NOAA Technical Memorandum NMFS-SEFC-290



1989-90 REPORT OF THE SEFC BILLFISH PROGRAM



August 1991

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

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U.S. DEPARTMENT OF COMMERCE Robert A. Mosbacher, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION John A. Knauss, Administrator

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

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

or

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

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

INDIVIDUAL CONTRIBUTORS:

Cooperative Game Fish Tagging Program Edwin L. Scott Joseph E. Tashiro Robert E. Bayley

Cooperative Recreational Billfish Surveys Wayne N. Witzell Joseph P. Contillo Paul J. Pristas Dennis W. Lee Robin L. Carter

ICCAT Enhanced Research Program for Billfish Eric D. Prince

> Illustration Joaquin C. Javech

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The employees of the Southeast Fisheries Center are grateful to the recreational and commercial fishermen who voluntarily cooperated in the collection of billfish statistics, and to the numerous state, university, federal employees and private research organizations who lent their time and support to billfish programs. We also recognize the cooperation of various international fisheries agencies who participated in the Enhanced Research Program for Billfish, conducted under the auspices of the International Commission for the Conservation of Atlantic Tunas (ICCAT).

1989-90 REPORT OF THE SEFC BILLFISH PROGRAM

Fishermen and representatives of private, state, and federal organizations have contributed significantly over the past two decades to the billfish research database at the Southeast Fisheries Center. 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. As a result, the Southeast Fisheries Center's billfish database is the world's most comprehensive source of scientific information on Atlantic blue marlin, white marlin, sailfish, and spearfish. These species are often referred to as "fish without a country" since their movement patterns encompass virtually the entire Atlantic Ocean and intersect the boundaries of many different nations. For this reason, we are now providing a more comprehensive presentation of research activities involving Southeast Fisheries Center scientists in this report to include 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 and the Cooperative Recreational Billfish Survey of the Southeast Fisheries Center, and the comparatively new 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 Cooperative Game Fish Tagging Program is to maintain a voluntary tagging system supported by recreational and commercial anglers within the United States and selected foreign countries. The purpose of the Cooperative Recreational Billfish Survey is to collect data on the number of billfish hooked, boated, and released during tournament and nontournament 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, start 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 Southeast Fisheries Center also provide billfish data on the number of billfish hooked and released incidentally in the U.S. and foreign fishing vessels operating within U.S. jurisdictional waters.

Past issues of this report have been published on an irregular basis due primarily to the timing of data analysis for various components of the report. In an effort to present this information on a more timely basis, this issue contains data from 1989 and also some information from 1990. Starting in 1991, data included in future reports will be published the year following data collection.

COOPERATIVE GAME FISH TAGGING PROGRAM

Information on tagged billfish can be found in archives of the Southeast Fisheries Center dating back to the 1950's, but tagging was sparse until 1971 when the Cooperative Game Fish Tagging Program formally began. Since 1971, the Cooperative Tagging Program has grown substantially in the number of

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species tagged, and the number of fish tagged, released and recaptured. In addition, the geographic area in which anglers participate in the program has expanded during this period. To encourage the tagging of fish, the Program provides tagging kits free upon request to individual anglers. Each kit contains tags and self-addressed stamped post cards for the angler to complete and return to the Southeast Fisheries Center when a tag is used. Also available, free upon request, is the "Cooperative Game Fish Tagging Program Annual Newsletter."

The Newsletter provides a detailed, up-to-date account of tagging information for ue marlin, white marlin, sailfish, swordfish, tuna, tarpon, amberjack, king mackerel, and red drum. Interested persons may contact:

Cooperative Game Fish Tagging Program Coordinator Southeast Fisheries Center 75 Virginia Beach Drive Miami, Florida 33149 Telephone: (305) 361-4200

Most of the information on tagging presented in this report covers Program activities for 1989, although some information obtained in 1990 is also included. The majority of Program activities encompass the Northwest Atlantic along the U.S. coast, through the Florida East coast and Keys, Gulf of Mexico, the Bahamas, and Caribbean Sea (Fig. 1). Participants normally



Figure 1. General area of activity for participants in the Cooperative Game Fish Tagging Program and the Cooperative Recreational Billfish Surveys of the Southeast Fisheries Center.

restrict Program activities to north of the equator, although some tagging and tag returns come from south of the equator and from the west coast of Africa. In 1989, 1,887 blue marlin were tagged in the Atlantic area of activity, 1,832 by recreational anglers, and 55 by commercial anglers (Table 1, Fig. 2). In 1990, 1,950 blue marlin were tagged and released by program cooperators (Table 1, Fig. 2). For the fourth straight year, tagging increased, due in part to 669 blue marlin tagged near St. Thomas, U.S. Virgin Islands. Other principal release areas (Fig. 1) for blue marlin in 1989 and 1990 were Puerto Rico (276 and 372), Gulf of Mexico (204 and 159), Bahamas (141 and 170), and the northeastern coast of the United States (77 and 154).

Table 1. Billfish tagged and released in 1989 and 1990.							
	Blue Merlin 1989 1990		White Marlin 1989 1990		Seilfimh 1989 1990		
U.S. Atlantic Coast							
Hev England		17		54			
Xid-Atlantic	54	93					
Florida East Coast	114	92	52	31	1,002	1,683	
U.S. Gulf Coast							
Florida Nest Cuast	87	58	73				
North-Central Gulf	79	61		14			
Texas Coast	26	32	ĩĩ	23	ž	13	
Nexico, Yucatan Peningula	40	14	77	4 3			
Berauda	28	61			3/0	/05	
Bahanag	141	170					
Belize							
Costs Rica	;	,					
Columbia				ž			
Contral Gulf of Mexico			š				
Jamaica			, i	**			
Cube			:	:			
Mispaniola	20		:				
Puerto Rico	276	177		14		1	
Virgin Telende					10	1	
Venetuela							
Other Areas	128	116	10	29	113	127	
Total	1,877	1,950	1, 167	1,270	2.014	3.303	

A total of 1,179 white marlin were tagged in 1989, 1,094 by recreational anglers and 85 by commercial fishermen. In 1990, 1,270 white marlin were tagged by program cooperators. Principal areas for white marlin releases in 1989 and 1990 (Fig. 1) were the mid-Atlantic states (615 and 649); La Guaira, Venezuela (195 and 185); Gulf of Mexico (113 and 137); east coast of Florida (51 and 31); and Cozumel-Cancun, Mexico (67 and 61).

RETURNED



RELEASED



Figure 2. Blue marlin, white marlin, and sailfish tag releases and returns from the Cooperative Game Fish Tagging Program, 1971-1990.

A total of 2,103 sailfish were tagged in 1989, 2,046 by recreational anglers and 57 by commercial anglers. In 1990, 3,303 sailfish were tagged by program cooperators. Principal areas for sailfish releases in 1989 and 1990 (Fig. 1) were the east coast of Florida (1,016 and 1,683); Cozumel-Cancun, Mexico (566 and 703); and Venezuela (253 and 615).

1989 Tag Recoveries

Eleven tagged blue marlin were recaptured and reported to the Southeast Fisheries Center in 1989. Five of the fish were originally tagged near St. Thomas, U.S. Virgin Islands, and of those, 2 were recaptured near Guadaloupe, West Indies; 1 near the east coast of Florida; and 2 in the Gulf of Guinea off west Africa. Two blue marlin tagged in the Bahamas were recaptured in 1989: 1 near the Bahamas and 1 near Miami, Florida. A blue marlin tagged at Cozumel, Mexico, was recaptured in the Gulf of Mexico in 1989, and another tagged in the area of Horta Faial, Azores, was recaptured in the same area.

Eleven white marlin were recaptured in 1989. Of eight fish tagged from North Carolina to New Jersey: 4 were recaptured in the same area, 3 were recaptured in the Gulf of Mexico, and 1 was recaptured in the Bahamas. Two fish tagged off the east coast of Florida were recaptured in 1989: 1 from Martha's Vineyard, Massachusetts, and the other offshore of the mid-Atlantic states. One fish tagged off La Guaira, Venezuela, was also recaptured in La Guaira.

Thirty-one sailfish were recaptured in 1989. Of 15 fish tagged near Palm Beach, Florida: 6 were recaptured in the same area, 4 in the Florida Keys, 4 near Ft. Lauderdale, Florida, and 1 near St. Augustine, Florida. Of 6 fish tagged in the Florida Keys: 2 were recaptured in the same area, 3 near Palm Beach, and 1 near Ft. Lauderdale. Of 5 fish tagged near Ft. Lauderdale: 1 was recaptured in the same area, 2 in the Florida Keys, 1 near Miami, and 1 near Palm Beach. A fish tagged off Belize was recaptured off the south Texas coast.

1990 Tag Recoveries

Eight tagged blue marlin were recaptured and reported to the Southeast Fisheries Center in 1990. Two of the fish were originally tagged near St. Thomas, U.S. Virgin Islands; one was recaptured off St. Vincent and the other off Grenada. Two blue marlin tagged in the Gulf of Mexico were recaptured off Hatteras, North Carolina, and the other was recaptured near its release point. Two blue marlin released off the coast of Venezuela were recaptured in the same area and another Venezuelan release was recaptured off Barbados. One blue marlin was released and recaptured off the mid-Atlantic coast. A blue marlin released off Louisiana in 1987 and recaptured off Cuba was also reported in 1990.

There were 11 white marlin recaptures reported in 1990. Six of the recaptures were from white marlin tagged off the mid-Atlantic; 4 were recaptured in the mid-Atlantic, one was recaptured off Canada, and the other off the coast of the Dominican Republic. Three white marlin were tagged and released off the coast of Venezuela and were recaptured in the same area of release.

There were 55 sailfish recaptured in 1990. Thirty four sailfish recaptures were from fish tagged off the Florida east coast: 29 were recaptured near the area of release, 4 off the Florida Keys, and 1 off the coast of the Dominican Republic. Five recaptures were from sailfish tagged and released off the Florida Keys: 1 was recaptured near the area of release and 4 were recaptured off the Florida east coast. Five recaptures were from sailfish tagged and released off Cancun, Mexico: 2 were recaptured near the areas of release, 2 were recaptured off the Florida East Coast, and 1 was recaptured in the Gulf of Mexico. There were 2 recaptured sailfish originally tagged and released off Cozumel, Mexico, 1 was recaptured off Cancun and 1 was recaptured in the Gulf of Mexico. One sailfish tagged and released in the Bahamas was recaptured off the Florida east coast. One sailfish tagged and released off Hatteras, North Carolina, was recaptured off the Florida east coast.

Tag Recoveries by Region

The number of tag-recaptures returned since 1950 were computed for 5 regions within the general area of activity (Fig. 3; and Table 2): northwestern Atlantic, Gulf of Mexico, Caribbean Sea, southwestern Atlantic, and eastern Atlantic. Tags with missing information for the region of release or recapture were deleted from the table and corrections for data from last years' report are included.



NW Atlantic G of Mexico Caribbean SW Atlantic East Atlantic

Figure 3. Atlantic tag returns (1950-1990) from the Cooperative Game Fish Tagging Program for blue marlin, white marlin, and sailfish combined, by geographical area.

REGION TAGED	STRICT OF RECOVER							
	Northwestern	Calf of Maxica	Caribbeen See	Southwestern Atlantic	Eastern Atlantic			
SLOT WARLIN:								
Sethwestern Atlantic	3.		1	1	۵			
a.f of Mexico	1		2	2	0			
Caribbean Sea	0	1	15	3	5			
Southwestern Atlantic	0	1		,	6			
Bastern Atlantic	0	•	0	8	1			
WEITE HARLIN:								
Worthwestern Atlantic	157	12	46	36	٥			
Gulf of Mexico	1	49	7	3	· a			
Ceribbean Sea	4	2	23	3	đ			
Southwestern Atlantic	7	6	2.	5	0			
Zastern Atlantic	¢	•	- Ø	. 0	c			
SALLFISH:								
Northwestern Atlantic	1	0	¢	3	•			
Gulf of Mexico	0		· · · ·	14	ō			
Caribbean See	1	,	39	16				
Southwestern Atlantic	1	22	ii.	509	ō			
Eastern Atlantic	0	ő	0		2			

Inter-regional billfish movements were documented for:

Blue Marlin:

- Northwestern Atlantic Ocean to the Caribbean Sea, and southwestern Atlantic,
- Gulf of Mexico to the Caribbean Sea and southwestern Atlantic,
- Caribbean Sea to the Gulf of Mexico, southwestern Atlantic, and eastern Atlantic, and
- Southwestern Atlantic Ocean to the Gulf of Mexico.

White Marlin:

- Northwestern Atlantic Ocean to the Gulf of Mexico, Caribbean Sea, and southwestern Atlantic,
- Gulf of Mexico to the northwestern Atlantic, Caribbean Sea, and southwestern Atlantic,
- Caribbean Sea to the northwestern Atlantic, Gulf of Mexico, and southwestern Atlantic, and
- Southwestern Atlantic Ocean to the northwestern Atlantic, Gulf of Mexico, and Caribbean Sea.

Sailfish:

- Northwestern Atlantic Ocean to the southwestern Atlantic,
- Gulf of Mexico to the Caribbean Sea, and southwestern Atlantic,
- Caribbean Sea to the northwestern Atlantic, Gulf of Mexico, and southwestern Atlantic, and
- Southwestern Atlantic Ocean to the northwestern Atlantic, Gulf of Mexico, and Caribbean Sea.

The average time-at-large for a blue marlin tag is about one and one-half years (83 weeks). The average for white marlin is under 2 years (96 weeks), and the average for sailfish is under 1 year (43 weeks).

Tag Development and Tag Performance Experiments

The Southeast Fisheries Center and The Billfish Foundation have jointly developed a new fish tag. This tag is expected to be used initially with billfish but may also be appropriate for other large pelagic fishes. The tag was developed to minimize the long term component of tag shedding by encouraging the attachment of muscle tissue to the anchor (i.e., biologically compatible with fish flesh). Surgical grade nylon and an injection mold were used to construct the anchor portion of the tag and shrink tubing was incorporated as a mechanical attachment to secure the anchor to the streamer (legend). The performance of this new tag is now being tested in double tagging field experiments (administered by The Billfish Foundation) and laboratory experiments (in cooperation with TBF and the Miami Seaquarium) to determine if the tag is an improvement over the stainless steel tag now being used in the Cooperative Game Fish Tagging Program. Results of these experiments will be provided in future newsletters.

COOPERATIVE RECREATIONAL BILLFISH SURVEY

Since 1971, the number of fishing hours recorded through interviews with anglers has generally increased. In 1989, a near record of 101,091 hours were sampled and in 1990, 96,740 were

recorded (Fig. 4). However, the hours sampled by the survey represents only a small fraction of the total hours fished by the many recreational anglers who fish for billfish in the U.S. Atlantic, Gulf of Mexico, and Caribbean Sea.

FISHING EFFORT SAMPLED PER REGION





Of all billfish landed, only a small portion are actually measured, weighed, sexed, etc. In 1989, the largest blue marlin was a 1,002 pound female landed from the Atlantic north of Florida, a 139 pound white marlin was the largest observed in the Caribbean, and an 83 pound sailfish was the largest measured from the eastern Florida coast (Fig. 5). In 1990, the largest blue marlin examined was a 738 pound female from the Atlantic north of Florida, an 80 pound white marlin was boated from the Gulf of Mexico, and an 81 pound sailfish was taken off the eastern Florida coast (Fig. 5).







Figure 5. Largest billfish sampled 1971-1990. Blue marlin (top), white marlin (middle), sailfish (bottom).

Catch Rates

To estimate the relative abundance of billfish among years, the number of fish caught per 100 hours of fishing is computed. Since the initiation of the program in 1971, the 20 year average number of blue marlin caught per 100 hours of fishing is 1.1 (Fig. 6). The 20-year average catch rate for white marlin is 1.9 fish, and the sailfish catch rate is 2.2 fish per 100 hours (Fig. 6).



WHITE MARLIN



SAILFISH



Figure 6. Catch per 100 hours of fishing for blue marlin (top),

white marlin (middle), and sailfish (bottom), 1971-1990.

In 1989, 27,436 hours of fishing effort were sampled in the Atlantic north of Florida and 27,771 hours were recorded in 1990. Billfish (all species combined) caught per 100 hours of fishing effort was 2.9 in 1989, down 43% from 5.1 in 1988. In 1990, billfish caught per 100 hours of effort was 3.6, up 19% from 1989.

Along Florida's east coast and Keys, 26,467 hours of fishing effort were sampled in 1989 and 23,769 hours were sampled in 1990. The billfish catch rate in 1989 was 6.4, a decrease of 21% compared to 8.1 reported 1988. In 1990, billfish caught per 100 hours fished was 7.7, an increase of 17% from 1989.

In the northeastern Gulf of Mexico, about 13,000 hours of fishing effort were sampled in 1989, while 13,975 hours were sampled in 1990. The catch rate for billfish was 3.7 per 100 hours of fishing in 1989 and 2.0 per 100 hours in 1990. In the north-central Gulf of Mexico, nearly 8,000 hours of fishing were sampled in 1989 and 6,630 hours sampled in 1990. The billfish catch rate from this area was 2.6 in 1989 and decreased to 1.7 in 1990. In the northwestern Gulf of Mexico, nearly 5,000 hours of fishing effort were sampled in 1989 and 3,997 hours sampled in 1990. The billfish catch rate per 100 hours of fishing effort was 4.3 in 1989 and 3.5 in 1990.

In the Bahamas, 15,032 hours of fishing effort were sampled in 1989 and 14,679 hours were recorded in 1990. Billfish caught per 100 hours of fishing in 1989 averaged 2.7, this same catch rate was reported the previous year. The billfish catch rate in 1990 was 2.1 fish per 100 hours of fishing, a 22% decrease compared to 1989.

In the Caribbean, 11,043 hours of fishing effort were sampled in 1989 and 5,252 hours were sampled in 1990. Billfish caught per 100 hours of fishing averaged 6.5 in 1989, a 6% increase from the 6.9 reported in 1988. Billfish catch rate for 1990 was 7.2 per 100 hours of fishing effort, up 10% from 1989.

As with all fisheries, the variation among years in catch rates observed for many 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 the "random noise" in sampling, as well as many other habitat and environmental changes and premature conclusions should be avoided.

Billfish By-Catch

Until 1989, Japanese longline vessels annually fished tuna along the Atlantic coast of the United States. However, the Japanese chose not to fish inside the 200 mile limit of the U.S. Exclusive Economic Zone in 1989. Although U.S. regulations prohibit taking aboard species other than tuna, a small catch of billfish, predominantly white marlin, are hooked and released on Japanese longline gear. To ensure compliance when a Japanese longline vessel operates in U.S. waters, on-board observers from the National Marine Fisheries Service are assigned to each vessel. The observer records the name of each species hooked by the gear and whether it is dead or alive when brought alongside the boat. From 1982 to 1988, the average number of billfish hooked (all species combined) in U.S. waters was 221 per year (Table 3). All were returned to the sea, but an average of only 35% were released alive.

Table J. Billf	sh hooke U.S. Ex	d since clusiv	a 1982 Te Econ	by the omic S	Japan one.	ese lor	gline	fleet
	1982	1983	1984	1985	1986	1987	1988	1989
Blue Marlin	36	6	26	88	38	11	1	0
White Marlin	210	97	228	339	272	57	6	0
Sailfish	30	6	5	7	9	2	0	0
Spearfish	19	0	9	0	5	2	1	0
Unknown	19	3		0	5	2	1	0

Billfish are also hooked by U.S. swordfish and tuna longline vessels, and estimates of the 1989 longline mortality (number of billfish) was made for the U.S. Atlantic Ocean, Gulf of Mexico, and Caribbean Sea (Fig. 7). The estimates were computed by combining: 1) estimates of mortality of billfish released as reported on logbooks submitted to the Southeast Fisheries Center by vessel captains, and 2) the U.S. commercial landings. The latter was converted mathematically from weight of fish to numbers of fish. Since October, 1989, all U.S. commercial sales of Atlantic billfish are prohibited by the Billfish Management Plan.



Figure 7. Preliminary mortality estimates for billfish from the U.S. swordfish and tuna longline vessels fishing the Atlantic Ocean in 1989.

ICCAT ENHANCED RESEARCH PROGRAM FOR BILLFISH

The International Commission for the Conservation of Atlantic Tunas (ICCAT) currently has twenty-two member countries. These countries include some of the most active off-shore fishing nations in the Atlantic, such as the United States, Japan, France, Venezuela, Spain, Cuba, Soviet Union, and Korea. Although ICCAT has had management jurisdiction over Atlantic tunas and tuna-like fishes (including billfishes) since the mid-1960's, data for conducting rigorous stock assessments on billfishes have not been available. In 1986, ICCAT responded to requests from the U.S. delegation and formally recognized data deficiencies for Atlantic billfishes by initiating the Enhanced Research Program for Billfish. The objectives of this program include: (1) provide more detailed billfish catch and effort statistics; (2) develop an international tagging program for billfish; and (3) assist in collecting data for billfish age and growth studies.

Identification Kits

Most offshore fishing fleets in the Atlantic dress billfish at sea in such a manner that the headless, finless, gutless, and often tailless carcasses are difficult to identify to species (Fig. 8).



Figure 8. Billfishes caught by off-shore longline fisheries are dressed at-sea with all identifiable parts removed and stored frozen for up to 9 months prior to off-loading at major transhipment ports.

This makes obtaining species specific size and sex data from these landings very difficult. A research team at Florida Atlantic University is developing a field kit that might be used to identify the species of butchered billfish carcasses landed by these large offshore fleets. The kits, when completed, may also aid enforcement of the U.S. ban on possession and sale of Atlantic billfish by U.S. commercial boats. Isolating the appropriate antibody is the basis for determining the species of billfish from blood or tissue samples. The research team has succeeded in producing an antibody that consistently recognizes muscle or blood proteins for Atlantic sailfish, with little or no cross reactivity. Similar antibodies are being isolated for blue and white marlin.

Shore Based Sampling in the Caribbean Sea

Size measurements from over 400 blue marlin, white marlin, and sailfish were taken from industrial longline vessels fishing off Cumana, Venezuela in 1989. Most of the fish were from catches early in the year made by longline fleet that landed in Cumana harbor. By summer, many of the 19 industrial longline vessels moved to other Caribbean locations to land their catch for higher prices. A similar quantity of size frequency data were obtained from Venezuela in 1990. Conversely, over 1,000 size measurements were made on billfish (mostly sailfish) landings from Grenada in the past 12 months. These data were taken from the large fleet of artisanal canoes that fish longline gear for pelagic fishes. In Barbados, about 500 size measurements were taken from billfishes (blue and white marlin, sailfish, and spearfish) during 1989-90. These samples were collected primarily from the day-ice boats that fish for pelagic species in Barbadian waters.

Longline Observers in Venezuela

Observers were present aboard five yellowfin longline trips in 1989. Two trips were at the beginning of the year when billfish catches were high (20-60% of the catch), two in the summer, and one in the fall. The mortality of billfish brought to the side of the boat ranged from 35-55%. The fleet of 19 boats averages about twenty sets each per year for yellowfin tuna. A set consists of a mainline of about 20 miles and 700-1,000 hooks. Billfish catch rates average from 12 per haul in peak periods in the winter and fall to 3 per haul in the summer. All observer and shore-based sampling data are being computerized and a copy of computer summaries are available upon request by writing the Southeast Fisheries Center.

International Tournament Sampling

Through the efforts of ICCAT samplers or volunteer submissions by government officials, 1989 and 1990 billfish tournament data have been collected from recreational anglers in Barbados, Grenada, Venezuela, Jamaica, Dominican Republic, Turks and Caicos, Cuba, Cayman Islands, St. Maarten, and along the west African coast off Senegal and the Ivory Coast. Data collected in some areas also included size measurements and sex determination of the landings.

Age and Growth Research

A number of unusual size billfish samples were collected in 1989-90 for age and growth research. Biological samples from two blue marlin over 1,000 pounds were obtained in 1989 from Bermuda and North Carolina. About two dozen juvenile size swordfish and sailfish (ranging from 3 to 20 inches) were obtained from the stomachs of larger predators through a program administered by The Billfish Foundation, Miami, FL. In addition, several juvenile sailfish were also obtained from atsea observers on Venezuelan longline vessels. The Billfish Foundation also recently had reward posters for juvenile billfish and tetracycline injected billfish printed in Spanish for distribution by ICCAT technicians in non-English speaking

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