

**THE COOPERATIVE TAGGING CENTER MARK RECAPTURE DATABASE FOR
ISTIOPHORIDAE (1954-1995), WITH AN ANALYSIS OF THE WEST ATLANTIC
ICCAT BILLFISH TAGGING PROGRAM**

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SUMMARY

*A historical review of the NMFS Cooperative Tagging Center (CTC) mark recapture database for blue marlin (*Makaira nigricans*), white marlin (*Tetrapturus albidus*), and sailfish (*Istiophorus platypterus*) is presented for the period 1954 to 1995. The majority of blue marlin and white marlin are released in the west Atlantic during the summer months, July through September. Most sailfish have also been released in the west Atlantic, historically during early winter months, December and January, and again in the late spring during April and May. Historical recapture rates remain low, with 0.64% of blue marlin, 1.8% of white marlin, and 1.7% of sailfish being recaptured. Selected movements are also presented for each species. Information on historical releases and recaptures of billfish in areas covered by the ICCAT Billfish Tagging Program (IBTP) are presented for the CTC, as well as The Billfish Foundation (TBF). To assess the success of the IBTP in improving recapture/reporting rates, an analysis of the CTC recapture proportions prior to and after the implementation of IBTP areas in 1987 was performed. Prior to 1987, 5% of all billfish releases and 6% of all billfish recaptures were from designated IBTP areas compared to 8% releases and 17% recaptures after the program started. A chi-square contingency test confirmed a significantly higher ($p < .0001$) tag release rate and tag recapture/reporting rate after implementation of the IBTP.*

RÉSUMÉ

*La base de données du Cooperative Tagging Center (CTC) du NMFS, sur les récupérations des marques de makaire bleu (*Makaira nigricans*), de makaire blanc (*Tetrapturus albidus*) et de voilier (*Istiophorus platypterus*) a été actualisée pour les années 1954 à 1995. La plupart des makaires bleus et des makaires blancs ont été marqués et remis à l'eau dans l'Atlantique ouest au cours des mois d'été (juillet à septembre). La plupart des voiliers ont également été marqués et remis à l'eau dans l'Atlantique ouest, en hiver (mois de décembre et janvier), puis à la fin du printemps (entre avril et mai). Les taux historiques de récupération sont peu élevés : 0,64% de makaires bleus ; 1,8% de makaires blancs et 1,7% de voiliers ont été récupérés. Certains déplacements sont décrits pour chaque espèce. Les données historiques de marquage et de récupération d'istiophoridés dans des zones couvertes par le Programme ICCAT de marquage des istiophoridés (IBTP) ont été transmises au CTC ainsi qu'à la Billfish Foundation (TBF). Les taux de récupération avant et après la mise en place de l'IBTP en 1987 ont été analysés afin d'évaluer le succès du programme ICCAT et l'évolution des taux de récupération/déclaration. Avant 1987, 5% de tous les marquages d'istiophoridés et 6% de toutes les récupérations d'istiophoridés marqués provenaient de zones déterminées de l'IBTP. Depuis 1987, ces taux sont respectivement de 8% et de 17%. Un test a confirmé un taux de récupération de marques et de récupération/déclaration beaucoup plus élevé ($p < .0001$) depuis la mise en place de l'IBTP.*

RESUMEN

*Se presenta un estudio histórico de la base de datos de marcado y recaptura del "Cooperative Tagging Center (CTC)" del NMFS para la aguja azul (*Makaira nigricans*), aguja blanca (*Tetrapturus albidus*) y pez vela (*Istiophorus platypterus*), para el período 1954-1995. La mayoría de las agujas azules y agujas blancas se marcan en el Atlántico oeste durante el verano, de julio a finales de septiembre. La mayor parte de los peces vela también fueron marcados en el Atlántico oeste a principios del invierno, entre diciembre y enero y también a finales de la primavera, en abril y mayo. Históricamente, las tasas de recaptura son bajas: 0.64% de aguja*

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azul, 1,8% de aguja blanca y 1,7% de pez vela. También se presenta una selección de los movimientos de cada especie. Se da información sobre la historia del marcado y recaptura de marlines en zonas cubiertas por el Programa ICCAT de Marcado de Marlines (IBTP), para el CTS así como la Fundación Marlines (TBF). Con el fin de evaluar el éxito del IBTP en fomentar la comunicación de las recapturas, se llevó a cabo un análisis de las proporciones de recapturas antes y después de la implementación de zonas IBTP en 1987. Antes de 1987, el 5% de los marlines marcados y el 6% de las recapturas correspondían a zonas IBTP, en comparación con el 8% del mercado y el 17% de las recapturas, después del inicio del programa. Una comprobación de contingencia ji-cuadrado, confirmó que la tasa de marcado y de comunicación de recapturas era mucho mas alta ($p < .0001$) tras la implementación del IBTP.

1. INTRODUCTION

The National Marine Fisheries Service (NMFS) Cooperative Tagging Center (CTC) began in 1954 as the Cooperative Gamefish Tagging Program. The CTC is a joint research effort by scientists, recreational and commercial fishermen designed to provide information on the movements and biology of marine fish species in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea. Originally designed as a mark-recapture program for bluefin tuna, the program quickly expanded to include billfish (Istiophoridae) and swordfish (Xiphiidae) as target species. As of 1996, 20,371 blue marlin (*Makaira nigricans*), 28,950 white marlin (*Tetrapturus albidus*), and 61,428 sailfish (*Istiophorus platypterus*) have been released. Of these releases, 131 blue marlin, 512 white marlin, and 1,060 sailfish have been recaptured. This represents an extremely low recapture proportion (0.65%, 1.8%, and 1.7% respectively). Very low recaptures rates (<2%) for billfish are also observed elsewhere in the Pacific, southeast Atlantic and southwest Pacific (Southwest Fisheries Science Center Tagging Data, Dave Holts *pers. comm.*, Pepperell 1990; Murray 1990; van der Elst 1990, Squire and Nielsen 1983).

About 80% of the CTC releases have historically been concentrated in the northwest Atlantic Ocean (>18° N, >45° W). The ICCAT billfish program was initiated in 1987 as part of the Enhanced Research Program for Billfish to increase release and recapture activities and strengthen existing databases. One of the objectives of the IBTP is to increase tagging activities on both the eastern and western Atlantic. A detailed description of the rationale, objectives and goals of the IBTP is given in Brown *et al.* (1988).

It is important to recognize that the CTC release-recapture database is composed of sampling by many different gear types, levels of tagger expertise, and strengths of data reporting. However, the efficacy of the program is substantial, and the database has a great potential to aid in the understanding of the species. This paper has three main objectives. The first is to provide an update to Bayley and Prince (1994) on the status of the CTC release-recapture database. The second is to describe the combined historical release-recapture activities of The Billfish Foundation (TBF) with the CTC. The third objective is to examine the areas that are targeted by the IBTP, and determine if the program efforts are successful. That is, examine if there is increased tag release and recapture information coming from the areas targeted by the IBTP (1987-1995) compared to those prior to implementation of the program.

2. METHODS

An overall description of the CTC tagging program is given in Scott *et al.* (1990). Participants are given tagging kits which contain tags, report cards, and other items which are useful during the tagging event. The type of tags used has changed over the years, going from a stainless steel dart tag to a medical grade nylon double barb dart introduced by TBF in 1990 and NMFS in 1995 (National Marine Fisheries Service, 1995). The TBF tag is similar to the latter, though the CTC streamer includes the Japanese characters for the word "reward" in an effort to increase recoveries from Japanese longline vessels. When the fish is tagged, the participant fills in the tagging report tag and mails it to the NMFS Miami lab, where it is entered as reported into the main database, along with information on the angler. Release data consists of species, date, location, size in length and weight (along with more specific descriptors), and gear type. When the fish is recaptured, the angler calls a toll-free number or mail in the specifics of the recapture (CTC address and number are printed on the streamer). This information is quality controlled and then entered as reported into the database and coupled with the release information. If there are discrepancies in the release and recapture information (e.g. different species), every effort is made to correct the problem before the information is entered. Both the release and recapture participants receive a reward (tagging hat) and letter summarizing the date, movements, and size specifics of each tag event.

The program operations of the IBTP and TBF are similar in nature to the CTC, with the exception of the reward incentives. The CTC offers embroidered hats, TBF offers a T-shirt, and the IBTP offers financial incentives or T-shirts.

To increase the probability of reporting a recapture, the IBTP distributes posters in three languages (English, French, and Spanish) and TBF in two languages (English and Spanish).

In this paper, movements described are calculated in nautical miles using the release and recapture latitude and longitude coordinates. An algorithm developed by Shudde (1984) based on spherical geometry was used to compute straight line distance between the two coordinates. Since conventional tagging models represent a Eulerian approach to movement, no information is gained on the actual route taken by the fish to the recapture location. Hence, movements are the minimum distance route traveled and serve only to illustrate the overall displacement of the fish.

The success of the IBTP is measured by examining the activities in the locations targeted and observing releases and recaptures of CTC tags within and outside these geographic areas before and after implementation of the program. Specific IBTP procedures and program directives are described in Bayley and Prince (1993). Data is combined across years, and differences are examined statistically using a chi-square contingency table.

3. RESULTS

3.1 Blue Marlin

There have been a total of 20,371 blue marlin released by the CTC as of January, 1996 (Figure 1A). There was a substantial program expansion and increase in number of releases in the 1980's. This trend tapered off in the early 1990's due to government downsizing and a decreasing budget for purchasing tags and equipment for the CTC. Most releases take place during the summer months between July and September (Figure 2). There have been 131 (0.64%) of these releases recaptured since 1954 (Figure 1B). This is an extremely low percentage of return, and blue marlin remain one of the most difficult tagged fish to retrieve. However, the percentage of recaptured fish has increased since Bayley and Prince (1994) reported a (0.5%) recapture rate. This increase is related to the increase of reported recaptures in the southeast Caribbean IBTP area, and will be examined later.

There have been several significant movements of blue marlin, including trans-Atlantic, trans-equatorial, and trans-oceanic. A map of the ten longest straight line movements is presented in Figure 3. Table 1 outlines specific details of these tag-recaptures. A notable movement was a blue marlin released off Delaware and recovered off the island of Mauritius in the Indian Ocean (National Marine Fisheries Service, 1994). This movement was confirmed, and represents the first documented trans-oceanic movement of a billfish. The minimum path traveled was at least 9,100 nautical miles in just 1,108 days (3 years) at large (Table 1). There has been a total of six trans-Atlantic recaptures (not counting the Mauritius movement), all originating in the west and moving east. The easterly direction of movements are most likely an artifact of the majority of releases in the west. Historical seasonality and general movement patterns are summarized in Bayley and Prince (1994), Witzell and Scott (1990), Mather *et al.* (1972), Mather *et al.* (1974a), and Mather *et al.* (1974b).

3.2 White Marlin

There have been a total of 28,950 white marlin released by the CTC as of January, 1996 (Figure 1C). There were two peaks of annual release activity; one in the late 1960's and one in the early 1990's. Like the blue marlin, the number of released white marlin has tapered off somewhat in the last two years. Most releases of white marlin take place during the summer months between July and September (Figure 2). There have been 512 (1.8%) of these releases recaptured (Figure 1D). Although this is the highest percentage recaptured of the other two marlin species examined here, it is still considered an extremely low percentage for a mark recapture study. However, like blue marlin, there has been an increase in the recapture rate, though small, since Bayley and Prince (1994) reported an overall historical recapture percentage of (1.5%). There was a peak in the number of recaptures in 1971, which followed four years of high release activity. The yearly recaptures have been at near historic levels in the past few years.

The ten longest movements are shown in Figure 4 and described in detail in Table 2. The longest movement originated off the Virgin Islands and was recaptured off Morocco, a distance of at least 3,150 nm over 576 days (1.6 years). There are no other completely trans-Atlantic movements documented and this movement was not described in Bayley and Prince (1994). Like blue marlin, there is no conclusive evidence in the CTC tagging records that there is a single Atlantic-wide stock. Patterns of movement and seasonality are summarized in Bayley and Prince (1994), Mather *et al.* (1972), Mather *et al.* (1974a), and Mather *et al.* (1974b).

3.3 Sailfish

There have been a total of 61,428 sailfish released by the CTC as of 1996 (Figure 1E). Sailfish are released in much greater numbers most likely due to the more coastal distribution of this species and close proximity to recreational anglers. There was a peak in the number of fish released in 1992. The numbers of releases has dropped substantially in the past few years, as the shortage of tags and tagging equipment most profoundly affects this species. Historically, there have been two peaks of releases during the year, one in the late fall and early winter, and one in late spring (Figure 2). There have been a total of 1,060 (1.7%) sailfish recaptured (Figure 1F). Again, a very low rate of recovery, but one that has increased since Bayley and Prince (1994) reported a 1.4% return rate. The number of recaptures peaked in 1993, which followed three years of high release activity.

The ten longest movements are shown in Figure 5 and described in detail in Table 3. The longest movement originated off of North Carolina and was recovered just north of the eastern South American continent. This represents a minimum movement of at least 2,087 nm over 332 days. There are no trans-Atlantic or trans-equatorial movements in the database. Patterns of movement and seasonality are summarized in Bayley and Prince (1994) and Mather *et al.* (1974b).

4. CTC AND TBF COMBINED ACTIVITIES

The TBF billfish tagging program was initiated in 1990. Release and recapture data is shared under a memorandum of understanding between the CTC and TBF, and can be combined and examined as a single Atlantic pool of data. A histogram of combined blue marlin, white marlin, and sailfish total releases and recaptures of both programs is shown in Figures 6 and 7, respectively. Bars of the histogram are broken down by area released or recaptured in terms of within or outside area covered by the IBTP. The plots illustrate the growing importance of TBF releases and recaptures to the overall number of tagged billfish in the Atlantic. There was a combined peak of release activity in 1993 (Figure 6), with the past 4 years reaching historically high numbers of releases. There were historically high levels of recaptures during the early 1990's as well, with a combined peak of recaptures in 1994 (Figure 7).

The combined CTC and TBF releases and recaptures are broken down by species in Figure 8A-8F. From Figure 8A and 8C, it is clear that the TBF release efforts have greatly increased for blue and white marlin since the first releases in 1990. Sailfish releases (Figure 8E) have also increased since the start of the TBF program, but have stabilized in the past three years.

5. EFFECT OF THE IBTP ON RELEASE-RECAPTURE ACTIVITIES

The success of the IBTP can be measured by examining any changes in the proportion and geographic composition of releases or recaptures in terms of within or outside of the IBTP areas before and after the program was initiated. The geographic IBTP boundaries are defined in Figure 9. Because the IBTP program started in 1987, and the TBF program started in 1990, only the CTC tagging records were examined here. Figures 7 and 8 show the historical releases and recaptures of the CTC database as within or outside IBTP areas (for these purposes, the TBF data is only illustrative). Table 4 shows the specific breakdown of releases by area and period (before or after IBTP) combined across years, and Table 5 shows the recaptures by area and period (before or after IBTP) combined across years. Prior to 1987, 4.95% of the total billfish releases for all years were from designated IBTP areas compared to 8.03% of total releases after the program started. This represents a proportional increase of .63 in the percentage of overall releases from these designated areas (Table 8). To test for statistical significance, a chi-square contingency test was performed on the proportion of total releases from IBTP areas before and after the program was implemented under the hypothesis that the proportion of releases before and after are the same. This confirmed a significantly higher release rate ($p < 0001$) from these areas after implementation of the program.

The number of recaptures from IBTP areas vs. all other area was significantly changed after implementation of the program. Prior to 1987, 6.17% of the total billfish recaptures for all years were from designated IBTP areas compared to 17.4% of total recaptures after the program started. This represents proportional increase of 1.82 in the percentage of overall recaptures from these designated areas (Table 9). As with the releases, a chi-square contingency test was performed on the proportion of total recaptures from IBTP areas before and after the program was implemented. There was a significantly higher recapture percentage ($p < 0001$) from these areas after implementation of the program.

6. DISCUSSION

There has been an unprecedented effort to tag and release billfish in the past few years by the CTC and TBF (Figure 6). This is primarily due to education of the fishing community about the importance of resource conservation and encouraging the practice of catch and release fishing. There have been several improvements in the CTC tagging program since Bayley and Prince (1994) outlined problems and data deficiencies. For example, the tag design and tag anchor

material has changed to increase biological compatibility and decrease the probability of shedding. The data handling and angler communication has also changed and now better detects inconsistent information between the database and the participant and allows the CTC better quality control. The quality of information on growth (not addressed here) has also improved with the introduction of more specific information on tagging report cards. With higher rates of release and recapture, some of the data deficiencies (i.e. low recapture rates) are starting to show signs of improvement.

The suggested improvements implemented in the IBTP by the ICCAT Enhanced Research Program for Billfish to improve return rates appears to be successful. These suggestions, outlined by Bayley and Prince (1994), included: 1) offering immediate rewards for recoveries, communicated in native language as soon as the fish reaches the dock; 2) issuing highly visible tag-recaptures cards to the commercial and recreational communities with a listing of specific information about the recovery; 3) printing recapture cards and reward posters in native languages of important billfishing nations; and 4) publicizing the need for increased efforts on reporting recaptures. Although both releases and recaptures were significantly higher in IBTP areas after the program was initiated, it is interesting to note that the recapture percentage from these areas increased much more so than the release percentage. This suggests that the program, most likely due to the suggested improvements, has had a significant effect on the reporting rates and quality of information of recaptured billfish.

7. LITERATURE CITED

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Table 1. Ten selected long distance movements of blue marlin from the CTC database 1954-1995. Straight line distance routes (in nautical miles, nm) of specific movements are shown in Figure 3.

Movement	Tag Number	Release Date	Release Latitude	Release Longitude	Recapture Date	Recapture Latitude	Recapture Longitude	Days at Large	Distance (nm)
1	R158362	9/10/89	38.33 N	73.50 W	9/22/92	19.00 S	58.00 E	1108	9100
2	R059578	9/29/83	18.67 N	64.83 W	2/29/84	01.50 N	02.37 W	153	3810
3	R031867	7/16/81	18.67 N	64.83 W	5/29/89	04.10 N	02.13 W	2874	3771
4	R171206	9/14/89	18.67 N	64.83 W	12/27/89	04.50 N	02.50 W	104	3742
5	WH000053	8/9/76	18.00 N	64.00 W	2/12/77	04.00 N	06.17 W	187	3493
6	R219789	8/3/91	18.67 N	64.83 W	4/26/92	05.00 N	14.42 W	267	3060
7	R080839	9/21/84	11.33 N	66.83 W	11/21/85	16.70 N	18.48 W	426	2827
8	HM001237	2/14/95	14.62 N	62.85 W	7/4/95	38.33 N	73.50 W	140	1531
9	R055082	9/9/81	18.67 N	64.83 W	11/3/81	06.30 N	44.77 W	55	1387
10	R183252	9/4/90	18.50 N	66.17 W	8/1/91	39.98 N	68.17 W	331	1293

Table 2. Ten selected long distance movements of white marlin from the CTC database 1954-1995. Straight line distance routes (in nautical miles, nm) of specific movements are shown in Figure 4.

Movement	Tag Number	Release Date	Release Latitude	Release Longitude	Recapture Date	Recapture Latitude	Recapture Longitude	Days at Large	Distance (nm)
1	R155524	1/7/91	18.67 N	64.83 W	8/5/92	34.00 N	08.00 W	576	3150
2	M012111	4/23/69	25.67 N	79.33 W	9/21/70	03.95 N	40.33 W	516	2594
3	R307368	4/19/93	21.00 N	86.00 W	1/30/94	27.73 N	40.95 W	286	2482
4	R284341	12/9/92	38.50 N	28.50 W	4/14/93	02.27 N	25.28 W	126	2181
5	M005116	8/31/64	38.00 N	74.00 W	2/15/67	07.42 N	52.33 W	898	2179
6	R298395	8/5/92	38.17 N	73.83 W	7/3/93	08.12 N	52.48 W	332	2141
7	H019589	8/9/70	35.00 N	75.00 W	7/15/75	07.00 N	52.00 W	1801	2105
8	H011690	8/15/68	38.17 N	73.83 W	2/13/69	10.03 N	57.37 W	182	1907
9	R179012	8/18/89	18.67 N	64.83 W	12/1/89	01.72 N	38.50 W	105	1852
10	H018719	7/3/71	35.67 N	74.67 W	1/7/72	09.05 N	57.62 W	188	1849

Table 3. Ten selected long distance movements of sailfish from the CTC database 1954-1995. Straight line distance routes (in nautical miles, nm) of specific movements are shown in Figure 5.

Movement	Tag Number	Release Date	Release Latitude	Release Longitude	Recapture Date	Recapture Latitude	Recapture Longitude	Days at Large	Distance (nm)
1	R272830	8/5/92	35.83 N	75.50 W	7/3/93	08.12 N	52.48 W	332	2087
2	H010558	10/18/69	34.83 N	75.17 W	3/3/71	09.08 N	55.17 W	501	1895
3	N000995	9/30/69	30.00 N	87.00 W	1/6/70	12.13 N	61.82 W	98	1763
4	R114489	3/15/87	26.83 N	80.00 W	2/28/88	27.00 N	50.00 W	350	1601
5	R152261	10/6/90	29.25 N	86.83 W	11/15/91	11.00 N	66.00 W	405	1599
6	R174528	8/18/89	25.08 N	84.72 W	2/13/91	12.17 N	61.50 W	544	1527
7	R280040	6/3/93	21.00 N	86.00 W	1/25/94	12.17 N	61.50 W	236	1503
8	R199770	7/20/91	34.17 N	77.50 W	11/14/93	12.00 N	65.00 W	848	1495
9	R103072	5/8/86	21.00 N	86.00 W	2/17/87	12.00 N	61.83 W	285	1489
10	R045508	6/7/79	20.00 N	86.00 W	1/10/81	12.17 N	61.50 W	583	1486

Table 4. Numbers of tag released blue marlin, white marlin, and sailfish from the Cooperative Tagging Center (1954-1995) by IBTP area and period. The IBTP boundaries are defined in Figure 9, and the program was initiated in 1987. The category of other areas includes any area in the Atlantic ocean not covered by the IBTP.

Total Billfish Releases	IBTP Area Releases	Other Area Releases	IBTP % of All Releases	Proportional Increase After IBTP
1987-1995 (IBTP Program)	3,885	44,479	8.03%	.62
Before 1987	3,043	58,389	4.95%	
Total	6,928	102,868		

Table 5. Numbers of tag recaptured blue marlin, white marlin, and sailfish from the Cooperative Tagging Center (1954-1995) by IBTP area and period. The IBTP boundaries are defined in Figure 9, and the program was initiated in 1987. The category of other areas includes any area in the Atlantic ocean not covered by the IBTP.

Total Billfish Recaptures	IBTP Area	Other Area	IBTP % of All	Proportional
1987-1995 (IBTP Program)	598	2838	17.4%	1.82
Before 1987	142	2159	6.17%	
Total	740	4997		

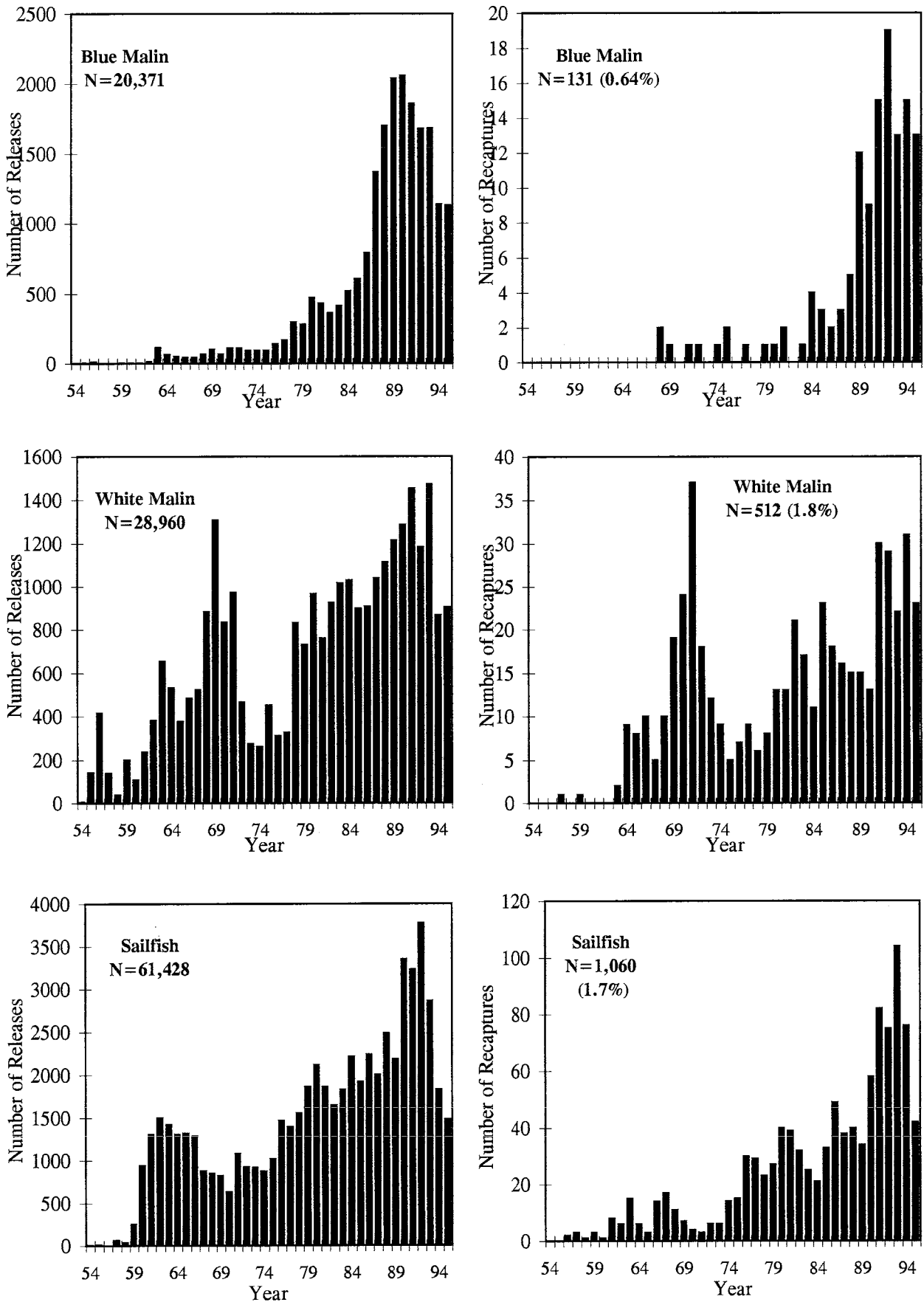


Fig. 1 Historical number tag releases and recaptures by year for the Cooperative Tagging Center. Figs. 1a and B are for blue marlin; Figs. 1C and D are for white marlin; Figs 1E and F are for sailfish. Total sample size (N) are given as well as percentate (%) recaptured for each species.

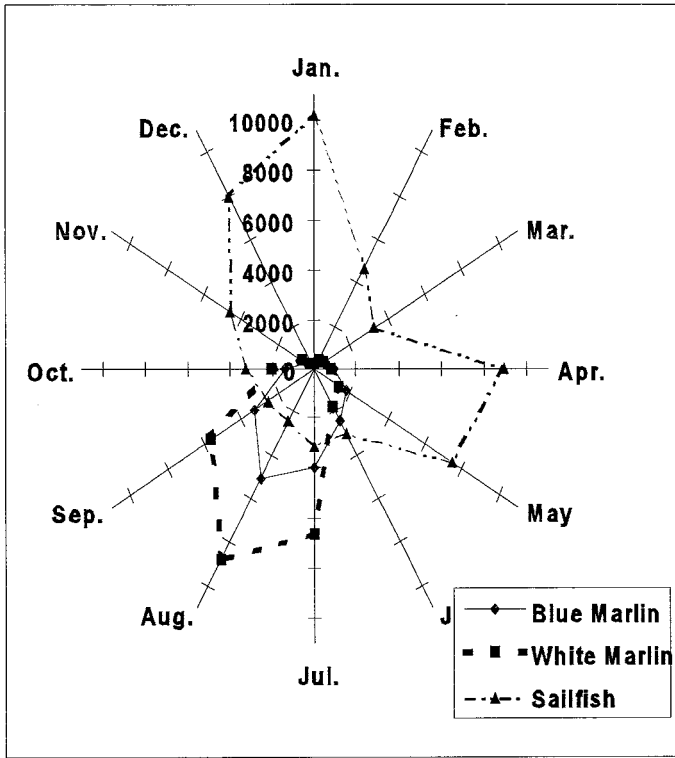


Fig. 2. Seasonal Cooperative Tagging Center releases by month for blue marlin, white marlin, and sailfish, 1954-1995.

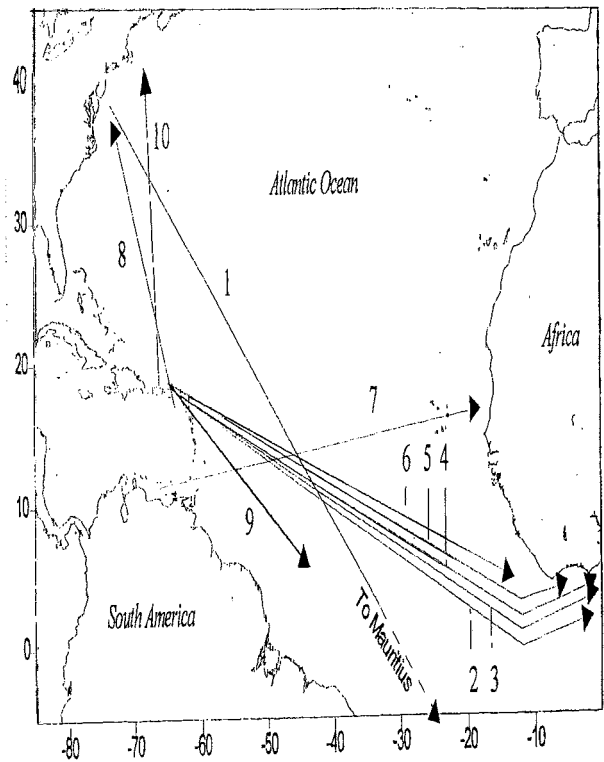


Fig. 3. Ten of the longest movements (minimum distance traveled, see text) for Atlantic blue marlin in the National Marine Fisheries Service's Cooperative Tagging Center, 1954-1995. Information on specific movements are summarized in Table 1.

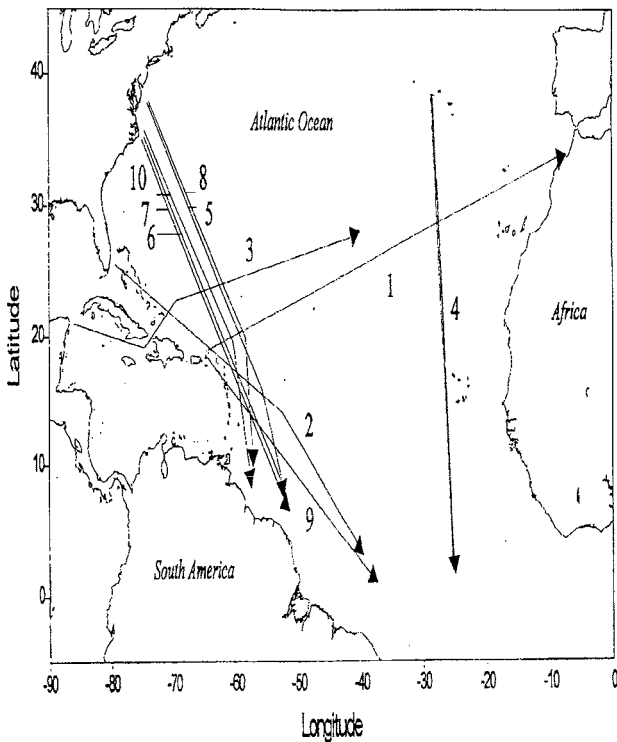


Fig. 4. Ten of the longest movements (minimum distance traveled, see text) for Atlantic white marlin in the National Marine Fisheries Service's Cooperative Tagging Center, 1954-1995. Information on specific movements are summarized in Table 2.

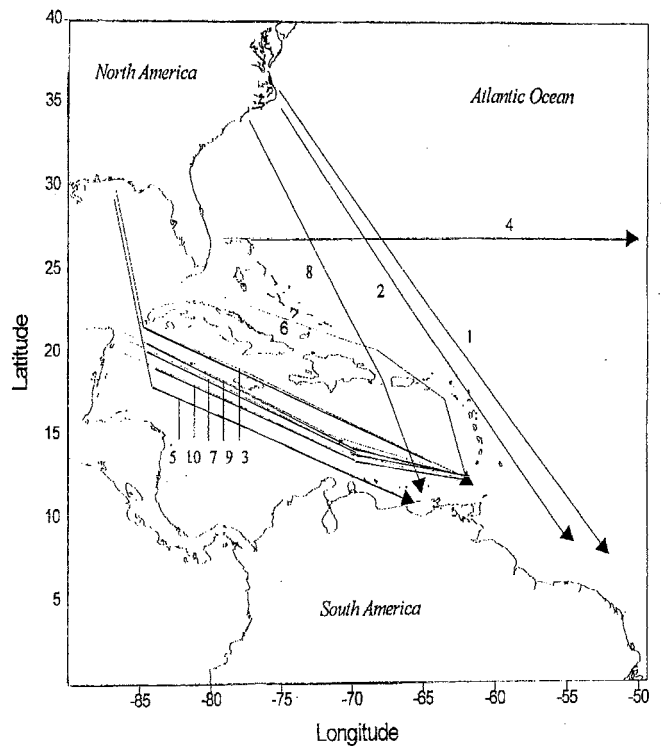


Fig. 5. Ten of the longest movements (minimum distance traveled, see text) for Atlantic sailfish in the National Marine Fisheries Service's Cooperative Tagging Center, 1954-1995. Information on specific movements are summarized in Table 3.

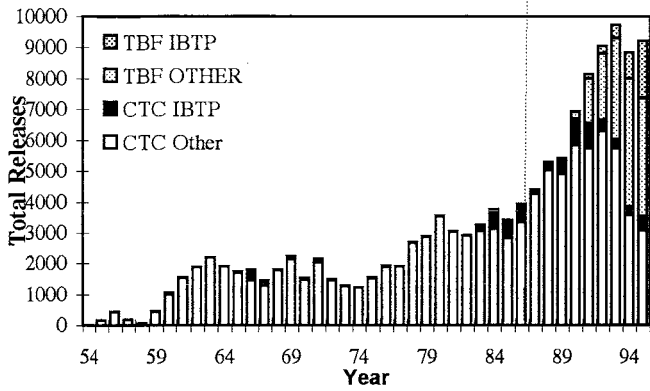


Fig. 6. Number of billfish (all species) releases reported in the Atlantic Ocean for combined Cooperative Tagging Center and the Billfish Foundation records. Yearly records are broken down by IBTP area releases. Vertical dotted line represents year IBTP started.

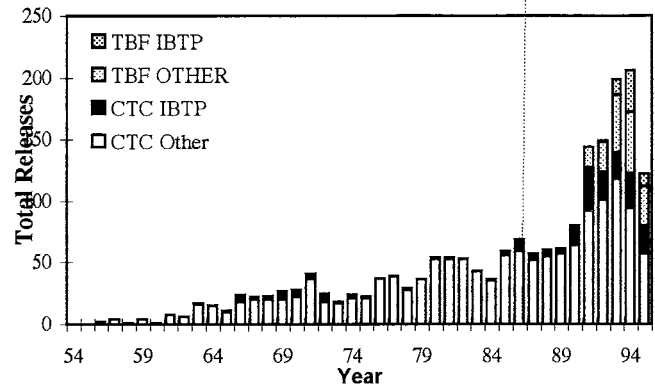


Fig. 7. Number of billfish (all species) recaptures reported in the Atlantic Ocean for combined Cooperative Tagging Center and the Billfish Foundation records. Yearly records are broken down by ICCAT billfish area or other area releases. Vertical dotted line represents year when IBTP started.

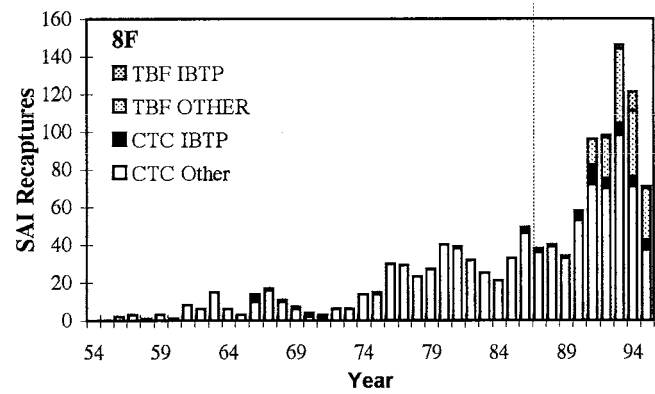
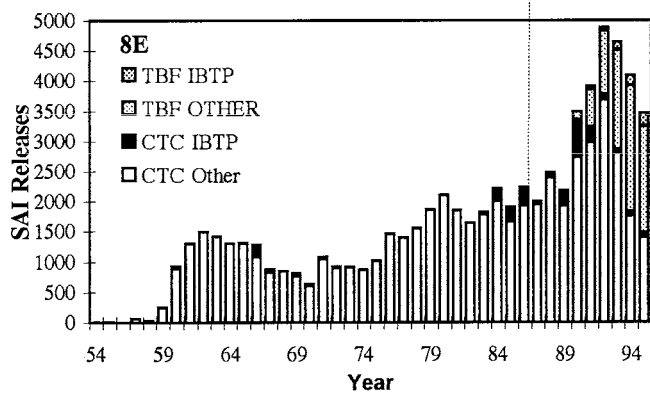
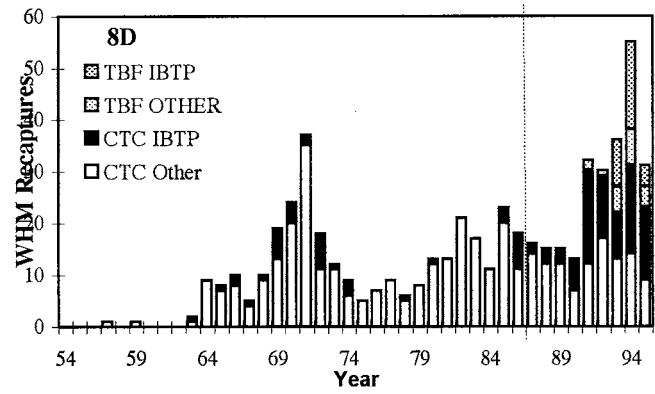
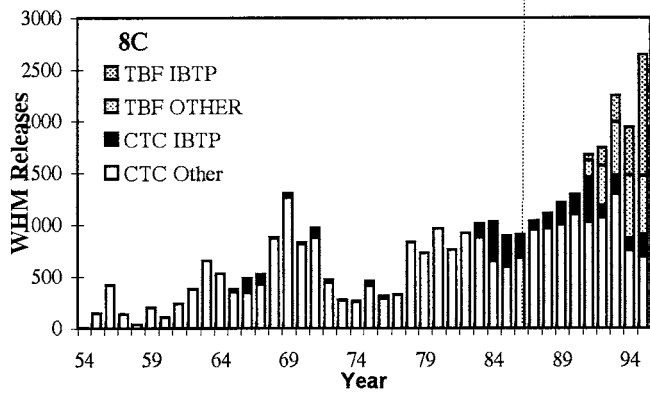
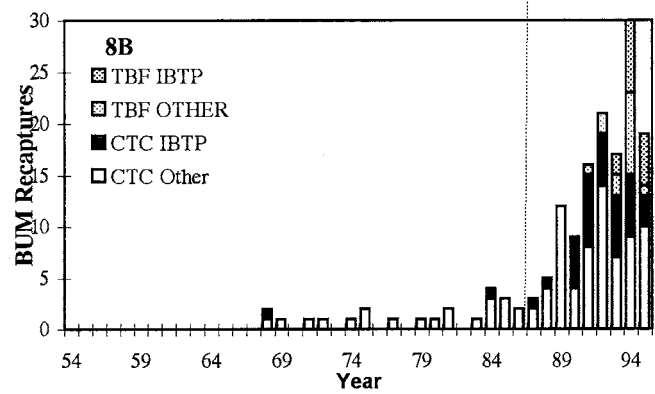
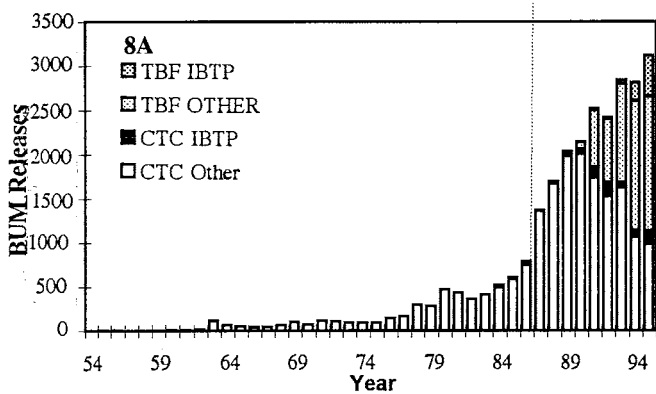


Fig. 8. Number of billfish released and recaptured in the Atlantic Ocean for combined Cooperative Tagging Center and the Billfish Foundation records. Figure A and B are for blue marlin; C and D are for white marlin; and E and F are for sailfin. Yearly records are broken down by ICCAT Billfish Tagging Area or other area releases. Vertical dashed line represents year that ICCAT Billfish Tagging Program was initiated.

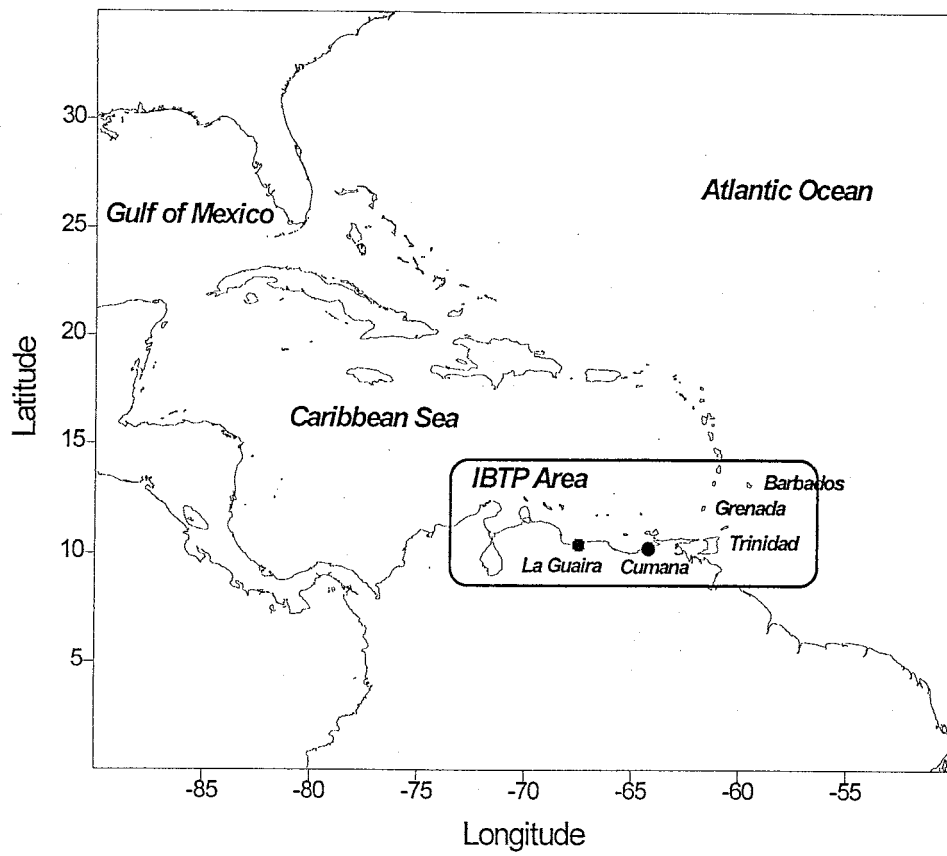


Figure 9. Map of western Atlantic ocean showing sampling location for the ICCAT Billfish Tagging Program in the southeastern Caribbean Sea, 1987-1995.