

## **Billfish Angler Catch Rates and Movements<sup>1</sup>**

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**January 2004**

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<sup>1</sup>Working document submitted to the Marlins Working Group for the Fourth Meeting of the Interim Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC), 26 January - 4 February 2004, Honolulu, Hawaii, USA. Document not to be cited without author's permission.

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## INTRODUCTION

The Southwest Fisheries Science Center's (SWFSC) billfish research program provides information for the conservation and management of billfish resources in the Pacific Ocean. This research includes recreational and commercial fishery monitoring, stock assessments, biological research into the life history and ecology of specific billfish species and determining the economic importance of billfish resources. Two major components of that research are the International Billfish Angling Survey and the Billfish Tagging Program. These produce essential information pertaining to the recreational billfish angling community for exploring conservation and management concerns. The Billfish Angler Survey provides recreational catch and fishing effort information at major fishing centers throughout the Pacific (Holts and Rasmussen 2003). The angler-based Billfish Tagging Program has provided tagging supplies to billfish anglers for 40 years, providing data on the biology, distribution and migration patterns of billfish.

## BILLFISH TAGGING PROGRAM

The Center's Billfish Tagging Program began in 1969. Recapture data indicate that blue marlin, striped marlin, sailfish and swordfish move extensively throughout the Pacific, but without an apparent specific pattern of migration. These trans-Pacific movements, whether seasonal migrations, nomadic wanderings or generally dispersive, expose them to high-seas commercial and coastal recreational fisheries. Billfish tagged and released by anglers and commercial fishers in the North Pacific are recaptured throughout the North and South Pacific by vessels operating in coastal and international waters. Fishery management conventions understand the international commercial importance of these highly mobile stocks and now need to recognize and characterize the importance of recreational catch and catch/release in the management process. Ortez et al. 2002 reported on the combined tag and release data from the five major constituent based billfish tagging programs. These included government and private tagging programs in all oceans. This global data set included 317,000 tagged billfish and 4,122 recaptures since 1954. Recapture rates for striped marlin and blue marlin were 1.4% and 1.7% respectively. The Center's rates of return vary somewhat from those global returns.

### **Movements**

**Striped Marlin:** Striped marlin are widely distributed in the Pacific and generally move in a directed yet dispersive manner away from core areas of high abundance including the Hawaiian archipelago and the central coast of Mexico (Au and Squire, 1990). To date (December 2003) the Center's striped marlin tag and releases total 21,730 with 334

recaptures yielding a 1.54% recapture rate (Table 1). The majority of tagged striped marlin were tagged and released from Hawaii, Southern California, and Baja California Sur, Mexico.

Recaptures indicate movement from southern California to Baja California Sur but show little movement in the reverse direction. Striped marlin tagged off southern California and Baja California Sur generally move south and offshore to the east. Several have been recaptured after moving great distances including Hawaii, Peru, and the South Pacific (Figure 1). There is little indication of direct movement from Hawaii to the West Coast although fish arriving off Baja and Southern California are thought to be from the central North Pacific.

It is not possible to determine growth rates from angler-estimated weights at release because 1) anglers often over state the size and weight of their catch and 2) weights recorded at recapture by commercial fishers are usually dressed (gilled and gutted) in one of several undetermined methods. When the recapture weight is correct as from recreational tournaments there is still the problem of initial, often generous, estimates given by excited anglers after releasing their billfish.

Recent studies with archival satellite pop up tag technology support the southward and offshore movement of striped marlin. Holts and Rasmussen (personal data) tagged 5 striped marlin off southern California in 2000. Three of these fish moved south into the waters off Baja within 30 days. Domeier and Dewar 2001 found similar results with 23 satellite tagged striped marlin tagged off Magdalena Bay in BCS, Mexico. Those striped marlin that survived the catch and tagging event primarily moved south or offshore to the southwest.

Blue Marlin: A total of 6,786 blue marlin have been reported tagged with 71 recaptures resulting in a 1.05% recapture rate. Of those, 11 (15%) had missing release information and could not be analyzed. Nearly half of these marlin were released and recaptured within 200 nm of Hawaii, indicating considerable inter-island movement and residence times (Figure 2A). Others released off Hawaii moved west and offshore from 200 to 600 nm (Figure 2B). One blue marlin was recaptured after traveling to the Marquesas Islands (2,357 nm), another to the South China Sea (4,450 nm), and a third to New Caledonia (3,508 nm). Blue marlin tagged off Baja California Sur also traveled west to Hawaii, and to the Marquesas in the South Pacific. Blue marlin are infrequent visitors to southern California with few releases and no recaptures exist (Figure 2C).

Broadbill Swordfish: Cooperating billfish anglers and US commercial fishers have tagged a total of 521 broadbill swordfish. Recaptures total 18 for a return rate of 3.45% (Table 1). The SWFSC, along with cooperating southern California billfish anglers and commercial fishers, conventionally tagged 17 swordfish in 1978 in an effort to identify movement patterns in the Southern California Bight. Six of those swordfish were recaptured within 35 days and none had moved more than 30 nm. Swordfish tagged north of Hawaii on US longline vessels moved northeast toward the West Coast of North America and were recaptured by other commercial fishing vessels (Figure 3). One

swordfish tagged northeast of Hawaii by a commercial longline vessel was recovered near San Clemente Island, California by a drift gillnet vessel fishing swordfish.

## **SURVIVAL OF TAGGED BILLFISH**

There is considerable recent effort to determine survival rates of billfish tagged and released in recreational fisheries. The progressive trend for most anglers is to release all recreationally caught billfish. This conservation ethic is evolving in counties where it is legal to sell sport caught fish as well as in the state of Hawaii. Recent studies using acoustic and satellite archival tagging methods which more accurately determine survival indicate mortality rates from 0 to 23% over periods of 5 days to several months (Graves et al., 2001, Prince et al. 2003, Holts and Bedford 1989, Brill et al. 1993, Domeier and Dewar 2002, Holts and Rasmussen personal data 2003). A major, though conspicuous, result of these studies is that skill and care in the catching, tagging and release of billfish is essential to survival. The use of circle hooks, heavy tackle, short time of play, precise placement of the tag and resuscitation of the billfish prior to release are all important factors in reducing tag mortality. Those factors aside the low rate of recovery may also be influenced by the laterally compressed or flattened body of small marlin and sailfish. There is some antidotal evidence that improper tagging leads to serious injury or that tags applied with excessive force may protrude out the opposite side (called buttoned). This allows the tag to be quickly shed rather than anchoring in the musculature as needed. It is therefor necessary that only the most careful and experienced anglers attempt to tag laterally compressed fish such as small marlin, sailfish and shortbilled spearfish. This lack of control during the tagging process is the major shortcoming of constituent based tagging programs.

Considering the tremendous amount of recreational billfish fishing effort throughout the Pacific, and globally, there is a need to continue research into the causes of post release mortality and to determine the most efficient methods of releasing billfish successfully. There are several existing tag and release protocols to promote the best opportunity for survival of released billfish. Many domestic and foreign billfish resorts and tournaments now prescribe to this convention. This is important due to the tremendous number of billfish being caught and released throughout the Pacific. Recent tournaments in Costa Rica, Guatemala and Mexico showed 400 to 550 sailfish released in tournaments of only 2 to 3 days (Holts pers. data 2004).

## **SURVEY OF SOUTHERN CALIFORNIA BILLFISHING CLUBS**

The fishing records from the three major Southern California sport fishing clubs (Balboa Angling Club, San Diego Marlin Club and the Tuna Club of Avalon) were collected in 2000 and provide time series data on catch and size of catch. The Tuna Club began documenting catch in 1898 and recorded the first striped marlin catch in 1903 and the first swordfish in 1909. The Balboa Angling Club was organized in 1926 and has records since 1940. The San Diego Marlin Club was founded in 1931 and has documented

striped marlin catches since 1952. The combined records from the three clubs provide seasonal data on catch and size of catch for southern California striped marlin, swordfish and tuna taken by their membership over nearly 100 years of record keeping. Information and data collected by the clubs did not include measures of fishing effort such as number of anglers or number of days fished.

Combined club records indicate 577 were swordfish taken off Southern California between 1909 and 1996. Catches ranged from zero catch in several years to a peak of 127 swordfish reported in 1978. Periods of greatest swordfish catch occurred between 1915 to 1930 and from 1969 to 1981. The increased catches during the 1970s correspond to a similar increase in landings from California's commercial harpoon fishery and reflect a generally higher abundance in southern California waters. Greater swordfish abundance coincided with warm periods associated with El Niño episodes.

The mean whole weight of 522 of the recreationally caught swordfish recorded between 1909 and 1996 was 116 kg or 255 lbs. (Figure 4). The documented weight of the swordfish taken by club members declined from 120 kg (265 lbs.) during 1909 to 1916 to 105 kg (231 lbs.) from 1986 to 1996 ( $P = 0.01$ ,  $R^2 = 0.052$ ).

Reported striped marlin catches from all three clubs (including landed, tagged and released) total 28,929 and ranged from 273 fish per year in the 1990s to 761 fish per year during the 1980s (Figure 5). The period between 1955 and 1965 had some of the highest catches in a single season. The mean whole body weight of 21,501 striped marlin weighed at the sportfishing clubs averaged 68 kg (150 lbs.) and individual weights ranged from 22 kg to over 180 kg (48 to over 400 lbs.) from 1903 to 2000 (Figure 6). Larger striped marlin were taken off southern California through the 1940s than in subsequent years. The average weight of striped marlin from 1910 to 1915 declined from 83 kg (182 lbs.) to 57 kg (126 lbs.) during 1995 to 2000. There are no records of striped marlin in excess of 160-kg (350 lbs.) landed off southern California since the 1950s. Although early weight records possibly include a few blue marlin and/or swordfish incorrectly identified as striped marlin, those few numbers will not change the fact that the size of striped marlin declined significantly ( $P = 0.01$ ,  $R^2 = 0.037$ ) over the period. The International Game Fish Association's all tackle record for striped marlin is 224 kg (494 lbs.) taken off New Zealand.

Club records also document a substantial increase in tag and release fishing. The number of striped marlin released, or tagged and released, increased from between 20% to 50% in the 1980s to nearly 90% in recent years (Figure 7). This trend has reduced the number of billfish being weighed in during tournaments and at sportfishing clubs resulting in fewer accurate catch records.

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Figure 2. Blue marlin movements from tag recaptures in the north Pacific (A), around Hawaii (B), and in southern California and Baja California, Mexico (C).

Figure 3. Swordfish movements from tag recaptures in the northeastern Pacific (A) and detail of southern California (B).

Figure 4. Weights of swordfish weighed in at the Tuna Club, Balboa Angling Club and the San Diego Marlin Club, 1906-1996. Data unavailable for some years.

Figure 5. Number of striped marlin recorded at the Tuna Club, Balboa Angling Club and the San Diego Marlin Club, 1906-2000. Data unavailable for some years.

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Figure 7. Percent of striped marlin recorded as tagged and /or released from the Tuna Club, Balboa Angling Club and the San Diego Marlin Club, 1948-2000 Data unavailable for some years.

**Table 1. Summary of billfish and tuna tagged in 2003 with releases and recoveries for 1963-2003.**

Species Name	Release 2003	Release Total	Return Total	Rate %
Striped Marlin	301	21730	334	1.54
Sailfish	204	8518	47	0.55
Pacific Blue Marlin	481	6786	71	1.05
Billfish, unid.	-	4308	5	0.12
Black Marlin	6	3355	69	2.06
Short-Billed Spearfish	140	1507	2	0.13
Broadbill Swordfish	2	521	18	3.45
Yellowfin Tuna	-	347	24	6.92
Skipjack Tuna	-	99	2	2.02
Albacore Tuna	-	87	0	0
Bigeye Tuna	-	79	2	2.53
Bluefin Tuna	-	56	6	10.71
<b>TOTALS</b>	<b>1134</b>	<b>47393</b>	<b>580</b>	<b>1.22</b>



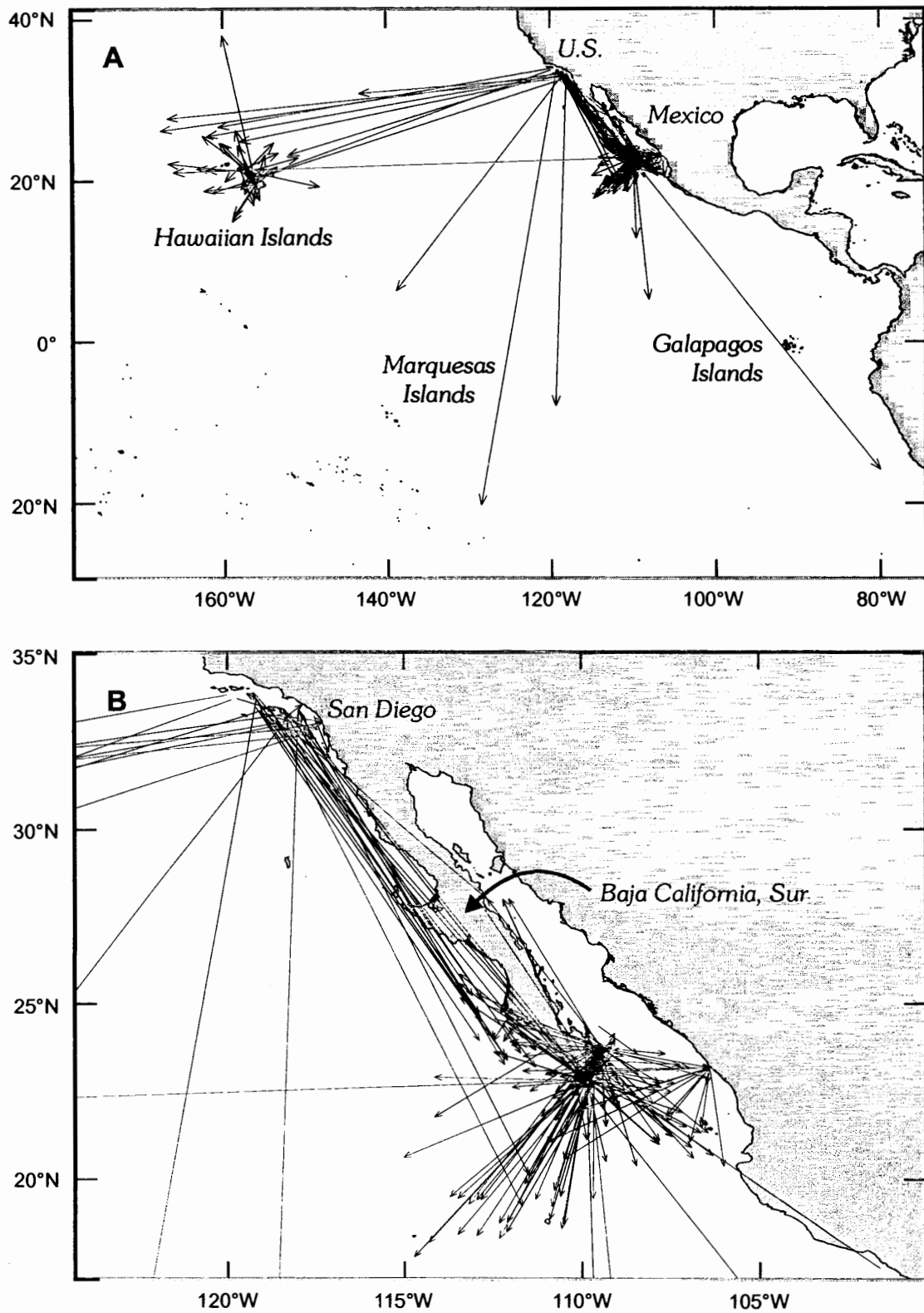


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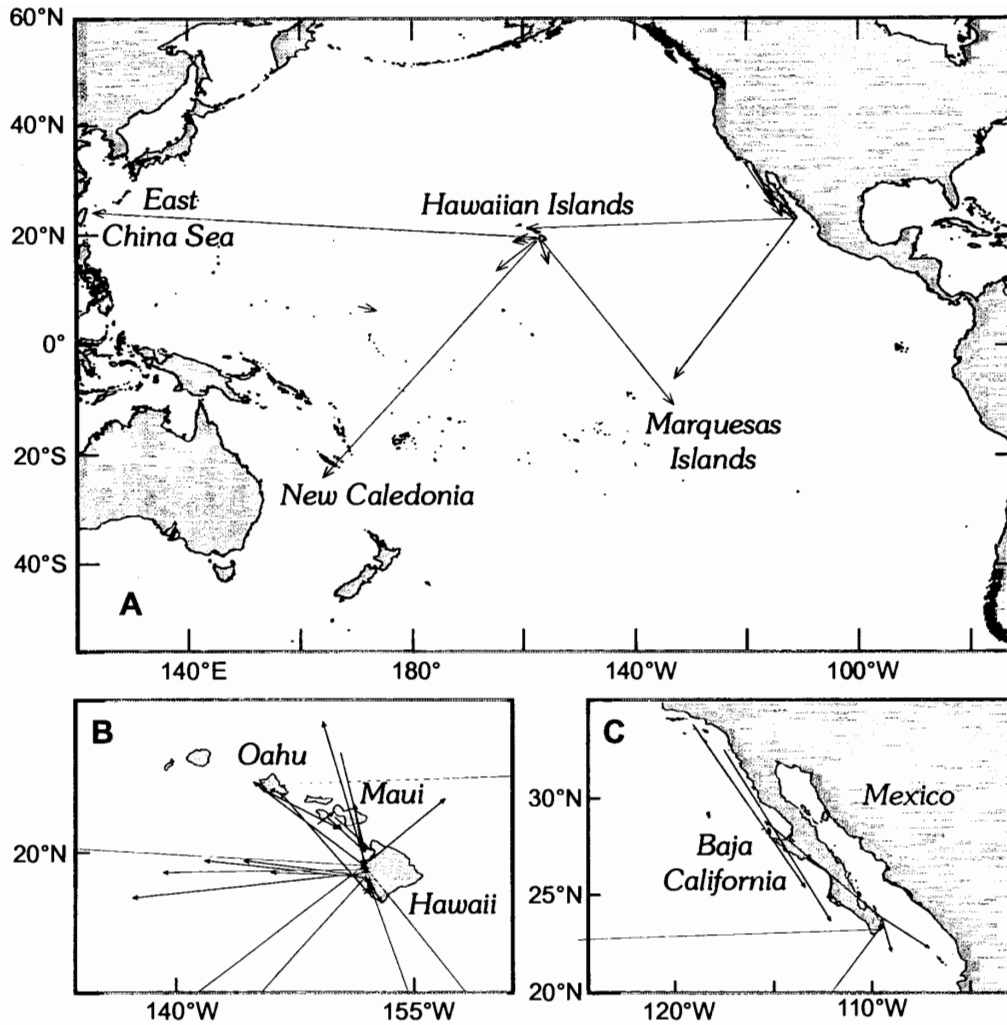


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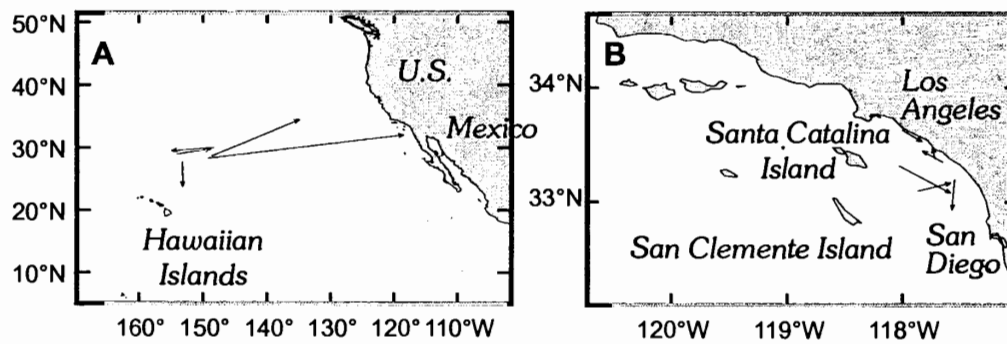


Figure 3. Swordfish movements from tag recaptures in the northeastern Pacific (A), and detail of southern California (B).

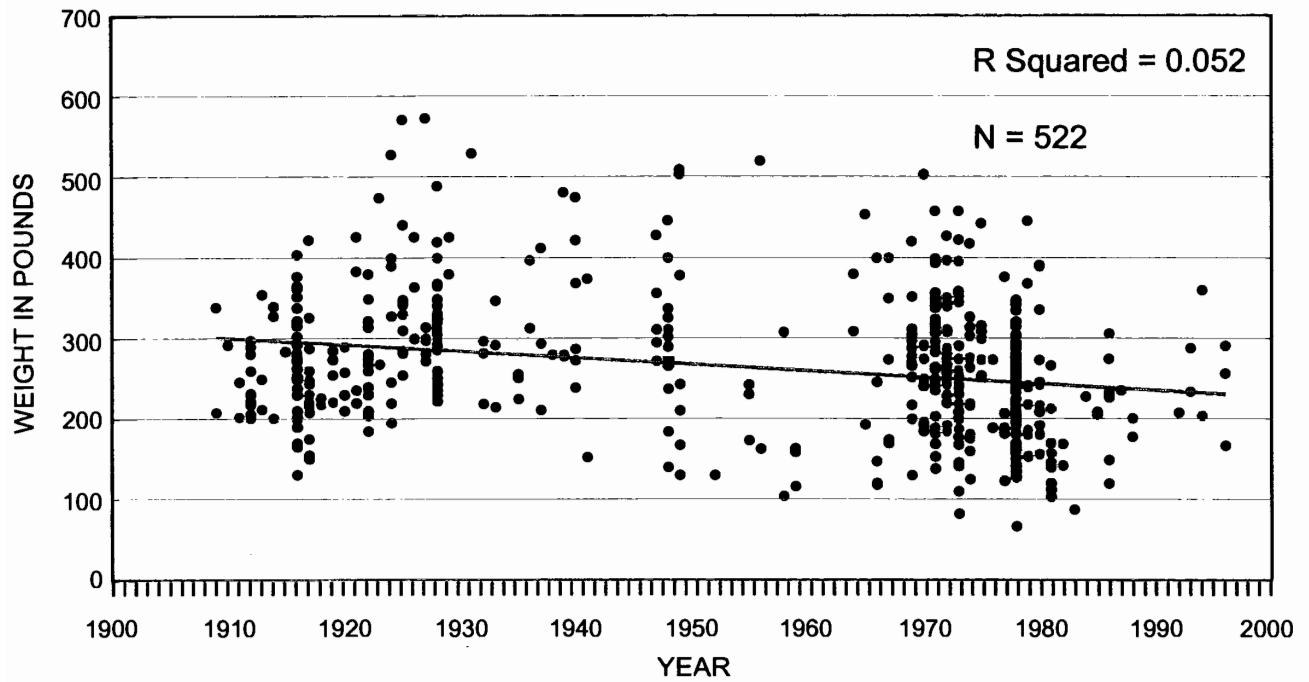


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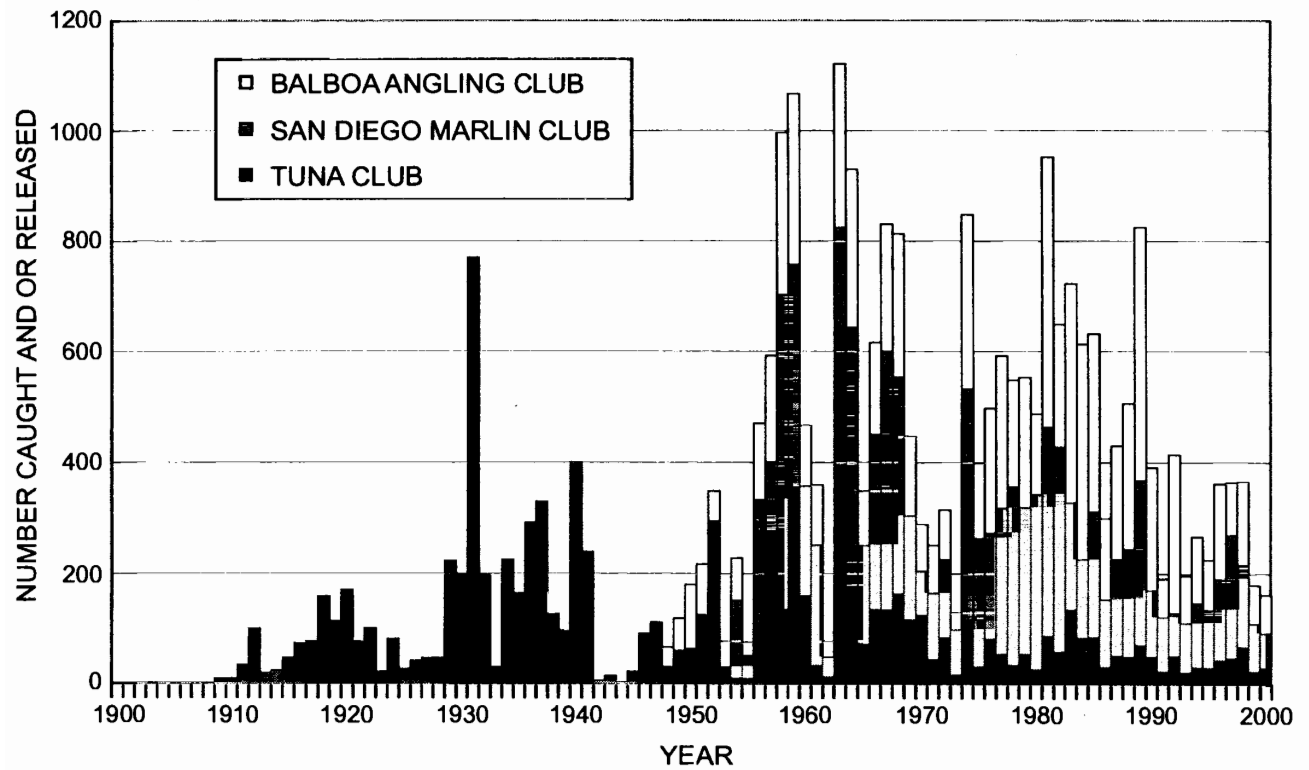


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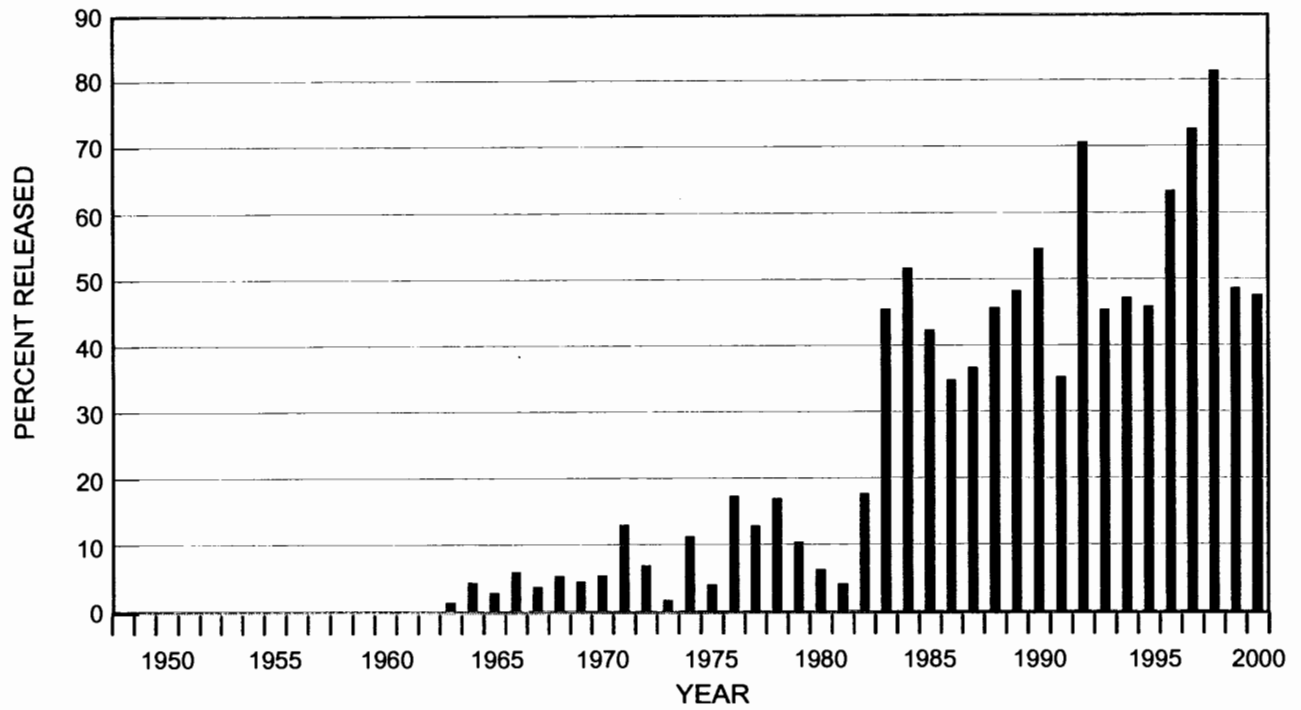


Figure 6. Percent of striped marlin recorded as tagged and/or released from the Tuna Club, Balboa Angling Club and the San Diego Marlin Club, 1948-2000. Data unavailable for some years.

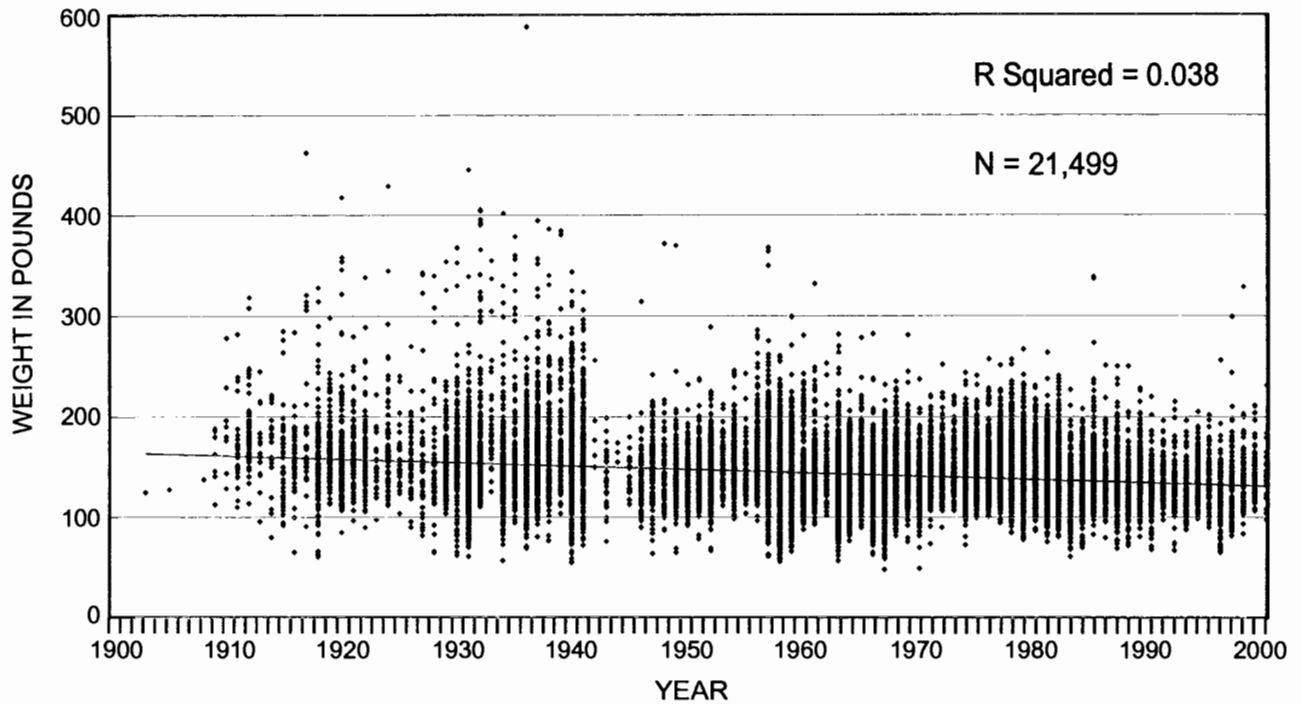


Figure 7. Weights of striped marlin weighed in at the Tuna Club, Balboa Angling Club and the San Diego Marlin Club, 1903-2000. Data unavailable for some years.