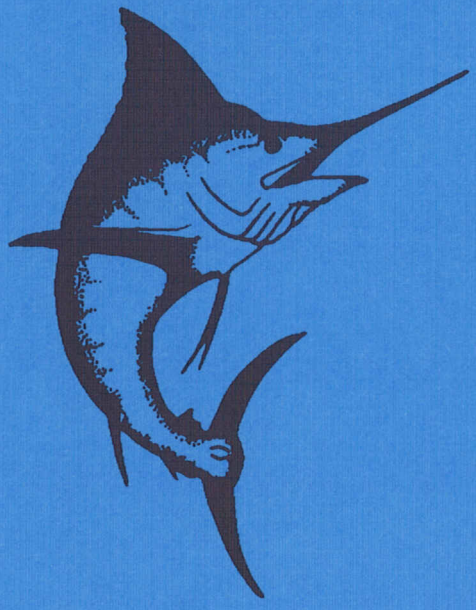
NOAA Technical Memorandum NMFS-SEFSC-316

1991/1992 REPORT OF THE SOUTHEAST FISHERIES SCIENCE CENTER BILLFISH PROGRAM



December 1992

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, Florida 33149

NOAA Technical Memorandum NMFS-SEFSC-316

1991/1992 REPORT OF THE SOUTHEAST FISHERIES SCIENCE CENTER BILLFISH PROGRAM[1]

U.S. DEPARTMENT OF COMMERCE
Barbara Hackman Franklin, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
John A. Knauss, Under Secretary for Oceans and Atmosphere

NATIONAL MARINE FISHERIES SERVICE
William W. Fox, Jr., Assistant Administrator for Fisheries

December 1992

[1]Contribution MIA-92/93-27 from the Southeast Fisheries Science Center, Miami Laboratory, Migratory Fishery Biology Division.

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National Marine Fisheries Service
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, Florida 33149

or

National Technical Information Service
5258 Port Royal Road
Springfield, Virginia 22161

This report was prepared with individual
contributions from scientists at the Miami and
Panama City Laboratories of the Southeast Fisheries Science Center

INDIVIDUAL CONTRIBUTORS

Cooperative Recreational Billfish Surveys
Mark I. Farber
Robin L. Carter
Joseph P. Contillo
Paul J. Pristas

Cooperative Game Fish Tagging Program
Robert E. Bayley
Joseph E. Tashiro
Christopher D. Jones

ICCAT Enhanced Research Program for Billfish
Eric D. Prince

Pelagic Longline Observer Program
Dennis W. Lee

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INTRODUCTION

Scientists at the Southeast Fisheries Science Center (SEFSC) have been involved in billfish research since at least the early 1970's. As a result, the SEFSC's billfish database is one of the most comprehensive sources of scientific information on Atlantic blue marlin, white marlin, sailfish, and spearfish. Many different segments of the fishing community – recreational anglers, commercial fishermen, representatives of billfish tournaments, university researchers, state agents, federal employees, and private research organizations – have donated their time, effort, data, and funds to assist our research program over the past two decades.

Billfishes are often referred to as "fish without a country" because their movement patterns encompass virtually the entire ocean and intersect the boundaries of many different nations. For this reason, this report provides a more comprehensive presentation of research activities involving SEFSC scientists and includes work on billfish that occurs outside, as well as inside, United States jurisdictional waters.

Most Atlantic billfish information is gathered through three Programs: the Cooperative Game Fish Tagging Program (CGFTP) of the SEFSC; the Cooperative Recreational Billfish Survey (CRBS) of the SEFSC; and the Enhanced Research Program for Billfish conducted under the auspices of the International Commission for the Conservation of Atlantic Tunas (ICCAT), located in Madrid, Spain. The purpose of the CGFTP is to maintain a voluntary tagging system supported by recreational and commercial anglers primarily in the western Atlantic Ocean. The purpose of the CRBS is to collect data on the number of billfish hooked, boated, tagged, and released during tournament and non-tournament fishing trips and to collect data on length, weight, and sex of individual billfish landed. The goals of the ICCAT Enhanced Research Program for Billfish are to improve the Atlantic-wide biostatistical fishery data for billfish, maintain an international Atlantic billfish tagging program, and assist in age and growth research. Besides these three major programs for billfish, the tuna and swordfish research programs at the SEFSC also provide billfish data on the number of billfish hooked and released incidentally in the U.S. and by foreign fishing vessels operating within U.S. jurisdictional waters. A review of this program is also presented in a separate section – Pelagic Longline Observer Program.

This report includes only 1991 data from the CGFTP and the CRBS because data compilation for these programs are normally not completed until the year following data collection. Data for 1992 are presented for the ICCAT Enhanced Research Program and other ICCAT Billfish related activities for 1991 and 1992 are also presented.

COOPERATIVE GAME FISH TAGGING PROGRAM

Information on tagged billfish has been kept by the Cooperative Game Fish Tagging Program (CGFTP) since the 1950s. Tagging activities have increased each year, with an increase in tag-and-release awareness and the expansion of the geographic area in which anglers participate.

The CGFTP provides tagging kits free upon request to individual anglers. Each kit contains tags and self-addressed, postage-paid tagging report cards and recapture cards to be filled out by the angler and returned to the CGFTP when tags are used or a tagged fish is recaptured. Also included in the kit, and available free upon request, is the CGFTP annual newsletter. The newsletter provides a detailed, up-to-date account of tagging information for billfishes, tunas, tarpon, amberjack, king mackerel, and red drum. Interested persons may contact:

Cooperative Game Fish Tagging Program
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, FL 33149

Toll free: (800) 437-3936

Tag Releases

Sailfish

In 1991, 3,206 sailfish were tagged and released by program cooperators, an increase of 3.9% over 1990. The number of sailfish releases for each type of gear is shown in Figure 1. The principal areas for sailfish tagging in 1991 were southeast Florida (with 1,530 releases), and Cancun/Cozumel, Mexico (859).

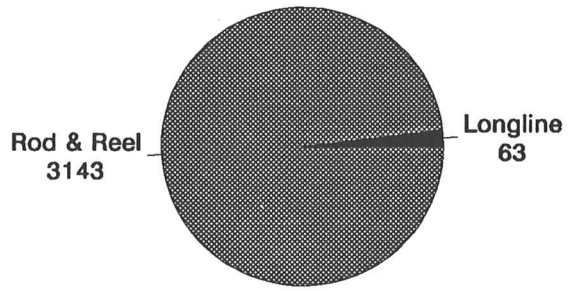


Figure 1. Number of sailfish tag releases in 1991, by gear.

Blue Marlin

A total of 1,789 blue marlin were tagged and released in 1991. This is a decrease of almost 13% from 1990's total. Figure 2 shows the breakdown of blue marlin releases by gear. Principal areas for blue marlin tagging are Puerto Rico and the U.S. Virgin Islands with 421 and 428 releases, respectively.

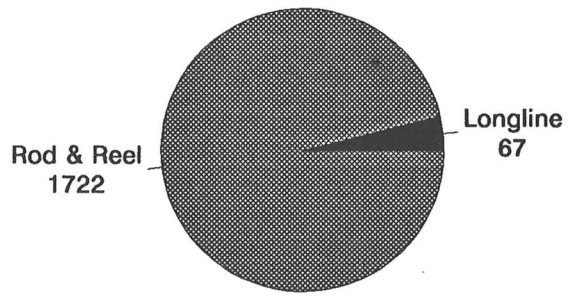


Figure 2. Number of blue marlin tag releases in 1991, by gear.

White Marlin

A total of 1,446 white marlin were tagged and released in 1991, an increase of 12.5% over 1990. The breakdown of white marlin releases by gear is given in Figure 3. Thirty-seven percent of the white marlin releases were off the U.S. East Coast (Hatteras, NC to Cape Cod, MA; 536 releases) and 30% were of La Guaira, Venezuela (428 releases).

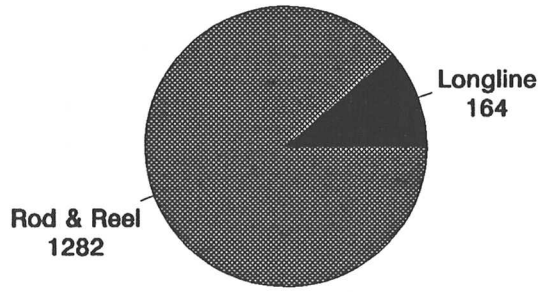


Figure 3. Number of white marlin tag releases in 1991, by gear.

Tag Recaptures

There were 101 billfish recaptures reported to the CGFTP for 1991. The numbers of billfish recaptured are shown by area of release and recapture in Table 1. The numbers of recaptured billfish by each type of gear are illustrated in Figures 4-6. The maps illustrating the 10 longest distances traveled by sailfish, blue marlin, and white marlin (Figures 7-9) were based on tag-recaptures from 1954-1991. A more detailed presentation of these data can be obtained by referring to a publication by Bayley and Prince (in press), which is available from the Southeast Fisheries Science Center upon request.

Sailfish

A total of 65 tagged sailfish were recaptured in 1991 (Table 1). Sailfish were recaptured almost exclusively by recreational fishermen – 55 out of 65 (Figure 4). Because sailfish have a more coastal distribution compared to marlins, a predominance of sailfish recaptures from recreational anglers, who fish closer to shore than commercial fishermen, is to be expected. The ten longest distances traveled for sailfish recaptures for all years are illustrated in Figure 7. Although sailfish are distributed closer to shore than the marlins, this species is still capable of extensive offshore movements, as inferred in Figure 7. For example, several sailfish released in the Mexican Caribbean (off Cozumel or Cancun) have been recaptured in Grenada or off Venezuela. One sailfish released off southeast Florida was recaptured by a longline vessel in the mid-Atlantic.

Table 1. Release area and number of recaptures reported by area for sailfish, blue marlin, and white marlin reported in the CGFTP for 1991.

Species	Release Area	Recapture Area	Number Recaptured
Sailfish	Southeast Florida	Southeast Florida	46
		N. Florida & Carolinas	2
		Southern Gulf of Mexico	1
		Cozumel, Mexico	1
		Cuba	1
	Cancun, Mexico	Cancun, Mexico	1
		Southeast Florida	1
		Venezuela	1
		N. central Gulf of Mexico	1
	Northern Bahamas	Southeast Florida	1
		Cuba	1
		Hispaniola	1
	N. Florida & Carolinas	Southeast Florida	1
	S. of Louisiana	Grenada	1
	Venezuela	Venezuela	1
	<No Release Info.>	Southeast Florida	4
		Total:	65
Blue Marlin	Virgin Islands	Virgin Islands	1
		Venezuela	2
		Barbados	1
		Puerto Rico	1
	Puerto Rico	Venezuela	1
		New England	1
	Florida Panhandle	S. of Mississippi Delta	1
	Hispaniola	Grenada	1
	Venezuela	Venezuela	1
	Northern Bahamas	Northern Bahamas	1
	Azores	Azores	2
		Total:	13
White Marlin	Venezuela	Venezuela	10
	Mid-Atlantic Bight	Mid-Atlantic Bight (U.S.)	6
		Venezuela	1
		W. of Bermuda	1
		E. of Bermuda	1
	Florida Panhandle	Florida Panhandle	1
		Mid-Atlantic Bight	1
	Southeast Florida	Mid-Atlantic Bight	1
	N. of Bermuda	Northern Bahamas	1
		Total:	23

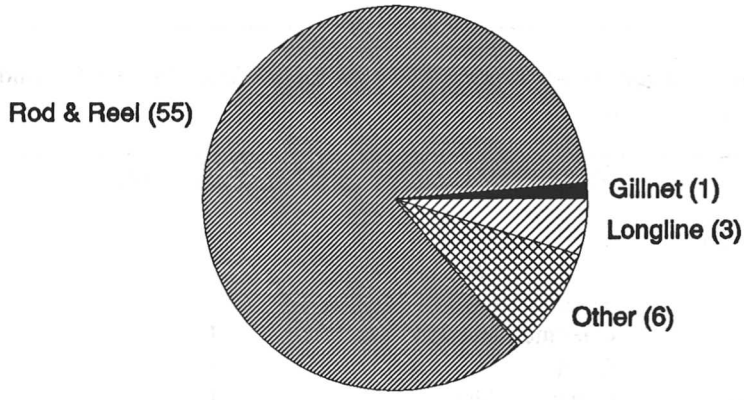


Figure 4. Sailfish recaptures reported in 1991, by gear.

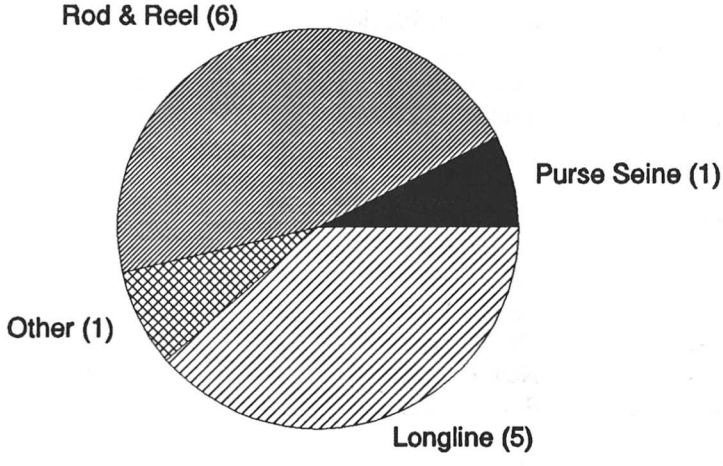


Figure 5. Blue marlin recaptures reported in 1991, by gear.

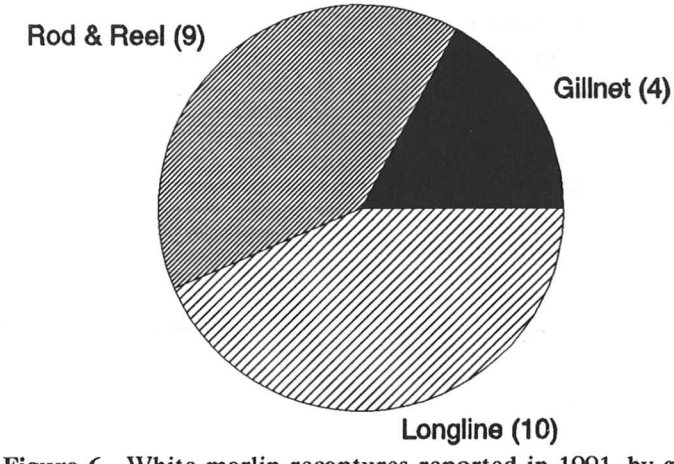


Figure 6. White marlin recaptures reported in 1991, by gear.

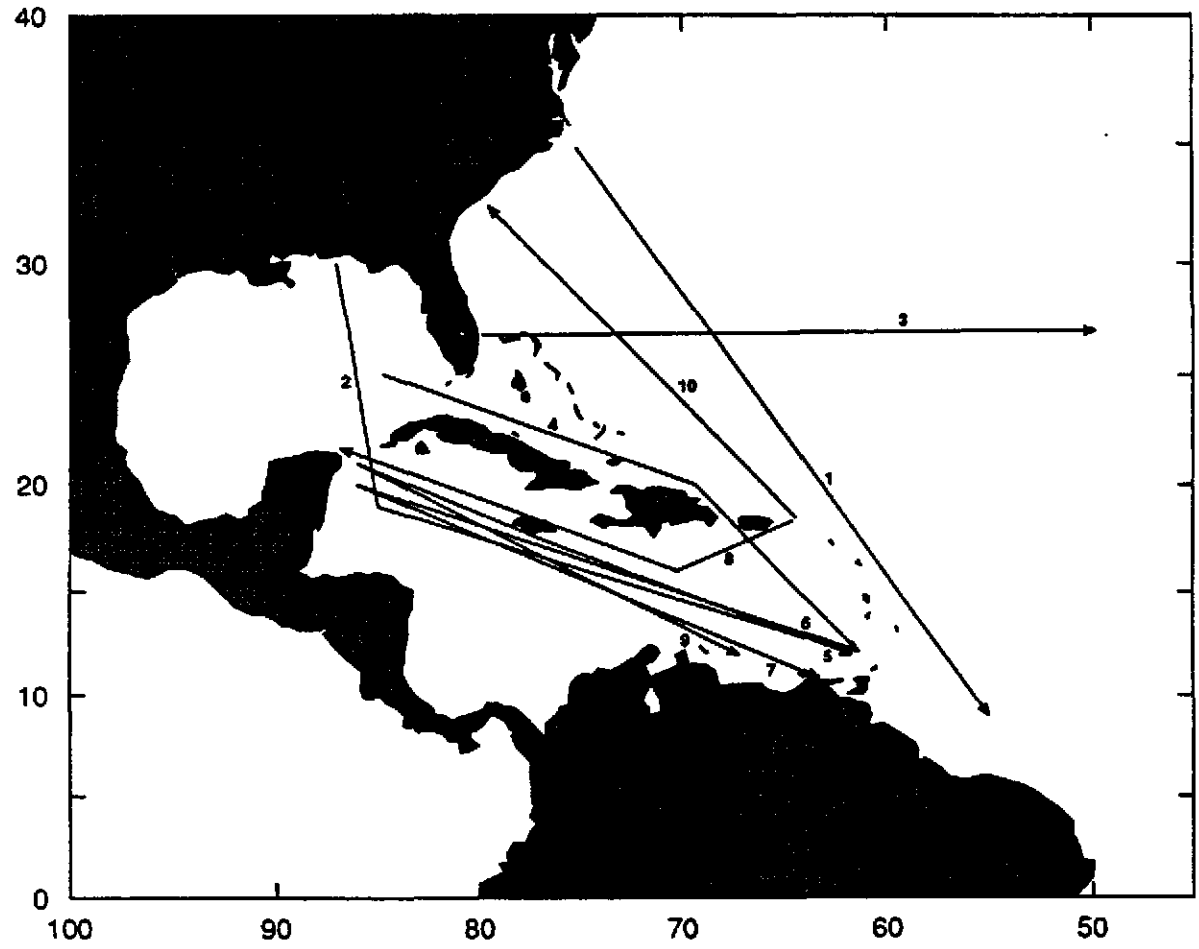


Figure 7. The ten longest movements (minimum distances traveled) for tagged sailfish documented by the CGFTP over all years.

Blue Marlin

A total of 13 tag-recaptured blue marlin were caught in 1991 (Table 1). Commercial and recreational fishermen each recaptured about half of the blue marlin (Figure 5). The ten longest distance movements for blue marlin recaptures for all years are illustrated in Figure 8. This species frequently makes transatlantic crossings, particularly from the Caribbean (U.S. Virgin Islands) to the west coast of Africa. Five fish tagged off Puerto Rico or the Virgin Islands were recaptured off Africa – 4 in the Gulf of Guinea and 1 off Sierra Leone. One fish tagged off Venezuela was recaptured 14 months later near Senegal.

White Marlin

A total of 23 tag-recaptured white marlin were caught in 1991 (Table 1). Commercial fishermen recaptured 60% (14), while recreational anglers recaptured 40% (9) of the white marlin in 1991 (Figure 6). The ten longest distance movements for white marlin recaptures for all years are illustrated in Figure 9. Evidence suggests that considerable movement takes place between the U.S. northeast coast and Venezuela. One fish tagged off Maryland was recaptured in the mid-Atlantic. Of the three species of billfish, white marlin have come the closest to making transequatorial movements (Figure 9).

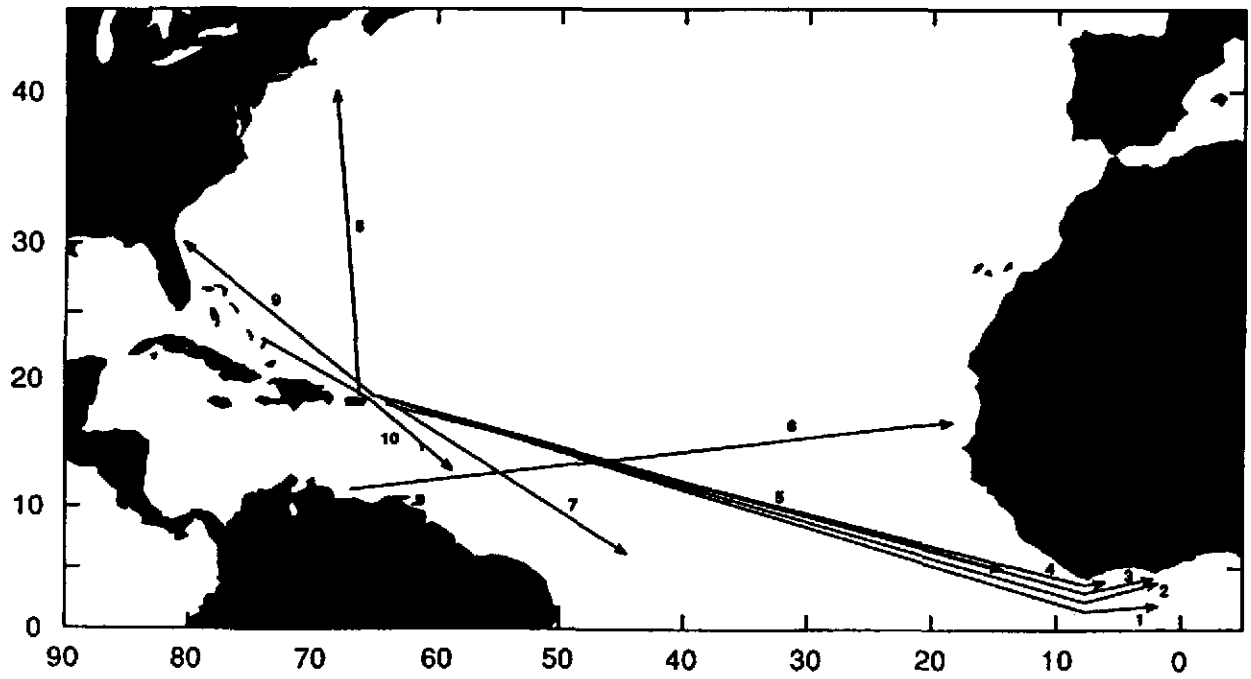


Figure 8. The ten longest movements (minimum distances traveled) for tagged blue marlin documented by the CGFTP over all years.

Tag Development and Tag Performance Experiments

Tag Design Changes

Several changes in tag design have been developed over the last few years through cooperative work between NMFS and The Billfish Foundation (TBF). Initially, a new tag anchor was designed for large billfish which combines the piercing quality of a stainless steel applicator with the biological compatibility of medical-grade nylon. Once the tag is inserted into the dorsal muscle, only the nylon anchor stays inside the fish after the steel applicator is withdrawn. Rather than gluing the head to the streamer, the attachment is mechanical, using a loop of monofilament and shrink-tubing. These qualities should help reduce tag shedding substantially. Field testing of the effectiveness of this design is presently being conducted through NMFS and TBF. In early 1993, a miniaturized version of The Billfish Foundation tag will be available on a limited basis for use on red drum, king mackerel, and tunas. Extensive tag performance experiments, using tagged fish held in captivity, are being planned for 1993-94. These experiments should establish if this new tag can be expected to perform better than the one currently in use by the CGFTP.

"Save It For Science" Program

For many years, the CGFTP has been known strictly as a tag and release program. For example, during the past forty years of billfish tagging through the CGFTP, anglers have tagged and released more than 66,000 billfish, yet less than 2% of these fish have been recaptured. In addition, only a handful of the 2% have been retained for scientific examination. This points out one of the most neglected aspects of the tagging program – i.e., *recapturing tagged fish and saving them for scientific examination*. Recapturing tagged fish is the last critical link in the tagging program and by not emphasizing recapture efforts, the overall value of information obtained from tagging is greatly reduced.

Examination of tag-recaptured billfish has a number of important uses. For example, to assess the well-being of an entire population of fish, knowledge of age, growth, reproduction, and death

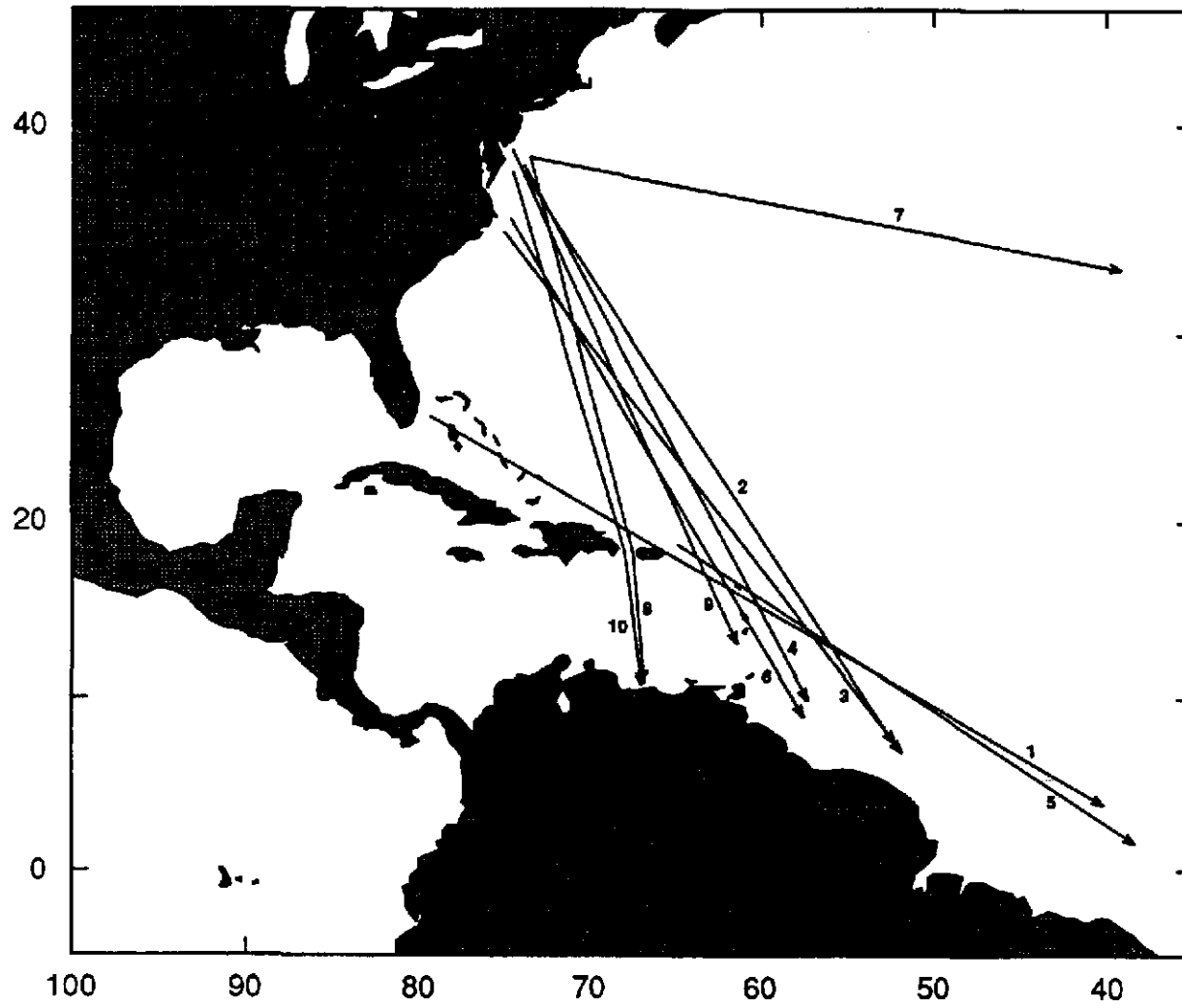


Figure 9. The ten longest movements (minimum distances traveled) for tagged white marlin documented by the CGFTP over all years.

rate are critical. In billfish research, tagging is one of the few ways scientists can obtain these valuable data. In particular, the accuracy of age and growth techniques can be validated by comparing the age known from tagging records with age estimated from the fishes skeletal structures. Participants in the tagging program, or anyone else recapturing tagged billfish, should be aware of the importance and potential contribution to science of saving skeletal structures from legal sized tag-recaptured billfish. In addition, in order to evaluate the effectiveness of the new tags in comparison with the standard billfish tags presently used in the CGFTP, scientists need to examine tag-recaptured billfish to determine levels of tissue rejection between the two tag types.

Recapturing a tagged billfish is indeed a rare event, and every fish has the potential of leading to a scientific breakthrough in our study of these species. *By sacrificing a few fish for science now, we can gain critical knowledge that may help conserve the billfish for future generations.*

If a tag-recaptured billfish of legal size is caught, anglers should save the whole fish (by freezing if possible) and contact the Southeast Fisheries Science Center for further instructions at 1-800-

437-3936. On weekends or at night call Dr. Eric Prince at 1-305-598-0944. Collect calls are accepted.

Tag Recapture and Tag Report Cards

In our efforts to continually improve the quality of data received in the CGFTP, we have developed a Tag Recapture Card (Figure 10), printed on fluorescent orange paper and available in Spanish as well as English. This card will assist anglers in reporting all the necessary data from a tag-recaptured fish. The bright color of the card should make it easy to find among your boat papers when the rare event of catching a tagged billfish occurs. We are also proposing to change the Fish Tagging Report card (Figure 11) so that data on tagging location and size at release can be clarified and improved.

Recapture Incentives and Rewards

In the past, the CGFTP has offered a $5.00 reward to the angler reporting a tagged fish. The CGFTP now awards a gray embroidered corduroy hat, with the NMFS tagging flag emblem, to the person reporting the capture of a tagged fish (monetary awards are still available but only by special request). The gray hats cannot be purchased; however, the same hat in black can be purchased for $10.00 ($2.00 of this charge goes towards a NMFS fund to buy the gray hats) from:

National Embroidery Company
P.O. Box 870
Portsmouth, RI 02871

(401) 683-4724

OMB Approved No. 0648-0259 Expires 09/30/94

TAG RECAPTURE CARD

1. **SPECIES:**_____
2. **TAG NUMBER:**_____
3. **DATE RECAPTURED:**_____
4. **LOCATION/COUNTRY RECAPTURED:**_____
5. **LENGTH** (inches/centimeters):_____ (lower jaw fork length)
6. **WEIGHT** (pounds/kilograms):_____ **SEX:** Male ☐ Female ☐
7. **FISHING GEAR:**_____
8. **NAMES OF BOAT AND CAPTAIN/ANGLER:**_____
9. **ADDRESS OF (8) ABOVE:**_____
10. **PHONE OF (8) ABOVE:**_____
11. **HAS FISH BEEN SAVED (FREEZING) SO IT CAN BE SAMPLED?**

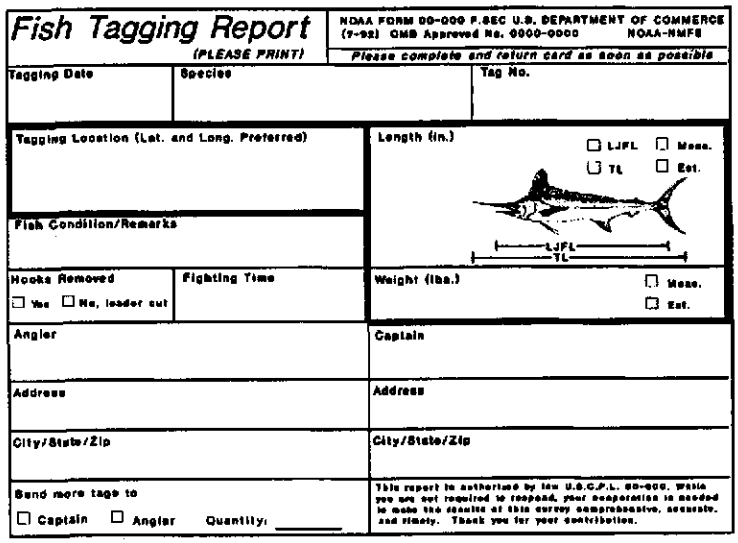
    YES ☐ **NO** ☐

    THERE IS AN EXTRA REWARD FOR A FROZEN FISH. CALL COLLECT

    (305) 361-4248 (Daytime)

    (305) 598-0944 (Night/Weekends)
12. **COMMENTS:**_____

Figure 10. New tag recapture cards are printed on fluorescent orange paper and are available in Spanish as well as English.



Fish Tagging Report
(PLEASE PRINT)

NOAA FORM 00-000 F.SEC U.S. DEPARTMENT OF COMMERCE
(7-92) OMB Approved No. 0000-0000 NOAA-NMFS
Please complete and return card as soon as possible

Tagging Date | Species | Tag No.

Tagging Location (Lat. and Long. Preferred)

Length (in.) ☐ LJFL ☐ Meas. ☐ TL ☐ Est.

LJFL
TL

Fish Condition/Remarks

Hooks Removed ☐ Yes ☐ No, leader cut | Fighting Time

Weight (lbs.) ☐ Meas. ☐ Est.

Angler | Captain

Address | Address

City/State/Zip | City/State/Zip

Send more tags to ☐ Captain ☐ Angler Quantity: _____

This report is authorized by law U.S.C.F.L. 00-000. While you are not required to respond, your cooperation is needed to make the results of this survey comprehensive, accurate, and timely. Thank you for your contribution.

Figure 11. Proposed fish tagging report card.

COOPERATIVE RECREATIONAL BILLFISH SURVEY

The Cooperative Recreational Billfish Survey of the SEFSC documented a total of 90,741 hours of fishing effort from 144 tournaments (89,457 hr) and 8 dock-sampling non-tournament (1,284 hr) locations throughout the western North Atlantic and Gulf of Mexico in 1991 (Figure 12). This total is down 6.2% from 1990, and reflects a general decrease in participation in the tournaments observed in 1991. The hours sampled by the survey represent an unknown fraction of the total hours fished by the many recreational anglers who target billfish in the Atlantic, Gulf of Mexico and Caribbean Sea.

A total of 3,854 billfish (1,770 sailfish, 1,151 blue marlin, and 933 white marlin) were reported caught (i.e., boated, released, or tagged and released) in 1991, of which 3,370 (87.4%) were released (Figure 13, A-C).

The proportion of billfish which are released, compared to being boated, has generally increased for all three species over the last 10 years. This coincides with the progressive increase in conservation fishing ethics which has been self-imposed by the recreational billfishing community for more than a decade.

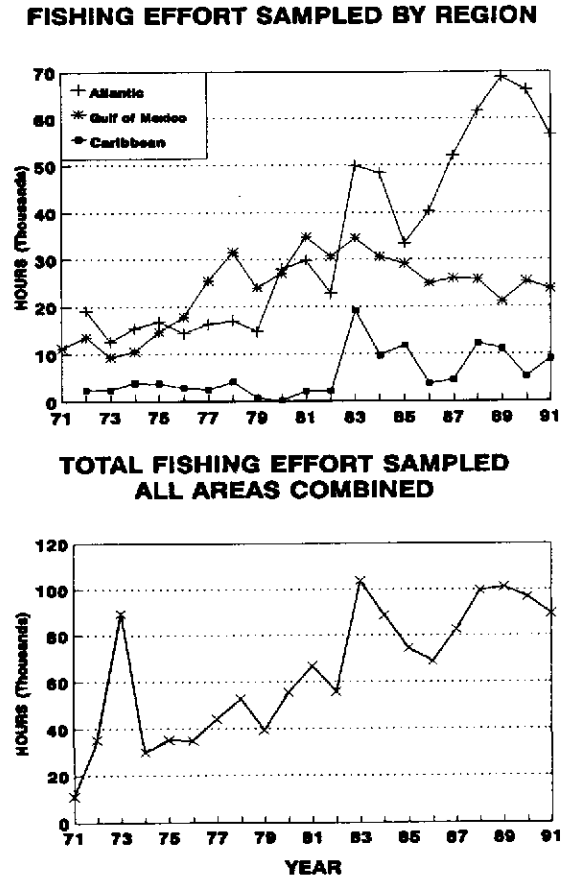
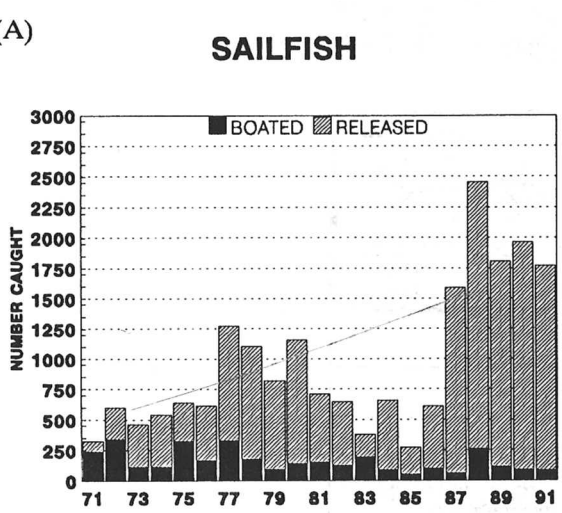


Figure 12. Yearly fishing hours sampled by region and for all areas combined.

(A)



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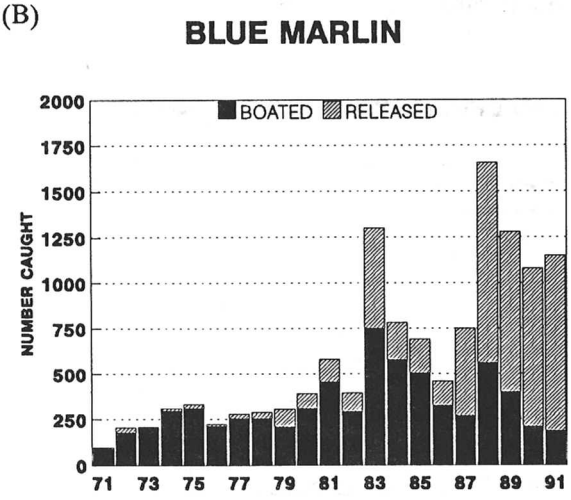

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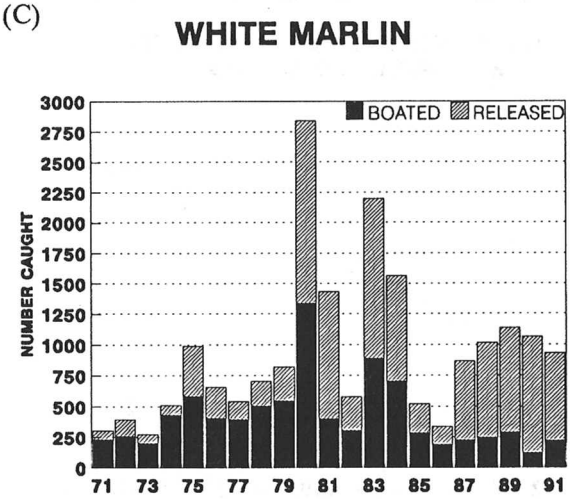


Figure 13. Numbers of billfish boated and released, all areas combined, for (A) sailfish, (B) blue marlin, and (C) white marlin, 1971-1991.

Average Size

Of all billfish landed, only a small portion are actually measured, weighed and sexed by survey personnel. The overall average weight of sailfish, blue marlin, and white marlin reported in 1991 were 51.8, 340.0, and 55.3 lbs, respectively. The largest sailfish weighed 69.8 lbs and was reported from the Florida East Coast/Keys during May. The largest blue marlin recorded during the 1991 survey weighed 754.3 lbs and was landed in the Bahamas in April. The largest white marlin reported was caught in the Caribbean in September and weighed 100.0 lbs.

Catch Rates and Fishing Effort

Estimated relative abundance of billfish is computed from the number of fish caught per 100 hrs of fishing effort (i.e., CPUE). These mean catch rates indicate that since 1971, the 21-year average CPUE for sailfish is 2.2, for blue marlin is 1.1, and for white marlin is 1.9 fish per 100 hrs of fishing (Figure 14, A-C). Sailfish catch rates have fluctuated about the mean over the 21-year period, with no long-term trends. Blue marlin catch rates have shown no long-term trends. However, for 9 of the past 11 years, the CPUEs were above the overall average, and the previous 6 years they were below that average. Annual white marlin CPUEs fluctuated with no long term trend during the 1970's. After a very high year in 1980, the CPUE declined through the early 1980's and has stabilized at a low level.

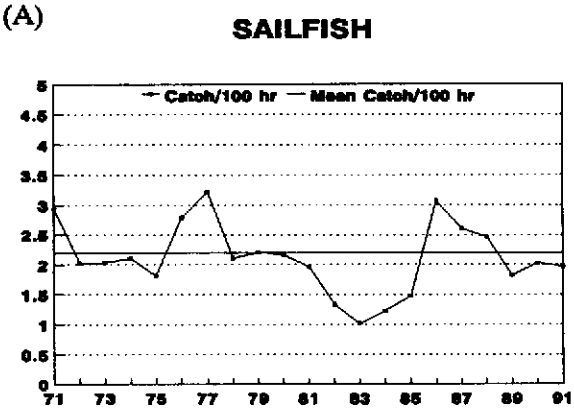
The U.S. recreational data series presented here follows a period of high exploitation of billfish by foreign longline vessels in the 1960's. During that period the bycatch rates of marlins were high and therefore may have affected the CPUEs in the recreational fisheries from the 1970's to the present.

U.S. East Coast

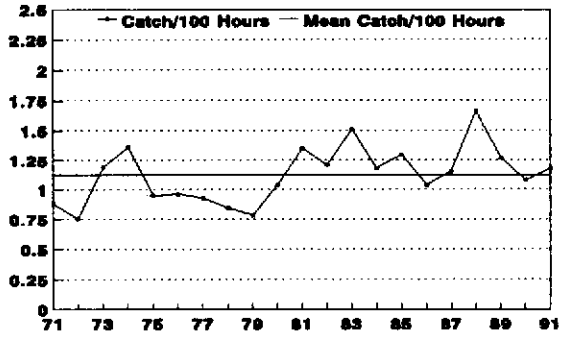
In 1991, 25,575 hours of fishing effort were sampled in the Atlantic north of Florida. Billfish CPUE for all species combined was 3.0 fish per 100 hours, up from 2.9 reported in 1990.

Along the Florida East Coast/Keys, a total of 21,131 hours of fishing effort, (12,180 live-baiting and 8,951 trolling) were reported. Billfish CPUE was 7.8 fish per 100 hrs, compared with 7.7 reported in 1990.

(A)



(B)



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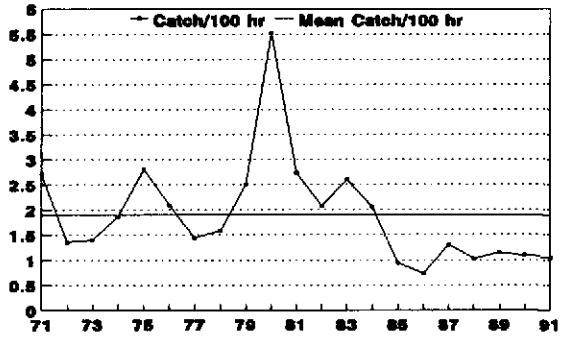

Figure 14. Catch per 100 hours of fishing effort for (A) sailfish, (B) blue marlin, and (C) white marlin, 1971-1991.

Bahamas

In the Bahamas, 9,936 hours of fishing effort were sampled in 1991. Billfish CPUE was 2.9 fish per 100 hrs, compared with 2.1 reported in 1990.

Caribbean

The Caribbean survey documented 9,017 hours of fishing effort resulting in a billfish catch rate of 7.4 fish per 100 hrs, compared with 7.2 in 1990.

Gulf of Mexico

From the northern Gulf of Mexico, 23,798 hours of trolling effort were recorded during the 1991 season, a decrease of 3% from 1990. The catch rate for billfishes was 2.0 fish per 100 hrs, compared with 2.1 reported in 1990. By region: 13,089 hours of trolling effort were recorded in the northeastern Gulf of Mexico, with a CPUE of 1.7 billfishes per 100 hrs of effort; 7,113 hrs in the northcentral Gulf, with a catch rate of 2.0; and 3,596 hrs of trolling in the northwestern Gulf, where the CPUE was 3.3. The reported percentages of catches released in the northeastern, northcentral, and northwestern Gulf were 53%, 88%, and 76%, respectively.

As with all fisheries, the variation among years in catch rates reported for the areas discussed above might not always reflect true changes in stock abundance or availability. For example, year-to-year changes in catch rates can be reflective of changes in angling technique as well as habitat and environmental changes. Therefore, premature conclusions should be avoided.

Billfish By-Catch

Billfish are hooked incidentally by U.S. longline vessels targeting swordfish and tuna in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea. Since October, 1988, the U.S. Fishery Management Plan for Atlantic Billfishes prohibits the retention of billfishes by commercial fishing vessels. The numbers of billfishes reported caught from this fishery are included on log books and are shown in Table 2.

Table 2. Billfish reported caught by U.S. swordfish and tuna longline vessels in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea, 1989-1991.

YEAR	SAILFISH	BLUE MARLIN	WHITE MARLIN
1989	1,544	3,173	2,928
1990	1,790	2,756	2,168
1991	2,781	3,294	2,372

ICCAT RELATED ACTIVITIES

The 1991 Standing Committee on Research and Statistics (SCRS) Report on Billfish

The SCRS noted in the description of fisheries that in addition to the traditional commercial and recreational fisheries for billfish, recent development and geographical expansion of major longline fisheries occurred in the Gulf of Mexico, Caribbean Sea, and west coast of Africa. Although the most recent stock assessment presented to the Committee was for eastern Atlantic sailfish in 1988, no other analyses on the status of stocks for other billfish species were presented to the SCRS since 1982, due to deficiencies in the database. Consequently, only summaries of the state of stocks based on analyses presented in previous years were provided. The agenda for the ICCAT Billfish Workshop in July, 1992, made numerous task assignments that when accomplished will lead to new assessments. The Committee stressed the need to closely monitor the fisheries for billfish, particularly for blue and white marlin. The 1992 SCRS report was recently completed and these results will be included in next years newsletter.

Second ICCAT Billfish Workshop

The Second ICCAT Billfish Workshop was held in Miami, Florida, July 22-29, 1992. A total of 42 scientists from 14 countries attended the meeting. The countries represented included: Argentina, Bermuda, Brazil, France, Ghana, Grenada, Japan, Mexico, Senegal, St. Vincent and the Grenadines, W.I. (CARICOM), Spain (ICCAT), Turks and Caicos Islands, U.S.A., and Venezuela. Several universities were also represented at the meeting: University of Miami, Florida Atlantic University, University of Mexico, and Virginia Institute of Marine Science. A total of 27 working documents were submitted to the meeting, including numerous historical CPUE data sets previously unavailable. The authors of working documents presented a brief oral summary to the working group for each document. Two documents (from Barbados and Jamaica) were summarized by the workshop chairman because scientists from these countries could not attend the meeting but still submitted papers.

A review of progress of the ICCAT Enhanced Research Program for Billfish (1987-1992) was presented to the working group by the area coordinators. This review included acquisition of catch statistics from the East and West Atlantic, the ICCAT billfish tagging program, and age and growth research. Work on the field species identification kits was presented to the workshop in the form of a demonstration by the research team from Florida Atlantic University.

A review of available landings, catch/effort, and size frequency data by country in the ICCAT centralized database was presented to the working group by the Assistant ICCAT Secretariat. Considerable progress on evaluating the accuracy of the ICCAT databases was accomplished during the working sessions and several important corrections were made.

A review of biological parameters useful in stock assessment was presented to the working group by scientists with expertise in the appropriate disciplines. The review was done separately by species (blue marlin, white marlin, and sailfish) for: (1) movement patterns; (2) age and growth; (3)

mortality; (4) reproduction; (5) size structure; and (6) stock identification.

Results of the working groups' preliminary stock assessment analyses were presented during the meeting. These consisted of a review of catch per unit effort data and extensive efforts by the working group to standardize CPUE indices from numerous sources. Successful standardization of numerous CPUE indices allowed the application of a non-equilibrium model for North and South Atlantic stocks of blue marlin and results of these assessments were accomplished during the working sessions. Model assumptions and recommendations based on assessment results were discussed and approved by the working group. The billfish working group was reluctant to make conclusions about the preliminary assessments for blue marlin until sensitivity analysis and verification of model assumptions could be completed. However, it was noted that in general, biomass of North and South Atlantic blue marlin is below that which could produce maximum sustainable yield.

An extensive discussion of the future direction of the ICCAT Enhanced Research Program for billfish was held by the working group. The working group identified important research topics to pursue and agreed on the approach and justification for future work. A copy of the workshop report can be obtained upon request by writing the Southeast Fisheries Science Center.

The 1992 Standing Committee on Research and Statistics (SCRS) Report on Billfish

The 1992 meeting of the ICCAT SCRS resulted in a billfish report which indicated progress in a number of areas. For example, the first stock assessments for blue and white marlin were presented to the SCRS in over a decade. These assessments were a result of the past 5 years of work of the Enhanced Research Program and the progress made at the 1992 ICCAT Billfish Workshop in July, 1992. Sensitivity analysis and verification of model assumptions referenced earlier in the billfish workshop were accomplished at the SCRS meeting. The assessments greatly improved our knowledge of these species and further substantiated previous indications that both blue and white marlin are overexploited. The status of blue marlin stocks in the North Atlantic was more optimistic than white marlin and showed signs of recovery during the last five years. However, stock trends for South Atlantic blue marlin were similar to white marlin and indicated that these species have been overexploited for about two decades and stock levels continue to be depressed below that which can produce maximum sustainable yield.

The SCRS recommended that all statistical and research programs which were helpful in successfully conducting the recent assessments be continued and that future emphasis be placed on West and East Atlantic sailfish. The Committee also felt that 1992 stock assessment results for blue and white marlin warranted consideration for management. One recommended option was to reduce billfish mortality from the off-shore longline fleet by releasing those billfish that are still alive brought alongside longline vessels. Data indicate this option potentially could reduce mortality from this fishery by as much as 40%. The Committee recommended several areas of research that would be needed to implement the management options discussed.

Summary of Shore-Based Sampling

Shore-based sampling activities to obtain size frequency of billfish landings from seven countries in the western North Atlantic Ocean (Barbados, Dominican Republic, Grenada, Jamaica, St. Maarten, Trinidad, and Venezuela) were initiated in 1987. Since then, the intensity of sampling efforts has increased each year. In most locations, the majority of information was collected from 1988 to the present. In 1991, a total of 3,656 billfish size measurements (blue marlin, white marlin, sailfish, and spearfish) were taken from shore-based sampling in the western North Atlantic and 722 measurements were taken from the eastern North Atlantic. Large sample sizes have been consistently reported by Grenada, St. Maarten, and Venezuela (Table 3).

At-Sea Sampling in Venezuela

At-sea sampling was initiated in 1987 by placing biological technicians aboard Venezuelan industrial longline vessels fishing out of the port of Cumaná. Data obtained from the catches included size, sex, time of landings, and whether the fish were alive

Table 3. Number of billfish size measurements, by country and species, for shore-based sampling, 1987-1992*. (SAI = sailfish, BUM = blue marlin, WHM = white marlin, and SPF = spearfish).

COUNTRY	SAI	BUM	WHM	SPF	TOTAL
BARBADOS	234	67	28	13	342
DOMINICAN REPUBLIC	38	27	224	0	289
GRENADA	1370	162	9	1	1542
JAMAICA	7	330	5	0	342
ST. MAARTEN	153	70	1065	4	1292
TRINIDAD	103	30	32	1	166
VENEZUELA	1715	644	1996	53	4408
TOTAL	3620	1330	3359	72	8381

* Through July, 1992.

or dead when brought alongside the boat. The intensity of sampling efforts improved each year with 3 observer trips initially accomplished in 1987 and 3, 4, 7, 15, and 15 trips completed in 1988-1992, respectively (1992 is incomplete). In 1991, observers were present aboard 10 yellowfin longline trips and 5 swordfish longline trips. The fleet of 19 boats averaged about 7 sets per trip. In 1991, the sets consisted of a mainline of about 39 km (23.4 mi) and 1,600 hooks. The number of hooks-per-set was higher during the winter and fall seasons. A total of 59 blue marlin, 60 white marlin, 94 sailfish, and 36 spearfish were sampled in 1991 (Table 4). Billfish catch rates were consistently higher in the winter and fall seasons. The mortality of billfish brought to the side of the boat ranged from 40-77%. All at-sea and shore-based sampling data are available upon request by writing the SEFSC, Miami, Florida.

AGE AND GROWTH RESEARCH

A total of 38 juvenile swordfish samples were obtained from the stomachs of larger predators through TBF's juvenile sampling program in Islamorada during 1991. Otoliths from these samples were extracted from the crania and shipped to Dr. Chuck Wilson at Louisiana State University. These samples will be evaluated for age and growth information, along with larger specimens, for Dr. Wilson's MARFIN project and publications will be prepared at the appropriate time (with the collaboration of NMFS scientists). In addition to the swordfish samples, numerous juvenile sailfish were also collected through this program. Several hard-part samples were obtained from extreme size categories, (i.e., very small and very large fish), through the ICCAT Enhanced Research Program for Billfish for 1991, including one 10 lb blue marlin. Biological sampling of swordfish for reproductive organs and hardpart samples was initiated through the ICCAT billfish program in Venezuela in 1991 and resulted in the collection of data from over 300 swordfish. Results of research on blue marlin sexual dimorphism were recently published (Wilson et al., 1991).

PELAGIC LONGLINE OBSERVER PROGRAM

The Pelagic Longline Observer Program was initiated in 1992 through the Swordfish Fisheries Management Plan. This Plan called for observer coverage of U.S. vessels in the longline fishery. Collection of reliable catch and effort data on tunas, swordfish, sharks, as well as marlins and sailfish, has become increasingly important with the need to manage pelagic fisheries to comply with both international and domestic goals. The purpose of the observer coverage is to confirm and

Table 4. Numbers of trips and sets, average number of hooks-per-set and longline length-per-set (km), numbers of billfish caught, and estimated mortality of billfish brought alongside the boat for at-sea sampling in Venezuela, 1987-1992*. (BUM=blue marlin, WHM=white marlin, SAI=sailfish, SPF=spearfish).

	1987	1988	1989	1990	1991	1992	TOTAL
No. of trips	3	3	4	7	15	15	47
No. of sets	23	37	34	42	100	114	350
Avg. hooks/set	1171	1224	1436	1564	1636	712	1232
Avg. length/set	57	58	42	46	39	45	45
No. BUM caught	38	13	11	32	59	39	192
No. WHM caught	144	60	47	18	60	34	363
No. SAI caught	30	7	18	66	94	47	262
No. SPF caught	0	0	0	8	36	3	47
% BUM mortality	68	40	64	77	67	49	63
% WHM mortality	55	55	65	57	55	70	58
% SAI mortality	50	67	72	67	77	72	71
% SPF mortality	N/A	N/A	N/A	75	67	67	68

* 1992 is incomplete and only includes trips completed as of July, 1992.

augment fisheries information supplied by the vessel captains and owners through the submission of the mandatory swordfish logbook forms. To generate a random list of vessels, data from the swordfish logbooks for 1991 were sorted by area, quarter, vessel and trip. Total days fished, number of trips, and average days fished per trip were computed for each vessel within each area and quarter. These summarized data formed the database from which vessels were selected to fulfill a 5% sampling level for observer coverage.

Observer coverage of the U.S. large pelagic fleet is being implemented by the NMFS Northeast Fisheries Science Center (NEFSC Woods Hole, MA) and SEFSC (Miami). Selection notification letters, along with return trip notification forms, were mailed from the SEFSC to vessel owners/captains on the selection list generated from the random selection process described above. The letter specifies that the owner/captain would need to notify the Observer Program Coordinator in writing of the vessel's fishing trips through the calendar quarter of interest, giving at least 5 business days notice prior to departure. The NEFSC, in association with its contractor providing the observer, utilized the approach of verbal notification via phone or personal contact. Once the observer was deployed to a vessel and the fishing trip completed, that vessel is relieved of observer coverage for the remainder of the quarter.

The observer is responsible for obtaining detailed information on the gear characteristics and to record these details on appropriate forms. During haulback of the gear, the observer collects and records length measurements of specific pelagic species of interest brought onboard. These procedures are similar to the billfish observer program sponsored through ICCAT to sample the Venezuelan fishery. Because of their data collection duties the observer does not stand vessel or crew watches. The observer records interaction with marine mammals, sea birds, and sea turtles,

including, but not limited to, sighting information and data collection for each marine mammal and sea turtle captured by the vessel during fishing operations. Specific tissue samples from these species are collected by the observer, if so required. The observer maintains an official field diary. When the vessel has returned to the dock, the observer is also responsible for monitoring the unloading of the catch for the purpose of obtaining dressed weights from the landed catch.

The observer program relies on the cooperation of the vessel owners and captains to be successful. The initial responses from the owners and captains were positive and in favor of observer coverage. As of September, 1992, a total of 24 longline vessel trips have been observed by the SEFSC and NEFSC laboratories. A total of 18 vessel trips have been observed in waters south of 35° N by SEFSC observers. Five of the vessels fished the coastal waters of Florida including the Florida Keys. Seven of the trips fished the waters of the South Atlantic Bight and six trips were observed in the Gulf of Mexico. The length of these trips ranged from 4 to 12 days. The East Coast and South Atlantic Bight trips generally target swordfish, while the Gulf of Mexico trips generally target tunas (yellowfin and bigeye). The NEFSC completed coverage of 6 longline vessel trips, in addition to 19 trips on gillnet vessels targeting swordfish in waters north of the 35° N. latitude, during the period April - September, 1992.

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