Documentation for the Hudson, Jax, Pt. Salerno, and Tampa Bay Recreational Fishing Tournaments catch series, along with the Crooke longline catch rate series

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SYNOPSIS OF A SURVEY OF THE FLORIDA RECREATIONAL SHARK FISHERY UTILIZING SHARK TOURNAMENT AND SELECTED LONG-LINE DATA

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INTRODUCTION

To assess completely the shark recreational fishery in Florida in terms of catch/effort, species composition, seasonality, and various socio-economic factors, a fine-scale survey is necessary. To provide meaningful, precise, and accurate information, a very large, labor-intensive effort that is technically and logistically complicated--and very expensive--is required. However, such a study typically provides information only on the present and future fishery. Historical data may be non-existent or may be overlooked with such an approach.

A cost-effective first step to assessing historical trends in this fishery is to analyze data available through organized sportfishing tournaments (also called "derbies" or "rodeos") for sharks. Since the mid-1970's, the number of tournaments that include or are directed solely toward sharks along the U.S. Atlantic and Gulf coasts has steadily increased. Such tournaments in this region have been conservatively estimated by NMFS to number about 65 per year as of 1989 (NMFS, 1989).

Over the past decade, shark tournaments became popular as fishing contests and fund-raisers in many fishing communities of the southeast U.S. In recent years, declining catches of sharks, both in number and size, have been reported in these tournaments via anecdotal sources. Although tournament directors have pointed to years of logbook information containing catch records, no formal attempt has been made previously to compile and analyze these records on a statewide basis. In light of the relative lack of published information on Florida's recreational shark fishery, these tournament records represent important historical data.

In addition, another valuable source of historical information exists in a database of longline catches compiled by Mr. C.F. Crooke, Jr. of Warrington (near Pensacola), Florida. The Crooke data pertain to small but remarkably consistent long-lining operations for large, inshore sharks over 15 years, from 1975 through 1989. The records include species, sex, water temperature, and other information for sharks caught in the waters off Pensacola, an area with a significant recreational interest in sharks. Thus, these data can serve as a comparison to the recreational tournament data over the last two decades. No previous attempt to compile and analyze the Crooke data has been made.

OBJECTIVES OF THE STUDY

The primary objectives of this project were as follows:

(1) Survey the recreational fishery for sharks in Florida from organized shark tournaments held during the period 1971-1991, by compiling historical and current data on tournament activity and distribution, catch, species/size/sex composition of catch, catch/effort, and other factors.

(2) Compile and analyze the 15 years of Crooke longline data (1975-1989) in conjunction with the recreational tournament data, and evaluate the two data sets for historical trends in the Florida shark fishery.

METHODS

Shark Sportfishing Tournaments

A total of 34 sportfishing tournaments devoted strictly to sharks and operating in Florida waters sometime between 1971 and 1991 was identified. (This survey does not include other tournaments that had sharks as a one category of catch--only dedicated shark tournaments are considered). In 25 (74%) of these, the tournament director or co-director was identified, located and interviewed. General information was collected on each tournament as follows:

--Official name of the tournament and its base location.

--Years of operation and current status (active or discontinued).

--Number of participating anglers and/or boats per year.

--Status of tournament record.

If written catch records of a tournament were located, the status of those records fell into one of three categories: 1) records provided to this study and suitable for analysis--9 tournaments (26%); 2) records incomplete and not suitable for analysis--6 (18%); or 3) records may have been suitable but were not provided, due either to passive noncompliance or deliberate noncooperation of record curators--5 (15%). For the rest of the tournaments (14/41%), no existing records were located.

Tournaments with suitable records were analyzed for catch by year. Primary data consisted of species and size (by total weight in pounds) of catch. Unfortunately, data on sex and length of sharks caught were rarely recorded, so these could not be included in the analysis. Given that the information came from competitive tournaments, it was assumed that weight measurements were accurate. On the other hand, it was not necessarily assumed that species identifications were accurate. The record-holders were interviewed to gauge the relative accuracy of the species ID's, and adjustments in the data were made where justified. However, some errors in species identification likely exist in the tournament data set, due to the inherent difficulties that anglers have in distinguishing between closely related species of sharks.

Number of sharks caught, heaviest shark (usually the winning catch), and average weight of sharks were determined and plotted (Sigma-Plot). Catch per unit effort was calculated and plotted where possible. Trends were determined from the plotted data.

Crooke Longline Data

Mr. C.F. Crooke, Jr. of Warrington, Florida, generously provided his data collected from 15 years of long-lining operations in the Florida panhandle region. Beginning in 1975 and ending in 1989, Mr. Crooke set a small longline regularly in the waters south of Pensacola, specifically to catch large sharks for supply of shark meat to local restaurants. His typical fishing year ran from late March/early April to late November/early December. Since these activities were incidental to Mr. Crooke's regular line of work, he fished usually on weekends or holidays. Through the 15 years, he averaged just over 18 successful sets of the gear per year ("successful" - at least one shark was caught and recorded), with a range of 9 successful sets in some years to 32 in his most active year (1978).

The Crooke longline was set each time on the bottom in the same location: just inside of 5

miles due south of the western end of Santa Rosa Island, near Pensacola Beach, in a depth of 50 feet of water. The gear consisted of Mustad 14/0 giant tuna hooks, baited with fresh or fresh-frozen bonito, jack crevalle, or mullet, on 5-ft. gangings placed about 20 feet apart on the groundline. From 1975 to 1986, Mr. Crooke set 20 hooks; in 1987, he increased the number of hooks to 30, which he used until he ceased operations in 1989.

The gear was typically set at sundown, preferably on an outgoing tide, and picked up the next morning at sunrise. The catch was hauled in to shore in whole condition and each shark was measured by length and identified by species and sex prior to dressing out the carcass. Notes were taken on the reproductive condition of females, stomach contents, and other aspects. Water temperature for each data was noted. All data were recorded on standardized data sheets and maintained in chronological order in an organized file in Mr. Crooke's home. One unfortunate drawback of the database was that data were taken only when sharks were caught, i.e. only on successful sets. Sets that caught no sharks were not recorded. and there appears to be no way to recover this information accurately. This compromises to some extent the catch/effort data, limiting the quantitative analysis to successful sets only.

Length of each shark was measured in feet/inches by Mr. Crooke in two of three ways. In all cases, Mr. Crooke measured total length of the shark by laying a flexible measuring tape over the entire dorsal surface of the shark's body, from snout to precaudal pit to tip of tail. Since this measurement is not equivalent to "total length" typically reported by other researchers (the straight-line distance down the body axis from snout to tail tip), this type of measurement will be referred to as total contour length in this report. Other length measurements taken by Mr. Crooke were either: 1) true, straight-line fork length of sharks caught in 1975-78; or 2) over-the-back, contour measurement from snout to precaudal tip, excluding the tail, on sharks from 1979-89. Since total contour length was measured on all sharks, raw data in this length category were used in all analyses.

In all, data on 659 sharks comprised of 13 species were collected over the 15 years of long-lining operations. The reliability of the species identifications is very high; beginning in the late 1960's, Mr. Crooke accumulated fishing experience with sharks of the area and educated himself on formal species identification. Consultations with shark biologists Dr. Perry Gilbert and Mr. Stewart Springer of Mote Marine Laboratory, as well as contact with other ichthyologists at nearby shark tournaments, reinforced his knowledge of shark biology.

Data from the original data sheets were transcribed and tabulated for analysis in this report. Data were plotted (Signma-Plot) and trends were assessed from the plotted data, using simple linear regression and ANOVA procedures where applicable.

RESULTS

Shark Sportfishing Tournaments

Tournament Overview. A total of 34 separate tournament operations, each one organized and

conducted as a distinct, usually multi-year tournament for sharks, was held in Florida state waters between 1971 and 1991 (see Heuter 1991). Two of these are based on the Florida border in Orange Beach, Alabama, but are included in this survey because they involve Florida anglers fishing in state waters). The average lifespan of these 34 tournaments is 6.2 yrs (s = 4.8), with a range of 1 yr of operation (one tournament begun in 1991) to a maximum of 18 yrs of continuous operation (one tournament discontinued in 1989). In all, 209 shark tournaments involving approximately 22,560 participants were held in state waters in the past 20 years.

Unlike the huge events held in northeast U.S. waters, such as the annual Bayshore and Montauk shark tournaments on Long Island in New York, shark tournaments in Florida typically have been smaller events held in late spring or summer months, on both Atlantic and Gulf coasts. These tournaments range in size from a few events with over 200 participants, which draw anglers, sponsors, and media attention from well outside the fishing area, to very small contents involving less than 50 anglers (Fig.3). Average tournament size in Florida is about 100 participants. The duration of the typical tournament is one weekend, usually a 40 to 48-hr period between Friday evening and Sunday afternoon or evening.

Nearly all tournaments are exclusively for boat fishermen, usually 2-4 registered anglers per boat; at least two tournaments also have involved beach or pier fishermen. Strictly rod and reel fishing under IGFA rules typically applies. Until very recently (the last 2-3 yrs), most tournaments had no restrictions on catch, either by number or size of sharks, except that many disallowed nurse sharks (*Ginglymostoma cirratum;* Table 2) as not being a good "fighting" fish.

[A joint study by Texas A&M University of the Gulf of Mexico recreational shark fishery for the NMFS/MARFIN program has been conducted concurrently with this study. Further socio-economic aspects of shark tournament participants in the Florida Gulf are surveyed in-depth in the Texas A&M study, under the supervision of Dr. R. Ditton of the Department of Wildlife and Fisheries Sciences and in cooperation with this study's principal investigator, Dr. R. Hueter].

The number of shark tournaments in the state began building after 1975 and reached a peak in 1989, then dropped in 1990 and 1991. Only one tournament (Jaycees Shark Rodeo, Marathon) was found for the years prior to 1975. In the summer of 1975 Jaws changed the way much of the public viewed sharks, and the number of new tournaments began growing: five added in 1976, and 10 by 1980. From 1985 to 1989, the total number of tournaments in the state increased by two per year, reaching a peak of 21 separate shark tournaments held in Florida in 1989. In recent historical terms, 1987-89 was the heyday of shark tournament activity in the state.

Since 1989, there has been a sharp decline in the number of shark tournaments held each year. Only 14 remain active, and of these only seven are large, viable events involving 100 anglers or more. Thus, of the 34 tournaments charted between 1971 and 1991, only 21% remain as significant tournaments today. This temporal pattern mirrors the trends evident in the NMFS/MRFSS data for Florida: a build-up in shark fishing activity through the early and mid-1980's, and a decline in the late 1980's.

The great majority of shark tournaments in the state (nearly 80%) have been held along the Gulf coast. Only four organized tournaments have been held along the Atlantic coast (Jacksonville, Sebastian Inlet, Port Salerno, and Lake Worth) and three in the Keys (Key West, Marathon, Islamorada). On the Gulf coast, five tournaments have been run in the panhandle region (Panama City, Destin, Pensacola, and two in Orange Beach, Alabama). The remaining 22 Gulf tournaments have been concentrated from just north of Tampa Bay to Naples. With the availability of large sharks indigenous to the broad continental shelf of the Central Gulf coast (Clark and von Schmidt, 1965), shark fishing in this region has attracted more tournament activity than in any other coastal zones.

Logbook records from nine tournaments were located and found suitable for analysis. Of the remaining 25 tournaments, usable records from only five may exist but were not made available to this study. Of these five, the record curator of only one tournament (Panama City) was deliberately noncooperative in providing information. Two of the nine tournaments providing suitable records were eliminated from the analysis: The St. Matthew's tournament in Naples; because 1991 was its first year; and the Gulf Coast Shark Census based in Sarasota, because its three-year-old format of 100% catch-and-release is categorically different from the kill tournaments.

The seven tournaments with catch data for analysis are: 1) Florida Shark Club Tournament in Jacksonville (Mayport); 2) Port Salerno Tournament near Stuart; 3) Tampa Bay Sharkers Tournament in St. Petersburg; 4) Port of Hudson Tournament in Hudson Beach, north of Clearwater; 5) Destin Tournament; 6) Perdido Pass Tournament in Orange Beach, Alabama; and 7) Monster Shark Tournament in Orange Beach, Alabama.

The usable catch records from these seven tournaments are summarized in Table 1. They range in duration from 16 years of continuous data from the Port Salerno tournament (1976-91) to three years of data from the Orange Beach Monster Shark tournament (1989-91). Four categories of data for each tournament are summarized in Table 1: 1) total number of sharks entered in the tournament; 2) largest shark entered by total whole weight in pounds; 3) average shark size entered, either averaging weights of all sharks entered or, where those data were not available, taking the average of the top three or five heaviest shark weights; and 4) number of tournament participants. The fishing effort in terms of numbers of anglers fishing was very steady within six out of the seven tournaments over the time periods indicated, except for the last year of the Jacksonville (1990), Tampa Bay (1990), and Hudson (1991) tournaments. In the case of Port Salerno tournament, angler registration is variable by year and is shown in Table 1.

Lines 1, 2, and 3 of Table 1 are plotted for the seven tournaments in Figs. 1A-E. Each graph plots shark number or CPUE data against the left axis and shark weight against the right axis. Fig. 1A shows the combined data for the three panhandle tournaments (Destin, Perdido Pass, Orange Beach Monster Shark). Although the records are not complete and cover only 3-4 years of activity, all three categories of catch (number of sharks, largest, average size) appear to be lower in 1990-91 vs. 1988-1989. Number of sharks caught per registered angler (CPUE) dropped for the Destin tournament from 71/150 = 0.47 in 1988 to 18/202 = 0.09 in 1991; the Orange Beach CPUE likewise dropped from

approximately 1.00 in 1989 to 0.06 in 1991. But the trends are not clear due to the short time period of coverage and small number of participants in the Perdido and Orange Beach tournaments.

For the Hudson tournament, however, the historical trends are quite clear (Fig. 1B). Over the seven years of this tournament (1985-91), all three categories of catch have shown sharp declines. This is true even though effort remained a steady 200-130 anglers per year until the last year (1991), when it dropped to 60 anglers. This tournament, which in 1985 landed 48 sharks with a 715-lb tiger as the winning shark, brought in only 4 sharks in 1991 with a 94.5-lb nurse shark as the winner. The most noticeable part of this decline began after 1988.

The Tampa Bay tournament (Fig. 1C) shows similar but perhaps less clear-cut trends over recent years. The 1987 tournament was nearly cancelled due to bad weather, and the tournament director reported that the boats could not get offshore that year. Thus, the transient declines in the 1987 catch vs. 1986 and 1988 were most likely due to this factor. But the declines from 1988 to 1990 are clear. In 1990, with good weather, the number of registrants dropped to 44, but the poor nature of their catch was nevertheless significant: a total of two sharks, a 82-lb nurse shark and a 142-lb bull shark. CPUE dropped from approximately 0.16 sharks/angler in 1985, when 32 sharks weighing from 606.5 to 79 lbs were entered by about 200 anglers, to 0.05 in 1990. After the 1990 tournament, the event was discontinued.

For the Port Salerno tournament (Fig. 1D) angler registration has varied, but fortunately the numbers of registrants are known for all but one of the 16 years of records. This allows for the plotting of true CPUE over the life of the tournament, and results in the best data set found for this study. Although there are some breaks in the data, this tournament shows declines in all categories of catch through the 1980's. CPUE dropped from a high of 0.89 in 1979 to a low of 0.14 in 1989, recovering slightly to 0.21 in 1990 and 0.23 in 1991. (The 1991 data are compromised by comparatively low angler registration and poor weather on the second day of the tournament).

The Jacksonville tournament data are shown in Fig. 1E. Although there are large breaks in these data, recent declines in catch by number and size of sharks are evident. The 1990 tournament resulted in eight sharks entered by 50 anglers (CPUE = 0.16, vs. 0.59 in 1979) and an average weight of 79 lbs for the eight sharks. Attempts by the Florida Shark Club to find large sharks in the area prior to the 1991 scheduled tournament were unsuccessful, even though two separate dates were tried, and so the tournament was cancelled that year.

In summary, it is clear that there have been sharp declines in the recreational catch of sharks by number, size, and CPUE in Florida coastal waters since the mid-to-late 1980's, as exemplified by shark tournament data. These lower catches are having a significant effect on tournament activity, leading to the demise of a number of previously well-organized and well-attended kill tournaments.

Species Distribution/Abundance. The breakdown of the seven-tournament catch into eight species categories (sandbar, dusky, tiger, hammerhead spp., bull, lemon, blacktip/spinner, and nurse), is shown in Table 2. The species representation is typical of the assemblage of large sharks inhabiting

Florida coastal waters in spring and summer months (Clark and von Schmidt, 1965; Castro, 1983). Generally, the decline in total catch in all tournaments, particularly after 1988-89, is reflected across-the-board in declines in catch by species. No particular species appears to escape this trend. Large dusky, tiger and hammerhead sharks become rare after 1989.

Further interpretations of these data are difficult given the low and irregular sample size and the unreliability of some of the species identifications. For example, the identification of 39 dusky sharks caught in the Destin tournament in the summer of 1988 is questionable. The common name "dusky" is used in that region to describe a number of shark species (C.F. Crooke, pers. com.), and no duskies were reported in the Crooke longline data for all of 1988 (see Crooke longline data, below). However, in previous years, Mr. Crooke reported catching duskies in the month of July (see below) so the Destin tournament data cannot be entirely ruled out.

The apparent lack of sandbar sharks in the 7/4/88 and 7/4/90 Jacksonville tournaments may be due to real declines in stocks of this species, which is heavily targeted by commercial longliners. On the other hand, the low numbers could be due to a mismatch between the timing of the 1988 and 1990 tournaments and movements of the inshore groups of sandbar sharks off northeast Florida during those two years. As an aggregating, highly migratory species, sandbar sharks can vary in the timing of their local seasonal abundance with climatic variation and other factors.

Nevertheless, with the above considerations, the overall picture of decreasing catch by species is consistent with the declines in the general catch data from the seven tournaments.

Crooke Long-line Data

Raw Data. The transcribed Crooke longline data are presented in Heuter (1991). Table 3 shows the compiled species totals by sex. A total of 659 sharks of 13 species were collected, comprised of 338 nongravid females, 43 gravid females, 245 males, and 33 sharks where sex was not determined (usually because the shark had been damaged on the longline by the predatory activity of other sharks). The species caught in order of abundance, from highest to lowest, were sandbar, blacktip, bull, tiger, dusky, scalloped hammerhead, great hammerhead, blacknose, nurse, spinner, sand tiger, lemon, and sharpnose sharks. The size of the longline gear (14/0 hooks) selected for larger sharks, and smaller species that inhabit the fishing area may be under-represented (e.g. blacknose and sharpnose) or not present (e.g. bonnethead, *Sphyrna tiburo)* in the catch.

Species Profiles. The distributions of catch by month of the year over the 15-year period are plotted for each of the 13 species in Figs. 2A-G. Mr. Crooke did not fish in the months of January and February, and rarely in March and December, so the primary sampling period extends from April through November each year.

Sandbar sharks, the most abundant species, were found throughout the fishing year off Pensacola but reached a distinct peak in October (Fig. 2A). Sex ratio for sandbars was 1:1.37 males to females. Ten percent of all females caught were gravid. Size of sandbars ranged from a 4.3-ft (total contour length-TCL) nongravid female caught 6/16/87 to a 7.8-ft TCL nongravid female caught 10/5/81.

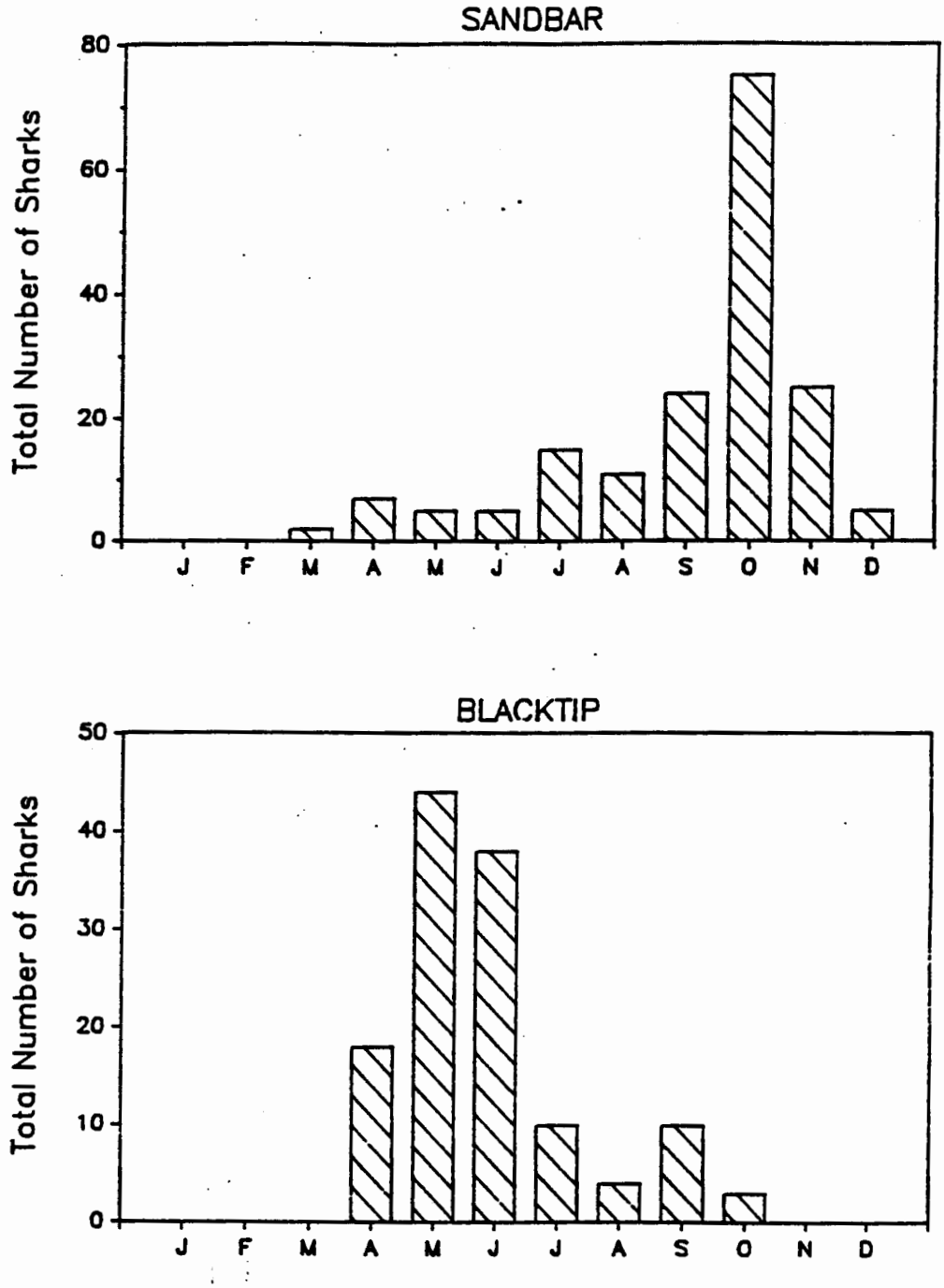

FIG. 2A. Number of sandbar and blacktip sharks in Crooke longline data by month caught over all years, 1975-89.

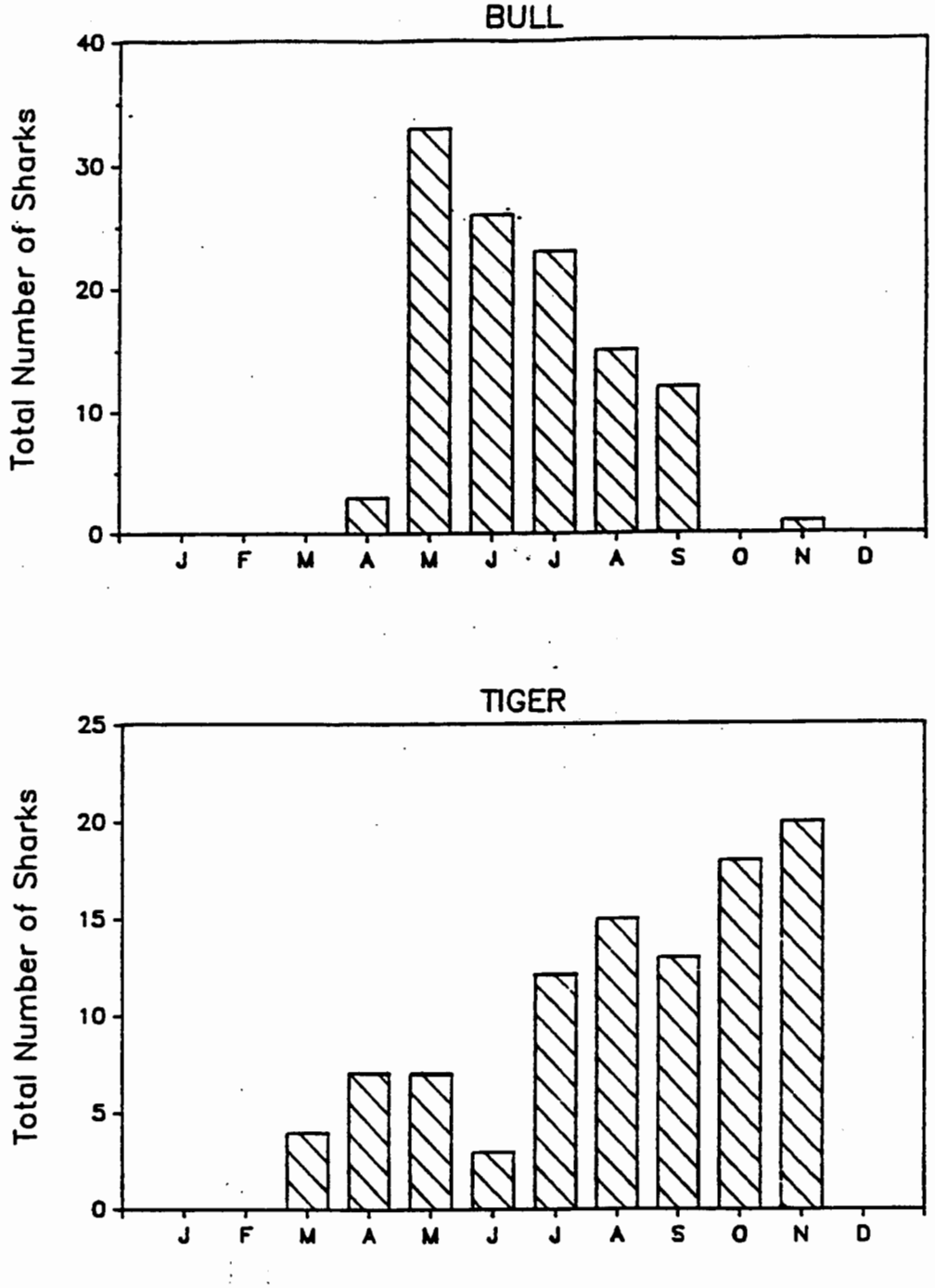

Fig. 2B. Number of bull and tiger sharks in Crooke longline data by month caught over all years, 1975-89.

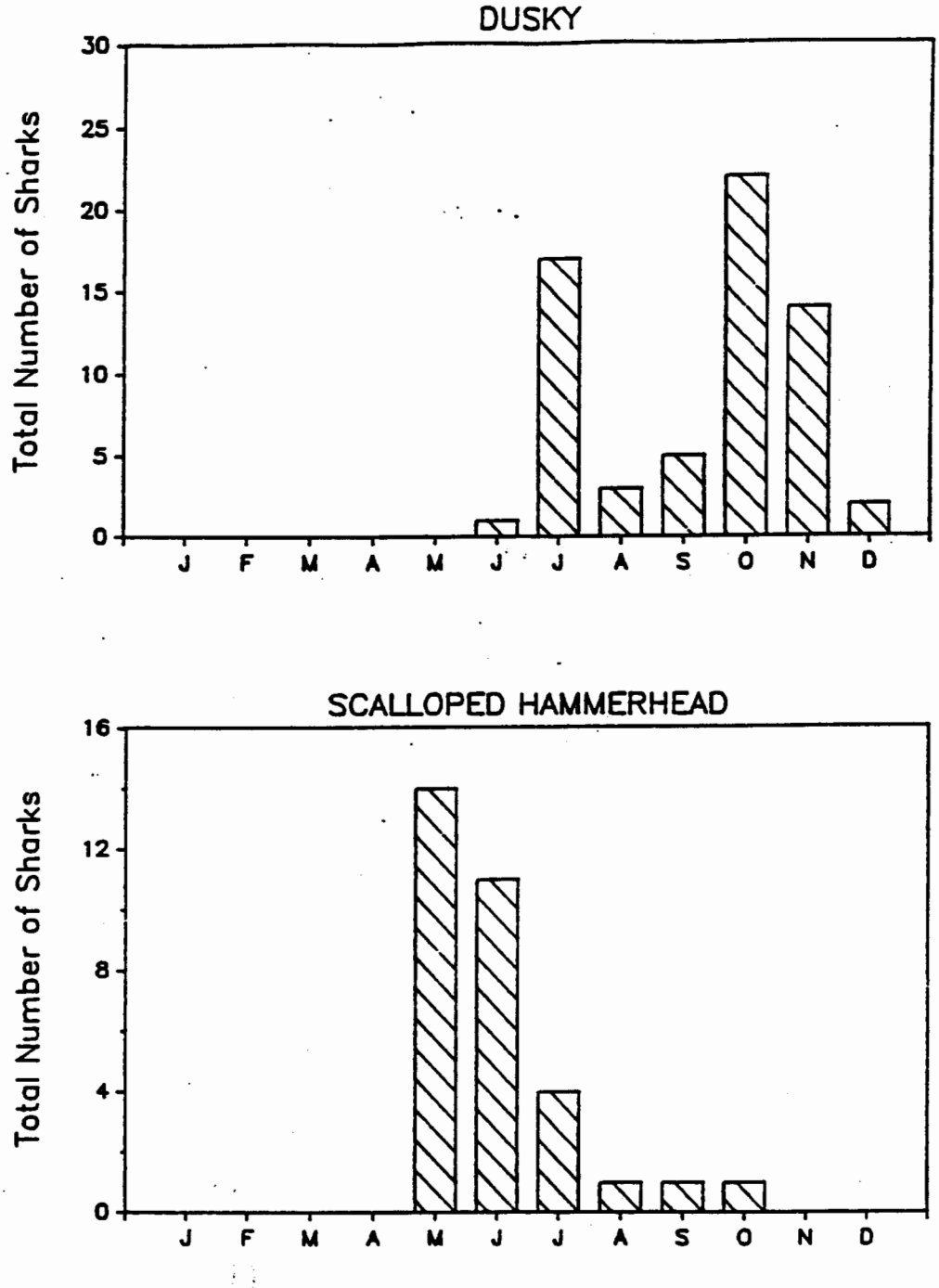

Fig. 2C. Number of dusky and scalloped hammerhead sharks in Crooke longline data by month caught over all years, 1975-89.

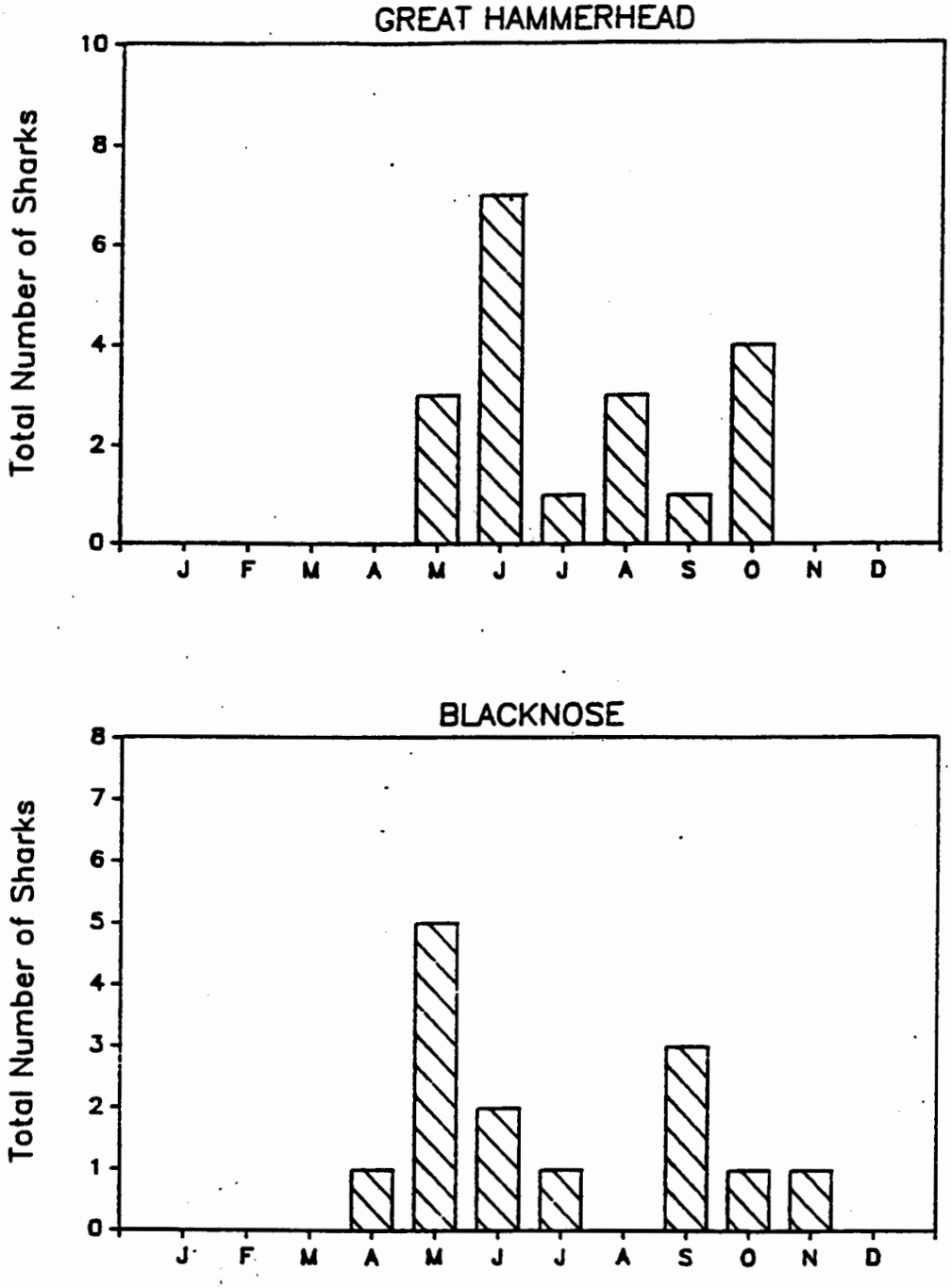

FIG.2D. Number of great hammerhead and blacknose sharks in Crooke longline data by month caught over all years, 1975-89.

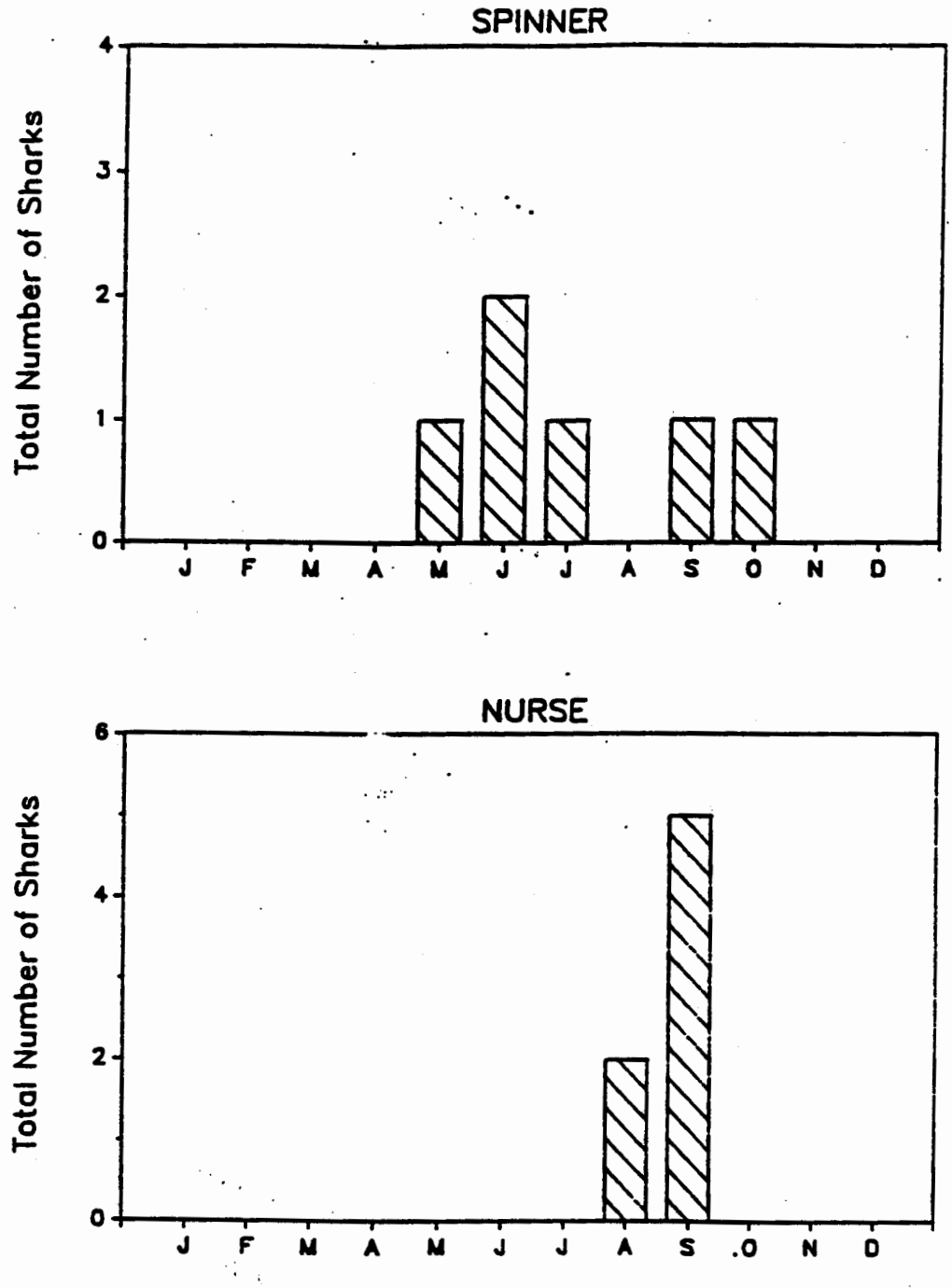

FIG. 2E. Number of spinner and nurse sharks in Crooke longline data by month caught over all years, 1975-89.

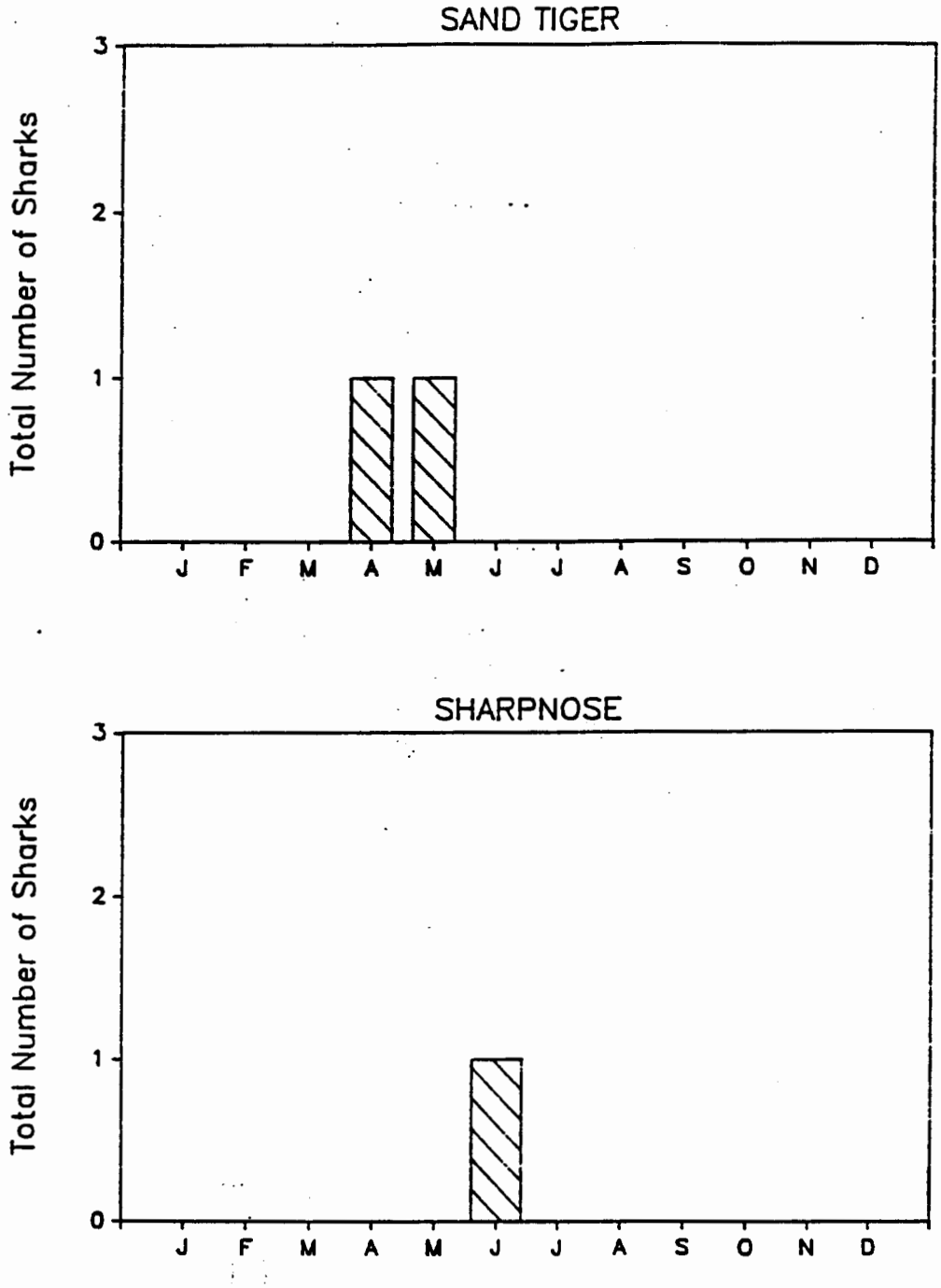

FIG. 2F Number of sand tiger and sharpnose sharks in Crooke longline data by month caught over all years, 1975-89.

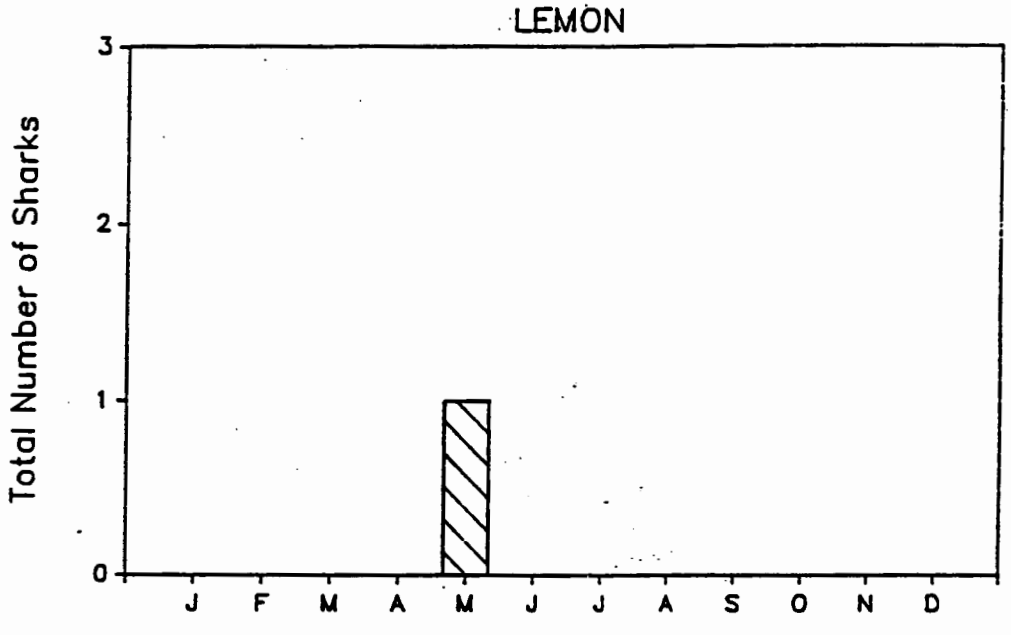

FIG. 2G. Number of lemon sharks in Crooke longline data by month caught over all years, 1975-89.

Blacktip sharks were more predominant in the late spring, reaching their peak in May and June (Fig.2A). Sex ratio was 1:3.87 males to females and 21% of females were gravid. For 12% of the blacktip sharks, sex was not identifiable. This was by far the most molested species of shark on the line, comprising over 50% of the sharks preyed on by other sharks after being caught. Size of blacktips ranged from a 3.9-ft TCL male caught 9/7/85 to a 6.4-ft TCL nongravid female caught 6/11/83.

Bull sharks usually appeared in the area in May at their peak abundance, and were caught with decreasing frequency throughout the summer into September (Fig. 2B). One bull was caught in November, a 6.6-ft TCL male captured 11/7/81. Sex ratio was 1:1.24 males to females; only 6% of females (4) were gravid. Size ranged from a 5.3-ft TCL nongravid female caught 4/9/77 to two 9.0-ft TCL nongravid females caught 6/1/78 and 7/13/88.

Tiger sharks were found in the area throughout the fishing year, basically increasing in frequency from March to November, with a transient decline in June (Fig.2B). Tigers were one of the most eurythermal species, found in a 26°F temperature range from 60°F to 86°F. Of the females caught during the 15 years of long-lining, only one was gravid (13 ft TCL, caught 7/4/80; this is the largest shark in the Crooke records). Sex ratio was 1:2.43 males to females and size ranged from a 3.3-ft TCL male (8/23/87) to the 13-ft female.

Dusky sharks were present from June to December with two peak periods, one in July and a higher one in October/November (Fig. 2C). The size of duskies in the catch was large, averaging 10.2 ft TCL (s = 0.99) and ranging from a 7.9-ft TCL nongravid female caught 10/28/78 to an 11.6-ft TCL nongravid female caught 7/3/85. As with the tiger sharks, only one gravid dusky female was found out of 33 females caught. Sex ratio was 1:1.22 males to females.

Scalloped hammerheads appeared suddenly on the scene in May, tapering off in frequency through the summer with only a few caught in August, September, and October (Fig. 2C). All scalloped hammerheads were male (four could not be identified by sex). Size ranged from 6.1 ft TCL (5/16/81) to 9.0-ft TCL (5/30/81 and 7/13/88).

The monthly distributions of the other seven species are shown in Fig.s. 2D-G. Numbers of sharks in these seven species were low, together comprising only 8% of the total catch. Interesting features among these species includes: gravid females outnumbered nongravid females among the blacknose sharks; all five nurse sharks caught were male; and the one lemon shark caught in 15 years of fishing was a gravid female, 9.0-ft TCL caught 5/1/82.

Catch per Unit Effort. CPUE is plotted from the 15 years of Crooke data in Fig. 4 as number of sharks caught per hook vs. year of fishing, for successful sets of the gear (see Methods/Crooke Longline Data). There is a noticeable decline in the CPUE plot between the early 1980's and the late 1980's. In 1980, CPUE reached its highest point at 0.154 sharks per hook. In 1988, at its lowest point, CPUE was exactly half that of eight years previously, at 0.077 sharks per hook. A linear regression fitted to the entire CPUE data shows a negative slope but the regression does not pass an ANOVA test for significance ($0.10<P<0.25$). If the catch data for the first two years of operation,

1975 and 1976 -- arguably the start-up learning period in which Mr. Crooke set the line only nine times each year -- are omitted from the analysis, the resulting regression shows a steeper negative slope that is highly significant ($0.005 < P < 0.01$; $r^2 = 0.48$).

Mr. Crooke reported in his annual written summaries which accompanied the database that catches were dropping off in 1987-89, with more unsuccessful sets occurring in those later years. He writes in his 1989 summary that it "was the first year ever to make 6 or more longline sets with no sharks". Thus, it is apparent that CPUE was dropping off even more dramatically than is shown in Fig. 3, but unfortunately the total number of unsuccessful sets each year was not recorded for quantitative analysis.

Summary. In the later years of the Crooke longline operation, size of sharks caught and CPUE in sharks per hook were both declining. It is evident from the data that one explanation for both phenomena is the near-complete disappearance of the dusky as well as the great hammerhead from the catch after 1985. Both of these are large-bodied species. The decline in average size of the most abundant species (sandbar) and fourth-most abundant species (tiger) contributed further to a general decline in size of catch.

Implications for the Local Shark Populations and the Florida Shark Fishery

Both sets of data presented in this report point to the same conclusion. The declines in numbers of large sharks in inshore waters off Florida are clearly seen in the tournament catches and in the Croke longline data. This decline appears to have taken hold in the late 1980's, a time when the state's recreational shark fishery was at its peak and the commercial shark fishery underwent exponential growth. Although such factors as habitat degradation and declines in prey species may play a role in this decline, the timing between the increases in fishery and the subsequent drops in shark catch point to overfishing of shark stocks. This is consistent with the conclusion of NMFS that sharks were overfished in the western Atlantic and Gulf of Mexico throughout the 1980's (NMFS, 1989).

The fact that the Port Salerno tournament data show a drop in CPUE in the early 1980's. even before the Florida commercial fishery began to expand in the mid-1980's, may indicate the relative impact of recreational fishing pressure on sharks. A possible scenario state-wide emerges from these data: increasing recreational targeting of sharks in the late 1970's and early 1980's had diminished stocks to some extent, so that when the intense commercial effort developed in the mid-1980's, rapid declines set in.

This may be underscored by the spatial "dispersal" phenomenon of shark tournament distribution along the Gulf coast in the later 1980's. Comparing the sequence of tournament locations with the focus of the commercial fishery in the Tampa Bay area, there is an apparent correlation between the development of the commercial fishery in the central Gulf and the withering of tournament activity in the same region. Although the commercial longliners out of Tampa Bay ports now fish throughout the eastern Gulf, the fishery began expanding in the mid-1980's with short runs to the inshore waters nearer to home.

It is interesting to speculate from these data on the potential impact of fishing pressure on local stock depletion of sharks. Although most Florida coastal sharks are migratory, it appears that specific inshore zones can be depleted relatively rapidly. Thus, even though individual sharks inhabiting an inshore site may migrate there from distant locations, once those sharks are removed, recruitment of more sharks to the site is low. This raises the interesting question of whether there exist subgroups of sharks that follow highly specific migratory routes, not unlike sea turtles that return to the exact same nesting beach year after year.

Table 1. Data summary for logbook records from seven Florida shark tournaments.

		1976	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91
Jax	1				67	-	-	-	-	80	-	-	-	-	-	8	
(79-90)	2				827	-	-	-	-	672	716	625	516	638	-	254	
	3				587_3	-	-	-	-	542_3	627_3	497_3	426_3	373_3	-	79	
	4				113a	-	-	-	-	-	-	-	-	-	-	50a	
Port	1	18	56	-	40	43	32	45	-	14	19	40	34	19	11	13	7
Salerno	2	389	670	1090	905	750	540	665	210	420	400	375	270	384	272	328	227
(76-91)	3	362_5	374_5	689_5	613_3	447_5	355_5	-	202_3	361_5	281_5	349_5	231_5	301_5	245_5	267_5	184_5
	4	107a	69a	-	45a	51a	83a	78a	109a	131a	111a	78a	100a	90a	76a	63a	30a
Tampa	1										32	18	5	22	11	2	
Bay	2										607	566	322	615	351	182	
(85-90)	3										243	302	234	176	198	162	
	4											(averages 200a/yr)				44a	
Hudson	1										48	22	26	21	11	4	5
(85-91)	2										715	752	530	860	300	95	63
	3										-	197	217	216	187	73	55
	4											(averages 230a/yr)					60a
Destin	1													71	28	18	-
(88-91)	2													605	757	387	-
	3													157	234	202_8	-
	4													(averages 150a/yr)			
Perdido	1													16	9	-	-
Pass	2													476	617	-	225
(88-91)	3													246	322	-	-
	4													20b	18b	-	-
Orange	1														32	10	2
Beach	2														566	989	177
(89-91)	3														353_5	-	-
	4														8b	-	-

****

1 No. sharks: Total number of sharks entered in tournament
2 Heaviest shark: Largest shark (lbs whole weight) entered in tournament
3 Avg. shark weight: Mean weight (lbs) of sharks entered [subscript denotes no. of sharks used in calculating mean weight when all shark weights were not available, e.g. x_5 = avg. wt. of top 5 *heaviest* sharks in tournament, etc.]
4 No. anglers/boats: Total number of registered participants in tournament
a = anglers
b = boats

Table 2 Representation of 8 species categories in catch from 7 Florida shark tournaments.

	1979	80	81	82	83	84	85	86	87	88	89	90	91
SANDBAR													
Orange Beach											0		
Perdido Pass										0	0		
Destin										0	0	0	
Hudson							0	0	0	1	0	0	
Tampa Bay												0	
Port Salerno											1	0	1
Jacksonville	22					31				7		0	
DUSKY													
Orange Beach											6		
Perdido Pass										0	0		
Destin										39	4	9	
Hudson							0	0	5	0	3	0	
Tampa Bay												0	
Port Salerno											0	0	0
Jacksonville	1					3				0		0	
TIGER													
Orange Beach											1		
Perdido Pass										4	6		
Destin										8	2	1	
Hudson							4	5	10	3	1	1	
Tampa Bay												0	
Port Salerno											1	0	0
Jacksonville	11					14				1		4	
HAMMERHEAD spp.													
Orange Beach											1		
Perdido Pass										3	3		
Destin										9	6	3	
Hudson							1	5	3	2	1	0	
Tampa Bay												0	
Port Salerno											0	1	1
Jacksonville	6					12				0		1	
BULL													
Orange Beach											8		
Perdido Pass										9	0		
Destin										15	12	2	
Hudson							2	3	3	5	2	1	
Tampa Bay												1	
Port Salerno											0	0	0
Jacksonville	7					7				2		0	

Table 2 (continued)

	1979	80	81	82	83	84	85	86	87	88	89	90	91
LEMON													
Orange Beach											0		
Perdido Pass										0	0		
Destin										0	0	0	
Hudson							1	2	2	4	1	0	
Tampa Bay												0	
Port Salerno											3	6	3
Jacksonville	8					4				0		2	
BLACKTIP/SPINNER													
Orange Beach											0		
Perdido Pass										0	0		
Destin										0	3	2	
Hudson							1	1	3	1	0	1	
Tampa Bay												0	
Port Salerno											1	0	0
Jacksonville	8					4				0		0	
NURSE													
Orange Beach											0		
Perdido Pass										0	0		
Destin										0	1	1	
Hudson							1	6	0	5	3	1	
Tampa Bay												1	
Port Salerno											1	4	2
Jacksonville	0					2				0		0	

NOTE: Species ID's not necessarily reliable

Species ID records incomplete for:
Orange Beach '89 (16/32 ID'ed)
Hudson '85 (10/48 ID'ed)
Port Salerno '89 (10/11 ID'ed)
Jacksonville '84 (77/80 ID'ed) & '88 (10/? ID'ed)

Table 3. Compiled Crooke longline catch (1975-89) by species and sex.

	SPECIES	# NONGRAVID FEMALES	# GRAVID FEMALES	# MALES	SEX NOT AVAILABLE	TOTALS
1.	Sandbar	90	10	73	1	174
2.	Blacktip	70	19	23	15	127
3.	Bull	58	4	50	1	113
4.	Tiger	67	1	28	3	99
5.	Dusky	32	1	27	4	64
6.	Scal. Hammerhead	0	0	28	4	32
7.	Great Hammerhead	12	2	5	0	19
8.	Blacknose	3	5	4	2	14
9.	Nurse	0	0	5	2	7
10.	Spinner	4	0	1	1	6
11.	Sand tiger	2	0	0	0	2
12.	Lemon	0	1	0	0	1
13.	Sharpnose	0	0	1	0	1
		338	43	245	33	659

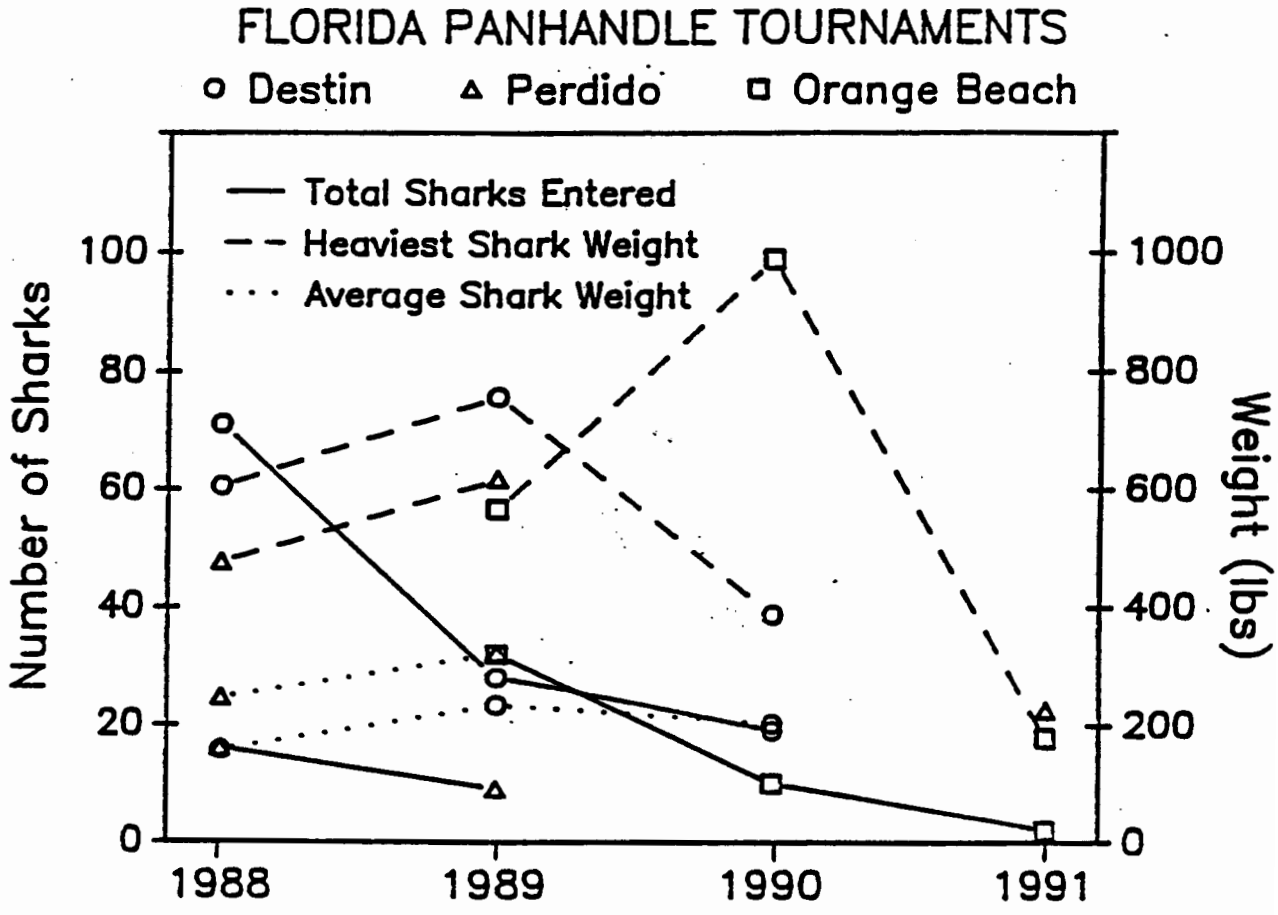

FIG. 1. Total number of sharks entered (left axis) and shark weights (right axis) for three Panhandle tournaments. Data from Table 1. The Δ in 1991 is heaviest shark weight (225 lbs) for the Perdido tournament.

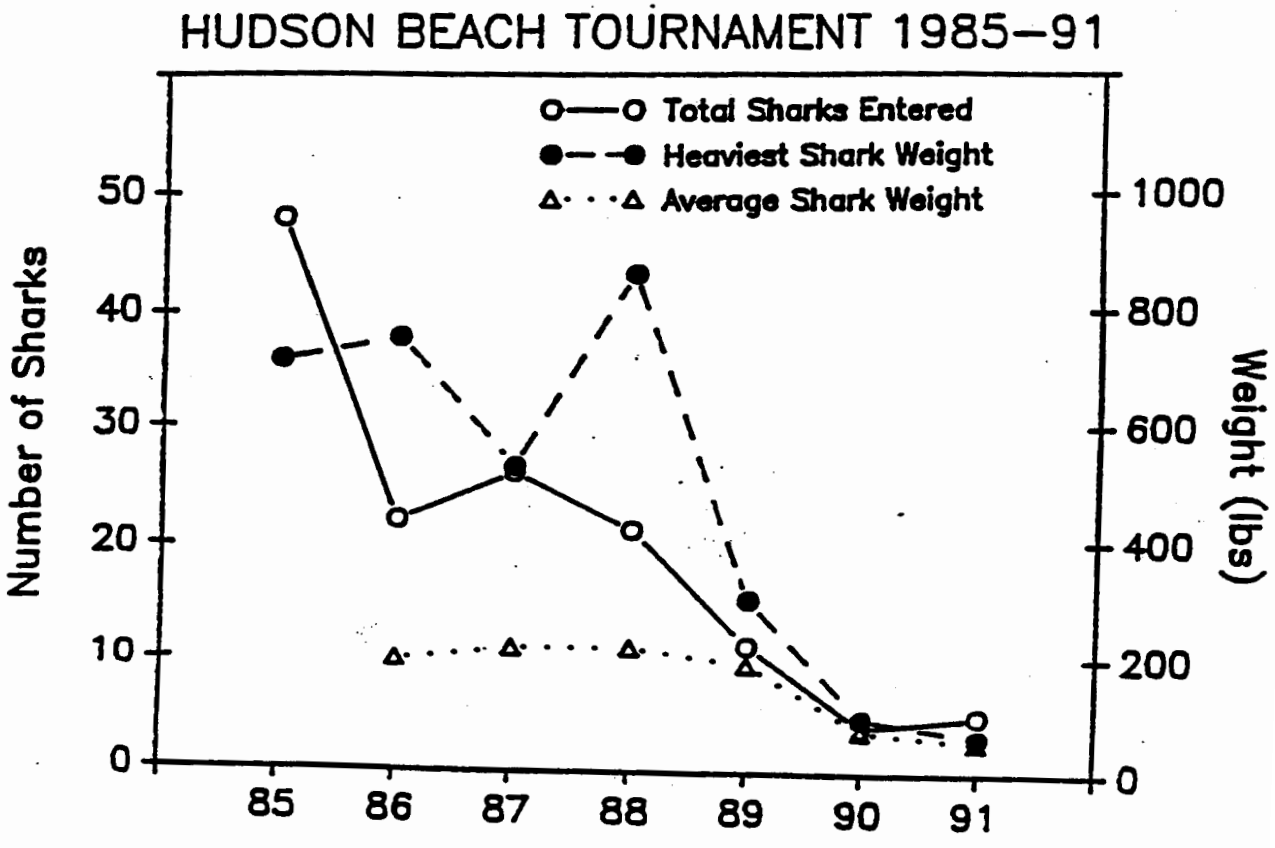

FIG. 1B. Catch data from Table 3 for Hudson tournament, 1985-91.

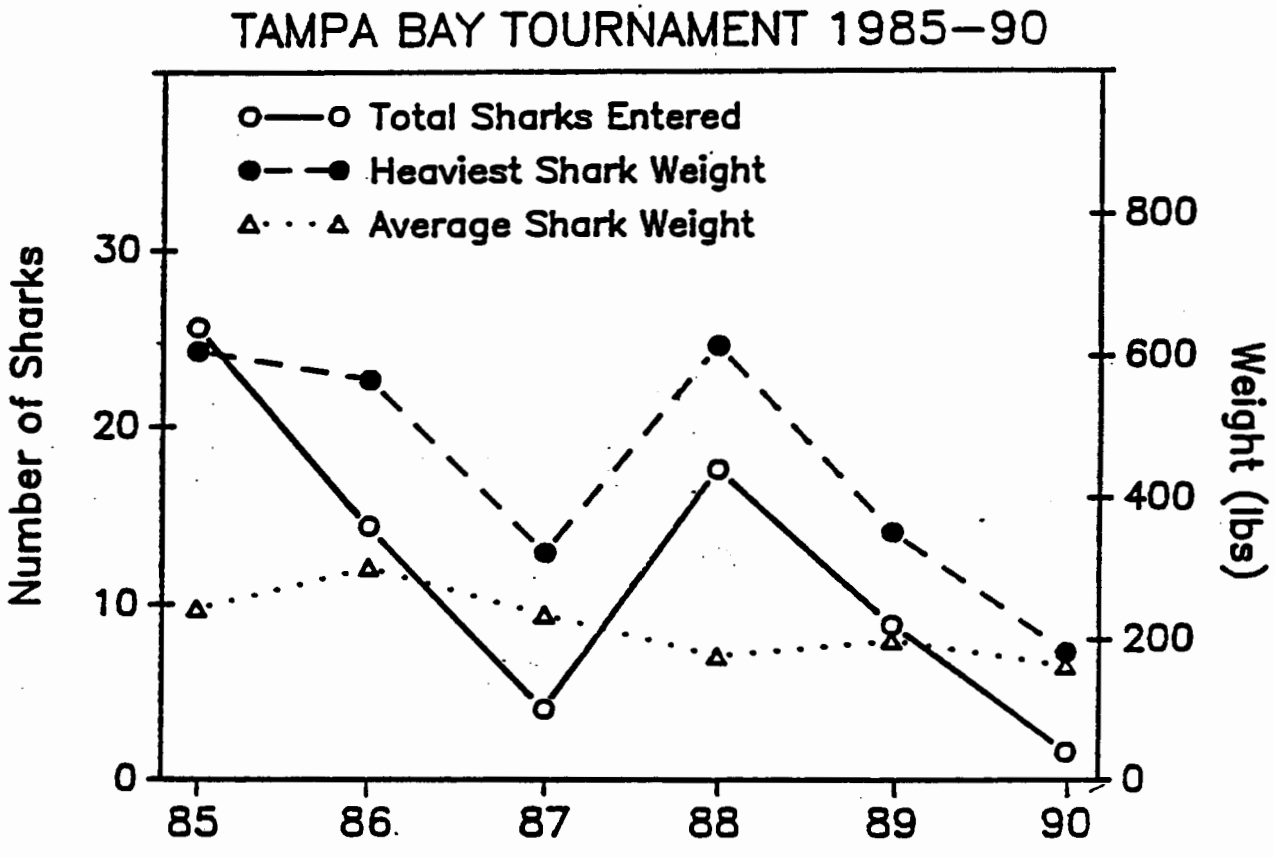

FIG. 1C. Catch data from Table 3 for Tampa Bay tournament, 1985-90.

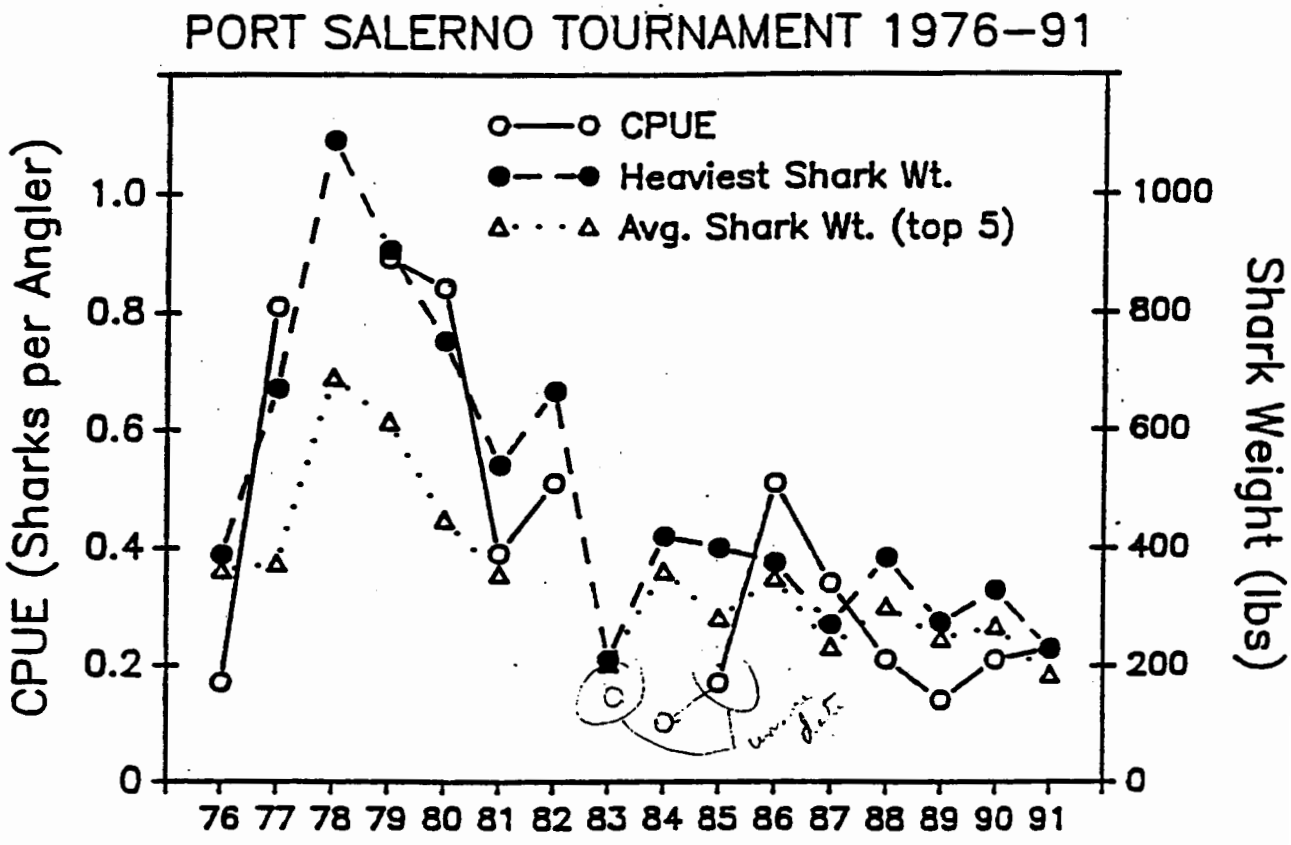

Fig. 1D. Catch data from Table 3 for Port Salerno tournament, 1976-91. Catch per unit effort (CPUE) is calculated as number of sharks entered in tournament per registered angler.

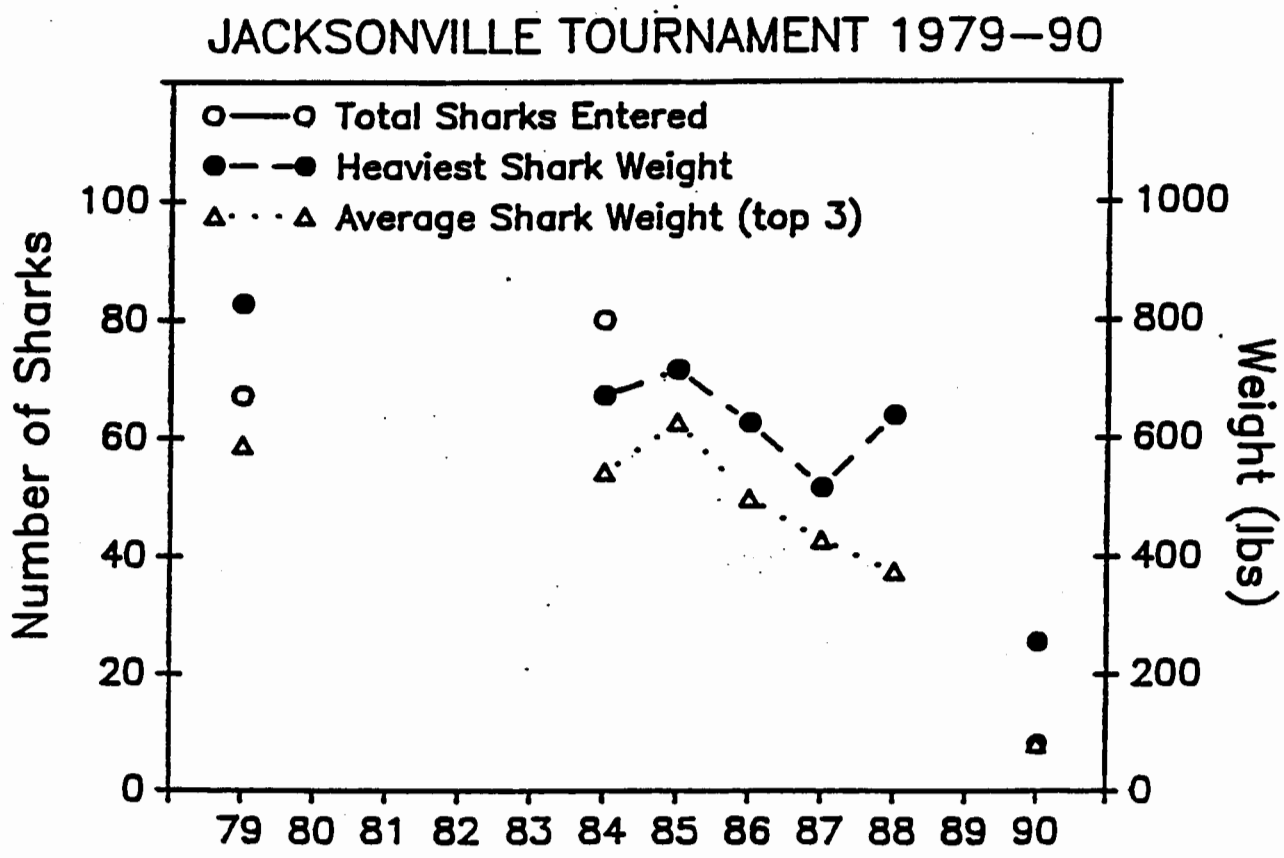

Fig. 1E. Catch data from Table 3 for Jacksonville tournament, 1979-90. The average shark weight for 1990 is for all 8 sharks entered in the tournament that year.

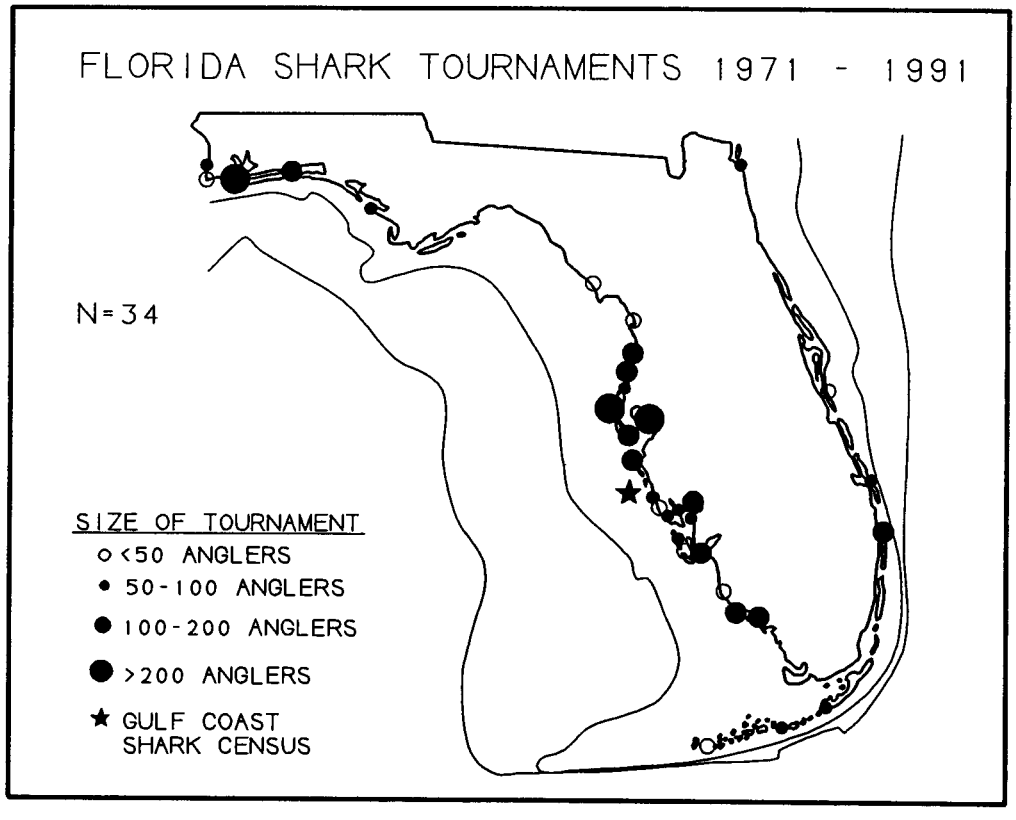

Fig. 3. Location and size (by number of registered anglers) of shark sportfishing tournaments in Florida, 1971-91. A total of 34 tournaments in the 20-year period was held in state waters. The Gulf Coast Shark Census is a non-kill, 100% catch-and-release shark tournament involving 100-200 anglers per year; all others are kill tournaments.

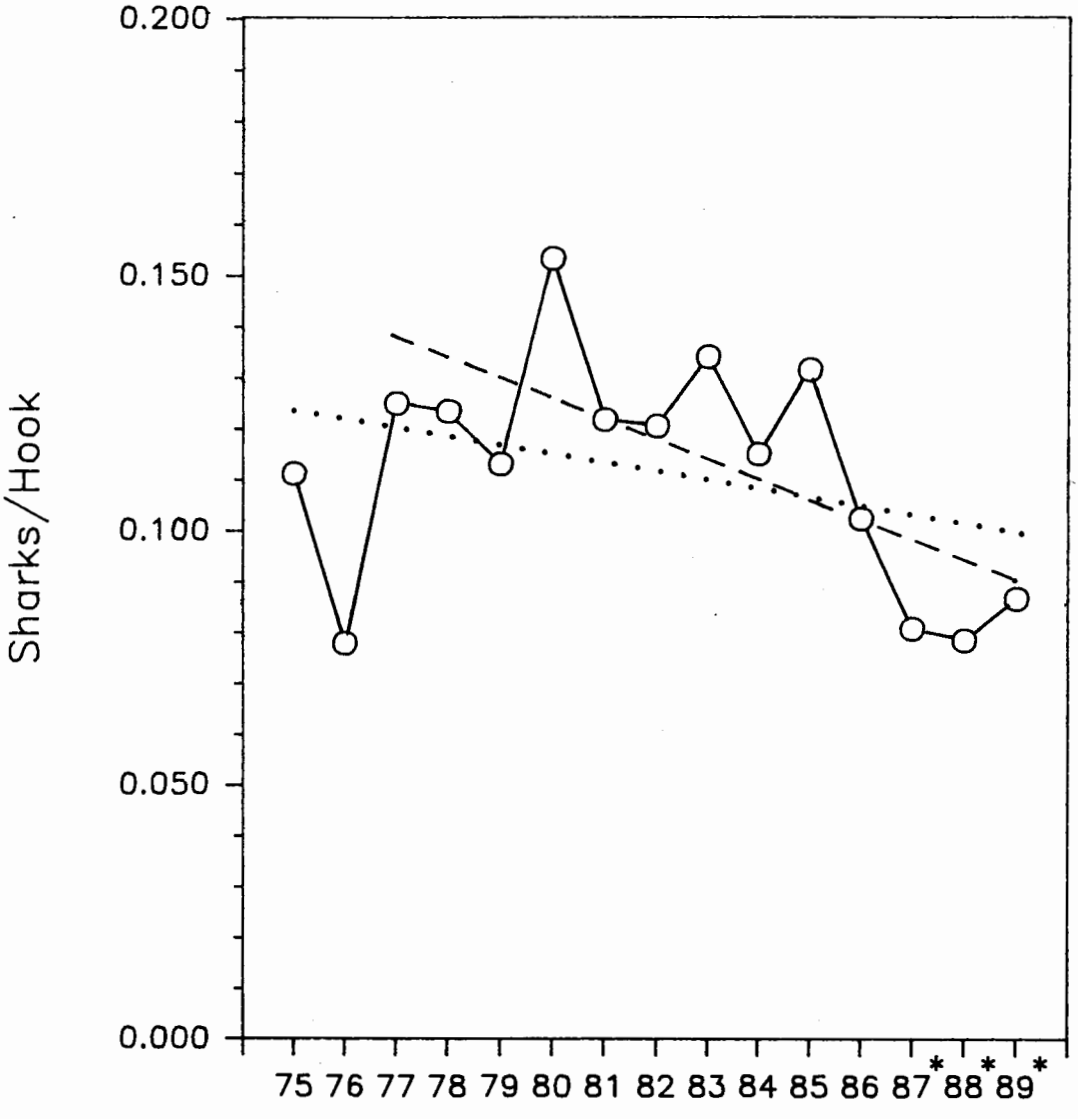

Fig. 4 Catch per unit effort (CPUE), in number of sharks caught per hook set, for successful sets (i.e. those catching at least one shark) for the Crooke longline data, 1975-89. In 1975-86, the line had 20 hooks per set; in 1987-89 (*), 30 hooks per set were used. The regression using all data (dotted line) is not significant; with the 1975-76 data omitted (see text), the negative slope of the regression (dashed line) is significant ($0.005<P<0.01$; $r = -0.70$).