporting, to improve observer coverage, and to adopt minimum sizes in recreational fisheries. The U.S. was required to have scientific observer coverage of at least 10% at recreational tournaments by 2002, and to limit to 250 the number of recreationally-caught blue and white marlin combined. This recommendation was subsequently extended through 2006. In Phase 2, the SCRS was mandated to conduct assessments of blue marlin and white marlin in 2002, and to present an evaluation of specific stock recovery scenarios. The Commission would consider the SCRS advice at the 2002 meeting and develop and adopt programs to rebuild Atlantic stock of blue marlin and white marlin to levels that would support MSY. Based on a suggestion from the SCRS at the 2001 Commission meeting, a recommendation was adopted (01-10) that postponed the assessment of blue marlin until 2003, but continued the conservation measures specified in Phase 1 of Recommendation 00-13.

In 2002, Phase 1 of the ICCAT Atlantic marlin rebuilding plan was extended through the year 2005 by adoption of ICCAT Recommendation 02-13. ICCAT amended the rebuilding program by specifying that, through 2005, the annual amount of blue marlin that can be harvested and retained by pelagic longline and purse seine vessels must be no more than 50 percent of the 1996 or 1999 landing levels, whichever is greater. For white marlin, the annual amount allowed to be harvested and retained by pelagic longline and purse seine vessels must be no more than 33 percent of the 1996 or 1999 landing levels, whichever is greater. The U.S. had already prohibited commercial retention of billfish since the implementation of the 1988 Atlantic Billfish FMP, so it was already compliant with this recommendation. For ICCAT members other than the U.S., the plan required the release of all live marlins taken as bycatch in commercial fisheries, but provided an allowance for the landing of fish unavoidably killed, provided that they were not sold. For its part of the rebuilding program, the U.S. agreed to continue limiting recreational landings of Atlantic blue and white marlin to 250 fish, annually, maintain its regulations prohibiting the retention of marlins by U.S. pelagic longline vessels, and continue monitoring billfish tournaments through scientific observer coverage of at least five percent initially, with the objective of 10 percent coverage by 2002. At present, the U.S. complies with the ICCAT observer requirements by requiring that all HMS tournaments register with NMFS, selecting all billfish tournaments for reporting their results, and assigning observers to many billfish tournaments. At the 2002 assessment of white marlin, 2001 landings data were not available from several parties. Therefore it was not possible to evaluate compliance with the mandated 67% reduction in white marlin landings implemented in 2001. Furthermore, assessment of compliance with live releases can only be determined through observer coverage. Most countries have limited or no observer coverage.

At the November 2004 ICCAT meeting, the United States chose not to apply the scalar expansion methodology for compliance purposes, but rather applied a methodology (RBS + Non-Tournament Reporting System + State Landing Tags) similar, but not identical to that used in the 2001 compliance report and the September 2003 Proposed Rule. Application of this methodology resulted in the United States reporting 131 marlin to ICCAT for compliance purposes in 2004. The United States is continuing to review its methodology to quantify recreationally landed marlins. Further, Recommendation 04-09 was adopted which extended Phase I of the Marlin Rebuilding Plan and delayed the planned 2005 assessment by SCRS of blue and white marlin to 2006 on the basis of inadequate data. This action resulted in an extension of the cap of 250 blue and white marlin, combined, for U.S. recreational landings through 2006.

In 2006, the SCRS completed a stock assessment of blue and white marlin, recommended to ICCAT that the management measures currently in effect be continued, and recommended to ICCAT that billfish mortality from artisanal fleets be regulated to control or reduce the fishing mortality generated by these fisheries. ICCAT extended Phase 1 of the ICCAT Atlantic marlin rebuilding plan through the year 2010 by adoption of ICCAT Recommendation 06-09. All Contracting Parties, non-Contracting Parties, Entities, and Fishing Entities are to take steps aimed at reducing the uncertainty in the SCRS stock status evaluations by substantial investment into SCRS research on blue marlin and white marlin habitat requirements and further verification of the historical catch and effort data for these species from all fisheries. All Contracting Parties, non-Contracting Parties, Entities, and Fishing Entities with artisanal marlin fisheries shall submit to SCRS in 2007 documentation of the character and extent of such fisheries and shall implement beginning in 2007, if feasible but not later than 2008, domestic measures to cap artisanal marlin catches at 2006 levels. This Recommendation also called for a preparatory meeting in 2009 with a stock assessment being completed in 2010, and consolidated all previous billfish resolutions and recommendations.

The following are management recommendations included in the 2006 stock assessment:

- The Commission should, at a minimum, continue the management measures already in place because marlins have not yet recovered.
- The Commission should take steps to assure that the reliability of the recent fishery information improves in order to provide a basis for verifying possible future rebuilding of the stocks. Improvements are needed in the monitoring of the fate and amount of dead and live releases, with verification from scientific observer programs. In addition verification of current and historical landings from some artisanal and industrial fleets needs to be conducted.
- Should the Commission wish to increase the likelihood of success of the current management measures of the marlin rebuilding plan, further reduction in mortality would be needed, for example by:
    - implement plans to improve compliance of current regulations,
    - encouraging the use of circle hooks in fisheries where its use has been shown to be beneficial,
    - broader application of time/area catch restrictions.
- Given the recent importance of the catch from artisanal fisheries, and to increase the likelihood of recovery of marlin stocks, the Commission should consider regulations that control or reduce the fishing mortality generated by these fisheries.
- While substantial research into habitat requirements of blue and white marlin have been undertaken since the last assessments, the results of this research are not yet sufficient to allow the Committee to reach scientific consensus on the best method for directly estimating MSY benchmarks for these species based on the complete time-series of data. The Commission should encourage continued research on development of methods to incorporate this information into stock assessments in order to provide a basis for increasing the certainty with which management advice can be provided.

Summary of Adequacy of ICCAT Measures

Considering reported catches of all nations in aggregate, the goals of Recommendation 97-9 appear to have been met, although not all countries complied. Some countries exceeded the recommended catch reductions, thus compensating for any overages. Reported landings for the total Atlantic (excluding exempted small-scale artisanal fisheries) were 1231 mt in 1996 and the target reduction to be achieved by the end of 1999 was 923 mt. Reported and estimated landings of white marlin available at the 2002 SCRS assessment meeting (excluding exempted small-scale artisanal fisheries) were 1025 mt in 1998, 951 mt in 1999, and 790 mt in 2000. The average catch of pelagic longline and purse seine vessels during the period 2001-2004 for white marlin was 59% of the maximum catch for those same fleets in the years 1996 or 1999 (ICCAT, 2006). Reductions were evident in the landings reported by most nations with the exception of Brazil and the EC-Spain. ICCAT's Compliance Committee will consider the data and make official determinations of non-compliance in conjunction with the annual ICCAT meetings.

Several other ICCAT Recommendations limiting effort or catch for various target species indirectly also provide benefits to white marlin. Country-specific quotas are in place for North Atlantic swordfish, western Atlantic bluefin tuna, and North Atlantic albacore. Catch and effort limitations exist for South Atlantic albacore, bigeye tuna, and yellowfin tuna. In addition, a seasonal closure on fish-aggregating-device (FAD) fishing in the Gulf of Guinea could reduce fishing pressure on white marlin. Also, in 2004, the Special Secretariat for Aquaculture and Fisheries of the President's Office passed a ruling that prohibited the national commercialization and export of the Atlantic white marlin and the Atlantic blue marlin captured in Brazilian jurisdictional waters or at open sea by Brazilian fishing vessels or foreign vessels rented by Brazilian fisheries businesses or cooperatives.

The final consideration regarding adequacy of international management measures relates to IUU fishing that occurs in the Atlantic Ocean. IUU fishing activities have continued and increased in the Atlantic Ocean and are diminishing the effectiveness of ICCAT conservation and management measures (SCRS, 2001). There is evidence to indicate that vessel owners have re-flagged to avoid ICCAT management measures. At its 1998 meeting, ICCAT adopted a resolution (98-18) to address IUU fishing by large-scale longline vessels, considering that mortality of certain species, including white marlin, could be considerably higher than current data reflect. The non-binding resolution requested that all countries that imported ICCAT species provide ICCAT with detailed information about the vessels landing those species. ICCAT would then utilize this data to recommend non-discriminatory trade restrictions on any country whose vessels may be conducting IUU fishing. The resolution also requested countries to revoke licenses of vessels that may be fishing in such a manner that diminishes the effectiveness of ICCAT measures.

In 1999, ICCAT adopted another resolution (99-11) that urged countries to, among other things, take every possible action to urge their importers and other businesses to refrain from engaging in any transaction concerning ICCAT species that were caught by IUU vessels. Since adoption of the 1998 resolution, ICCAT has taken measures to implement trade restrictions on several countries whose vessels are fishing in an IUU fashion. In 2000, ICCAT adopted yet another resolution (00-19) to address IUU fishing by urging Japan and Chinese Taipei to complete the scrapping of Japanese-built IUU longline vessels. This resolution further intensifies actions recommended in the 1999 resolution. In 2002, ICCAT adopted a recommendation (02-23) which establishes a list of vessels presumed to have carried out IUU fishing activities in the ICCAT convention area. It is clear that ICCAT members have committed to addressing IUU activity, although it is difficult to evaluate whether their efforts will ultimately be successful. If IUU fishing mortality on white marlin is substantial, ICCAT management measures alone may not be sufficient to protect the species in the long-term. These efforts are supported by long-term efforts made by the Food and Agriculture Organization.

b) United Nations Convention on the Law of the Sea

On December 4, 1995, the U.S. signed the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea (UNCLOS) relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. This U.N. Agreement has its origins in Agenda 21, the detailed plan of action adopted by the 1992 U.N.

Conference on Environment and Development. It builds upon certain fisheries-related provisions of the 1982 U.N. Convention on the Law of the Sea, and reaffirms the central role of the Convention as the accepted foundation and framework for this critical body of international law. While all States have the right to engage in fishing on the high seas, the Convention qualifies this right with the duty to conserve high seas resources and to cooperate with other States in conservation efforts. In fulfillment of these obligations, multilateral fishery agreements and organizations such as ICCAT have been established to conserve and manage high seas fisheries.

The U.N. Agreement is designed to strengthen and make more specific the provisions of the Convention, and back the provisions with effective enforcement techniques and compulsory dispute settlement. This should give the international community mechanisms to reverse overfishing trends and create an opportunity to ensure sustainable marine fisheries. The U.N. Agreement sets forth general principles for fishery conservation and management, including obligations to ensure the long-term sustainability of these stocks; take measures that are based on the best scientific information available; assess relevant environmental impacts; adopt conservation and management measures for other stocks belonging to the same ecosystem; minimize catch of non-target species; and take measures to prevent or eliminate overfishing and excess fishing capacity. UNCLOS does not have specific authority for technical species-specific management but rather defers to regional fishery management organizations.

As of March 2007, 66 countries had ratified the agreement. The U.S. has not ratified the convention; however, they have followed all provisions of the treaty since 1994. The agreement entered into force in 2001, after 30 countries had ratified it. There is no effective enforcement tool. While the Agreement recognizes that most of the actual conservation and management work for highly migratory fish stocks must be carried out through ICCAT or other regional fishery management organizations, it recommends some specific measures to strengthen the operations of such organizations. For example, one Article requires any State whose fishermen wish to harvest a stock that is governed by such an organization either to join or to agree to apply the conservation and management measures established by the organization. Many countries fishing in the Atlantic are not members of ICCAT, and IUU fishing continues to occur.

Summary of Adequacy of UNCLOS

Because ICCAT exists as a regional fishery management body, the UNCLOS depends on ICCAT to protect white marlin. As a stand-alone instrument, the UNCLOS Straddling Stocks agreement is not adequate to protect white marlin. At a review conference in May 2006, States met to assess the effectiveness of the Agreement in securing the conservation and management of straddling and highly migratory fish stocks by reviewing and assessing the adequacy of its provisions and if necessary, making changes to strengthen implementation. At this meeting, several States described the measures they had adopted to implement the Agreement. Those measures included the establishment of total allowable catches for tuna in the exclusive economic zone; measures to manage fishing capacity and effort; national observer programs and program for boarding and inspection; efforts to implement the ecosystem approach; measures for the licensing and authorization of vessels; the setting up of monitoring systems and research centers, and measures for port States, in particular, to combat IUU fishing.

2. Domestic Authorities

In the U.S., Atlantic HMS are managed under the dual authority of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and the Atlantic Tunas Convention Act (ATCA). Under the Magnuson-Stevens Act, NMFS must, consistent with the National Standards, manage fisheries to maintain optimum yield (OY) by rebuilding overfished fisheries and preventing overfishing. Under ATCA, NMFS is authorized to promulgate regulations, as may be necessary and appropriate, to implement the recommendations from the ICCAT. Additionally, any management measures must also be consistent with other domestic laws including, but not limited to, the National Environmental Policy Act (NEPA), the ESA, the MMPA, and the Coastal Zone Management Act (CZMA).

a) Atlantic Tunas Convention Act

The Atlantic Tunas Convention Act of 1975 (ATCA) authorizes the Secretary of Commerce to administer and enforce all provisions of the International Convention for the Conservation of Atlantic Tunas. Pursuant to this goal, the Secretary cooperates with the duly authorized officials of the government of any party to the Convention as well as any other Federal department or agency or any State.

The Secretary of Commerce is authorized to issue regulations deemed necessary to implement the Convention. ATCA authorizes the Secretary to use the personnel, services, and facilities of any agency of any party to the Convention, any other Federal department or agency, or any agency of any State. ATCA also charges the Secretary with issuing regulations for the advancement of any recommendation from ICCAT. However, regulations promulgated under ATCA are, to the extent practicable, to be consistent with fishery management plans prepared and implemented under the Magnuson-Stevens Act.

ATCA authorizes the Secretary of Commerce to prohibit the entry into the U.S. of any species subject to regulations recommended by ICCAT and taken from the Convention area in a manner that would diminish the effectiveness of ICCAT's conservation efforts. The Secretary may also prohibit the importation of any fish regulated by the Convention from a country whose fishing vessels are harvesting in the Convention area in a manner which would diminish the effectiveness of ICCAT's recommendations.

All domestic management measures for white marlin are implemented under the dual authority of the Magnuson-Stevens Act and ATCA.

b) Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Act establishes the authority and responsibility of the Secretary of Commerce to develop fishery management plans and subsequent amendments for Atlantic HMS. The Magnuson-Stevens Act requires NMFS to allocate both overfishing restrictions and recovery benefits fairly and equitably among sectors of the fishery. Fisheries managed under an international agreement, such as HMS, must reflect traditional participation in the fishery, relative to other nations, by fishermen of the U.S. The Magnuson-Stevens Act specifies that NMFS must provide fishing vessels of the U.S. with a reasonable opportunity to harvest any allocation or quota of an ICCAT species to which the U.S. has agreed. The FMP or amendment to such a plan must specify a time period for ending overfishing and rebuilding the fishery that shall be as short as possible, taking into account the status and biology of the stock of fish, the needs of fishing communities, recommendations by international organizations in which the U.S. participates, and the interaction of the overfished stock within the marine ecosystem. The rebuilding plan cannot exceed ten years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the U.S. participates dictate otherwise.

(1) U.S. Fishery Management Plan for Atlantic Billfish and Sharks

Atlantic billfish managed by NMFS are Atlantic blue marlin (*Makaira nigricans*), white marlin (*Tetrapturus albidus*), sailfish (*Istiophorus platypterus*), and longbill spearfish (*T. pfluegeri*). Atlantic billfish management strategies have been guided by international and domestic considerations and mechanisms since the 1970s.

Domestic management of Atlantic billfish resources has been developed, modified, and implemented in three primary stages and through a series of other rulemakings. In January 1978, NMFS published the Preliminary Fishery Management Plan (PMP) for Atlantic Billfish and Sharks (43 FR 3818), which was supported by an EIS (42 FR 57716). This PMP was a Secretarial effort. The management measures contained in the plan were designed to:

1. minimize conflict between domestic and foreign users of billfish and shark resources;
2. encourage development of an international management regime; and
3. maintain availability of billfishes and sharks to the expanding U.S. fisheries.

Primary management measures in the Atlantic Billfish and Shark PMP included:

- Mandatory data reporting requirements for foreign vessels;
- A prohibition on the foreign commercial retention of all billfishes caught within the Fishery Conservation Zone (FCZ) of the United States and stipulated release in a manner that will maximize the probability of survival;
- A hard cap on the catch of sharks by foreign vessels, which when achieved would prohibit further landings of sharks by foreign vessels;
- Permit requirements for foreign vessels to fish in the FCZ of the United States;
- Radio checks by foreign vessels upon entering and leaving the FCZ;
- Boarding and inspection privileges for U.S. observers; and
- Prohibition on intentional discarding of fishing gears by foreign fishing vessels within the FCZ that may pose environmental or navigational hazards.

(2) U.S. Fishery Management Plan for the Atlantic Billfishes

Building upon the PMP for Atlantic Billfish and Sharks was the Fishery Management Plan for the Atlantic Billfishes (53 FR 21501). This plan was jointly developed by five Atlantic regional councils (Caribbean, Gulf, South Atlantic, Mid-Atlantic, and New England) and implemented in October 1988 (53 FR 37765). The 1988 FMP defined the Atlantic billfish management unit to include sailfish from the western Atlantic Ocean, white marlin and blue marlin from the North Atlantic Ocean, and longbill spearfish from the entire Atlantic Ocean; described objectives for the Atlantic billfish fishery; and established management measures to achieve those objectives. The objectives identified in the Billfish FMP were to:

1. Maintain the highest availability of billfishes to the U.S. recreational fishery by implementing conservation measures that will reduce fishing mortality;
2. Optimize the social and economic benefits to the nation by reserving the billfish resource for its traditional use, which in the continental United States is almost entirely a recreational fishery; and
3. Increase understanding of the condition of billfish stocks and the billfish fishery.

The primary management measures adopted to achieve the stated objectives of the 1988 Billfish FMP included:

- Defining OY in qualitative terms;
- A prohibition on the sale of Atlantic billfish, with an exemption for small-scale handline (artisanal) fishery in Puerto Rico;
- Establishment of minimum sizes for Atlantic billfish;
- A prohibition on possession of Atlantic billfish by commercial longline and drift net vessels; and
- Establishment of data reporting requirements.

As previously mentioned, passage of the 1996 Magnuson-Stevens Act initiated fundamental changes in U.S. fishery management policy, shifting emphasis to precautionary management strategies. In September 1997, NMFS listed fishery resources considered to be overfished, which included Atlantic blue and white marlin. This action triggered a suite of management requirements, including development of a rebuilding plan for overfished stocks, and reduction in bycatch and bycatch mortality. Further, in 1998, western Atlantic sailfish was added to the list of overfished species.

(3) Interim Rules

On March 24, 1998, NMFS published an interim rule (63 FR 14030) under section 305(c) of the Magnuson-Stevens Act, that increased the minimum size limits for Atlantic blue marlin and Atlantic white marlin to 96 inches LJFL and 66 inches LJFL, respectively, and required tournament operators to notify NMFS of tournaments involving any Atlantic billfish at least four weeks prior to commencement. NMFS utilized the increases in size limits to immediately reduce overfishing, and to implement the 1997 ICCAT recommendation, as required by the ATCA. NMFS published an extension and amendment of the interim rule on September 29, 1998 (63 FR 51859), that:

- Further increased the minimum size for Atlantic blue marlin to 99 inches LJFL;
- Restated the minimum size for Atlantic white marlin as 66 inches LJFL;

- Established a recreational bag limit of one Atlantic marlin (blue or white marlin) per vessel per trip;
- Granted the Assistant Administrator for Fisheries the authority to adjust the bag limit, with a three-day notice, including adjustment to a zero bag limit, if necessary to meet international and domestic management objectives; and
- Continued requirements to notify NMFS of tournaments involving any Atlantic billfish at least 4 weeks prior to commencement.

NMFS amended the interim rule on November 13, 1998 (63 FR 63421) by removing the adjustable bag limit provision.

(4) Amendment One to the Atlantic Billfish Fishery Management Plan

In response to Magnuson-Stevens Act requirements, and concurrent with efforts on the interim rule discussed above, NMFS prepared Amendment One to the Atlantic Billfish Fishery Management Plan and published final regulations on May 28, 1999 (64 FR 29090). Amendment One maintained the objectives of the original 1988 Billfish FMP and identified the following additional objectives:

1. Prevent and/or end overfishing of Atlantic billfish and adopt the precautionary approach to fishery management;
2. Rebuild overfished Atlantic billfish stocks, and monitor and control all components of fishing mortality, both directed and incidental, so as to ensure the long term sustainability of the stocks and promote Atlantic-wide stock recovery to the level where MSY can be supported on a continuing basis;
3. Establish a foundation for the adoption of comparable international conservation and management measures, through international entities such as ICCAT, to rebuild overfished fisheries and to promote achievement of optimum yield for these species throughout their range, both within and beyond the EEZ;
4. Minimize, to the extent practicable, release mortality in the directed billfish fishery, and minimize, to the extend practicable, bycatch and discard mortality of billfish on gears used in other fisheries;
5. Better coordinate domestic conservation and management of the fisheries for Atlantic tunas, swordfish, sharks, and billfish, considering the multispecies nature of many HMS fisheries, overlapping regional and individual participation, international management concerns, and other relevant factors;
6. Provide the data necessary for assessing the fish stocks and managing the fisheries, including addressing inadequacies in collection and ongoing collection of social, economic, and bycatch data on Atlantic billfish fisheries;
7. Coordinate domestic regulations and ICCAT conservation measures for controlling Atlantic-wide fishing mortality;
8. Consistent with other objectives of the amendment, manage Atlantic billfish fisheries for the continuing OY, so as to provide the greatest overall benefit to the Nation, particularly with respect to recreational opportunities and taking into account the protection of marine ecosystems. Optimum yield is the maximum sustainable yield from the fishery, as reduced by any relevant social, economic, or ecological factors;

9. Minimize adverse social and economic effects on recreational and commercial activities to the extent practicable, consistent with ensuring achievement of the other objectives of this plan, and with all applicable laws;
10. Maximize protection of areas identified as essential fish habitat for Atlantic billfish, particularly for critical life stages; and
11. Promote the live release of Atlantic billfish through active outreach and educational programs.

Primary management measures included:

- Adjustment of minimum size regulations for Atlantic billfish;
- A prohibition on the retention of longbill spearfish;
- Maintenance of prohibitions on commercial possession and retention;
- Allowed removal of the hook from Atlantic billfish;
- A requirement for permits and logbook reporting for charterboats targeting billfish, if selected, as part of an HMS charter/headboat system;
- Implementation of billfish tournament notification requirements;
- Implementation of a June 1 to May 31 fishing year;
- Development and implementation of outreach programs; and
- An extension of the management unit for Atlantic marlins.

(5) Amendment One to the Atlantic Tunas, Swordfish, and Sharks FMP

Reduced the occurrence of bycatch and incidental catch by the U.S. Atlantic pelagic longline fishery by establishing time and area closures and gear restrictions to pelagic longline fishing to reduce the bycatch and bycatch mortality of HMS, threatened or endangered turtle species, and the incidental catch of marine mammals and sea birds. Prohibited the use of pelagic longline gear year-round in an area of the northeastern Gulf of Mexico (DeSoto Canyon) and an area along the east coast of Florida (East Florida Coast). Prohibited pelagic longline gear from February through April off Georgia, South Carolina and a portion of North Carolina (Charleston Bump. Prohibited the use of live bait on pelagic longline gear used in the Gulf of Mexico.

(6) Recreational Permitting and Reporting Rules

A key element in complying with Phase I of the ICCAT marlin-rebuilding plan and improving the monitoring of recreational billfish and swordfish landings was establishing a comprehensive monitoring program for all recreational landings of marlin, sailfish and swordfish, particularly those landed outside of fishing tournaments, which are monitored through the RBS.

In early 2002, the HMS and Billfish APs again discussed monitoring U.S. recreational billfish landings, and focused upon both a landings tag program (similar to those operating for the recreational bluefin tuna fisheries in North Carolina and Maryland) and a call-in requirement for all billfish landings.

On December 18, 2002 (67 FR 77434), NMFS published a final rule requiring all vessel owners fishing for Atlantic HMS to obtain an Atlantic HMS recreational angling category permit. On

January 7, 2003 (68 FR 711), a final rule establishing a mandatory reporting system for all non-tournament recreational landings of Atlantic marlins, sailfish, and swordfish was published. These requirements became effective in March 2003 and in combination with mandatory tournament reporting, are improving the ability of the United States to accurately monitor all recreational landings of Atlantic marlins, sailfish, and swordfish, however, non-compliance by recreational anglers remains a significant issue.

(7) Proposed Rule to Codify the 250 Marlin Landing Limit

On September 17, 2003, NMFS published a proposed rule (68 FR 54410) to codify an annual landings limit of 250 Atlantic blue and white marlin combined, and to implement a provision to carry forward over- and underharvest of the Atlantic blue and white marlin landing limit into subsequent fishing years, consistent with ICCAT recommendations. To remain in compliance with the landing limit and to maximize allowable landings, NMFS proposed to increase the legal recreational minimum size of Atlantic blue and white marlin for the remainder of a fishing year when 80 percent of the landing limit was projected to be achieved. If the landing limit was attained, NMFS proposed to allow only catch-and-release fishing for these species for the remainder of the fishing year. The proposed rule was not finalized due to a need to review the methodology of calculating recreational marlin landings. The proposed rule incorporated landings as reported by the Recreational Billfish Survey (RBS), and indicated landings levels of 129 fish for 2002. Application of a new methodology (scalar expansion) resulted in the United States reporting 279 marlin to ICCAT for compliance purposes for 2002, which exceeded the annual 250 fish landings limit by 29 fish. NMFS is continuing to review various methodologies to identify the most appropriate approach for estimating recreational marlin landings. The proposed rule for this current Draft HMS FMP formally withdrew this 2003 proposed rule. Similar measures to those in the 2003 proposed rule are analyzed in Chapter 4 of this document.

(8) Consolidated HMS FMP

The Consolidated HMS FMP (October 2, 2006; 71 FR 58058) combined the management of all Atlantic HMS into one FMP and combined and simplified the objectives of the previous FMPs. Related to Atlantic billfish conservation and management, the Consolidated HMS FMP made strides to reduce post release hooking mortality of Atlantic billfish by establishing a requirement that all HMS permitted vessels participating in Atlantic billfish tournaments deploy only non-offset circle hooks when using natural baits or natural bait/artificial lure combinations effective January 1, 2007. In response to comments from Atlantic billfish tournament fishermen that additional time was needed to allow fishermen to become more familiar and proficient with circle hooks, the circle hook requirement in Atlantic billfish tournaments was temporarily suspended until January 1, 2008 when it will go back into effect. The Consolidated HMS FMP also implemented domestically the ICCAT recommendations on recreational marlin landings limits thereby codifying the 250 blue and white marlin annual landing limit.

3. State Authorities

State fishery management agencies have authority for managing fishing activity in state waters only (0-3 miles in most cases; 0-9 miles off Texas and the Gulf coast of Florida). Considering that white marlin do not frequently enter the waters of most states, state authority is limited. Some states have implemented regulations to protect marlin caught in Federal waters, however, through implementation of possession prohibitions. For example, the state of Georgia has established a catch-and-release fishery for both blue and white marlins, with no possession of marlins allowed, regardless of where they were caught. Most states that have implemented regulations have copied Federal regulations for white marlin (Table 15).

Table 15. Fishery management regulations by individual statefor white marlin (as of May 30, 2006).

State	Management Measures
Maine	None
New Hampshire	Possession limit Minimum size Gear restriction No sale
Massachusetts	None
Rhode Island	None
Connecticut	None
New York	No sale
New Jersey	None
Delaware	No sale
Maryland	Atlantic billfish required to be tagged
Virginia	No Sale
North Carolina	Possession limit Minimum size No sale
South Carolina	Gear restriction No sale
Georgia	No possession, catch and release only
Florida	Possession limit Minimum size Gear restriction No sale
Alabama	None
Mississippi	Minimum size No sale
Louisiana	Minimum size
Texas	Minimum size Gear restriction No sale
Puerto Rico	Federal regulations apply
US Virgin Islands	Federal regulations apply

Summary of Adequacy of Domestic Measures

Domestic management measures implemented under the Magnuson-Stevens Act, ATCA, or state legislation are not adequate to protect white marlin given that U.S. fishing mortality is such a small proportion of the total mortality. In any case, most states' regulations and Federal regulations implement minimum sizes to comply with an ICCAT recommendation; these minimum sizes (as implemented in Federal waters) were not designed to protect a certain portion of the population but rather were designed to maintain landings below a certain level.

NMFS implemented a live bait prohibition on longlines operating in the Gulf of Mexico. This measure is predicted to reduce numbers of marlin caught on U.S. longlines by 326-2400 (NMFS, 2000). Time/area closures are expected to reduce U.S. longline billfish catch by 12% if there is no re-distribution of effort and could increase discards of white marlin by 11%, if all effort is re-distributed to other areas (NMFS, 2000). It is likely that some re-distribution had occurred but data are not yet available to evaluate the effectiveness of these closures. Additional time/area closures were implemented in 2001 to reduce bycatch of sea turtles in the longline fishery. Interestingly, this U.S. closure affects only U.S. longline vessels, and it occurs outside of U.S. waters, where vessels from other nations may continue to fish. Such a closure is not likely to have a significant positive impact on marlin bycatch given the location as well as the ability of other nation's vessels to fill the "void" created by the closure to U.S. vessels. New time/area closures were specified in the Final Consolidated FMP. The Madison–Swanson and Steamboat Lumps Marine Reserves (in the Gulf of Mexico) are closed to all HMS fishing, except that surface trolling for HMS may be conducted from May through October (Fig. 8).

These measures alone, implemented under the Magnuson-Stevens Act and the ATCA are not adequate to protect white marlin. There may be some limited benefits, however, resulting from implementation of domestic management measures such as time/area closures in U.S. waters, particularly such measures that reduce overall fishing effort on white marlin. Longline closures in any area of high billfish bycatch could provide additional incremental protection that would complement international efforts.

Summary of Adequacy of Existing Regulatory Mechanisms

The U.S. currently accounts for approximately 5% of the total, reported catch of white marlin. It is realized that reporting of white marlin catches from some countries' artisanal and industrial fisheries is lacking, and as a result, the U.S.' actual share of the total fishing mortality on the Atlantic-wide stock of white marlin may be substantially less than 5%. If white marlin are listed as threatened or endangered, every effort would be made to minimize domestic interactions with the species, and in theory, there would be minimal U.S. fishing mortality. This would decrease total fishing mortality on the Atlantic-wide stock by a maximum of 5% (Fig. 2).

In reality, it is likely that a closure of the U.S. pelagic longline and recreational fisheries would not result in a 5% reduction of fishing mortality on white marlin. The loss of target catch (tunas and swordfish) from the domestic pelagic longline fishery would be offset with increased imports from other nations. This demand would translate to increased fishing effort by other nations, and a resultant increase in the incidental catch of white marlin. Similarly, it is likely that some U.S. offshore anglers would opt to fish for white marlin on foreign flagged vessels stationed in other countries. The language of the ESA is quite broad regarding the activities of U.S. citizens away from U.S. waters; however, an ESA listing could increase recreational fishing effort in those countries. In some areas where white marlin are considered a valuable food source, it is likely that there would be less of a tendency for catch and release fishing, further increasing fishing mortality on the species.

In conclusion, the BRT recognizes that domestic measures by the U.S. alone will have a negligible impact on the stock status of white marlin. However, measures implemented by ICCAT appear to be having some success as the most recent stock assessment indicates that a slight increase in white marlin abundance was observed in the 2001-2004 abundance estimates. It is important to note, however, that this trend is based only on a few years of observations and as such, confirmation of this trend will require at least another four or five years of data (ICCAT, 2006). This increasing trend was observed even though the 67% reduction in white marlin landings was not achieved (average catch from 2000 – 2004 was 36% of the maximum catch in 1996 or 1999), there is most likely not full compliance by all parties with all management measures, and there may be an unknown impact from IUU fishing.

Issues regarding compliance with ICCAT Recommendations, achieving the 67% reduction in landings, and assessing the extent and impacts of IUU fishing need to be addressed by ICCAT in order to fully rebuild the white marlin stock; however, the BRT concludes that the best available information indicates that current regulatory mechanisms are sufficient to prevent continued stock decline of white marlin.

E. Other Natural or Manmade Factors Affecting White Marlin's Continued Existence

The U.S. Navy's proposed use of the Surface Towed Array Sensor System Low Frequency Active (LFA) sonar was raised in the original 2001 petition to list white marlin and the subsequent 2002 SR as a potential threat to the species. The LFA sonar is a low-frequency, extremely high energy active sound transmission to detect acoustically quiet targets over long distances. Based on the Navy's current operational requirements, exercises using these sonar systems would occur in the Pacific, Atlantic, and Indian oceans, and the Mediterranean Sea. The 2001 petition raised concerns that exposure to this high decibel sound source may injure or kill white marlin and other marine life. In 2002, the Navy prepared a final environmental impact statement (FEIS) on LFA sonar and applied for and received from NMFS in 2002 a small take authorization under the MMPA for the effects of the system on marine mammals (67 FR 46712). NMFS, in issuing the small take authorization, determined that LFA sonar would have a negligible effect on stocks of acoustically-sensitive marine mammals. However, in order to address concerns raised at the district court level, the Navy prepared a Supplemental Environmental Impact Statement (SEIS) in April 2007. In the SEIS, the Navy presents information on studies that were specifically conducted on rainbow trout and channel catfish to determine the impacts of the LFA sonar on fish. According to the Navy (2007), the sound level to which fish were exposed in these experiments was 193 decibels (dB) received level, a level that is only found within about 200 m of the LFA source array. The likelihood of exposure to this or a higher sound level is low, considering all the possible places a fish might be relative to the sound source. The fish exposed to the LFA sonar in these studies represent a worst-case scenario as they were exposed repeatedly to the high sonar levels and for longer durations. The LFA sonar is normally operated from a moving vessel and as such, fish species are exposed for shorter durations (a few seconds depending on the speed of the vessel and whether the fish is moving). In the SEIS, the Navy made the following conclusions: no fish died as a result of the study and all appeared healthy when sacrificed or returned to the fish farm from which they were taken; there were no pathological effects on the experimental fish (e.g., there were no significant differences in the condition of major body organs in experimental, control, or baseline fish); there were no short or long term effects on ear tissue; fish behavior after sound exposure was no different than behavior prior to or after tests; catfish and some rainbow trout showed 10-20 dB of hearing loss immediately after exposure to the LFA sound when compared to baseline and control animals, but hearing appeared to return to, or close to, normal within about 24 hours for catfish and most likely within less than 96 hours for rainbow trout (researchers were unable to reach firm conclusions on recovery time for trout but based on the preliminary data, it is expected to occur in less than 96 hours); and finally, at some times of the year, some rainbow trout showed hearing loss while others did not which suggests that some environmental or other variable may affect a species sensitivity to sound (Department of the Navy, 2007). The researchers also concluded that different species are affected by sound in different ways, and as such, the results of this study are preliminary. However, the fact that neither species exhibited any internal damage or unrecoverable hearing loss even under the worst case scenario, suggests that white marlin, which are highly motile would not experience significant long lasting impacts from LFA sonar.

Other threats to white marlin that have been raised include impacts from global warming including the loss of biodiversity in the ocean and reduction in overall oceanic productivity, and ocean acidification from absorption of carbon dioxide which will restrict the ability of marine invertebrates near the base of food chain to produce shells.

According to the German Advisory Council on Global Change (2006), anthropogenic climate changes initially affect phytoplankton communities and consequently, impact primary production. Various projections for future alterations in phytoplankton communities and primary production rates are not all in agreement. Some projections indicate that production in the tropics will decline due to stronger stratification and the resulting decrease in nutrient supply while it will increase in the subpolar regions (German Advisory Council on Global Change, 2006). Other models show a slight increase in global primary production (Sarmiento et al. 2004, cited in German Advisory Council on Global Change, 2006). According to Sarmiento et al., 2004 (cited in German Advisory Council on Global Change, 2006), the quality of the information that can be used in climate, ocean, and ecosystem models is insufficient to allow for definitive conclusions on future impacts on primary production. However, some regional models are capable of identifying the connections between changes in ocean currents and resulting perturbations in primary production (Brander, 2005 cited in German Advisory Council on Global Change, 2006). Changes in primary productivity will result in alterations in secondary production by zooplankton which is a significant food source for some fish populations (German Advisory Council on Global Change, 2006).

According to the German Advisory Council on Global Change (2006), changes in zooplankton assemblages as a result of human induced climate changes have already been recognized. This results in the need for fish, seabirds, and mammals to adapt to the new conditions (Richardson and Schoeman, 2004 cited in German Advisory Council on Global Change, 2006). As water temperatures rise, cold-water species will shift toward the poles seeking cooler water and prey; thereby, placing increased pressure on marine polar regions (German Advisory Council on Global Change, 2006). However, as water temperatures increase, there is the potential for more habitat to become available to highly migratory species with tropical/temperate distributions such as white marlin. White marlin are piscivorous (e.g., feeding on various fish species such as herring, dolphinfish, hardtail jacks), and they also consume squid (NMFS, 2006; Collette and Klein-MacPhee, 2002). Their diverse diet would be expected to enable them to adapt to potential changes in the food web resulting from global warming.

There is evidence to suggest that within the next several decades, high latitude calcifying organisms (such as pteropods and cold water corals) may be negatively affected as changes in seawater chemistry occur (Orr et al., 2005). Increasing atmospheric carbon dioxide concentrations are reducing ocean pH and carbonate ion concentrations resulting in lower calcium carbonate saturation (Orr et al., 2005). According to Orr et al. (2005), organisms with exoskeletons comprised of calcium carbonate may be unable to maintain their shells due to this low saturation of calcium carbonate. This could result in alterations in the biodiversity of polar ecosystems by the end of this century (Orr et al., 2005). While this is a significant issue, evidence suggests that these changes may occur in polar regions not occupied by white marlin. Thus, impacts to white marlin populations are not expected.

Conclusion: The BRT does not consider any of the natural or manmade factors mentioned above to be affecting the continued existence of the white marlin.

VI. Evaluation of Conservation Efforts and Non-Regulatory Measures

Because the BRT considered white marlin to be a panmictic species managed internationally through ICCAT, the BRT decided that it was appropriate to review both conservation efforts taking place in the U.S. (through the Policy for the Evaluation of Conservation Efforts) as well as those being undertaken internationally. The following is a review of the major conservation efforts and whether these efforts are having a positive conservation benefit on white marlin.

Current conservation efforts include not only domestic and international conservation and management measures, but also non-regulatory conservation efforts. These non-regulatory programs are generally long-term programs, although some programs of shorter duration that have specific targets may be as or more effective at raising awareness and contributing to conservation.

A. U.S. Recreational Fishers

Spreading a catch-and-release ethic among recreational fishermen perhaps has been the most effective non-regulatory conservation effort in the U.S. billfish fishery to date. The Billfish Foundation has developed a release certificate program to reward release fishing. For each billfish released, anglers receive from the Foundation a certificate of congratulations. Annual Release Awards are given to captains, anglers and clubs worldwide. U.S. anglers have achieved a white marlin release rate of over 96% by most estimates since 1999, and this practice of releasing white marlin and other Atlantic billfish has spread outside the U.S.

The Billfish Foundation continues a "No Marlin on the Menu" education campaign; the intent of which is to discourage Americans from eating marlin and increase support for the fishery's recreational status. Whenever Foundation staff receive information about an establishment selling imported marlin, they contact the establishment and explain the conservation implications. A copy of that correspondence is sent to a local reporter. A follow up letter is sent later. Establishments that agree to discontinue sales of marlin are sent a certificate that can be framed and a thank-you letter. This program has been in place for years and likely serves to increase awareness of white marlin.

U.S. anglers have also promoted and developed recreational fishing in other parts of the world. Because billfish anglers expect high catch rates and pursue larger fish, expanded international recreational fishing may provide economic incentives for other countries to conserve white marlin. These promotional activities have indeed led to increased involvement in the fishery management process and stewardship of the resource. For example, the Bahamian government prohibits the use of longline gear in state waters largely to protect the economically more valuable recreational fishing industry (predominantly billfish tournaments and trips).

Finally, recreational anglers have worked through the Billfish Foundation and the NMFS Cooperative Tagging Center to record and tag marlin. This program has been ongoing for years and has provided data regarding migrations of marlin. While tagging data has limited use in age and growth studies, it has provided information to assist in describing the migratory pathways of Atlantic white marlin.

B. International and Domestic Conservation Organizations

1. International Union for Conservation of Nature and Natural Resources

The International Union for Conservation of Nature and Natural Resources (IUCN) was founded in 1948 and comprises States, government agencies, and a diverse range of non-governmental organizations. The IUCN produces a Red List of Threatened Species. The threatened species categories have been in place, with some modification, for almost 30 years. The most recent revision of listing criteria (Version 3.1) was approved at the 51st meeting of the IUCN Council on February 9, 2000. The red list categories most consistent with the ESA are: critically endangered, endangered, and vulnerable. The distinctions among these categories are largely determined by the extent and rate of population decline, geographic range, estimated population size, and analyses of the probability of future extinction. Species may also be categorized as lower risk, meaning that the species does not satisfy the criteria for the above categories. For example, a species may be listed as conservation dependent if it is the focus of a continuing conservation program, the cessation of which would result in the species qualifying for one of the threatened categories above within five years.

Criteria based on reductions in population size to meet the critically endangered category include a population size reduction of at least 90% over the last 10 years or three generations, whichever is longest, where the causes of the reduction are clearly reversible, understood, and ceased. If the causes of reduction are not understood, not reversible, or have not ceased, a population reduction of at least 80% over the last ten years or three generations, whichever is longest, or a projected reduction of at least 80%, to be met within the next ten years or three generations, whichever is longest, would apply. In the case of white marlin, available information suggests that the cause of population reduction is fishing mortality. Fishing mortality is reversible, but the fishing mortality rates remain high and one could not claim that the cause of population decline has ceased; thus, the 80% standard would apply. To be classified as endangered a reduction of 70% when the causes are known and ceased would apply and a reduction of 50% when the causes are unknown or not ceased would apply. The vulnerable standard is based on a reduction of 50% when the causes are known and ceased, and 30% when the causes are unknown or not ceased. White marlin are not currently on the IUCN Red List of Threatened Species, they have not been assessed nor are they on the assessment schedule.

2. American Fisheries Society

The American Fisheries Society (AFS) in Musick et al. (2000) modified the IUCN criteria to better reflect the population dynamics of exploited fish stocks and suggested four categories be used to evaluate risk:

1. Rarity
2. Small Range and Endemics
3. Specialized Habitat Requirements
4. Population Decline

AFS proposed a two-tier system that first assesses the productivity of the stock and then provides standards regarding levels of decline of stocks based on productivity. Stock productivity is assigned to one of 4 levels: high, medium, low, or very low. Productivity is assessed based on the intrinsic rate of increase ‘r’, the K parameter from the von Bertalanffy growth equation, fecundity, age at sexual maturity, and longevity. Stocks with declines exceeding threshold decline levels for their productivity class would then be classified as vulnerable, and would warrant close scrutiny. The AFS intent with a ‘vulnerable’ classification is twofold: 1) to inspire more detailed evaluation to determine if extinction were a foreseeable threat; and 2) to provide early enough warning such that corrective management action might be taken before a serious extinction risk developed. The other three AFS criteria are based on qualitative factors such as rarity, specialization in habitat requirements, and small range. Musick et al. (2000) did not recognize white marlin in the list of 82 species/subspecies of marine fishes that they considered to be at least vulnerable to extirpation in North American waters. This methodology was used by the BRT to assist in developing a portion of the thresholds utilized to assess white marlin as threatened or endangered.

3. Convention on International Trade in Endangered Species of Wild Fauna and Flora

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments that regulates international trade in wild animals and plants. CITES was drafted as a result of a resolution adopted in 1963 at a meeting of members of the IUCN. CITES works by regulating aspects of international trade in selected species.

The species covered by CITES are listed in appendices according to the degree of endangerment and the level of protection provided. Appendix I includes species threatened with extinction; trade in specimens of these species is permitted only in exceptional circumstances. Appendix II includes species not necessarily threatened with extinction, but for which trade must be controlled to avoid exploitation rates incompatible with species survival. Appendix III contains species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade.

CITES criteria for identifying a species as threatened with extinction include measures of population size, geographic range, and rate of decline. Guidelines are provided through examples as to what constitutes a small wild population in terms of absolute numbers. Examples such as <5,000 for a population or <500 for a subpopulation are given but CITES recognizes that these may not be applicable to all species. Geographic range is evaluated in terms of defining the smallest area essential for the survival of a species. As examples, figures of <10,000 km2 for a population and <500km2 for subpopulations are given; however, these are given only as examples recognizing that it is impossible to give a figure applicable to all taxa.

CITES gives guidance to assist in identifying rates of decline in wild populations that should trigger concern. Examples are given of >50% in 5 years or 2 generations; or for a small population >20% in 10 years or 3 generations. Again these numbers are offered only as guidelines recognizing that they will not be applicable to all species.

CITES also encourages a proactive approach and suggests listing in Appendix I species that if not protected, would be likely to meet the above criteria within 5 years. Criteria for listing in Appendix II basically address the likelihood of a species meeting Appendix I criteria in the near future, unsustainable levels of exploitation, whether harvest for international trade has or will reduce the population to a level where it is threatened by other factors, and the issue of species that resemble another species that qualifies biologically, and must be listed for enforcement reasons. Currently, white marlin are not listed on any of the CITES Appendices.

4. Committee on the Status of Endangered Wildlife in Canada

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was established in 1977 to provide Canadians with a scientifically based determination of wildlife species at risk of extinction. The group began its assessments in 1978 and meets each year. In 2003, the Species at Risk Act (SARA) was established in order to protect wildlife species at risk (the Canadian equivalent to the ESA). Under SARA, COSEWIC functions as the independent body of experts responsible for identifying and assessing species considered to be at risk. COSEWIC assesses the status of the particular species and provides their assessment to the Canadian government. The Canadian government is then responsible for determining if legal protection and recovery under SARA is warranted. To date, COSEWIC has not initiated a status assessment for white marlin.

Summary of the Conservation Efforts and Non-Regulatory Mechanisms

The effectiveness of the non-regulatory measures largely implemented by the recreational fishing community is difficult to evaluate. The catch-and-release ethic practiced in the U.S. has had an important impact on recreational landings, although post-release mortality still accounts for some unknown level of mortality in this fishery. This ethic has probably been important in gaining the respect of the international community, which was not familiar with the value of recreational fishing or the public interest in catch-and-release fishing in general. Many countries view fishing as a means to land seafood. There has been some concern by the international community about the impact of the recreational fishery, given the gaps in data collection from this fishery in the past. It is likely that the catch-and-release nature, coupled with the use of circle hooks (that are known to reduce post-release mortality) in Atlantic billfish tournaments beginning January 1, 2008, will minimize the concerns of the foreign fishing nations regarding the U.S. recreational fishery.

Despite the "No Marlin on the Menu" campaign, marlin continues to be widely offered by grocery store chains and in restaurants, thereby undermining the educational nature of the campaign. It is not likely that this campaign has boosted conservation of the species, but it may have enhanced enforcement of the ban on sale of Atlantic marlin.

Promoting recreational marlin fishing opportunities in other parts of the world could have a substantial impact on how small island nations, in particular, view commercial fishing. For example, a nation that realizes the value of marlin fishing and the related tourism benefits may be likely to favor the recreational take of marlin over commercial landings. Any nation that has an economic incentive to protect marlin is more likely to cooperate with restrictive measures recommended by ICCAT.

Recreational and commercial participation in billfish tagging programs has produced a substantial amount of data related to marlin biology and ecology. Although this information has not led to any specific conservation measures being adopted by ICCAT (e.g., time/area closures), it may contribute to the determination of essential habitat for this species.

The BRT concludes that the existing conservation efforts and non-regulatory mechanisms are beneficial to the persistence of the species and should be continued.

VII. Extinction Risk Analysis

The process for determining whether a species should be listed under the ESA is based upon the best available scientific and commercial information. This determination is based on an assessment of whether the species is threatened or endangered because of any of the factors specified in section 4(a)(1) of the ESA. The BRT performed a three-step analysis in determining the extinction risk of the white marlin. First, they determined thresholds for an ESA endangered and threatened listing by utilizing the definitions set forth in the ESA. Then, the BRT defined the "foreseeable future" for white marlin in order to determine a timescale over which to assess the thresholds. The BRT then considered the population projections from the recent 2006 stock assessment along with new runs of the Bayesian model to measure the status of the species relative to the listing criterion.

During deliberations, the BRT considered the white marlin as a single species throughout the Atlantic Ocean. This was based on the determination that white marlin comprise a single stock, and the fact that no geographic area or segment of the population was more or less important than another in considering the status of the species.

A. Listing Thresholds

Musick et al. (2000) suggested that a reduction of a population by 95% for species with medium productivity would be classified as vulnerable and may merit further study. The BRT agreed with Musick et al. (2000) that a classification of "vulnerable" is a lower threshold than threatened or endangered. The BRT reviewed the available life history data and available estimates for r and determined that white marlin are best classified as a species with medium productivity based on the following:

- High fecundity
- Low age at maturity (2-3 years)
- Relatively short generation time (3-5 years)
- Rapid rate of growth
- High natural mortality rates
- Recent estimates of r are ≥ 0.15

The 2007 BRT followed the work of the 2002 SRT that determined that the threshold for extinction risk was equivalent to 1% of biomass over carrying capacity ($B/K = 0.01$). Extending the logic described in Musick et al. (2000) whereby a threshold of 0.05K would be classified as "vulnerable," the BRT decided that for white marlin 0.01K would be an appropriate threshold for the more extreme threatened or endangered classification.

The BRT established the following metrics in order to assess the extinction risk of the white marlin based upon the definition provided in the ESA and by the thresholds described above:

1. Threatened

$B/K \leq 0.01$

and some combination of the following:

a. Decreasing trends in absolute population size or biomass;
b. A reduction in spatial distribution relative to historic geographic range;
c. Loss of any observed size class(es) or other evidence of recruitment failure; or
d. Sustained increase in F.

2. Endangered

$B/K < 0.01$

in combination with the factors listed above for threatened, and either of the following:

a. Interactions becoming increasingly rare, for example rarity in tournament landings and releases, or
b. Depensation detected.

The BRT firmly notes herein that the benchmarks established and considered within the following extinction risk analysis were specifically determined and utilized in this 2007 review with due consideration to the complexity and sensitivity of various datasets and associated analyses. The metrics described below, and utilized by the BRT to assess status of the 2007 white marlin, are not intended as a guide for future status reviews or listing determinations.

B. Foreseeable future

In order to determine the timescale for forecasting the status of the white marlin, the BRT noted the following:

1. Lack of a population viability analyses (PVAs),
2. Paucity of life history information,
3. Mean generation time (defined as a measure of how long it takes on average for a sexually mature female fish to be replaced by offspring with the same spawning capacity (Pacific Fishery Management Council)) is estimated to be 3-5 years,
4. Forecast periods by conservation agencies (CITES and IUCN) include 10 years or 3 generations whichever is longest (IUCN) and based on a mean generation time of 3-5 years, this is approximately equivalent to 9-15 years,
5. Projected period deduced by BRT to realize increase in absolute abundance based on life history is about 10 years (3 years of data utilized between 2002 and 2006 stock assessments; seek 4-5 more years of data for next stock assessment; response in fishery observed about 2 years later),
6. Because no significant reduction in compliance with management measures is anticipated, F is likely to remain relatively stable for next 10-15 years,
7. The 2002 SRT focused on a 10-year time horizon, and
8. Bayesian model projections are based on 5-year increments (variability significantly increases with projections greater than 10-15 years).

The BRT considered several potential time frames for foreseeable future, and determined that based on the best available information presented above, a period between 10-15 years is an appropriate time frame for the foreseeable future.

C. Population Projections

The BRT reviewed population projections of white marlin under various management/compliance scenarios in order to predict effectiveness of ICCAT measures (resolutions and recommendations). As described in section V, ICCAT continues to assess and implement management measures to rebuild marlin, with the Compliance Committee making official determinations of non-compliance and tracking landings to assess progress in reducing landings in relation to the 1996 or 1999 baseline. The current estimate of 2006 total landings is 45% of 1996 value.

As previously discussed in the 2002 SR, population projections are an integral part of stock assessment and, in this case, are important for determining the likely fate of stocks under consideration for ESA listings. Projection methodology for white marlin is limited because of the lack of age or size-based information on stock demographics. There are two viable choices for population projections in this case: 1) empirical projections based on trends in population sizes or indices; and 2) use of projection formulations consistent with production models used in stock assessment.

Recent population abundances indicate that the number of white marlin in the size range vulnerable to the fishery is between 100,000 – 2,000,000, likely around 200,000 (Table 14). No new evidence specific to recruitment is available. Catches have been reduced since 1996.

Similar to the 2002 SRT, the 2007 BRT requested a series of population projections based on the Bayesian surplus production model of Babcock & McAllister (kindly provided on request by E. Babcock). Model runs from both 2002 (Fig. 19) and 2007 (Fig. 20) are presented below for comparison. Several statistics can be computed from these projections, including the expected value of the final (year N) biomass in relation to K, and the probabilities that the biomass in year N exceeds various biomass benchmarks. Like the 2002 SRT, the BRT decided to examine the probability that stock size reaches or falls below 0.01K under several future harvest scenarios. The effects of five constant fishing mortality rates (F) based policies on white marlin biomass were evaluated in 2002 and again in 2007 (Figs. 19 and 20). Projections were provided for 5-year, 10-year, 20-year, 25-year, and 30-year horizons. The BRT focused on the 10-year projection in discussion, but all results are given in Figures 19 and 20. For comparison, the same values of F were run in 2007 that were run in 2002 (see legend). The BRT decided that this range of F was appropriate considering the values of F estimated in the 2006 stock assessment (Table 16).

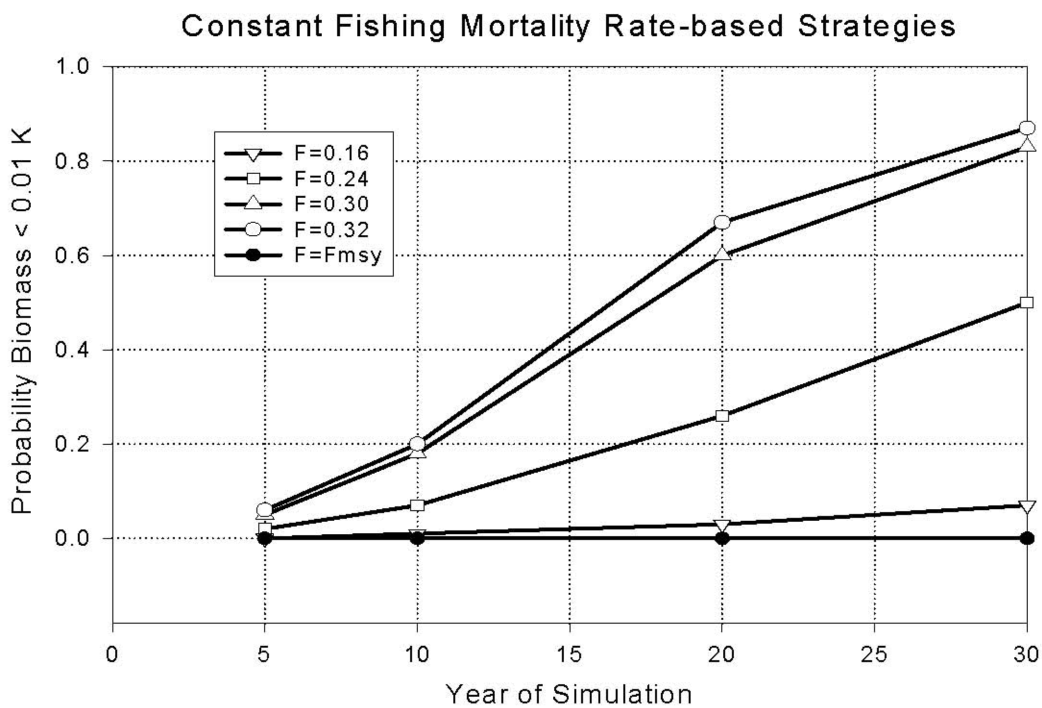


Figure 19. 2002 calculated probabilities of white marlin biomass declining below 1% of carrying capacity (K) over time, based on the results of stochastic populations projections from a Bayesian Schaefer production model. Probabilities are evaluated for five F-based policies in the legend. Source: 2002 SRT.

Figure 20. 2007 calculated probabilities of white marlin biomass declining below 1% of carrying capacity (K) over time, based on the results of stochastic populations projections from a Bayesian Schaefer production model. Probabilities are evaluated for five-based policies in the legend. Courtesy of E. Babcock, RSMAS.

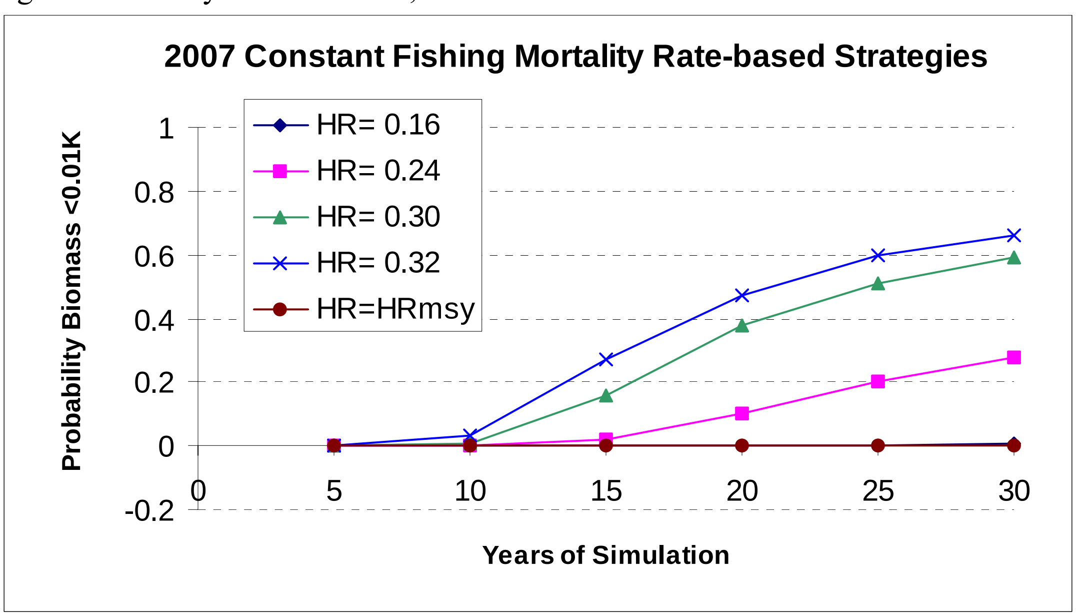


Table 16. Summary of fishing mortality (F) estimates generated from the 2006 stock assessment by year. LCI = lower confidence interval; UCI is upper confidence interval. Confidence intervals are 80%. Estimates courtesy E. Babcock, RSMAS.

Year	LCI	Median	UCI
1990	0.12	0.18	0.27
1991	0.12	0.18	0.28
1992	0.11	0.17	0.26
1993	0.12	0.19	0.28
1994	0.17	0.26	0.38
1995	0.14	0.23	0.36
1996	0.17	0.27	0.43
1997	0.11	0.20	0.33
1998	0.11	0.20	0.33
1999	0.11	0.20	0.34
2000	0.10	0.20	0.34
2001	0.07	0.14	0.24
2002	0.09	0.17	0.30
2003	0.07	0.13	0.23
2004	0.06	0.11	0.19
2005	0.05	0.10	0.18
2006	0.05	0.09	0.17

The 2002 SRT projection results indicated low probabilities of the stock declining to 1% of K or lower in the next 10 years. At the highest level of F considered (0.32) in 2002, there was a 20% probability of reaching the 0.01 level in the 10-year time period considered by the SRT (Fig 19). In 2007, projections were more optimistic. Estimates of F are lower and decreasing (Table 16), and the status of the population with respect to B/K is better. None of the F values investigated (Fig. 20) show an appreciable probability for the population to decline to or below the 0.01K level in the foreseeable future (10-15 years).

Conclusions

The BRT assessed current status of white marlin to determine if it is in danger of extinction throughout all or a significant portion of its range by utilizing the benchmarks determined for an "endangered" status. The BRT notes that the current stock of white marlin is greater than 1% carrying capacity (K) (on the order of 20% K or greater in 2006; Table 14) and is expected to remain stable or increase given current management requirements. The BRT then utilized data from the Recreational Billfish Survey (RBS) as a proxy to determine that encounter rates with white marlin continue to be frequent (Fig. 5). The BRT decided the RBS database was the best available data to provide insight of the recreational interactions given the expertise of these recreational fishers in targeting billfish, potential implications if the species were to be listed under the ESA in the U.S., and the unique recreational-based fishery of the U.S. There is no indication that depensation is occurring: there are no signals in the population models or in estimates of absolute abundance (Table 14). The BRT concludes that none of the criteria for an "endangered" listing are being or are expected to be met.

The team concludes white marlin are not threatened. Within the foreseeable future (10-15 years), throughout all its range, the stock of white marlin is expected to remain greater than 1% of K and is expected to remain stable or increase given management requirements. The 2006 stock assessment indicated that white marlin abundance appears to be increasing in response to the ICCAT management restrictions on harvest. This is an expected population response to reduced fishing mortality. This observation is based on compliance between 2002 and 2006, and observed in population trends reported in the 2002 and 2006 stock assessments (Fig. 13). While there is no direct evidence, there has been no reported loss of a white marlin size class since 2002, nor is there any reason to expect one to occur. In addition, the BRT noted that the absolute population size appears to be increasing (Fig. 13, Table 14), there is no apparent constriction of geographic range (Figs. 16 and 17), and F has decreased continually since 2002 (Table 16). It appears that both decreasing population size and biomass, and sustained increase in F have been abated by current management efforts. Therefore, because neither the "threatened" or "endangered" benchmarks were met, the BRT concluded that ESA listing for white marlin is not warranted.

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