Bycatch and Catch-Release Mortality of Small Sharks in the Gulf Coast Nursery Grounds of Tampa Bay and Charlotte Harbor

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BYCATCH AND CATCH-RELEASE MORTALITY OF SMALL SHARKS IN THE GULF COAST NURSERY GROUNDS OF TAMPA BAY AND CHARLOTTE HARBOR

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I. EXECUTIVE SUMMARY

The bays and estuaries of the southeast U.S. coast generally are thought to serve as nursery areas for various species of coastal sharks, where juvenile sharks find abundant food and are less exposed to predation by larger sharks. Because these areas typically support substantial commercial and recreational fisheries, fishing mortality of sharks in the nurseries, particularly as bycatch, may be significant. This two-year project assessed the relative importance of two estuaries of the southwest Florida Gulf coast, Tampa Bay and Charlotte Harbor/Pine Island Sound, as shark nursery areas, and examined potential fishing mortality of these young sharks in the nurseries. Biological aspects of the early life history of these shark species, including distribution, feeding, and migration, were also investigated.

Fishery-independent (F-I) and fishery-dependent (F-D) surveys for juvenile and small adult sharks were conducted in the study areas from November 1991 to October 1993. Weekly F-I surveys used commercial-type gear (gill nets and longline) to collect sharks and associated skates and rays, teleosts, and other vertebrates. F-D surveys were conducted aboard cooperating commercial vessels using purse seines (targeting baitfish), trawls (bait shrimp and food shrimp), gill nets (mullet, mackerel, and pompano), and trammel nets (mullet, seatrout, and jack). Total catch was documented for each gear set in both F-I and F-D surveys. Recreational F-D data were collected via two years of operation of the Gulf Coast Shark Census, an annual catch-and-release shark tournament conducted along the southwest Florida coast. Both F-I and F-D components incorporated a new shark tagging program using nylon-head, multi-recapture dart tags specially designed for small sharks. The stomach contents of dead sharks collected in the surveys were analyzed for species-specific food habits.

A total of 3,339 sharks were documented during the nearly two years of sampling in the study areas. Of the 1,862 sharks of 13 species documented by scientific personnel, 1,275 were tagged and released, 17 were alive and were retained or released without tags, and 570 were dead and retained. An additional 1,477 sharks were documented and released alive by anglers in the 1992 and 1993 Gulf Coast Shark Census. In all, 903 skates and rays of eight species, approximately 73,231 bony fishes of over 79 species, six sea turtles of two species, and one marine mammal were documented in the total catch of the project.

The numerically predominant species of sharks were bonnethead, blacktip, and blacknose, with lesser numbers of bull, Atlantic sharpnose, great hammerhead, nurse, lemon, scalloped hammerhead, Florida smoothhound, spinner, finetooth, and sandbar sharks. Juveniles of all species except Florida smoothhound and sandbar, and neonates of four species (blacktip, bull, lemon, and blacknose), were collected in the study area, with neonates from an additional five species (bonnethead, great and scalloped hammerheads, nurse, and spinner) suspected of occurring in the area. Thus, the Tampa Bay and Charlotte Harbor areas serve as nurseries for at least 11 species of sharks, with at least four, and possibly as many as nine, of these species giving birth to pups within the region.

Observed shark bycatch in commercial fisheries was low, with 19 sharks of six species (juvenile blacktip, adult Florida smoothhound, juvenile and adult bonnethead, juvenile Atlantic sharpnose, juvenile lemon, and juvenile nurse) documented in 48 gear sets. All but three of these sharks were caught in gill nets targeting mackerel (an observed bycatch rate of four sharks per set for this fishery). These observations may have been affected by two external factors during the course of the project: 1) a Florida shark management plan implemented in April 1992, which essentially eliminated the commercial value of shark bycatch in state waters; and 2) relatively low effort in the 1992-93 pompano and mackerel fisheries, combined with decreasing cooperativeness of commercial fishermen with fishery scientists in the face of a proposed statewide net ban, which resulted in lower-than-expected commercial F-D sampling in the project.

As of 7 December 1993, a total of 52 shark recaptures, representing 4.2% of all tagged sharks at liberty, were reported. Longest time at liberty was 358 days and longest distance traveled was a minimum of 105 nautical miles. Based on tag return data, we estimate an average of 34.8% of sharks released alive after being caught do not survive the catch-and-release event. This delayed mortality, combined with an immediate “at-the-boat” observed mortality of 30.6%, yields an estimated total mortality from a single fishing event of 54.8% of all juvenile and small adult sharks caught. These mortality estimates apply primarily to sharks caught in gill nets within the study areas.

II. INTRODUCTION

Commercial fisheries for sharks in the Gulf of Mexico experienced dramatic growth in the late 1980's. After five years of increased effort and landings in the fishery, sharks became the fourth most valuable commercial finfish resource in the state of Florida by 1989, exceeded only by the state's grouper, mullet, and snapper fisheries. The Florida commercial shark fishery in 1989 accounted for about $4.6 million in landed meat and fins (swordfish and tuna landings were valued higher, but these fishes are caught in waters far outside the Florida coastal zone). Total state landings of shark meat in 1989 reached 7 million pounds whole weight (FDNR, 1989), corresponding to about 100,000 sharks. Two-thirds of these landings were brought into Florida Gulf ports. Landed fin weights in the state reached 217,873 pounds (FDNR, 1989), taken from approximately 50,000 sharks, and 87% of these were landed at Gulf ports.

In the Florida recreational fishery, shark fishing increased from the late 1970's through the 1980's to become one of the state's more popular sport fisheries. During this time, about 30 organized shark tournaments involving over 3,000 anglers each year were held in state waters (Hueter, 1991). Recreational landings of sharks along Florida's Gulf coast doubled between 1979 and 1986 (NMFS, 1987). After 1988, the recreational fishery for sharks in Florida declined. Today, less than 10 of the 30 shark tournaments conducted in the state over the past 20 years remain active. Most of the larger, successful operations folded due to one major factor: lack of large sharks (Hueter, 1991). As large coastal sharks became relatively scarce, the recreational fishery abandoned offshore fishing for the larger sharks, and nearshore fishing for smaller sharks gained greater acceptance. These smaller sharks targeted by anglers include juveniles of large coastal species as well as adults of small coastal species.

Because of a life history that includes very slow growth, late sexual maturity, and few offspring, sharks are especially vulnerable to overfishing and present special problems to fishery management (Holden, 1974). In the face of increasing landings of sharks in the state, Florida implemented the first management plan for shark fisheries in state waters in April 1992, with daily bag limits of one shark per person per day up to two sharks per boat, regardless of shark species. The effect of this legislation was to render sharks a non-commercial species group in state waters, meaning that nearly all commercial catch of sharks in state waters after April 1992 became bycatch. The plan also sought to reduce the recreational harvest, encouraging anglers to practice catch-and-release. The juveniles of the large coastal species, in particular, were a primary group considered for protection under this management plan.

Meanwhile, for the offshore shark fishery, the National Marine Fisheries Service (NMFS) determined in 1989 that the ever-increasing demand for sharks and shark products had exceeded the reproductive capacity of some Gulf and Atlantic coast shark species. On April 26, 1993, NMFS implemented the nation's first federal fishery management plan (FMP) for sharks, covering U.S. shark fisheries of the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea. The FMP placed 39 species of sharks under management in federal waters and included commercial quotas, closed seasons, recreational bag limits, and a ban on shark "finning" (NMFS, 1993).

III. PURPOSE

A. Description of Problem

The federal shark FMP did not address in depth the issue of bycatch of juvenile and small sharks in coastal fisheries. And yet, a shark population assessment used to develop the federal plan (Parrack, 1990) showed that in one fishery alone-the Gulf of Mexico shrimp fishery-three times more sharks were caught annually as bycatch than all of the sharks landed by commercial and recreational shark fishermen combined in U.S. Gulf and Atlantic waters. In 1989, commercial fishermen targeting sharks in the Gulf and Atlantic landed approximately 350,000 sharks. Recreational fishermen accounted for approximately 213,000 sharks. The Gulf shrimp bycatch in 1989 was 1.86 million sharks, with an annual average for 1986-l989 of 2.4 million sharks per year (Parrack, 1990).

Reportedly, most of this bycatch consisted of Atlantic sharpnose sharks ***(Rhizoprionodon terraenovae;*** Table I), a small species of shark that forms large aggregations. If only 20% of these small sharks were juveniles of larger species, however, then the shrimp trawl fishery in past years was taking more individuals of these species as bycatch than the entire commercial shark fishery of the U.S. east coast. Today, the mandatory use of TED's (turtle excluder devices) in shrimp trawls is reportedly helping to reduce small shark bycatch in this fishery.

Unless we gain a better understanding of the current importance of shark bycatch, federal and state management measures to rebuild stocks may fall short. The Gulf shrimp fishery is but one area of concern. Another concern lies within the inshore, estuarine areas of the southeast U.S. coast. Contained within these waters, where fishery operations and other human activities are prevalent, are the pupping and nursery grounds for many large coastal species of sharks. These nursery areas have been defined as geographically discrete regions where gravid female sharks give birth to pups (in viviparous species) or deposit eggs (in oviparous species), and where the young spend their first weeks, months, or years (Castro, 1993b).

Because of the close stock-recruitment relationship in sharks, the location and mapping of their nursery areas has been targeted as a critical research need for better understanding and management of U.S. shark resources (NMFS, 1993; Castro, 1993b). In fact, in the federal FMP, NMFS considered closing shark nursery grounds to fishing to reduce mortality, but the measure was

> rejected because of insufficient knowledge of specific nursery areas and the adverse effect closures would have on other fisheries, such as the shrimp trawl fishery. Further, this action would preempt state authority where nursery areas are in state waters. (NMFS, 1993: p. 97).

Florida is one of those states, with a number of Gulf coastal areas potentially serving as important shark nursery grounds, including Apalachicola Bay, Tampa Bay, Charlotte Harbor, and Florida Bay. Juvenile sharks or adult small coastal sharks may spend many years of their lives in these critical, inshore regions. And yet,

ichthyofauna1 surveys in these areas rarely include detailed information on the shark fauna, because sampling gear excludes sharks or surveys emphasize teleost fauna. As a result, we know little about either the early life history and biology of important shark species in these areas, or about the impact of human activities, primarily bycatch mortality, on these inshore life stages.

B. Project Objectives

The primary objectives of this project were to:

1) assess the importance of Tampa Bay and Charlotte Harbor/Pine Island Sound as shark nursery grounds;

2) survey these estuaries for bycatch of small sharks, teleosts, and other vertebrates in inshore fisheries;

3) assess the potential impact of shark bycatch mortality in these nursery grounds; and

4) conduct basic biological studies of shark distribution, migration, feeding, and reproduction in these inshore areas.

To meet these objectives, three major strategies were utilized:

a) Fishery-independent (F-I) ichthyofaunal/bycatch surveys: independent sampling operations using commercial-type gear (gill nets and longlines) to survey study areas for small sharks, map nursery grounds, tag or collect specimens, examine stomach contents of collected specimens for food habits, and other studies.

b) Fishery-dependent (F-D) bycatch surveys: cooperative work with commercial fishermen to collect data on shark and teleost bycatch in commercial operations, further identify nursery grounds for sharks, and capture small sharks in commercial gear for biological studies.

c) Tagging program: a full-scale tagging program for small sharks in the study areas including new tag development, an in-house tag retention study, and field tagging of sharks in F-l and F-D operations and in recreational fishery; plus tagging of large, recreationally important species of teleosts, as well as sea turtles, using other tags from Mote Marine Laboratory (MML), Florida Department of Environmental Protection/Florida Marine Research Institute (FDEP/FMRI), and NMFS.

Tampa Bay and Charlotte Harbor/Pine Island Sound (Fig. 1) were chosen for this study for a number of reasons. Both bays are semi-enclosed, geographically defined, estuarine systems that lend themselves well to broad surveys. From a logistical standpoint, both areas are accessible from MML due to the Laboratory's central location in Sarasota. The two estuaries are climatically and ecologically comparable due to their geographic proximity and common features, and both systems have been the subject of intensive studies on their physical features, water chemistry, estuarine

dynamics, and other ecological aspects (e.g. Treat et al., 1985; Estevez et al., 1984; Wang and Raney, 1971). Each embayment is fed by several large rivers: the Alafia, Little Manatee, and Manatee Rivers for Tampa Bay; and the Myakka, Peace, and Caloosahatchee Rivers in the Charlotte Harbor system (Fig. 2).

Overall dimensions of the two embayments are comparable. The enclosed estuarine surface area of Tampa Bay, including tidal fresh, mixing, and seawater zones, is 346 mi^2 and has a length of 42.6 mi, a maximum width of 13.7 mi, and an average width of 8.1 mi (NOAA, 1985). The Charlotte Harbor system is 311 mi^2, 58.7 mi long, 12.9 mi in maximum width, and 4.6 mi in average width. Average depth in Tampa Bay as a whole is 16.2 ft. Depths in Tampa Bay beyond the coastal shoals average about 10 ft, dropping to 20-30 ft in the middle of the bay, especially in the southern half. Average depth in the entire Charlotte Harbor system is 8.3 ft, with depth averaging about 10 ft beyond shoal areas and dropping to 15-20 ft in the middle of the bay. Southern Charlotte Harbor is divided by Pine Island into Pine Island Sound on the west side and Matlacha Pass on the east side, both of which are generally quite shallow, with most depths in the two areas less than 5 ft.

Both Tampa Bay and Charlotte Harbor systems are characterized by the presence of seagrass, mangrove, and salt marsh habitats (Figs. 3-5). The two systems contrast in the degree of urban and industrial development. Generally, Tampa Bay is subjected to more intensive development, with the cities of Tampa and St. Petersburg and several major seaports located on its shores (Fig. 2).

Finally, both estuarine systems support inshore fishing operations and, allegedly through mostly anecdotal information, large populations of sharks. Trawling for bait and food shrimp, gill and trammel netting for mullet, pompano, seatrout, mackerel, and other fishes, and purse seining for several species of baitfishes are conducted in the two areas and in adjacent coastal waters. Some commercial harvest of sharks from state waters has occurred in the past, but the Florida shark management plan effectively ended commercial shark fishing in state waters as of April 1992. Recreational fishing in both Tampa Bay and Charlotte Harbor is very popular year-round, so that recreational bycatch and catch-and-release mortality of sharks may be a factor in these areas. The number of shark species utilizing these estuaries as nursery grounds has been previously unknown.

IV. APPROACH

A. Description of Work Performed

1. Project scoping/fishermen interviews/literature search. The start-up of the project included a review of the technical literature on Tampa Bay and Charlotte Harbor ichthyofauna. Charts of the two estuaries were prepared to map shark nurseries and to track fishery operations. Interviews with commercial and recreational fishermen were conducted to learn: a) types and seasonality of fishing operations within the bays; and b) local knowledge of distribution of sharks in the bays. This information was used to help design F-I and F-D surveys. For purposes of data handling, each estuary was divided into a number of primary sampling areas (11 for Tampa Bay, 9 for Charlotte Harbor/Pine Island Sound), based upon shoreline features, habitat, depth, fishery-dependent information, and other factors (Table 2; Figs. 6 and 7).

2. Fishery-independent ichthyofaunal/bycatch surveys. From November 6, 1991, to October 1, 1993, F-I surveys in the two study areas were conducted on a regular basis using MML vessels and equipment. Gill nets, bottom longlines, and rod-and-reel were used to collect sharks and associated teleosts. Over the two years of sampling, a total of 782 gear sets encompassing 1,564.8 hours of fishing effort were accrued in the F-l surveys, which averaged 7.9 sets and 15.81 hours of effort per week (for 99 weeks total). In general, the field crew was on the water for an average of 2-3 days per week, weather permitting (Tables 3 and 4; Fig. 8).

F-l sampling alternated continually between the two study areas, with Tampa Bay one week, Charlotte Harbor the next week, Tampa Bay the third week, and so on. Selection of weekly sampling sites was decided each week at Monday morning staff meetings using several criteria. These included previous catch success, F-D information on teleost and shark distribution, water temperature, key habitat, weather forecast, and other factors. In this way, location of fishing effort was targeted and did not follow a random sampling design, in order to maximize catches and not expend much effort in barren areas of the estuaries. This approach precluded the use of the results for estimating species abundance but allowed for the broadest survey possible given the time, manpower, and equipment constraints of the project.

Nearly all of the F-l work was performed from the MML vessel R/V ***Tiburon,*** a 20-ft Tremblay net boat with fiberglass-over-wood construction, forward console, aluminum observation tower, and 90 hp outboard motor mounted in a center well. This boat design is typical of that used in inshore commercial net fisheries in the region.

Three types of sinking, bottom-set monofilament gill nets were used during the F-l portion of the study. The first net was 300 yd long and 6 ft deep, and comprised three 100 yd panels of 3", 4", and 5" stretch mesh with a monofilament diameter of 0.47 mm. The floatline was a 3/l6" braided polypropylene rope with 1.8 oz buoyancy floats tied every 5 ft, and the leadline was a leadcore polypropylene line. This net was manufactured and purchased from Memphis Net & Twine Company, Memphis,

Tennessee. An additional leadline consisting of 1 oz leads tied every 4 ft was added for more weight. A float with pennant and a 7.5 lb Danforth-style anchor were attached to each end of the net.

This net was modified in October 1992 by MML staff to a 300 yd long by 6 ft deep net of all 4" stretch mesh with a monofilament diameter of 0.52 mm. Floatline, leadline, and float characteristics remained the same as in the original net.

The third net was 400 yd long and 9½ ft deep, and was composed of all 4 5/8" stretch mesh with a monofilament diameter of 0.52 mm. The floatline and leadline were ¼" braided polypropylene rope. Floats with 3 oz buoyancy were tied every 3 ft along the floatline and 1 oz leads were tied every 1 ft. This net was manufactured by commercial net fishermen in Cortez, Florida, and was constructed similarly to the type used in the local pompano gill net fishery. Styrofoam ball floats (1 ft diameter) were clipped to the floatline approximately every 60 yd upon setting the net and a float with pennant and 7.5 lb Danforth-style anchor were attached to each end.

All three types of nets typically were set for approximately one hour. Actual set times were measured to the nearest 0.1 hr as the time between the beginning of the set and the end of retrieval. The nets were set in a fashion similar to that used in local commercial fisheries and as dictated by Florida state regulations.

The bottom-set longline gear was composed of a 200 yd groundline of 1/8" yacht-braid nylon, 4 ft gangings of braided, 1/32" stainless steel cable with a swivel and snap, and 60 straight Mustad hooks comprising 20 hooks each of 6/0, 7/0, and 8/0 sizes. Hooks were baited with fresh cut fish, primarily Crevalle jack ***(Caranx hippos)*** or yellowfin menhaden ***(Brevoortia smithi).*** This rig was modified in October 1992 to 400 yd of the same groundline and 60 hooks all of size 6/0. In both cases, the groundline was anchored at each end and in the middle with a 7.5 lb Danforth-style anchor, and a large can-type buoy was attached to each end of the groundline. Set times for the longlines varied between 1 and 12 hr during the course of the study.

Rod-and-reel tackle occasionally used in the F-l component utilized medium spinning reels on light graphite rods. Twenty lb-test monofilament line was used with stainless steel leaders and straight hooks size 4/0 to 6/0. Fresh cut fish was used as bait, and chumming with fish parts and blood was occasionally done.

Types of data collected in the field included the following (Fig. 9):

a. ***Gear Description:*** type (gill net, longline, etc.); mesh size (stretch mesh); # hooks; set time; target species; etc.

b. ***Physical Data:*** locality (description and lat/long by Voyager SportNav hand-held LORAN unit); depth (by Signet depth sounder); tide; salinity, conductivity, and water temperature (by Beckman induction salinometer) at mid-depth; bottom type; etc.

C. ***Total Shark Catch:*** species; number; sex; stage of maturity (neonate = open umbilical scar, immature = non-neonate juvenile, and mature = sexually

mature adult); length (precaudal, fork, total, and stretch total); weight (by Manley 2013 brass spring scales); live vs. dead; etc. (Fig. 10). Live sharks were tagged and released, with condition at release noted (see below). Stomach contents, reproductive tissue, blood, and other specimens were taken from dead sharks.

d. ***Total Bony Fish Catch:*** species; number; fork length (up to 10 individuals per species per set); etc. Live large gamefish (Cobia, black drum, red drum, spotted seatrout, and snook) were tagged with Florida Marine Research Institute (FDEP/FMRI) tags and released; Cobia were also tagged with MML Cobia-amberjack-dolphin (CAD) tags and released.

e. ***Other Vertebrate Catch (rays, skates, sea turtles, marine mammals):*** species; number; size (disc width for rays and skates, straight carapace length for turtles, total length for marine mammals); etc. Live turtles were tagged with NMFS flipper tags and dead turtles were retained and sent to FDEP/FMRl. Marine mammals were reported to Florida Marine Patrol and NMFS.

Shark condition after capture was scored with a "vitality code" using the following criteria:

Condition 1 (Good) - No revival time required when shark is returned to the water. Rapid swimming away upon release, usually with a vigorous splash.

Condition 2 (Fair) - No revival time required. Slow but strong swimming away upon release.

Condition 3 (Poor) - Short revival time (up to 30 sec) required. Once revived, slow but sometimes atypical swimming away upon release.

Condition 4 (Very poor) - Long revival time (more than 30 sec). Once revived, limited or no swimming observed upon release but respiration functional.

Condition 5 (Dead) - Dead upon removal from gear, or moribund and unable to revive even after long submergence time.

3. Fishery-dependent bycatch surveys. With the cooperation of commercial fishermen working in the Tampa Bay and Charlotte Harbor areas, F-D surveys were conducted from November 1991 through August 1993, to document total catch in various fisheries, monitor bycatch of sharks, rays, bony fishes, and other vertebrates in commercial operations, and further identify shark nursery grounds. Trips were pre-arranged with fishermen on a weekly basis. All surveys were coordinated as part of the commercial fishermen's normal routines, and no fishing trips were made for the singular purpose of collecting data for this study. There was no compensation paid to the fishermen for allowing an observer to ride aboard a fishing vessel and document catches. Thus, these F-D surveys were strictly dependent upon the cooperativeness of commercial fishermen, boat owners, and seafood dealers in the region.

Total catches were documented for commercial fishing trips in the following fisheries: 1) purse seine fishery for baitfish in Tampa Bay area; 2) roller frame trawl fishery for bait shrimp in Pine Island Sound; 3) otter trawl fishery for food shrimp in

Charlotte Harbor; 4) gill net fishery for Spanish mackerel in Tampa Bay area; 5) gill net fishery for mullet in Tampa Bay and Charlotte Harbor; 6) gill net fishery for pompano in Tampa Bay and Charlotte Harbor; 7) trammel net fishery for mullet in Tampa Bay; 8) trammel net fishery for Crevalle jack in Tampa Bay; and 9) trammel net fishery for seatrout in Tampa Bay. Over the course of the entire study, a total of 48 commercial gear sets fishing for over 58.3 hr was documented (Tables 3 and 4; Fig. 11).

Upon retrieval of commercial gear after each set, the catch was sorted by species, counted, and measured similarly to the F-I surveys to the fullest extent possible. When fishing procedure did not always allow counting of individual fish-for example, in the case of purse seining, which can catch tens of thousands of baitfish in a single set-estimates of fish number were made, usually based upon total weight of the catch by species and average weight per fish. Gear description, locality, and other fishing conditions were noted for each set as in the F-l surveys (Fig. 12). When sharks were captured in commercial sets, data were collected on each shark as in the F-l surveys (Fig. 10). Stomach contents from dead sharks were usually collected, and live sharks were tagged and released. Live, large gamefish were also tagged as in the F-l surveys.

F-D data also were collected from the summer recreational fishery for sharks in the study region and adjacent areas via 1992 and 1993 operation of the Gulf Coast Shark Census tournament, a 10-day recreational catch-and-release survey coordinated by MML in late June/early July. Data including shark species, sex, size, and locality were collected cooperatively by recreational fishermen participating in the surveys. MML staff accompanied a select number of cooperating anglers during the tournaments to collect data and tag small sharks caught on recreational gear (Fig. 13).

4. Stomach contents. Stomachs were dissected from dead sharks by cutting anteriorly at the esophagus and posteriorly at the duodenum or colon, and were transported in plastic bags on ice to the laboratory. Those that could not be examined immediately were stored frozen until contents could be analyzed. Fresh or thawed stomachs were cut open lengthwise and contents were transferred onto a plastic dish, sorted, identified to the lowest taxon possible, weighed to the nearest 0.01 g (wet weight), and preserved in 70% isopropyl alcohol (Fig. 14). Total number of sharks for which stomach contents were examined and analyzed was 546 sharks comprising 8 species.

Species-specific stomach contents data were analyzed using typical indices as described by Pinkas (1971), Hyslop (1980), and others. These include a gravimetric index on a wet-weight basis (%W), a numerical index (%N), the frequency of occurrence (%0), and the Index of Relative Importance (IRI). IRI was expressed further on a percentage basis (%IRI) in a manner similar to that used recently by Carrasson et al. (1992). These various indices are calculated as follows:

$$\%\,w = \frac{\text{Weight of all items of a food type in all stomachs of a shark species}}{\text{Total weight of all material in all stomachs of that shark species}} \times 100\%$$

$$\%\,N = \frac{\text{Number of all items of a food type in all stomachs of a shark species}}{\text{Total number of items in all stomachs of that shark species}} \times 100\%$$

$$\%\,0 = \frac{\text{Number of stomachs of a shark species in which a food type occurs}}{\text{Total number of stomachs of a shark species containing food items}} \times 100\%$$

$$IRI = (\%W + \%N) \times \%0$$

$$\%IRI = \frac{\text{IRI for a food type}}{\Sigma\text{IRI's for all food types}} \times 100\%$$

5. Tagging program. A new tagging program directed toward juvenile and small adult sharks inhabiting the study areas was developed and implemented during this project. This tagging program was designed to study catch-and-release mortality, assess residence time in the nursery ground, and follow aging and growth of the young sharks. The program involved the following major components:

a. ***New tag development and testing.*** Five designs of fish tags were tested on juvenile lemon sharks in captivity at MML prior to deploying tags in the field. The five designs were: 1) Petersen-type disc fin tag; 2) Rototag-type fin tag; 3) NMFS M-type dart shark tag; 4) Floy prototype dart tag; and 5) Hallprint modified PDB dart tag. The disc tags were applied through the first dorsal fins of the sharks, and the dart tags were applied under the skin through the dorsal musculature below the left side of the first dorsal fin. Tags were applied to 22 lemon sharks ranging from 63.5-84.0 cm total length (53.0-71.5 cm fork length) and the sharks were maintained in a quarter-acre, tidally flushed, semi-natural marine pond at MML from 29 September 1991 to 24 February 1992, a test period of approximately five months. An additional 10 sharks were tagged and maintained for observation in large round tanks supplied with filtered seawater or in MML's 135,000-gallon public aquarium. During the test period, tags were assessed for their retention and shedding characteristics, effect on shark tissues (good wound-healing vs. necrosis around the tag head), hydrodynamic qualities (drag production and its physical effect on shark swimming), biofouling, recognition and readability (as would be required for recapturing fishermen), and other factors.

Based upon these observations, a single tag design, the Hallprint (South Australia) modified PDB dart tag with nylon head, was chosen as superior to all other designs tested. Qualities of this tag design included high retention, excellent wound-healing, very low hydrodynamic drag, low to average biofouling of the external streamer, and good recognition and readability. Its relatively small size and excellent construction made it preferable to the similarly designed but larger Floy prototype, which suffered from higher shedding, poorer wound-healing, and greater biofouling. Both types of fin tags had high shedding rates and therefore were rejected. The NMFS M-tag, which has been the most commonly used tag for large sharks, suffered from a number of problems when applied to small sharks. The stainless steel blade that serves as the M-tag head produced severe, localized necrosis of muscle and skin tissue, leading to

poor wound-healing, and the blade tip occasionally migrated out through the shark's skin rostra1 to the original entrance wound, resulting in a new external wound and ultimately in shedding of the entire tag. Drag created by the external tag capsule caused continual movement of the streamer, irritating the entrance wound through the skin and further interfering with wound-healing. A previous study by Manire and Gruber (1991) found that juvenile lemon sharks tagged with M-type dart tags grew at approximately one-half the normal rate. For these various reasons, the M-tag was rejected for use on small sharks in the field. (Subsequent to this decision, MML staff conducting F-I surveys in the study area recaptured small sharks tagged by recreational anglers with NMFS M-tags. Condition of these animals, including healing of the tag wound and overall body condition, was relatively poor, corroborating the laboratory observations.)

The Hallprint modified PDB dart tag selected for the field tagging was custom-manufactured to project specifications and supplied at a cost of approximately $0.62 per tag. The tag consisted of a 1.5 cm-long nylon head of 2-3 mm thickness, with a single 2 mm-wide barb 1.5 cm in length, and a 12.5 cm-long plastic streamer of 1.5 mm thickness molded directly to the head. The streamer consisted of two segments molded together: a 6 cm yellow segment proximal to the tag head, and a 6.5 cm orange segment distal to the head. Tag number and recapture information were printed on each segment, with instructions to the recapturing angler to cut off the distal orange segment and send to MML. This design accomplished two objectives: 1) each tag served as a double tag for multiple recaptures of the same fish, while at the same time requiring only a single tag application; and 2) return of the distal segment provided physical evidence of the tag and its number, while still allowing the recapturing fisherman to re-release the tagged shark, if desired, without removing the entire tag.

Tags were applied to sharks by puncture through the skin with a 4 mm-wide, hollow, sharpened, stainless steel applicator. The tag head was inserted on the shark's left side at the base of the first dorsal fin, through the basal cartilages just below the fin and well above the vertebral column, and penetrating just across the shark's midline. Streamer angle was about 30° from the caudad longitudinal axis, and the tag barb was oriented projecting toward the midline. The tag was advanced until the point of the applicator could barely be felt through the skin on the opposite (right) side of the shark. Retracting the applicator left the tag well-anchored in the cartilage above the vertebral column, not merely in the dorsal musculature.

b. ***Tag deployment in the field.*** Live sharks captured in F-l and F-D operations were documented as described above, tagged by MML scientific staff with MML/Hallprint small shark tags, and released. Over the course of the project, a total of 1,247 sharks of 12 species were tagged and released (Table 5). Tagging of recreationally caught sharks in the 1992 and 1993 Gulf Coast Shark Census tournaments accounted for 129 tagged sharks of 6 species. An additional 8 sharks of 3 species (5 blacknose, 2 blacktips, 1 great hammerhead) were caught by recreational fishermen not during the tournaments and were tagged by MML staff prior to release. In addition to these sharks, an additional 105 teleosts of five species (Cobia, black drum, red drum, spotted seatrout, and snook) were tagged and released,

and tag information was sent to FDEP/FMRl. Two Kemp's ridley sea turtles were tagged and released and the information was sent to NMFS.

C. ***Publicity and rewards.*** Information about the shark tags was distributed along the Florida Gulf coast from Panama City to the Florida Keys by telephone calls and visits to fishing areas, by distributing flyers to fishermen, and by posting large format, brightly colored posters (Fig. 15). Television and radio interviews and newspaper articles containing information on the tagging program also were used to notify fishermen within the study area. A page was devoted to the tags in the 1992 and 1993 Gulf Coast Shark Census tournament flyers and booklets, of which about 3,000 were printed and distributed each year. A reward of a limited edition MML Shark Tagging Program fisherman's cap (retail value approx. $7.50) was offered to each fisherman returning tag recapture information.

d. ***Recapture data.*** Fishermen recapturing tagged sharks were interviewed for information that included date and location of recapture, shark and tag condition, length and weight of shark, and fishing gear used. With few exceptions, sharks and accompanying tags were reported in excellent condition upon recapture (n = 52), with complete healing of tag entrance wounds and no secondary necrosis or infection noticeable (except for one reported case of inflammation around the tag). In the majority of cases, low to moderate algal growth and good readability of tag inscription were reported (except for several cases of heavy algal growth on tags of some sharks recaptured during hot summer months). Reward hats and first-capture information on the sharks were sent to recapturing fishermen.

6. Database management and analysis. Field and recapture data were transferred from hard-copy data sheets to a Paradox (Borland) database totaling 1.8 Megabytes, for sorting and analysis. Data were exported to Excel (Microsoft) for some calculations and to print tables. Maps were generated on AutoCAD (Autodesk) using a Florida map file (Blue Line Highway Maps) and by incorporating location data exported from the Paradox database. Some plots and statistical analyses were performed on the Paradox database using SigmaPlot and SigmaStat (Jandel) and some graphics were generated using Harvard Graphics (Software Publishing).

B. Project Management

The work was performed entirely by staff and volunteer student interns at Mote Marine Laboratory's Center for Shark Research (CSR) under the direction of P/l Dr. Robert Hueter, MML Senior Scientist and CSR Director. Dr. Charles Manire, MML Senior Biologist, was in charge of field operations and database management and is a co-author of this report. Michael Friday, MML Technician, was a field crew chief and assisted on field studies and laboratory analyses.

Acknowledgment is given to the many persons and organizations who assisted in the completion of this research project. At MML, Dr. Enric Cortes, CSR Postdoctoral Scientist, provided expertise on stomach contents analyses, and Dr. Don Hayward and Jay Sprinkel assisted with the computer database and graphics. Dr. Jose Castro of

the NMFS/SEFSC/Miami Laboratory assisted with the design and execution of all phases of this project, and John Casey of the NMFS/NEFSC/Narragansett Laboratory assisted with the development and implementation of the tagging program. Michael Hall of Hallprint Pty. Ltd. assisted with the design and production of the shark tags. FDEP/FMRI provided data for computer maps of seagrass, mangrove, and salt marsh habitat in the study area. Warren Servatt collected live sharks for laboratory testing of tag designs. Harbour Village Condominium in El Jobean and Holiday Inn in Apollo Beach assisted with overnight accommodations for field crews. Finally, acknowledgment is given to the many commercial and recreational fishermen and fishing organizations who provided assistance and cooperation with MML staff on this project.

V. FINDINGS

A. Accomplishments and Findings

1. Total catch and bycatch data.

a. *All surveys combined.* Total catch documented by scientific personnel in all surveys combined for the entire project (not including sharks documented by anglers in the Gulf Coast Shark Census tournaments) was 1,862 sharks of 13 species, 903 skates and rays of 8 species, approximately 73,231 bony fishes of over 79 species[1], 6 sea turtles of 2 species, and 1 marine mammal (Table 6). This catch resulted from a total effort of 830 sets of various gear types (both F-I and F-D) fishing for 1,623.1 hr at the locations plotted in Fig. 7. Locations of samples (= gear sets) where sharks were caught in the study, area, and samples that yielded no sharks in the catch, are shown in Figs. 16 and 17. The total catch of sharks was dominated by bonnetheads (1,118), followed by blacktips (387), blacknose (187), bulls (60), Atlantic sharpnose (45), great hammerheads (20), and 45 other sharks of 8 species[2] (Fig. 18).

b. *Fishery-independent surveys.* F-I surveys at locations plotted in Fig. 8 resulted in the total catch shown in Table 8. The catch is broken down between Tampa Bay and Charlotte Harbor F-I surveys in Tables 9 and 10.

F-I gill net catches are shown in Tables 11-21. F-I gill net sets accounted for 662 gear sets fishing for 1,051.2 hrs, or about 85% of the total number of F-I sets and 67% of the total F-I fishing effort. Project total catches, Tampa Bay totals, and Charlotte Harbor totals for F-I gill net surveys are shown in Tables 11-13. In all, 11 species of sharks, 8 species of skates and rays, 62 + species of bony fishes, 2 species of sea turtles, and 1 marine mammal made up the F-I gill net total catch. Dominant species of teleosts in the total catch included gafftopsail and hardhead catfishes, yellowfin menhaden, Spanish mackerel, spadefish, and ladyfish. Tables 14-17 show the breakdown of F-l gill net sets by mesh size (3", 4", 4 5/8", and 5" stretch mesh, respectively) and Tables 18-21 show the F-l gill net effort and catch by seasons[3] (winter, spring, summer, and fall, respectively).

[1]Some numbers of bony fishes had to be estimated in very large F-D catches and some teleost species were lumped into species groups, e.g. "searobin" (Table 1).

[2]Unless otherwise stated, all reports of shark length in this document are in cm of fork length (FL). Formulas to convert shark FL to precaudal length (PCL), total length (TL), or stretch total length (STL) were derived by performing linear regressions with the study length data and are given in Table 7.

[3]For this report, the seasons are delineated as follows: winter = January 1 - March 31; spring = April 1 - June 30; summer = July 1 - September 30; fall = October 1 - December 31.

F-I longline catches are shown in Table 22. Longline sets accounted for 108 gear sets fishing for 488.5 hr with a total catch of 87 sharks of 8 species, 121 skates and rays of 5 species, and 518 bony fishes of 16 species. In general, the longline was not nearly as effective as gill nets in catching small sharks except for blacknose sharks, which tended to aggregate in deeper water where the gill nets could not be set. F-l rod-and-reel catches for the project accounted for an additional 6 sharks of 5 species (2 bulls 62 cm and 96 cm FL, 1 blacktip 53 cm FL, 1 Atlantic sharpnose 46 cm FL, 1 bonnethead 44 cm FL, and 1 great hammerhead 98 cm FL), 1 clearnose skate (33 cm disc width), and 1 black sea bass (31 cm FL) in the total catch reported for all F-l surveys combined (Table 8).

c. *Fishery-dependent commercial surveys.* Total catch from all F-D commercial fishery surveys is shown in Table 23. Shark bycatch in the 48 commercial gear sets consisted of 19 sharks of 6 species, with 32% of this bycatch being juvenile blacktip sharks. The rest of the F-D commercial total catch consisted of 5 species of rays and 60 + species of bony fishes, dominated numerically by Atlantic thread herring, pinfish, round scad, striped mullet, and Spanish sardine.

Table 24 shows the total catch from 5 sets in the baitfish purse seine fishery in the Tampa Bay area. No sharks were observed in the bycatch. The total fish catch from 2 sets in the bait shrimp roller frame trawl fishery in Pine Island Sound is shown in Table 25. A single small nurse shark was observed in the bycatch from these 2 sets. No sharks were observed in the bycatch from 1 set in the food shrimp otter trawl fishery in Charlotte Harbor (Table 26).

The total catches from F-D gill and trammel net surveys are shown in Tables 27-29. In 22 sets in the mullet gill net fisheries in Tampa Bay and Charlotte Harbor, a single juvenile lemon shark (93 cm FL) was the only shark observed in the bycatch (Table 27). The gill net, fishery for mackerel in the Tampa Bay area produced the majority of the observed shark bycatch in all F-D commercial surveys combined (Table 28). A total of 16 sharks (84% of total observed commercial shark bycatch) of 4 species was documented in 4 sets of mackerel gill nets, an average of 4 sharks per set, with 38% of this bycatch being juvenile blacktips averaging 58.8 cm FL. In the gill net fisheries for pompano in Tampa Bay and Charlotte Harbor, a single Florida smoothhound was the only shark observed in 6 sets (Table 28). In 8 sets of trammel nets targeting mullet, seatrout, and Crevalle jack in Tampa Bay, no sharks were observed in the bycatch (Table 29).

d. *Fishery-dependent recreational catch.* The total catch of sharks in the 1992 and 1993 Gulf Coast Shark Census tournaments is shown in Tables 30-32 and Fig. 19. In 1992, a total of 652 sharks were caught, documented, and released by 77 of the 147 anglers registered in the tournament. In 1993, 958 sharks were documented by 116 of the 180 registered anglers. These 1,610 sharks in 1992-93 were reported to

be of 11 species[4]. Catches in both years were dominated by small, female blacknose and juvenile blacktip sharks with estimated total lengths of 2-4 ft (approx. 51-104 cm estimated FL). Tables 31-32 and Fig. 20 show the breakdown of the catches by species, size, sex, and region.

e. Summary of F-I and F-D catch data. A comparison of Tables 9 and 10 shows that the Tampa Bay and Charlotte Harbor faunas caught by fishing methods as were used in the F-I surveys are quite similar. According to Table 11, gill nets in the study area caught all shark species documented in the project except two (finetooth and sandbar, which were each represented by a single individual caught on the F-l longline). The longline, which was always baited with fish, was capable of catching most of the same shark species that dominated the gill net catches in the study area except for bonnetheads. In general, F-D catches differed from F-I catches as follows: 1) lower species diversity of sharks and fewer individuals on a per set-hr basis (except in the mackerel gill net fishery) in the shark bycatch in the F-D surveys; 2) slightly lower species diversity in the bony fish catch/bycatch in the F-D surveys; and 3) greater proportional catch of target species in the F-D surveys. These three traits would be expected to characterize commercial fishing operations that select for certain commercially desirable species of teleosts.

2. Shark biology and ecology. Data from all surveys combined were sorted and analyzed to determine the following species-specific aspects of the biology and ecology of sharks inhabiting the study area.

a. *Distribution patterns.* Species distributions by area, season, temperature, salinity, depth, habitat, and life stage (stage of maturity of shark) were examined with the catch data.

Geographic overviews. Figs. 21-33 show the sites of all samples where each of the 13 species of sharks was collected during the project. Blacknose sharks (Fig. 21) generally were found in deeper areas, especially in lower Tampa Bay, around deep channels, and along coastal beaches. Blacktips (Fig. 22) were concentrated in shallower regions inside Tampa Bay and Pine Island Sound (especially southern Pine Island Sound), in southern Matlacha Pass, and along coastal beaches. Bonnetheads, the most abundant shark species in the total catch, were caught with regularity in shallow waters of Tampa Bay south of the St. Petersburg peninsula (Pinellas Point area) and off the mouth of Terra Ceia Bay, in southern Pine Island Sound, Matlacha Pass, and portions of Charlotte Harbor, and off some coastal beaches (Fig. 23). Bulls (Fig. 24) were found in two main locations: eastern Hillsborough Bay in northern Tampa Bay, especially around the mouth of the Alafia River; and in northern Charlotte

[4]Although tournament anglers were trained in species identification and length estimation techniques, and many anglers provided photographs of their catch with the catch records, the great majority of these sharks were not documented first-hand by MML personnel. Thus, species, size, and sex analyses for the Gulf Coast Shark Census data are not subject to the same quality assurance as the rest of the project data.

Harbor at the mouth of the Myakka River. The single finetooth shark recorded in the study was taken by longline in Charlotte Harbor south of Cape Haze (Fig. 25). Great hammerheads (Fig. 26) primarily were found in lower Tampa Bay and around Sanibel Island, whereas scalloped hammerheads were collected only around Sanibel (Fig. 27). Lemon sharks (Fig. 28) were found in a few shoreline areas of southern Tampa Bay, and nurse sharks (Fig. 29) were collected in scattered locations near the southeast shore of Tampa Bay, in Pine Island Sound, and along coastal beaches. The single sandbar shark recorded in the study was taken by longline off the beach on Gasparilla Island, just outside Charlotte Harbor (Fig. 30). Atlantic sharpnose sharks (Fig. 31) were found along coastal beaches, in lower Tampa Bay, and inside southern Pine Island Sound, and Florida smoothhounds (Fig. 32) were collected in scattered locations off coastal beaches. The two spinner sharks recorded in the study were caught off a coastal beach south of Tampa Bay and inside northern Pine Island Sound (Fig. 33).

Temporal patterns and spatial distributions by season. Total catch of sharks of all species, as well as shark CPUE (expressed as sharks caught per set-hour, all surveys and gear types combined), followed a seasonal pattern that peaked in late spring/early summer and fell to its lowest point in winter (Fig. 34). Shark CPUE in June was approximately 45 times the January CPUE. A secondary peak in shark total catch and CPUE occurred in September. Lower catch in August compared to those of July and September may have been a result of reduced effort in August 1992 due to equipment problems, but August CPUE showed the same drop (Fig. 34). Tables 33-35 show the numbers of sharks caught each month by species and the sizes of the most abundant species (bonnethead, blacktip, blacknose, and bull) by month of capture. Most of the 13 species of sharks collected in the study showed a species-specific seasonality that basically mirrored that of the total shark catch, i.e. higher in spring and summer and lower in late fall and early winter (Table 33). The only species indicating an apparent preference for inhabiting the study area in fall and winter was the Florida smoothhound.

Winter, spring, summer, and fall maps of shark catches are shown in Figs 35-70. Each season is represented by a map showing locations of all samples conducted for that season (Figs. 35, 44, 53, and 62), a map of all samples where sharks were caught (Figs. 36, 45, 54, and 63), a map of all samples where no sharks were caught (37, 46, 55, and 64), and species-specific maps showing where sharks were caught during that season (Figs. 38-43, 47-52, 56-61, and 65-70). In winter, few sharks appear to be inside the estuaries (Fig. 36), with scattered numbers of bonnetheads and blacktips moving inside Pine Island Sound in late winter (Figs. 38 and 39). In spring, the small sharks have moved well up into both Tampa Bay and Charlotte Harbor/Pine Island Sound (Fig. 45), with spring catches still dominated by bonnetheads and blacktips (Figs. 47 and 48). The general distribution pattern in summer (Fig. 54) is similar to that in spring, with the addition of blacknose and great hammerhead sharks entering lower Tampa Bay and Charlotte Harbor, and young bull sharks appearing in Hillsborough Bay and northern Charlotte Harbor (Figs. 56-61). In fall, the sharks appear to leave most of Tampa Bay and Pine Island Sound (Fig. 62), with primarily bonnetheads found along some coastal beaches and passes (Fig. 65).

Temperature/salinity/depth profiles. The average, minimum, and maximum temperatures, salinities, and depths at which each shark species was found in the study are shown in Table 36 and plotted in Fig. 71. Average water temperatures were 27-31°C and maximum temperatures were 30-34°C for most species. Lower temperature limits varied more by species, with bonnethead, blacknose, blacktip, Atlantic sharpnose, Florida smoothhound, and nurse sharks found in temperatures below 20°C, and bull, great and scalloped hammerhead, lemon, and spinner sharks not collected in temperatures below 20°C. The fall/winter preference of the Florida smoothhound is reflected in its narrow temperature range of 17-19°C.

Salinity ranges were narrow for most species (Fig. 71), usually about 25-37°/oo (with average salinities of about 31-33°/oo for most species), with only two exceptions. The broad range of salinities where bull sharks were found, from near-freshwater at 3°/oo up to a maximum of 28.5°/oo, is consistent with the well-known and unusual euryhalinity of this shark species (Castro, 1983). The report of a single finetooth shark in very brackish (11.5°/oo), warm (33.8ºC) water in Charlotte Harbor (Fig. 25) is problematic considering the depth of capture for this specimen (19 ft) and reports of this species inhabiting primarily surf zone and shallow coastal waters in other regions (Castro, 1993a). [This anomaly in salinity, and perhaps also temperature, is probably due to improper technique in this singular case, for it appears that salinity and temperature for this one sample were taken at the surface rather than at mid-depth. Extremely heavy rains immediately prior to the date of this sample could have driven surface salinity down through heavy freshwater outflow from the Myakka and Peace Rivers, but it is doubtful that the salinity at the depth where the shark was caught was so low.]

Depth ranges were broad for about half of the documented species (Fig. 72). Six species (blacknose, blacktip, bonnethead, Atlantic sharpnose, Florida smoothhound, and spinner) ranged from near the surface to 24-30 ft. Great hammerhead and nurse sharks were caught at depths varying from near the surface to about 20 ft. Bull, scalloped hammerhead, and lemon sharks were collected only in depths of 10 ft or less. Average depth of capture for the 13 species was about 4-9 ft in all but three cases: blacknose sharks (average depth about 15 ft), which were found more often in deeper regions of lower Tampa Bay and offshore from coastal beaches; the lone finetooth specimen (described above); and Florida smoothhounds (average depth about 18 ft), which were found strictly off coastal beaches.

Habitat preferences. Relationships between shark species and habitat, in terms of type of benthic community at capture site, were discernable for the four most abundant species by sorting the shark database by species and location bottom type (Fig. 73). For bonnetheads, 93% were found over seagrass, with the remaining sharks found over sand or mud (comparison of Fig. 23 with Fig. 3 shows rough agreement with this finding). For blacktips, 85% were found over seagrass and the remainder were found over sand or mud (compare Fig. 22 with Fig. 3). Blacknose sharks showed a stronger preference for sand or mud bottoms (61%), with 24% found over seagrass and 15% over hard bottom. This is consistent with their generally being found in deeper water (Fig. 72). Bull sharks showed no clear preference, with 54% being found over sand or mud and 46% found over seagrass.

Distributions of life stages. Table 37 shows the breakdown of the total shark catch by species and stage of maturity. Neonates are defined as newborn, free-swimming sharks with umbilical (or yolk stalk) scars that have not yet closed. Juveniles are all young sharks between neonate and adult stages, i.e. they have completely closed or no umbilical (yolk stalk) scars and they are not sexually mature. Adults are defined as sexually mature sharks as follows: adult males have enlarged, rigid, calcified claspers, and may have sperm in tubules or sacs of the urogenital system; adult females show ovarian and oviducal development, have mature eggs and possibly evidence of copulation (mating scars) during mating periods, and may have embryos during gestation periods. Sizes at maturity were established for each shark species by internal examination of dead specimens when possible, or by consulting the literature (e.g. Compagno, 1984; Castro, 1983).

The size of the fishing gear used in this study was selective for young sharks or adults of small species. Of the total catch of 1,862 sharks, 65% were neonates or juveniles, and of the total adult catch, 93% were bonnethead sharks (Table 37). Neonates of four species- blacknose, blacktip, bull, and lemon-were caught in the study area, with an additional five species of sharks suspected of having neonates in the area (Table 38) because: 1) very small, post-natal juveniles and/or post-partum adult females were collected during the project; and/or 2) other collections or studies have indicated the presence of neonates in the region. Juveniles of all but two species (Florida smoothhound and sandbar sharks) were captured in the study area during this project. In addition, data from this study and other collections have demonstrated the regional presence of adult sharks of all 13 species collected in this study except the finetooth shark (Table 38). Thus, by Castro's (1993b) definition of shark nursery areas, the Tampa Bay and Charlotte Harbor estuaries and adjacent coastal waters serve as nurseries for at least 11 species of sharks, with at least four, and possibly as many as nine, of these species giving birth to pups within the region.

The geographical distributions by life stages of sharks in the study area are shown in Figs. 74-77. Catches of neonates (Fig. 74) were concentrated in a few key spots, including southern Pine Island Sound (primarily blacktips), eastern Hillsborough Bay and northern Charlotte Harbor (bulls), and lower Tampa Bay off Pinellas Point and inside Egmont Key (lemon and blacktip sharks in shallow waters, blacknose sharks in deeper areas). Catches of juveniles, on the other hand, were widespread in distribution throughout the study area (Fig. 75). Adult distribution was similar to that of juveniles (Fig. 76), but when bonnetheads are removed from the adult map (Fig. 77), it is apparent that most of the adults of the other species were found in deeper areas of lower Tampa Bay, near passes, and off coastal beaches.

Species-specific catches of the three life stages of sharks by month of the year are shown in Table 39. Neonate catches were restricted to the four months of May through August, with primarily blacktip neonates appearing in spring and bull neonates appearing in early summer. Juvenile catches were concentrated from late March through September, peaking in June and July for most species (Fig. 78). Blacktip, Atlantic sharpnose, and scalloped hammerhead sharks showed a resurgence of juveniles in the September catch. Bonnetheads were the only species with juveniles showing up in the catch in all months of the year. Adult sharks in the catch were

dominated by bonnetheads, also in the area as adults year-round, and blacknose sharks, for which adults were found in the area from late spring through summer (Table 39).

b. *Food habits.* Stomach contents were analyzed for 546 sharks of eight species with fork lengths shown in Table 40. Overall, 77% of these sharks had food items in the stomach. Of the five species for which more than 10 stomachs were examined, the percentage of non-empty stomachs by species ranged from a high of 95% for the bonnethead (n = 332) to a low of 39% for the blacknose (n = 33). Results of stomach contents analyses are shown in Tables 41 and 42 and Figs. 79 and 80. Two shark species, the bonnethead and blacktip, are represented by relatively large sample sizes of non-empty stomachs (bonnethead, 314; blacktip, 65), while the other six species are represented by much smaller sample sizes (blacknose, 13; Atlantic sharpnose, 10; bull, 6; great hammerhead, 5; scalloped hammerhead, 5; spinner, 1).

For the bonnethead shark, crustaceans were the dominant food category on a wet weight (%W = 84.2%), per number (%N = 62.9%), and occurrence (%O = 92.5%) basis (Table 41). According to the %IRI, crustaceans made up 89.6% of the bonnethead diet, and this food category was dominated overwhelmingly by blue crabs *(Callinectes sapidus),* with a species-level %IRI of 85.9% (Fig. 79). Several species of seagrasses constituted 8.4% of bonnethead stomach contents. The remainder of the bonnethead stomach contents was composed primarily of unidentifiable material (%IRI = 2.6%). In contrast to the bonnethead diet, that of the blacktip shark consisted mainly of teleosts (Table 41 and Fig. 79). Total %IRI of teleosts of all species was 97.8% for the blacktip. Thus, the bonnethead and blacktip differ markedly in their feeding habits in the study area, in that bonnetheads specialize on crabs and blacktips specialize on teleost fishes, even though there is considerable overlap in their distributions (Figs. 22 and 23).

For the other six shark species, stomach contents were dominated by teleosts (Table 42 and Figs. 79 and 80). The only shark species of the group with any identifiable elasmobranch material in its stomach contents was the bull shark. One juvenile bull (out of 11 examined) of 64 cm FL had remains of a small cownose ray(s) in its stomach. As adults, bull sharks are known to feed on elasmobranchs as well as teleosts, with adults taking more elasmobranch prey than do young bull sharks (Compagno, 1984).

c. Species associations. To detect possible ecological associations between species in the study area, the total catch database was sorted and analyzed for correlations between catches of sharks (all shark species combined) and catches of other elasmobranchs and teleosts. Table 43 shows the associated CPUE of 24 species of fishes compared with five levels of shark CPUE (0 sharks per set-hour; greater than 0 and less than 3 sharks per set-hour; 3 to less than 5 sharks per set-hour; 5 to less than 10 sharks per-set hour; 10 or more sharks per set-hour) for all F-l gill net surveys. These data are broken down further between Tampa Bay and Charlotte Harbor in Tables 44 and 45. Visual scanning of Table 43 for increasing or decreasing trends with shark CPUE identified six species for further analysis: gafftopsail and hardhead catfishes, yellowfin menhaden, cownose ray, Spanish mackerel, and Atlantic thread

herring. Fig. 81 shows plots of shark CPUE vs. CPUE for each of these six species for all surveys combined. Spearman's non-parametric test for rank correlation was performed on these data to detect significance of association between shark CPUE and these other species CPUE, and the results are shown in Table 46. Significant correlations were found for gafftopsail and hardhead catfishes and Atlantic thread herring, but not for Spanish mackerel, cownose ray, or yellowfin menhaden. The positive correlation between catfish CPUE and shark CPUE presumably reflects a real ecological association of common habitat utilized by these various species in Tampa Bay and Charlotte Harbor, but it may also involve a degree of gear selectivity for these species. The positive correlation between Atlantic thread herring and sharks in the study area may also involve these two factors as well as a third possibility of prey-predator association between herring and the piscivorous sharks. In fact, Atlantic thread herring were identified in the stomach contents of blacktip and blacknose sharks (Tables 41 and 42).

d. *Migrations.* The shark tagging program established with this project will yield cumulative information with time, as recaptures are reported in the future. The ultimate goals of this program are to plot residence time in the nursery grounds, track long-distance migrations, examine age and growth, and estimate population abundance and mortality. To those ends, the tagging database remains open and further tagging efforts will continue. Meanwhile, the recaptures reported during the two-year duration of this project can be examined for information on migratory habits of shark species.

Table 47 shows data from all recaptures prior to 7 December 1993. As of this date, 52 recaptures of five species-representing 4.2% of all tagged sharks (1,247) at liberty-had been reported. The longest time at liberty was 358 days for a subadult (80 cm FL when tagged) male blacknose shark tagged in July 1992 and recaptured in July 1993 in lower Tampa Bay (sampling area T4; Table 2 and Fig. 6). Since this species was absent in this area in fall and winter surveys (Figs. 40 and 67), this tag return may reflect an annual spring/summer return of individual blacknose sharks to lower Tampa Bay after overwintering either offshore or at another coastal location. Times at liberty for other blacknose recaptures were too brief to confirm this pattern. The longest distance traveled (using the shortest possible water route connecting tagging and recapture locations) was approximately 105 nautical miles (nm) by a young-of-the-year (YOY) female bull shark (69 cm FL). This shark was tagged in eastern Hillsborough Bay (northeastern Tampa Bay) on 29 July 1993 and was recaptured on 6 December 1993 in San Carlos Bay north of Matanzas Pass, near the eastern tip of Sanibel Island (Fig. 82). This migration represents an average movement of 0.8 nm/day. Other small bull sharks tagged in Hillsborough Bay in July/August 1993 were recaptured as much as 113 days later still inside Hillsborough Bay (Table 47 and Fig. 82).

The second-longest distance between tagging and recapture sites was approximately 100 nm for a female bonnethead (75 cm FL), which traveled from southern Pine Island Sound in May 1993 to off Clearwater Beach north of Tampa Bay in July 1993. This represents an average daily movement of 1.2 nm/day. Other bonnethead movements were relatively small, with 29 sharks moving 0-4.5 nm over 2-189 days, one shark moving 8 nm over 74 days, and another shark moving 17 nm

over 83 days (Table 47). Tag returns for young blacktip sharks (n = 9) indicate spring/summer residence inside the estuaries, with the longest movement being 10.5 nm over 11 days (1.0 nm/day). One tag return from a neonate female lemon shark (51 cm FL), tagged in May 1992 off Pinellas Point in Tampa Bay, showed little movement (< 1 nm) in 15 days at liberty.

3. Fishing mortality. Two types of fishing mortality were assessed in this study: 1) immediate or "at-the-boat" (acute) mortality of sharks, rays, teleosts, and other vertebrates as a result of being caught in/on the fishing gear; and 2) delayed fishing mortality of sharks, i.e. eventual but not immediately observable mortality of sharks due to the singular episode of being caught in/on the fishing gear. These two types of mortality were then combined for sharks to obtain total (episodic) mortality resulting from a single fishing episode.

a. *At-the-boat (acute) mortality of sharks.* The total number of sharks captured in this study that were dead at the boat (Condition 5; see Approach, above) was divided by the total number of all sharks caught to obtain the observed at-the-boat (acute) fishing mortality rate. For all shark species and gear types combined, the observed at-the-boat mortality rate was 570/1,862 = 30.6%. Table 48 shows the results of this assessment for all F-I gill net data, with the breakdown of acute fishing mortality by shark species. The observed at-the-boat mortality of sharks caught in gill nets was 31.4% for all shark species combined. The species mortality rates ranged from 0% in the Florida smoothhound (n = 9), lemon shark (n = 10), and nurse shark (n = 6) to a high of 55.6% in the scalloped hammerhead (n = 9). Acute mortality rates for the four most abundant species were 31.4% for the bonnethead (n = 1,115), 37.8% for the blacktip (n = 323), 1.8% for the bull (n = 56), and 34.0% for the blacknose (n = 47). These mortality rates are derived for all F-l gill net captures during the entire study; conditional factors such as water temperature, shark size, and specific mesh size of the net may affect these rates.

The finding of low acute mortality from gill net capture in the Florida smoothhound, young lemon, and young nurse sharks is consistent with their known benthic habits including an ability to rest on the bottom and respire normally, as well as their adaptability to confinement in captivity. The low acute mortality of young bull sharks was an interesting result that indicates a similar ability to respire without swimming but also may be a direct result of the F-l gill net mesh sizes (3-5"). Young bull sharks have relatively broad, rounded heads that preclude them from becoming "gilled" in a small-mesh net, so that net capture in this case usually occurs through entanglement of the fins and/or tail. This may result in their relatively higher survivability.

b. *At-the-boat (acute) mortality of other fishes and vertebrates.* Table 48 shows observed at-the-boat mortality rates for species other than sharks collected in the study. [Collection of the ray and teleost mortality data was not part of the original work plan but was added late in the project, so these data apply only to the period of 17 August to 1 October 1993.] No gill net mortality was observed for any of the five species of rays captured during this period. Of the teleosts documented, high mortality rates as derived from moderate to large sample sizes included those for Spanish

mackerel (93.4% mortality, n = 198), ladyfish (81.4%, n = 118), bluefish (61.9%, n = 21), and yellowfin menhaden (52.6%, n = 78). Medium mortality rates were found for Atlantic thread herring (34.2%, n = 381, gafftopsail catfish (33.2%, n = 392), bumper (28.6%, n = 35), and Crevalle jack (24.2%, n = 33). Of a total of 6 sea turtles (3 green, 3 Kemp's ridley) caught during the entire project-in 662 sets of F-I gill nets fishing for 1,051.2 hr, one green sea turtle was dead upon net retrieval. Also over the same period, a single male Atlantic bottlenosed dolphin (225 cm FL) was entangled in the 4 5/8" F-I gill net and was dead upon retrieval.

c. *Delayed mortality of sharks as a result of a single capture in/on fishing gear.* The observable at-the-boat mortality of all sharks as a combined group was 30.6% as described above. This figure, however, does not include sharks that are released alive after capture but do not recover and subsequently die from that single fishing event. Direct observation and quantification of such "delayed" mortality can be difficult. Given certain assumptions, tag return data can be used to estimate this additional mortality, so that overall fishing mortality from a single fishing event can be assessed.

To estimate this additional mortality for the sharks caught and released in this study, the following procedure was followed. First, all sharks and gear types were pooled in this analysis because of the relatively small number of recaptures by the project end. (In the future, these analyses can be subdivided into categories of sharks and gear as more tag returns are reported.) A statistical test on number of tag returns reported from sharks originally tagged in F-I, F-D/commercial, or F-D/recreational surveys showed no significant difference between these three groups (Table 49), which supports the pooling of the tag return data. Next, the database of tagged sharks was sorted by vitality code (condition number), and tag returns for each release condition were examined, using the following assumptions:

Assumption 1: Best case scenario - All Condition 1 sharks survive the singular catch-tag-release event. This means that the resulting mortality estimates will be conservative, i.e. if ***any*** Condition 1 sharks die from the event, mortality will be underestimated. Thus, the procedure estimates ***minimum*** total mortality.

Assumption 2: Post-event mortality **-** Subsequent mortality rates for all sharks with release conditions 1-4 are equal after sharks recover from the singular catch-tag-release event. Thus, the event is assumed to have no further effect on survivability of sharks after they fully recover.

Assumption 3: Equal catchability - Subsequent catchability and tag reporting of sharks is equal for all release conditions. Thus, tag returns will not be affected by differences in release condition after sharks have fully recovered.

Assumption 4: Tag effect - The effect of the tag and the tagging process is negligible in calculations of delayed fishing mortality, because any tag effects are treated as being equal for all conditions of sharks. Thus, the delayed mortality estimated in this procedure is strictly a result of the sharks being caught in/on fishing gear, not due to any effect of tagging ***per se.***

Given these four assumptions, tag returns can be compared proportionally to releases for each condition, and relative mortality rates by release condition can be

calculated using the formulas shown in Table 50. If Assumption 1 is met, the number of tag returns for Condition 1 sharks (R,) divided by the total number of Condition 1 sharks tagged (T,) sets the proportion of all tag returns *expected* (E) for Conditions 2-4 sharks, given Assumptions 2 and 3. Any shortfalls in tag returns in these three categories from the expected numbers, then, are attributed to delayed mortality resulting from the catch-release episode, i.e. such differences reflect the proportions of sharks that do not recover after release. These proportional mortality rates by release condition (P_n) are then summed to obtain an estimate of total delayed mortality resulting from a single catch-and-release episode.

Table 50 shows the results of this analysis. For each condition level, a condition mortality rate was estimated from the tag return data, e.g. 15.0% of Condition 2 sharks were dying after release as a direct result of the catch-and-release event, 66.7% of Condition 3 sharks were dying, etc. These condition mortality rates (M_n) were adjusted according to the relative proportions of sharks in each condition to obtain proportional mortality rates by condition (P_n). These proportional rates were then totaled to obtain the total delayed mortality. For all shark species and gear types combined, delayed mortality was estimated to be 34.8% of all sharks released alive after capture.

d. *Total (episodic) fishing mortality of sharks.* The immediate and delayed mortality rates for sharks were combined to obtain a total mortality rate as a result of a single fishing episode. Immediate, observable mortality was 30.6% of all sharks caught, and of the sharks released alive after capture (69.4% of all sharks caught), 34.8% were estimated to die as a direct result of the fishing episode. Combining these figures, the following is obtained:

Total mortality = Immediate mortality + (Delayed mortality X Proportion released)

= .306 + (.348 X .694)

= **.548**

Thus, of all sharks caught in the study area with the gear type used in this project, 54.8% are expected to die as a result of a single fishing episode. Since gill nets accounted for approximately 88% of the sharks caught and used in this analysis, the 54.8% mortality rate is most applicable to the effects of gill net fishing in the study area.

B. Significant Problems Experienced during the Project

The number of sets (48) observed in the F-D surveys of commercial fisheries in the study areas was lower than expected due to at least two sets of circumstances beyond the control of project management. First, the amount of fishing effort in the 1992-93 pompano and mackerel net fisheries was unusually low, reducing the opportunities for sampling in those fisheries. The reported reason for low effort in the pompano fishery was low abundance of fish in the study areas in 1992-93, especially in the winter fishery operating with trammel and gill nets in the daytime. The reported

reason for low effort in the mackerel fishery was a market surplus of frozen mackerel leading to depressed value of fresh-caught fish in 1992-93.

The second set of circumstances involved the cooperativeness of commercial fishermen in allowing F-D sampling aboard their vessels. Although pledges of cooperation were high when the project proposal was submitted-and a number of commercial fishermen did follow through and were cooperative during the project-much of the cooperative spirit diminished prior to or during the project, due to at least two factors. The first of these was a growing political effort to ban entangling nets (primarily gill and trammel nets) on a statewide basis in nearshore waters, including those of the study areas. As this effort became widespread, many commercial fishermen grew embittered to any operation that monitored their activities, including scientific studies of their catch and fishing effort. In addition, the implementation of a daily bag limit on sharks in April 1992 (about one-third of the way into this project), which restricted even commercial fishermen to landing no more than two sharks per trip, caused further resentment resulting in decreased cooperation for this study. Since project management in this case (Mote Marine Laboratory) had no power to compel commercial fishermen to carry observers, the dependency on cooperativeness resulted in lower sample sizes in the F-D portion of the surveys. The observed low rate of shark bycatch in the commercial fisheries, therefore, must be considered in the context of low sample size. However, the state regulations on shark fishing no doubt decreased the actual bycatch rate of sharks in nearshore commercial fisheries during the course of the project. This was because the fishermen's incentive to avoid this bycatch was increased, since sharks caught in state waters could no longer be sold in significant quantities after April 1992, and so the damage that even small sharks do to fishing gear no longer could be offset by compensation for the shark meat and fins in the marketplace. None of these factors, however, directly affected the estimates of shark bycatch mortality derived in this project.

Some of the seasonal catch data may have been affected by temporary equipment (research vessel) and field crew problems in August 1992, which resulted in lower F-l sampling during August and September of that year. These problems were ameliorated by October 1992, and F-I sampling was extended to October 1993 to compensate for the lack of surveys in the late summer of 1992. This situation did not appear to affect project results in any profound way.

VI. EVALUATION

A. Original Project Goals and Objectives

The original goals and objectives of this project, as stated in the grant application to the MARFIN Program, were to: "1) survey two Gulf coast estuarine systems-Tampa Bay and the Charlotte Harbor/Pine Island Sound system-for the bycatch of small sharks in inshore fisheries; 2) assess the importance of these estuaries as critical nursery grounds for commercially and recreationally important species of sharks; and 3) assess the impact of bycatch mortality in these shark nurseries. In addition to sharks, bycatch of associated teleosts also will be documented during the survey of inshore fishing operations." Each of these goals was attained with quantifiable results without major modification to the original objectives and work plan. The project was designed to benefit the fishing industry in the following ways: 1) by providing new information on critical habitat areas for the early life stages of commercially and recreationally important shark species; 2) by assessing the extent of the shark bycatch problem in inshore commercial fisheries; and 3) by determining the significance of bycatch mortality of small sharks caught in commercial gear targeting other species.

B. Accomplishments of the Project

This project resulted in considerable new information addressing the original project goals and objectives. A total of 3,339 sharks were documented during the nearly two years of sampling in the Tampa Bay and Charlotte Harbor study areas. Of the 1,862 sharks of 13 species documented by scientific personnel, 1,275 were tagged and released, 17 were alive and were retained or released without tags, and 570 were dead and retained. An additional 1,477 sharks were documented and released alive by recreational anglers in the 1992 and 1993 Gulf Coast Shark Census, a 100% catch-and-release shark tournament conducted in the study areas and adjacent waters. In all, 903 skates and rays of eight species, approximately 73,231 bony fishes of over 79 species, six sea turtles of two species, and one marine mammal were documented in the total catch of the project. The numerically predominant species of sharks were bonnethead, blacktip, and blacknose, with lesser numbers of bull, Atlantic sharpnose, great hammerhead, nurse, lemon, scalloped hammerhead, Florida smoothhound, spinner, finetooth, and sandbar sharks. Juveniles of all species except Florida smoothhound and sandbar, and neonates of four species (blacktip, bull, lemon, and blacknose), were collected in the study area, with neonates from an additional five species (bonnethead, great and scalloped hammerheads, nurse, and spinner) suspected of occurring in the area. Thus, the Tampa Bay and Charlotte Harbor areas serve as nurseries for at least 11 species of sharks, with at least four, and possibly as many as nine, of these species giving birth to pups within the region. Observed shark bycatch in commercial fisheries was low, with 19 sharks of six species (juvenile blacktip, adult Florida smoothhound, juvenile and adult bonnethead, juvenile Atlantic sharpnose, juvenile lemon, and juvenile nurse) documented in 48 gear sets. All but three of these sharks were caught in gill nets targeting mackerel (an observed bycatch rate of four

sharks per set for this fishery). [These observations may have been affected by two external factors during the course of the project: 1) Florida legislation virtually eliminating the commercial value of shark bycatch in state waters was implemented in April 1992; and 2) relatively low effort in the 1992-93 pompano and mackerel fisheries, combined with decreasing cooperativeness of commercial fishermen with fishery scientists in the face of a proposed statewide net ban, resulted in lower-than-expected commercial F-D sampling in the project.] As of 7 December 1993, a total of 52 shark recaptures, representing 4.2% of all tagged sharks at liberty, were reported. Longest time at liberty was 358 days and longest distance traveled was a minimum of 105 nautical miles. Based on tag return data, we estimate an average of 34.8% of sharks released alive after being caught do not survive the catch-and-release event. This delayed mortality, combined with an immediate "at-the-boat" observed mortality of 30.6%, yields an estimated total mortality from a single fishing event of 54.8% of all juvenile and small adult sharks caught. These mortality estimates apply primarily to sharks caught in gill nets within the study areas.

C. Benefits to the Fishing Industry

The new information obtained in this project will provide the fishing industry with a number of benefits. The study areas of Tampa Bay and Charlotte Harbor have been identified as nurseries for several species of commercially and recreationally important sharks, including blacktip (commercial and recreational), spinner (c/r), bull (c/r), Atlantic sharpnose (c/r), blacknose (r), great and scalloped hammerhead (r), lemon (r), and bonnethead (r) sharks. Furthermore, the project has provided a model for studies designed to reveal the extent of shark nursery areas in other locations. With such information, these areas can be managed to maintain critical habitat for shark reproduction (pupping) and growth (juvenile feeding grounds), in order to sustain successful recruitment of young sharks into commercially and recreationally important stocks of Gulf and south Atlantic sharks. Along these lines, continued research in these nurseries can provide quantitative measures of relative abundance of younger year-classes, which could form the basis of predictive models of future stock strength for the shark fishery. Although based on low sample size, the finding of relatively low shark bycatch for inshore commercial fisheries (except perhaps for the mackerel gill net fishery) indicates that at least some of these fisheries are capable of operating in coastal waters without significantly impacting juvenile sharks. However, the finding that over half (54.8%) of those sharks caught on commercial-type gear in the nurseries do not survive that single fishing episode should be considered carefully by the fishing industry and management. Bycatch mortality of juvenile sharks must be assessed as a combination of the bycatch rate (shark CPUE) together with the rate of episodic fishing mortality (in this case, 54.8% of all sharks caught as bycatch). This approach is particularly crucial given the close stock-recruitment relationship of shark species.

D. Economic Benefits of Project

The new information obtained in this project potentially can provide economic benefits to the fishing industry in the form of sustained landings of adult sharks as well

as development of gear and methodology to reduce juvenile shark bycatch. Sustainability of shark landings can be advanced by managing critical habitats for the early life stages of sharks, so that successful recruitment to adult stocks is promoted. Fishing gear and methodology can be developed that minimizes bycatch of juvenile sharks in nursery areas. This also promotes sustainability of adult shark landings, but it provides the further economic benefit of reducing shark damage to fishing gear used in coastal fisheries targeting other species.

E. Need for Federal Assistance

The results of this project will be of benefit to the state of Florida, to Gulf coastal states, and to all other U.S. states with an interest in shark fisheries. A significant portion of the funding for this work (70% of total project costs) was provided by the state of Florida through the FDEP Marine Resources Grants Program. Mote Marine Laboratory cost-shared 5 % of total project costs. The remaining 25% of project costs, therefore, was required from federal sources and was provided by the MARFIN Program.

VII. CONCLUSION

A. Conclusions from the Project

In the Tampa Bay and Charlotte Harbor systems of the Florida Gulf coast, the predominant species of juvenile and small adult sharks are bonnethead, blacktip, and blacknose, with lesser numbers of bull, Atlantic sharpnose, great hammerhead, nurse, lemon, scalloped hammerhead, Florida smoothhound, spinner, finetooth, and sand bar sharks. Juveniles of all species except Florida smoothhound and sandbar, and neonates of four species (blacktip, bull, lemon, and blacknose), inhabit the area, with neonates from an additional five species (bonnethead, great and scalloped hammerheads, nurse, and spinner) suspected of occurring in the area. Thus, the Tampa Bay and Charlotte Harbor systems serve as nurseries for at least 11 species of sharks, with at least four, and possibly as many as nine, of these species giving birth to pups within the region.

Bonnethead and blacktip sharks differ markedly in their feeding habits in the area, in that juvenile and adult bonnetheads specialize on crabs and juvenile blacktips specialize on teleosts, even though there is considerable overlap in their distributions and habitat preferences. Most other species of juvenile and small adult sharks in the area appear to be primarily piscivorous.

Recaptures of sharks tagged in the area (4.2% recapture rate as of 7 December 1993) show movements of at least 105 nautical miles between tagging and recapture sites. Exchanges by individual sharks between the Tampa Bay and Charlotte Harbor systems occur in at least two species (bull and bonnethead). A pattern of spring/summer residence in the estuaries, with overwintering at another location and return to the estuaries the following spring/summer, is indicated by tag returns for at least one species (blacknose). In general, the new shark tag tested and implemented in this project appears to perform well when deployed in small sharks. When tagging sharks of less than about 1.5 m total length, nylon-headed dart tags should be considered as a preferable alternative to shark tags traditionally used on larger fish.

Observed shark bycatch in commercial fisheries in the area is low, except perhaps for the gill net fishery targeting mackerel, with an observed bycatch rate of four sharks per set. The observations leading to these conclusions may have been affected by two external factors during the course of this project: 1) a Florida shark management plan implemented in April 1992, which essentially eliminated the commercial value of shark bycatch in state waters; and 2) relatively low effort in the 1992-93 pompano and mackerel fisheries, combined with decreasing cooperativeness of commercial fishermen with fishery scientists in the face of a proposed statewide net ban, which resulted in lower-than-expected commercial F-D sampling in the project.

Based on tag return data, we estimate an average of 34.8% of sharks released alive after being caught do not survive the catch-and-release event. This delayed mortality, combined with an immediate “at-the-boat” observed mortality of 30.6%, yields an estimated total mortality from a single fishing event of 54.8% of all juvenile

and small adult sharks caught. In other words, we estimate that less than half (45.2%) of all small sharks caught just once in inshore fishing gear will survive that singular event. These mortality estimates apply primarily to sharks caught in gill nets within the study areas.

B. Success of the Project

The project was successful in meeting the original goals and objectives and in providing substantial new information on shark biology, nursery areas, bycatch, and catch-release mortality in the eastern Gulf of Mexico. A new tagging program targeting juvenile sharks was successfully implemented with the project, and a new method of estimating bycatch mortality based on tag returns was developed and applied.

C. Further Work Needed

Further studies of shark nursery areas and juvenile shark bycatch mortality in Gulf and Atlantic waters are needed to elucidate many issues raised in this study, including the following: 1) the distribution of nurseries for all shark species inhabiting U.S. state and federal waters; 2) the actual abundance of neonate and juvenile sharks in the nurseries on a species-specific basis; 3) the movements, age, and growth of sharks utilizing the nurseries; 4) the extent of juvenile shark bycatch in other nursery areas within state and federal waters; and 5) the impact of environmental degradation and destruction of coastal habitats on juvenile year classes of shark populations. Among other approaches, the tagging program begun in this project needs to be continued in order to increase the scope and accuracy of information on juvenile shark movements, growth rates, and aging. By using standardized survey and quantification methods in the nursery areas, furthermore, the relative importance of each area as a nursery for commercially and recreationally important shark species can be assessed. This approach ultimately will allow for the mapping and characterization of all shark nursery areas located within the coastal zones of the Gulf of Mexico and the Atlantic Ocean. With this information, fishery managers can make more informed decisions about the wise use and conservation of shark resources of the southeast U.S.

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IX. TABLES

Table 1. Common and scientific names of marine organisms discussed in this report.

COMMON NAME	SCIENTIFIC NAME
SHARKS	
Shark, Atlantic Sharpnose	*Rhizoprionodon terraenovae*
Shark, Blacknose	*Carcharhinus acronotus*
Shark, Blacktip	*Carcharhinus limbatus*
Shark, Bonnethead	*Sphyrna tiburo*
Shark, Bull	*Carcharhinus leucas*
Shark, Finetooth	*Carcharhinus isodon*
Shark, Florida Smoothhound	*Mustelus norrisi*
Shark, Great Hammerhead	*Sphyrna mokarran*
Shark, Hammerhead	*Sphyrna* spp.
Shark, Lemon	*Negaprion brevirostris*
Shark, Nurse	*Ginglymostoma cirratum*
Shark, Sandbar	*Carcharhinus plumbeus*
Shark, Scalloped Hammerhead	*Sphyrna lewini*
Shark, Silky	*Carcharhinus falciformis*
Shark, Spinner	*Carcharhinus brevipinna*
Shark, Tiger	*Galeocerdo cuvier*
OTHER ELASMOBRANCHS	
Guitarfish, Atlantic	*Rhinobatos lentiginosus*
Ray, Cownose	*Rhinoptera bonasus*
Ray, Smooth Butterfly	*Gymnura micrura*
Ray, Spotted Eagle	*Aetobatus narinari*
Skate, Clearnose	*Raja eglanteria*
Stingray, Atlantic	*Dasyatis sabina*
Stingray, Bluntnose	*Dasyatis say*
Stingray, Southern	*Dasyatis americana*
BONY FISHES	
Anchovy	*Anchoa* spp.
Batfish, Polka-dot	*Ogcocephalus radiatus*
Blenny, Florida	*Chasmodes saburrae*
Blue Runner	*Caranx crysos*
Bluefish	*Pomatomus saltatrix*
Bumper	*Chloroscombrus chrysurus*
Burrfish, Striped	*Chilomycterus schoepfi*
Butterfish, Gulf	*Peprilus burti*
Catfish, Gafftopsail	*Bagre marinus*
Catfish, Hardhead	*Arius felis*
Cichlid	*Tilapia* spp.
Cobia	*Rachycentron canadum*
Cowfish, Scrawled	*Lactophrys quadricornis*

Table 1 Continued

Croaker, Atlantic	***Micropogonias undulatus***
Drum, Black	***Pogonias cromis***
Drum, Red	***Sciaenops ocellatus***
Eel	**Anguilliformes**
Filefish, Orange	***Aluterus schoepfi***
Filefish, Planehead	***Monacanthus hispidus***
Filefish, Scrawled	***Aluterus scriptus***
Flounder, Gulf	***Paralichthys albigutta***
Flounder, Southern	***Paralichthys lethostigma***
Gar, Longnose	***Lepisosteus osseus***
Grouper, Black	***Mycteroperca bonaci***
Grouper, Red	***Epinephelus morio***
Grunt	***Haemulon* spp.**
Hake, Southern	***Urophycis floridana***
Harvestfish	***Peprilus alepidotus***
Herring, Atlantic Thread	***Opisthonema oglinum***
Houndfish	***Tylosurus crocodilus***
Jack, Crevalle	***Caranx hippos***
Jack, Horse-eye	***Caranx latus***
Kingfish, Gulf	***Menticirrhus littoralis***
Kingfish, Southern	***Menticirrhus americanus***
Ladyfish	***Elops saurus***
Leatherjacket	***Oligoplites saurus***
Lizardfish, Inshore	***Synodus foetens***
Lookdown	***Selene vomer***
Mackerel, King	***Scomberomorus cavalla***
Mackerel, Spanish	***Scomberomorus maculatus***
Menhaden, Yellowfin	***Brevoortia smithi***
Mojarra, Striped	***Diapterus plumieri***
Mojarra, Yellowfin	***Gerres cinereus***
Moonfish, Atlantic.	***Selene setapinnis***
Mullet, Striped	***Mugil cephalus***
Mullet, White	***Mugil curema***
Needlefish, Atlantic	***Strongylura marina***
Parrotfish, Emerald	***Nicholsina usta***
Perch, Sand	***Diplectrum formosum***
Perch, Silver	***Bairdiella chrysoura***
Permit	***Trachinotus falcatus***
Pigfish	***Orthopristis chrysoptera***
Pinfish	***Lagodon rhomboides***
Pipefish	***Syngnathus* spp.**
Pompano	***Trachinotus carolinus***
Porgy, Grass	***Calamus arctifrons***

Table 1 Continued

Porgy, Littlehead	***Calamus proridens***
Puffer, Southern	***Sphoeroides nephelus***
Razorfish, Pearly	***Hemipteronotus novacula***
Remora	***Remora remora***
Sardine, Scaled	***Harengula jaguana***
Sardine, Spanish	***Sardinella aurita***
Scad, Round	***Decapterus punctatus***
Scorpionfish	***Scorpaena* spp.**
Sea Bass, Black	***Centropristis striata***
Seahorse	***Hippocampus spp.***
Searobin	***Prionotus spp.***
Seatrout, Sand	***Cynoscion arenarius***
Seatrout, Spotted	***Cynoscion nebulosus***
Sharksucker	***Echeneis naucrates***
Sheepshead	***Archosargus probatocephalus***
Snapper, Gray	***Lutjanus griseus***
Snook	***Centropomus undecimalis***
Spadefish	***Chaetodipterus faber***
spot	***Leiostomus xanthurus***
Tarpon	***Megalops atlanticus***
Toadfish, Gulf	***Opsanus beta***
Tonguefish	***Symphurus* spp.**
Triggerfish, Gray	***Balistes capriscus***
Tripletail	***Lobotes surinamensis***
Tunny, Little	***Euthynnus alletteratus***
SEA TURTLES	
Sea Turtle, Green	***Chelone mydas***
Sea Turtle, Kemp's Ridley	***Lepidochelys kempi***
MARINE MAMMALS	
Dolphin, Atlantic Bottlenosed	***Tursiops truncatus***
INVERTEBRATES	
Crab, Blue	***Callinectes sapidus***
Crab, Hermit	**Paguridae**
Crab, Stone	***Menippe mercenaria***
Shrimp, Mantis	***Squilla empusa***
Shrimp, Penaeid	***Penaeus* spp.**
Shrimp, Pink	***Penaeus duorarum***
ANGIOSPERMS	
Grass, Manatee	***Syringodium filiforme***
Grass, Shoal	***Halodule wrightii***
Grass, Turtle	***Thalassia testudinum***
ALGAE	
Algae, Green	**Chlorophyta**

Table 2. Brief description of each primary sampling area and the designation used during the study for all surveys. See Figure 6.

	TAMPA BAY
	Bay Mouth
T1	- Mullet Key/North Egmont banks/beaches
T2	- North Anna Maria banks/beaches
	South Bay
T3	- South of Pinellas Peninsula (both sides of Skyway)
T4	- Marker 70 area (15-18'-deep water SW of Skyway)
T5	- Terra Ceia Bay/Manatee River mouth and adjacent area
T6	- Bishop Harbor/Cockroach Bay and adjacent area
T7	- South of Apollo Beach/Little Manatee River mouth
	North Bay
T8	- East Hillsborough Bay/Alafia River mouth
T9	- South of MacDill AFB/Interbay Peninsula
T10	- West Old Tampa Bay
T11	- North of Courtney Campbell Causeway/Safety Harbor
	CHARLOTTE HARBOR/PINE ISLAND SOUND
	Harbor Entrances
C1	- Banks/beaches near Boca Grande Pass
C2	- Banks/beaches near Matanzas Pass
	South Charlotte Harbor
C3	- Bull Bay/Turtle Bay/Cape Haze and adjacent area
	North Charlotte Harbor
C4	- East Harbor between Alligator Creek and Burnt Store Marina
C5	- Peace River/Hog Island and adjacent area
C6	- Myakka River/Tippecanoe Bay
	Pine Island Sound/Matlacha Pass
C7	- North Pine Island Sound north of Demere Key
C8	- South Pine Island Sound south of Demere Key
C9	- Matlacha Pass

Table 3. Total fishing effort by fishery, gear type, and area (Tampa Bay vs. Charlotte Harbor/Pine island Sound) of all fishery-independent and fishery-dependent samples for the entire study. Size of gear shown in inches of stretch mesh (in SM). NA = not available.

FISHERY GEAR AND EFFORT (#SETS/HOURS EFFORT)

FISHERY	GEAR	SIZE (in SM)	TOTAL	TAMPA BAY	CH. HARBOR
F-Indep.	Gill Net	3-5	152/297.1	71/139.4	81/157.7
F-Indep.	Gill Net	3.0	15/25.8	7/11.4	8/14.4
F-Indep.	Gill Net	4.0	10/16.2	10/16.2	
F-Indep.	Gill Net	4 5/8	485/712.1	236/348.8	242/353.5
F-Indep.	Longline	(#hooks var)	108/488.5	54/230.3	54/258.2
F-Indep.	Rod and Reel		12/25.1	6/14.6	6/10.5
F-I SUBTOTALS			**782/1564.8**	**384/760.7**	**391/794.3**
Baitfish	Purse Seine	0.5	5/8.1	5/8.1	
Bait Shrimp	Roller Frame Trawl	0.5	2/9.8		2/9.8
Food Shrimp	Otter Trawl	1.75	1/9.8		1/9.8
Mullet	Trammel Net	12/3-3.5	2/NA	2/NA	
Seatrout	Trammel Net	6/3	5/2.7	5/2.7	
Crevalle Jack	Trammel Net	12/3-3.5	1/NA	1/NA	
Mullet	Gill Net	3	7/5.9	1/0.4	6/5.5
Mullet	Gill Net	3-5 3/8	3/NA		3/NA
Mullet	Gill Net	3.5-4	3/NA	3/NA	
Mullet	Gill Net	4	3/1.0	3/1.0	
Mullet	Gill Net	4.25	6/6.2	6/6.2	
Mackerel	Gill Net	3.5	4/7.7	4/7.7	
Pompano	Gill Net	4.75	6/7.9	5/7.3	1/0.6
F-D SUBTOTALS			**48/58.3+**	**35/43.4+**	**13/25.7+**
TOTALS			**830/1623.1**	**419/794.3**	**404/820.0**

Table 4. Fishing effort by fishery, gear type, and season in Tampa Bay and Charlotte Harbor/Pine Island Sound surveys. Size of gear shown in inches of stretch mesh (in SM). NA = not available.

TAMPA BAY FISHERY, GEAR AND EFFORT (#SETS/HOURS EFFORT)											
FISHERY	GEAR	SIZE (in SM)	FALL91	WIN92	SPR92	SUM92	FALL92	WIN93	SPR93	SUM93	FALL93
F-Indep.	Gill Net	3-5		14/27.3	34/66.6	23/45.5					
F-Indep.	Gill Net	3.0								7/11.4	
F-Indep.	Gill Net	4.0					6/11.8	4/4.6			
F-Indep.	Gill Net	4 5/8					22/37.2	46/64.4	87/129.0	81/118.2	
F-Indep.	Longline	(#hooks var)		13/37.8	14/79.0	13/39.9	7/31.7		2/13.5	5/28.4	
F-Indep.	Rod and Reel					3/7.7	2/6.1				
Baitfish	Purse Seine	0.5	1/0.8				2/3.8	1/1.3		1/2.2	
Bait Shrimp	Frame Trawl	0.5									
Food Shrimp	Otter Trawl	1.75									
Mullet	Trammel Net	12/3-3.5				2/NA					
Seatrout	Trammel Net	6/3						5/2.7			
Crevalle Jack	Trammel Net	12/3-3.5				1/NA					
Mullet	Gill Net	3		1/0.4							
Mullet	Gill Net	3-5 3/8									
Mullet	Gill Net	3.5-4			3/NA						
Mullet	Gill Net	4	3/1.0								
Mullet	Gill Net	4.25	1/0.5				5/5.7				
Mackerel	Gill Net	3.5	2/3.5						2/4.2		
Pompano	Gill Net	4.75			5/7.3						
CHARLOTTE HARBOR FISHERY, GEAR AND EFFORT (#SETS/HOURS EFFORT)											
FISHERY	GEAR	SIZE (in SM)	FALL91	WIN92	SPR92	SUM92	FALL92	WIN93	SPR93	SUM93	FALL93
F-Indep.	Gill Net	3-5		21/41.4	37/72.1	24/45.2					
F-Indep.	Gill Net	3								8/14.4	
F-Indep.	Gill Net	4									
F-Indep.	Gill Net	4 5/8					19/34.0	39/65.0	83/118.1	100/135.4	3/5.2
F-Indep.	Longline	(#hooks var)		17/62.3	13/76.8	8/35.8	10/40.1	2/16.5	3/20.0	1/6.7	
F-Indep.	Rod and Reel		4/9.1							2/1.4	
Baitfish	Purse Seine	0.5									
Bait Shrimp	Frame Trawl	0.5		1/5.0				1/4.8			
Food Shrimp	Otter Trawl	1.75		1/9.8							
Mullet	Trammel Net	12/3-3.5									
Seatrout	Trammel Net	6/3									
Crevalle Jack	Trammel Net	12/3-3.5									
Mullet	Gill Net	3			3/NA						
Mullet	Gill Net	3-5 3/8									
Mullet	Gill Net	3.5-4									
Mullet	Gill Net	4									
Mullet	Gill Net	4.25									
Mackerel	Gill Net	3.5			6/5.5						
Pompano	Gill Net	4.75		1/0.6							

Table 5. Species and number of sharks tagged in all surveys, sharks tagged in the recreational fishery (via Gulf Coast Shark Census tournaments and other sources), and other marine animals tagged in all surveys.

SHARKS TAGGED IN ALL SURVEYS	
Common name	**Number**
Shark, Atlantic Sharpnose	29
Shark, Blacknose	143
Shark, Blacktip	232
Shark, Bonnethead	743
Shark, Bull	52
Shark, Florida Smoothhound	8
Shark, Great Hammerhead	14
Shark, Lemon	10
Shark, Nurse	10
Shark, Sandbar	1
Shark, Scalloped Hammerhead	4
Shark, Spinner	1
Totals	1218
SHARKS TAGGED IN RECREATIONAL FISHERY	
Common name	**Number**
Shark, Atlantic Sharpnose	4
Shark, Blacknose	100
Shark, Blacktip	26
Shark, Bonnethead	2
Shark, Great Hammerhead	4
Shark, Nurse	1
Totals	133
NON-SHARKS TAGGED IN ALL SURVEYS	
Common name	**Number**
Cobia	25
Drum, Black	3
Drum, Red	21
Seatrout, Spotted	53
Snook	3
Sea Turtle, Kemp's Ridley	2
Totals	107

Table 6. Total catch from all surveys combined showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width; ** measurements are straight carapace length; * * * numbers were estimated in a few instances). NA = not available.

CATCH FROM ALL SURVEYS COMBINED					
			830 Sets	1623.1 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Atlantic Sharpnose	45	44	52.3	37	82
Shark, Blacknose	187	164	71.9	36	107
Shark, Blacktip	387	384	61.3	42	110
Shark, Bonnethead	1118	1116	63.9	30	94
Shark, Bull	60	57	67.9	56	106
Shark, Finetooth	1	1	74.0	74	74
Shark, Florida Smoothhound	9	8	65.6	57	93
Shark, Great Hammerhead	20	14	79.4	62	104
Shark, Lemon	10	10	61.7	51	93
Shark, Nurse	13	5	94.6	53	132
Shark, Sandbar	1	1	156.0	156	156
Shark, Scalloped Hammerhead	9	9	49.2	47	54
Shark, Spinner	2	2	61.5	60	63
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	29	25	56.1	32	72
Ray, Cownose*	532	268	46.7	26	84
Ray, Smooth Butterfly*	9	9	30.8	23	40
Ray, Spotted Eagle*	18	13	59.5	3	102
Skate, Clearnose*	66	61	38.3	19	53
Stingray, Atlantic*	130	112	25.2	15	56
Stingray, Bluntnose*	8	8	24.0	14	47
Stingray, Southern*	111	87	58.1	16	120
BONY FISHES					
Anchovy	13	3	9.0	9	9
Batfish, Polka-dot	7	2	26.0	22	30
Blenny, Florida	1	1	8.0	8	8
Blue Runner	24	24	24.3	17	27
Bluefish	59	58	37.8	22	53
Bumper	111	63	17.8	12	32
Burrfish, Striped	116	87	20.8	12	32
Butterfish, Gulf	10	10	15.9	15	17
Catfish, Gafftopsail	2200	1816	39.3	14	53
Catfish, Hardhead	2027	1522	32.0	2	48
Cichlid	4	4	32.0	23	36
Cobia	52	49	62.1	42	87
Cowfish, Scrawled	57	28	22.7	15	37
Croaker, Atlantic	6	6	29.5	20	42
Drum, Black	13	12	37.8	29	47
Drum, Red	30	28	44.7	23	60
Eel	10	1	60.0	60	60
Filefish, Orange	18	14	31.4	16	41
Filefish, Planehead	2	2	15.5	10	21
Filefish, Scrawled	1	0	NA	NA	NA
Flounder, Gulf	117	93	31.9	10	55
Flounder, Southern	4	4	24.3	21	32
Gar, Longnose	4	4	103.5	87	114
Grouper, Black	2	2	30.0	28	32
Grouper, Red	2	2	28.0	21	35
Grunt	10	0	NA	NA	NA
Hake, Southern	11	0	NA	NA	NA
Harvestfish	129	96	16.8	11	21
Herring, Atlantic Thread***	57368	145	15.5	8	19

Table 6 Continued

COMMON NAME	N captured	N measured	Average	Minimum	Maximum
Houndfish	2	2	80.5	73	88
Jack, Crevalle	343	201	29.1	17	50
Jack, Horse-eye	1	1	35.0	35	35
Kingfish, Gulf	6	1	23.0	23	23
Kingfish, Southern	11	11	30.1	24	35
Ladyfish	439	301	33.4	14	57
Leatherjacket	17	17	18.3	12	22
Lizardfish, Inshore	15	10	24.4	14	36
Lookdown	24	24	16.9	8	20
Mackerel, King	1	0	NA	NA	NA
Mackerel, Spanish	565	334	45.4	15	68
Menhaden, Yellowfin	1182	453	22.9	14	30
Mojarra, Striped	69	22	23.0	12	28
Moonfish, Atlantic	1	1	12.0	12	12
Mullet, Striped	996	208	34.0	26	45
Needlefish, Atlantic	1	1	40.0	40	40
Parrotfish, Emerald	10	0	NA	NA	NA
Perch, Sand	19	6	13.8	4	18
Perch, Silver	14	9	18.8	14	26
Permit	193	187	24.0	12	55
Pigfish	203	194	22.1	14	26
Pinfish***	2344	214	15.4	6	27
Pipefish	219	10	11.5	9	13
Pompano	192	179	27.8	17	41
Porgy, Grass	3	3	18.3	18	19
Porgy, Littlehead	1	1	23.0	23	23
Puffer, Southern	58	14	10.4	3	19
Razorfish, Pearly	6	0	NA	NA	NA
Remora	1	1	58.0	58	58
Sardine, Scaled	145	6	11.0	8	13
Sardine, Spanish***	910	10	15.9	15	17
Scad, Round***	1552	32	16.3	14	21
Scorpionfish	11	0	NA	NA	NA
Sea Bass, Black	46	1	31.0	31	31
Seahorse	9	0	NA	NA	NA
Searobin	192	23	16.7	13	23
Seatrout, Sand	63	56	28.2	14	75
Seatrout, Spotted	119	112	42.0	11	64
Sharksucker	12	11	45.7	30	65
Sheepshead	116	111	28.0	6	49
Snapper, Gray	19	19	26.0	24	34
Snook	9	8	44.6	34	68
Spadefish	366	266	19.1	11	38
Spot	54	53	21.5	14	27
Tarpon	1	1	44.0	44	44
Toadfish, Gulf***	200	10	13.0	11	18
Tonguefish	20	0	NA	NA	NA
Triggerfish, Gray	15	0	NA	NA	NA
Tripletail	3	3	57.7	50	66
Tunny, Little	25	23	63.8	53	88
SEA TURTLES					
Sea Turtle, Green**	3	3	32.7	30	38
Sea Turtle, Kemp's Ridley**	3	3	25.7	23	28
MARINE MAMMALS					
Dolphin, Atlantic Bottlenosed	1	1	225.0	225	225

Table 7. Formulas for conversion of fork length (FL) in cm to precaudal length (PCL), total length (TL), and stretch total length (STL) in cm for shark species for which data were sufficient to calculate, using data collected for this study only. Ranges of FL used in calculating linear regressions are given below species names. Correlation coefficients, significances, and standard errors of the regressions are shown. ** = insufficient data available.**

CONVERSIONS FROM FORK LENGTH FOR SHARK SPECIES					
Common Name	Formula (in cm)	N	R	Significance	Std. Error
Atlantic Sharpnose	PCL = 0.702 + 0.898xFL	43	0.997	P<0.001 ***	0.738
(37-82cm FL)	TL = 0.377 + 1.158xFL	43	0.980	P<0.001 ***	1.158
	STL = 3.911 + 1.152xFL	31	0.997	P<0.001 ***	1.202
Blacknose	PCL = 0.058 + 0.907xFL	151	0.997	P<0.001 ***	1.319
(36-107cm FL)	TL = 3.517 + 1.132xFL	151	0.985	P<0.001 ***	3.898
	STL = 3.352 + 1.192xFL	97	0.989	P<0.001 ***	2.956
Blacktip	PCL = -0.407 + 0.907xFL	385	0.997	P<0.001 ***	1.836
(42-110cm FL)	TL = 1.214 + 1.173xFL	385	0.982	P<0.001 ***	6.076
	STL = 1.682 + 1.233xFL	268	0.999	P<0.001 ***	1.057
Bonnethead	PCL = -3.605 + 0.978xFL	1209	0.995	P<0.001 ***	7.444
(30-94cm FL)	TL = -0.275 + 1.189xFL	1209	0.986	P<0.001 ***	14.968
	STL = 6.749 + 1.148xFL	921	0.994	P<0.001 ***	8.027
Bull	PCL = 1.033 + 0.883xFL	62	0.997	P<0.001 ***	0.651
(56-106cm FL)	TL = 1.795 + 1.143xFL	62	0.977	P<0.001 ***	2.270
	STL = 1.826 + 1.224xFL	58	0.997	P<0.001 ***	0.818
Florida Smoothhound	PCL = 13.763 + 0.711xFL	4	0.945	P<0.001 ***	0.761
(57-93cm FL)	TL = 20.395 + 0.816xFL	4	0.996	P<0.001 ***	0.229
	****				
Great Hammerhead	PCL = -1.845 + 0.937xFL	14	0.998	P<0.001 ***	0.889
(62-104cm FL)	TL = -7.743 + 1.370xFL	14	0.985	P<0.001 ***	3.793
	STL = 1.012 + 1.327xFL	9	0.998	P<0.001 ***	1.270
Lemon	PCL = 1.162 + 0.897xFL	11	0.999	P<0.001 ***	0.539
(51-93cm FL)	TL = 3.668 + 1.100xFL	11	0.987	P<0.001 ***	2.316
	STL = -4.519 + 1.265xFL	4	0.998	P=0.002 **	0.668
Nurse	PCL = 2.080 + 0.872xFL	5	1.000	P<0.001 ***	0.912
(53-132cm FL)	TL = -2.800 + 1.309xFL	5	1.000	P<0.001 ***	1.236
	****				
Scalloped Hammerhead	PCL = -3.391 + 0.976xFL	9	0.971	P<0.001 ***	0.561
(47-54cm FL)	TL = -17.328 + 1.571xFL	9	0.993	P<0.001 ***	0.433
	STL = 5.308 + 1.231xFL	9	0.967	P<0.001 ***	0.756

Table 8. Total catch from all fishery-independent surveys showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width; ** measurements are straight carapace length). NA = not available.

CATCH FROM ALL FISHERY-INDEPENDENT SURVEYS					
			782 Sets	1564.8 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Atlantic Sharpnose	38	38	50.0	37	78
Shark, Blacknose	87	86	62.3	36	99
Shark, Blacktip	355	354	60.0	42	110
Shark, Bonnethead	1113	1112	64.0	30	94
Shark, Bull	60	57	67.9	56	106
Shark, Finetooth	1	1	74.0	74	74
Shark, Florida Smoothhound	4	4	60.5	57	63
Shark, Great Hammerhead	16	14	79.4	62	104
Shark, Lemon	9	9	58.2	51	69
Shark, Nurse	11	5	94.6	53	132
Shark, Sandbar	1	1	156.0	156	156
Shark, Scalloped Hammerhead	9	9	49.2	47	54
Shark, Spinner	2	2	61.5	60	63
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	28	24	56.1	32	72
Ray, Cownose*	520	267	46.6	26	84
Ray, Smooth Butterfly*	9	9	30.8	23	40
Ray, Spotted Eagle*	14	12	55.9	3	68
Skate, Clearnose*	63	58	38.8	31	53
Stingray, Atlantic*	118	109	25.2	15	56
Stingray, Bluntnose*	8	8	24.0	14	47
Stingray, Southern*	104	81	58.7	16	120
BONY FISHES					
Anchovy	3	3	9.0	9	9
Batfish, Polka-dot	1	1	22.0	22	22
Blue Runner	16	16	24.1	17	27
Bluefish	45	45	37.5	22	53
Bumper	66	61	17.9	12	32
Burrfish, Striped	90	85	20.7	12	32
Catfish, Gafftopsail	2178	1794	39.4	14	53
Catfish, Hardhead	1897	1486	32.1	2	48
Cobia	44	42	64.3	42	87
Cowfish, Scrawled	20	19	23.1	15	37
Croaker, Atlantic	5	5	27.0	20	32
Drum, Black	7	7	34.6	32	37
Drum, Red	26	26	45.2	23	60
Eel	1	1	60.0	60	60
Filefish, Orange	13	13	32.6	26	41
Filefish, Planehead	2	2	15.5	10	21
Filefish, Scrawled	1	0	NA	NA	NA
Flounder, Gulf	84	79	33.2	19	55
Flounder, Southern	1	1	32.0	32	32
Gar, Longnose	4	4	103.5	87	114
Grouper, Black	2	2	30.0	28	32
Grouper, Red	2	2	28.0	21	35

Table 8 Continued

COMMON NAME	N captured	N measured	Average	Minimum	Maximum
Harvestfish	129	96	16.8	11	21
Herring, Atlantic Thread	116	102	15.8	12	19
Houndfish	2	2	80.5	73	88
Jack, Crevalle	211	176	28.2	17	49
Jack, Horse-eye	1	1	35.0	35	35
Kingfish, Gulf	1	1	23.0	23	23
Kingfish, Southern	11	11	30.1	24	35
Ladyfish	323	278	33.1	21	57
Leatherjacket	17	17	18.3	12	22
Lizardfish, Inshore	7	7	26.3	19	36
Lookdown	19	19	17.3	15	20
Mackerel, Spanish	468	290	45.6	15	68
Menhaden, Yellowfin	1162	443	22.8	14	30
Mojarra, Striped	42	21	23.6	15	28
Mojarra, Yellowfin	2	2	22.0	21	23
Moonfish, Atlantic	1	1	12.0	12	12
Mullet, Striped	17	17	31.2	26	34
Mullet, White	2	2	29.0	28	30
Needlefish, Atlantic	1	1	40.0	40	40
Perch, Silver	7	7	17.4	14	21
Permit	192	186	23.9	12	55
Pigfish	119	108	21.6	14	26
Pinfish	214	190	15.9	8	27
Pompano	157	145	27.2	17	41
Porgy, Grass	3	3	18.3	18	19
Porgy, Littlehead	1	1	23.0	23	23
Puffer, Southern	8	4	17.8	16	19
Remora	1	1	58.0	58	58
Sardine, Scaled	5	5	11.4	8	13
Scad, Round	2	2	19.5	18	21
Sea Bass, Black	1	1	31.0	31	31
Searobin	8	7	19.3	17	23
Seatrout, Sand	60	53	26.9	18	42
Seatrout, Spotted	100	98	45.1	29	64
Sharksucker	12	11	45.7	30	65
Sheepshead	49	49	26.8	17	37
Snapper, Gray	17	17	26.0	24	34
Snook	6	6	37.5	34	43
Spadefish	330	247	18.6	11	38
Spot	45	44	21.9	14	27
Tarpon	1	1	44.0	44	44
Tripletail	3	3	57.7	50	66
Tunny, Little	24	23	63.8	53	88
SEA TURTLES					
Sea Turtle, Green**	3	3	32.7	30	38
Sea Turtle, Kemp's Ridley**	3	3	25.7	23	28
MARINE MAMMALS					
Dolphin, Atlantic Bottlenosed	1	1	225.0	225	225

Table 9. Total catch from all fishery-independent surveys in Tampa Bay showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width; * * measurements are straight carapace length).

TOTAL CATCH FROM TAMPA BAY FISHERY-INDEPENDENT SURVEYS					
			384 Sets	760.7 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Atlantic Sharpnose	23	23	49.6	40	78
Shark, Blacknose	63	62	67.1	37	94
Shark, Blacktip	84	83	66.7	44	110
Shark, Bonnethead	568	567	66.1	31	94
Shark, Bull	46	46	66.7	56	96
Shark, Florida Smoothhound	3	3	60.3	57	63
Shark, Great Hammerhead	5	3	94.0	77	104
Shark, Lemon	9	9	58.2	51	69
Shark, Nurse	2	1	95.0	95	95
Shark, Spinner	1	1	60.0	60	60
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	21	20	57.1	51	72
Ray, Cownose*	348	144	45.8	26	84
Ray, Smooth Butterfly*	2	2	30.5	28	33
Ray, Spotted Eagle*	3	1	55.0	55	55
Skate, Clearnose*	23	23	38.0	31	53
Stingray, Atlantic*	78	69	25.4	15	48
Stingray, Bluntnose*	8	8	24.0	14	47
Stingray, Southern*	41	35	60.8	19	103
BONY FISHES					
Anchovy	3	3	9.0	9	9
Blue Runner	2	2	21.5	17	26
Bluefish	12	12	39.3	22	53
Bumper	16	16	20.4	14	32
Burrfish, Striped	29	29	20.3	13	32
Catfish, Gafftopsail	839	738	39.8	14	53
Catfish, Hardhead	1276	960	33.0	2	48
Cobia	22	22	67.2	48	87
Cowfish, Scrawled	13	13	22.5	15	28
Croaker, Atlantic	3	3	24.3	20	27
Drum, Black	7	7	34.6	32	37
Drum, Red	19	19	46.7	30	60
Eel	1	1	60.0	60	60
Filefish, Orange	10	10	32.7	27	37
Filefish, Planehead	2	2	15.5	10	21
Flounder, Gulf	47	46	33.3	20	51
Harvestfish	85	69	16.6	11	21
Herring, Atlantic Thread	12	12	15.8	12	17
Houndfish	2	2	80.5	73	88
Jack, Crevalle	60	60	32.2	19	49
Jack, Horse-eye	1	1	35.0	35	35
Ladyfish	198	158	32.9	21	47
Leatherjacket	9	9	18.2	12	22
Lizardfish, Inshore	6	6	26.3	19	36
Lookdown	10	10	17.2	15	19

Table 9 Continued

COMMON NAME	N captured	N measured	Average	Minimum	Maximum
Mackerel, Spanish	219	145	48.4	26	68
Menhaden, Yellowfin	407	145	23.7	19	30
Mojarra, Striped	2	2	23.0	22	24
Mojarra, Yellowfin	1	1	23.0	23	23
Moonfish, Atlantic	1	1	12.0	12	12
Mullet, Striped	8	8	30.6	26	34
Needlefish, Atlantic	1	1	40.0	40	40
Perch, Silver	1	1	17.0	17	17
Permit	116	110	25.4	17	55
Pigfish	81	70	21.7	15	25
Pinfish	145	131	16.2	8	27
Pompano	68	68	27.4	17	38
Porgy, Grass	3	3	18.3	18	19
Sardine, Scaled	4	4	12.3	12	13
Scad, Round	1	1	18.0	18	18
Sea Bass, Black	1	1	31.0	31	31
Searobin	3	3	19.0	19	19
Seatrout, Sand	26	26	26.3	21	42
Seatrout, Spotted	55	55	44.4	29	64
Sharksucker	4	4	39.3	30	48
Sheepshead	30	30	26.5	17	35
Snapper, Gray	4	4	25.0	24	26
Snook	1	1	43.0	43	43
Spadefish	265	182	18.7	11	38
Spot	14	14	21.8	14	27
Tunny, Little	24	23	63.8	53	88
SEA TURTLES					
Sea Turtle, Green**	2	2	30.0	30	30
Sea Turtle, Kemp's Ridley**	1	1	26.0	26	26
MARINE MAMMALS					
Dolphin, Atlantic Bottlenosed	1	1	225.0	225	225

Table 10. Total catch from all fishery-independent surveys in Charlotte Harbor/Pine Island Sound showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width; * * measurements are straight carapace length). NA = not available.

TOTAL CATCH FROM CHARLOTTE HARBOR FISHERY-INDEPENDENT SURVEYS					
			391 Sets	794.3 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Atlantic Sharpnose	15	15	50.5	37	71
Shark, Blacknose	24	24	49.9	36	99
Shark, Blacktip	248	248	58.6	43	93
Shark, Bonnethead	539	539	61.8	30	91
Shark, Bull	14	11	72.7	58	106
Shark, Finetooth	1	1	74.0	74	74
Shark, Florida Smoothhound	1	1	61.0	61	61
Shark, Great Hammerhead	11	11	75.4	62	98
Shark, Nurse	9	4	94.5	53	132
Shark, Sandbar	1	1	156.0	156	156
Shark, Scalloped Hammerhead	9	9	49.2	47	54
Shark, Spinner	1	1	63.0	63	63
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	7	4	51.3	32	60
Ray, Cownose*	172	123	47.5	30	81
Ray, Smooth Butterfly*	7	7	30.9	23	40
Ray, Spotted Eagle*	11	11	56.0	3	68
Skate, Clearnose*	40	35	39.4	31	46
Stingray, Atlantic*	40	40	25.0	16	56
Stingray, Southern*	63	46	57.2	16	120
BONY FISHES					
Batfish, Polka-dot	1	1	22.0	22	22
Blue Runner	14	14	24.4	23	27
Bluefish	33	33	36.9	30	49
Bumper	50	45	16.9	12	24
Burrfish, Striped	61	56	21.0	12	31
Catfish, Gafftopsail	1288	1043	39.1	16	53
Catfish, Hardhead	620	525	30.2	16	43
Cobia	22	20	61.1	42	82
Cowfish, Scrawled	7	6	24.5	17	37
Croaker, Atlantic	2	2	31.0	30	32
Drum, Red	7	7	41.0	23	57
Filefish, Orange	3	3	32.3	26	41
Filefish, Scrawled	1	0	NA	NA	NA
Flounder, Gulf	37	33	32.9	19	55
Flounder, Southern	1	1	32.0	32	32
Gar, Longnose	3	3	101.0	87	114
Grouper, Black	2	2	30.0	28	32
Grouper, Red	2	2	28.0	21	35
Harvestfish	9	9	16.6	11	19
Herring, Atlantic Thread	104	90	15.8	14	19
Jack, Crevalle	151	116	26.2	17	47
Kingfish, Gulf	1	1	23.0	23	23
Kingfish, Southern	11	11	30.1	24	35
Ladyfish	125	120	33.3	23	57

Table 10 Continued

COMMON NAME	N captured	N measured	Average	Minimum	Maximum
Leatherjacket	8	8	18.4	13	22
Lizardfish, Inshore	1	1	26.0	26	26
Lookdown	9	9	17.4	16	20
Mackerel, Spanish	249	145	42.8	15	59
Menhaden, Yellowfin	754	297	22.4	14	30
Mojarra, Striped	40	19	23.6	15	28
Mojarra, Yellowfin	1	1	21.0	21	21
Mullet, Striped	9	9	31.8	29	34
Mullet, White	2	2	29.0	28	30
Perch, Silver	6	6	17.4	14	21
Permit	75	75	21.6	12	34
Pigfish	38	38	21.5	14	26
Pinfish	69	59	15.2	10	20
Pompano	84	72	27.0	18	41
Porgy, Littlehead	1	1	23.0	23	23
Puffer, Southern	8	4	17.8	16	19
Remora	1	1	58.0	58	58
Sardine, Scaled	1	1	8.0	8	8
Scad, Round	1	1	21.0	21	21
Searobin	5	4	19.5	17	23
Seatrout, Sand	34	27	27.6	18	38
Seatrout, Spotted	45	43	45.9	30	64
Sharksucker	8	7	49.4	36	65
Sheepshead	19	19	27.4	22	37
Snapper, Gray	13	13	26.3	24	34
Snook	5	5	36.4	34	40
Spadefish	65	65	18.2	11	30
Spot	31	30	22.0	16	24
Tarpon	1	1	44.0	44	44
Tripletail	3	3	57.7	50	66
SEA TURTLES					
Sea Turtle, Green**	1	1	38.0	38	38
Sea Turtle, Kemp's Ridley**	2	2	25.5	23	28

Table 11. Total catch from all fishery-independent gill net surveys showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width; ** measurements are straight carapace length). NA = not available.

TOTAL CATCH FROM FISHERY-INDEPENDENT GILL NET SURVEYS					
			662 Sets	1051.2 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Atlantic Sharpnose	35	35	50.1	37	78
Shark, Blacknose	48	48	57.9	36	92
Shark, Blacktip	318	318	58.6	42	110
Shark, Bonnethead	1112	1111	64.0	30	94
Shark, Bull	56	55	67.7	56	106
Shark, Florida Smoothhound	4	4	60.5	57	63
Shark, Great Hammerhead	14	12	76.9	62	104
Shark, Lemon	9	9	58.2	51	69
Shark, Nurse	6	2	70.5	53	88
Shark, Scalloped Hammerhead	9	9	49.2	47	54
Shark, Spinner	2	2	61.5	60	63
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	28	24	56.1	32	72
Ray, Cownose*	519	267	46.6	26	84
Ray, Smooth Butterfly*	9	9	30.8	23	40
Ray, Spotted Eagle*	13	11	60.7	51	68
Skate, Clearnose*	2	1	34.0	34	34
Stingray, Atlantic*	116	107	24.9	15	56
Stingray, Bluntnose*	8	8	24.0	14	47
Stingray, Southern*	47	36	50.6	16	120
BONY FISHES					
Anchovy	3	3	9.0	9	9
Batfish, Polka-dot	1	1	22.0	22	22
Blue Runner	16	16	24.1	17	27
Bluefish	45	45	37.5	22	53
Bumper	66	61	17.9	12	32
Burrfish, Striped	89	85	20.7	12	32
Catfish, Gafftopsail	1832	1468	39.5	14	53
Catfish, Hardhead	1790	1379	32.2	16	48
Cobia	40	39	64.5	47	87
Cowfish, Scrawled	20	19	23.1	15	37
Croaker, Atlantic	5	5	27.0	20	32
Drum, Black	7	7	34.6	32	37
Drum, Red	26	26	45.2	23	60
Filefish, Orange	13	13	32.6	26	41
Filefish, Planehead	2	2	15.5	10	21
Filefish, Scrawled	1	0	NA	NA	NA
Flounder, Gulf	83	79	33.2	19	55
Flounder, Southern	1	1	32.0	32	32
Gar, Longnose	4	4	103.5	87	114
Grouper, Red	1	1	21.0	21	21
Harvestfish	129	96	16.8	11	21
Herring, Atlantic Thread	116	102	15.8	12	19
Houndfish	2	2	80.5	73	88
Jack, Crevalle	211	176	28.2	17	49

Table 11 Continued

COMMON NAME	N captured	N measured	Average	Minimum	Maximum
Jack, Horse-eye	1	1	35.0	35	35
Kingfish, Gulf	1	1	23.0	23	23
Kingfish, Southern	11	11	30.1	24	35
Ladyfish	323	278	33.1	21	57
Leatherjacket	17	17	18.3	12	22
Lizardfish, Inshore	7	7	26.3	19	36
Lookdown	19	19	17.3	15	20
Mackerel, Spanish	466	289	45.6	15	68
Menhaden, Yellowfin	1118	443	22.8	14	30
Mojarra, Striped	42	21	23.6	15	28
Mojarra, Yellowfin	2	2	22.0	21	23
Moonfish, Atlantic	1	1	12.0	12	12
Mullet, Striped	17	17	31.2	26	34
Mullet, White	2	2	29.0	28	30
Needlefish, Atlantic	1	1	40.0	40	40
Perch, Silver	7	7	17.4	14	21
Permit	192	186	23.9	12	55
Pigfish	119	108	21.6	14	26
Pinfish	213	189	15.9	8	27
Pompano	155	143	27.1	17	41
Porgy, Grass	3	3	18.3	18	19
Porgy, Littlehead	1	1	23.0	23	23
Puffer, Southern	8	4	17.8	16	19
Remora	1	1	58.0	58	58
Sardine, Scaled	5	5	11.4	8	13
Scad, Round	2	2	19.5	18	21
Searobin	8	7	19.3	17	23
Seatrout, Sand	59	53	26.9	18	42
Seatrout, Spotted	100	98	45.1	29	64
Sharksucker	10	10	45.9	30	65
Sheepshead	49	49	26.8	17	37
Snapper, Gray	17	17	26.0	24	34
Snook	6	6	37.5	34	43
Spadefish	330	247	18.6	11	38
Spot	44	44	21.9	14	27
Tarpon	1	1	44.0	44	44
Tripletail	1	1	50.0	50	50
Tunny, Little	24	23	63.8	53	88
SEA TURTLES					
Sea Turtle, Green**	3	3	32.7	30	38
Sea Turtle, Kemp's Ridley**	3	3	25.7	23	28
MARINE MAMMALS					
Dolphin, Atlantic Bottlenosed	1	1	225.0	225	225

Table 12. Total catch from all fishery-independent gill net surveys in Tampa Bay showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width; * * measurements are straight carapace length).

TOTAL CATCH FROM TAMPA BAY FISHERY-INDEPENDENT GILL NET SURVEYS					
			324 Sets	515.8 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Atlantic Sharpnose	21	21	50.0	40	78
Shark, Blacknose	27	27	67.3	47	92
Shark, Blacktip	53	53	63.7	44	110
Shark, Bonnethead	568	567	66.1	31	94
Shark, Bull	45	45	66.8	56	96
Shark, Florida Smoothhound	3	3	60.3	57	63
Shark, Great Hammerhead	5	3	94.0	77	104
Shark, Lemon	9	9	58.2	51	69
Shark, Spinner	1	1	60.0	60	60
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	21	20	57.1	51	72
Ray, Cownose*	348	144	45.8	26	84
Ray, Smooth Butterfly*	2	2	30.5	28	33
Ray, Spotted Eagle*	3	1	55.0	55	55
Skate, Clearnose*	1	1	34.0	34	34
Stingray, Atlantic*	78	69	25.4	15	48
Stingray, Bluntnose*	8	8	24.0	14	47
Stingray, Southern*	18	16	55.7	19	103
BONY FISHES					
Anchovy	3	3	9.0	9	9
Blue Runner	2	2	21.5	17	26
Bluefish	12	12	39.3	22	53
Bumper	16	16	20.4	14	32
Burrfish, Striped	29	29	20.3	13	32
Catfish, Gafftopsail	681	580	39.8	14	52
Catfish, Hardhead	1223	906	33.1	17	48
Cobia	22	22	67.2	48	87
Cowfish, Scrawled	13	13	22.5	15	28
Croaker, Atlantic	3	3	24.3	20	27
Drum, Black	7	7	34.6	32	37
Drum, Red	19	19	46.7	30	60
Filefish, Orange	10	10	32.7	27	37
Filefish, Planehead	2	2	15.5	10	21
Flounder, Gulf	47	46	33.3	20	51
Harvestfish	85	69	16.6	11	21
Herring, Atlantic Thread	12	12	15.8	12	17
Houndfish	2	2	80.5	73	88
Jack, Crevalle	60	60	32.2	19	49
Jack, Horse-eye	1	1	35.0	35	35
Ladyfish	198	158	32.9	21	47
Leatherjacket	9	9	18.2	12	22
Lizardfish, Inshore	6	6	26.3	19	36
Lookdown	10	10	17.2	15	19
Mackerel, Spanish	218	144	48.4	26	68
Menhaden, Yellowfin	407	145	23.7	19	30

Table 12 Continued

COMMON NAME	N captured	N measured	Average	Minimum	Maximum
Mojarra, Striped	2	2	23.0	22	24
Mojarra, Yellowfin	1	1	23.0	23	23
Moonfish, Atlantic	1	1	12.0	12	12
Mullet, Striped	8	8	30.6	26	34
Needlefish, Atlantic	1	1	40.0	40	40
Perch, Silver	1	1	17.0	17	17
Permit	116	110	25.4	17	55
Pigfish	81	70	21.7	15	25
Pinfish	144	130	16.2	8	27
Pompano	66	66	27.4	17	38
Porgy, Grass	3	3	18.3	18	19
Sardine, Scaled	4	4	12.3	12	13
Scad, Round	1	1	18.0	18	18
Searobin	3	3	19.0	19	19
Seatrout, Sand	26	26	26.3	21	42
Seatrout, Spotted	55	55	44.4	29	64
Sharksucker	4	4	39.3	30	48
Sheepshead	30	30	26.5	17	35
Snapper, Gray	4	4	25.0	24	26
Snook	1	1	43.0	43	43
Spadefish	265	182	18.7	11	38
Spot	14	14	21.8	14	27
Tunny, Little	24	23	63.8	53	88
SEA TURTLES					
Sea Turtle, Green**	2	2	30.0	30	30
Sea Turtle, Kemp's Ridley**	1	1	26.0	26	26
MARINE MAMMALS					
Dolphin, Atlantic Bottlenosed	1	1	225.0	225	225

Table 13. Total catch from all fishery-independent gill net surveys in Charlotte Harbor/Pine Island Sound showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width; * * measurements are straight carapace length). NA = not available.

TOTAL CATCH FROM CHARLOTTE HARBOR F-I GILL NET SURVEYS					
			334 Sets	530.8 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Atlantic Sharpnose	14	14	50.1	37	71
Shark, Blacknose	21	21	45.9	36	74
Shark, Blacktip	242	242	58.4	43	93
Shark, Bonnethead	538	538	61.9	30	91
Shark, Bull	11	10	71.8	58	106
Shark, Florida Smoothhound	1	1	61.0	61	61
Shark, Great Hammerhead	9	9	71.2	62	90
Shark, Nurse	6	2	70.5	53	88
Shark, Scalloped Hammerhead	9	9	49.2	47	54
Shark, Spinner	1	1	63.0	63	63
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	7	4	51.3	32	60
Ray, Cownose*	171	123	47.5	30	81
Ray, Smooth Butterfly*	7	7	30.9	23	40
Ray, Spotted Eagle*	10	10	61.3	51	68
Skate, Clearnose*	1	0	NA	NA	NA
Stingray, Atlantic*	38	38	24.1	16	56
Stingray, Southern*	29	20	46.6	16	120
BONY FISHES					
Batfish, Polka-dot	1	1	22.0	22	22
Blue Runner	14	14	24.4	23	27
Bluefish	33	33	36.9	30	49
Bumper	50	45	16.9	12	24
Burrfish, Striped	60	56	21.0	12	31
Catfish, Gafftopsail	1100	875	39.2	16	53
Catfish, Hardhead	566	472	30.3	16	42
Cobia	18	17	61.0	47	77
Cowfish, Scrawled	7	6	24.5	17	37
Croaker, Atlantic	2	2	31.0	30	32
Drum, Red	7	7	41.0	23	57
Filefish, Orange	3	3	32.3	26	41
Filefish, Scrawled	1	0	NA	NA	NA
Flounder, Gulf	36	33	32.9	19	55
Flounder, Southern	1	1	32.0	32	32
Gar, Longnose	3	3	101.0	87	114
Grouper, Red	1	1	21.0	21	21
Harvestfish	9	9	16.6	11	19
Herring, Atlantic Thread	104	90	15.8	14	19
Jack, Crevalle	151	116	26.2	17	47
Kingfish, Gulf	1	1	23.0	23	23
Kingfish, Southern	11	11	30.1	24	35
Ladyfish	125	120	33.3	23	57
Leatherjacket	8	8	18.4	13	22
Lizardfish, Inshore	1	1	26.0	26	26
Lookdown	9	9	17.4	16	20

Table 13 Continued

COMMON NAME	N captured	N measured	Average	Minimum	Maximum
Mackerel, Spanish	248	145	42.8	15	59
Menhaden, Yellowfin	710	297	22.4	14	30
Mojarra, Striped	40	19	23.6	15	28
Mojarra, Yellowfin	1	1	21.0	21	21
Mullet, Striped	9	9	31.8	29	34
Mullet, White	2	2	29.0	28	30
Perch, Silver	6	6	17.4	14	21
Permit	75	75	21.6	12	34
Pigfish	38	38	21.5	14	26
Pinfish	69	59	15.2	10	20
Pompano	84	72	27.0	18	41
Porgy, Littlehead	1	1	23.0	23	23
Puffer, Southern	8	4	17.8	16	19
Remora	1	1	58.0	58	58
Sardine, Scaled	1	1	8.0	8	8
Scad, Round	1	1	21.0	21	21
Searobin	5	4	19.5	17	23
Seatrout, Sand	33	27	27.6	18	38
Seatrout, Spotted	45	43	45.9	30	64
Sharksucker	6	6	50.3	36	65
Sheepshead	19	19	27.4	22	37
Snapper, Gray	13	13	26.3	24	34
Snook	5	5	36.4	34	40
Spadefish	65	65	18.2	11	30
Spot	30	30	22.0	16	24
Tarpon	1	1	44.0	44	44
Tripletail	1	1	50.0	50	50
SEA TURTLES					
Sea Turtle, Green**	1	1	38.0	38	38
Sea Turtle, Kemp's Ridley**	2	2	25.5	23	28

Table 14. Total catch from all fishery-independent surveys using 3 inch stretch mesh gill nets showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width). NA = not available.

TOTAL CATCH FROM 3" FISHERY-INDEPENDENT GILL NET SURVEYS					
			167 Sets	322.9 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Blacknose	10	10	39.9	36	44
Shark, Blacktip	25	25	61.3	43	93
Shark, Bonnethead	26	26	57.3	30	89
Shark, Bull	2	1	80.0	80	80
Shark, Florida Smoothhound	1	1	61.0	61	61
Shark, Great Hammerhead	2	1	104.0	104	104
Shark, Lemon	3	3	55.0	54	56
Shark, Nurse	1	1	88.0	88	88
OTHER ELASMOBRANCHS					
Ray, Spotted Eagle*	1	1	68.0	68	68
Stingray, Atlantic*	4	4	41.0	40	42
Stingray, Southern*	1	0	NA	NA	NA
BONY FISHES					
Blue Runner	7	7	24.9	23	27
Bluefish	13	13	34.8	31	44
Bumper	22	22	15.9	12	22
Burrfish, Striped	10	9	16.7	13	23
Catfish, Gafftopsail	25	25	30.1	25	42
Catfish, Hardhead	544	409	29.4	17	42
Cobia	1	1	47.0	47	47
Cowfish, Scrawled	1	0	NA	NA	NA
Croaker, Atlantic	2	2	31.0	30	32
Drum, Red	3	3	33.3	31	35
Flounder, Gulf	12	11	31.0	19	51
Grouper, Red	1	1	21.0	21	21
Herring, Atlantic Thread	17	17	15.5	12	17
Houndfish	1	1	73.0	73	73
Jack, Crevalle	115	89	23.7	17	37
Kingfish, Gulf	1	1	23.0	23	23
Kingfish, Southern	10	10	29.8	24	35
Ladyfish	11	10	34.3	25	57
Leatherjacket	6	6	19.5	17	22
Lizardfish, Inshore	4	4	24.3	19	36
Lookdown	2	2	17.5	17	18
Mackerel, Spanish	31	27	40.7	15	57
Menhaden, Yellowfin	868	271	22.6	19	28
Mojarra, Striped	1	1	15.0	15	15
Mullet, Striped	17	17	31.2	26	34
Mullet, White	2	2	29.0	28	30
Perch, Silver	2	2	19.5	18	21
Permit	4	4	15.8	12	27
Pigfish	95	84	22.1	19	26
Pinfish	149	126	15.6	10	27
Pompano	6	3	20.7	19	23
Puffer, Southern	2	2	16.5	16	17
Searobin	6	5	19.4	17	23
Seatrout, Sand	6	5	33.4	29	38
Seatrout, Spotted	27	26	37.5	31	48
Sharksucker	2	2	49.0	42	56
Sheepshead	4	4	20.3	17	25
Snapper, Gray	9	9	27.3	24	34
Snook	2	2	38.5	34	43
Spadefish	6	6	14.8	12	19
Spot	41	40	21.9	14	27
Tarpon	1	1	44.0	44	44

Table 15. Total catch from all fishery-independent surveys using 4 inch stretch mesh gill nets showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width).

TOTAL CATCH FROM 4" FISHERY-INDEPENDENT GILL NET SURVEYS					
			162 Sets	313.3 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Blacknose	3	3	41.7	39	46
Shark, Blacktip	11	11	64.3	52	83
Shark, Bonnethead	22	22	62.2	35	90
Shark, Bull	1	1	78.0	78	78
Shark, Great Hammerhead	2	1	101.0	101	101
Shark, Lemon	3	3	55.7	51	61
OTHER ELASMOBRANCHS					
Ray, Cownose*	9	8	48.8	33	84
Ray, Smooth Butterfly*	1	1	25.0	25	25
Stingray, Atlantic*	15	15	21.3	15	28
Stingray, Bluntnose*	4	4	21.3	14	41
Stingray, Southern*	6	3	28.7	16	45
BONY FISHES					
Burrfish, Striped	15	13	18.7	12	28
Catfish, Gafftopsail	59	58	38.8	27	49
Catfish, Hardhead	191	178	33.4	21	47
Cobia	1	1	54.0	54	54
Cowfish, Scrawled	1	1	25.0	25	25
Drum, Red	4	4	45.8	43	49
Flounder, Gulf	13	11	32.1	24	36
Herring, Atlantic Thread	21	21	15.6	14	17
Houndfish	1	1	88.0	88	88
Jack, Crevalle	6	6	30.0	17	36
Kingfish, Southern	1	1	33.0	33	33
Ladyfish	25	21	31.6	23	40
Leatherjacket	3	3	18.3	13	22
Lizardfish, Inshore	1	1	26.0	26	26
Mackerel, Spanish	3	1	50.0	50	50
Menhaden, Yellowfin	18	17	23.1	21	26
Mojarra, Striped	32	11	22.4	20	25
Perch, Silver	2	2	15.0	14	16
Permit	11	11	27.1	19	36
Pigfish	7	7	21.3	17	23
Pinfish	8	7	16.1	14	18
Pompano	25	18	25.4	18	34
Puffer, Southern	3	2	19.0	19	19
Seatrout, Sand	6	1	33.0	33	33
Seatrout, Spotted	2	2	31.0	31	31
Sharksucker	1	1	43.0	43	43
Sheepshead	14	14	27.4	23	34
Snapper, Gray	1	1	24.0	24	24
Spadefish	30	27	18.6	11	34

Table 16. Total catch from all fishery-independent surveys using 4 5/8 inch stretch mesh gill nets showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width; * * measurements are straight carapace length). NA = not available.

TOTAL CATCH FROM 4 5/8" FISHERY-INDEPENDENT GILL NET SURVEYS					
			485 Sets	712.1 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Atlantic Sharpnose	21	21	55.7	46	78
Shark, Blacknose	31	31	65.9	41	92
Shark, Blacktip	260	260	58.0	42	110
Shark, Bonnethead	1041	1041	64.3	34	94
Shark, Bull	53	53	67.3	56	106
Shark, Florida Smoothhound	3	3	60.3	57	63
Shark, Great Hammerhead	10	10	71.8	62	90
Shark, Lemon	2	2	61.5	55	68
Shark, Nurse	4	0	NA	NA	NA
Shark, Scalloped Hammerhead	2	2	50.5	47	54
Shark, Spinner	2	2	61.5	60	63
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	25	24	56.1	32	72
Ray, Cownose*	445	214	46.4	30	81
Ray, Smooth Butterfly*	5	5	32.0	23	40
Ray, Spotted Eagle*	10	8	59.4	51	65
Stingray, Atlantic*	50	50	26.1	15	48
Stingray, Bluntnose*	1	1	16.0	16	16
Stingray, Southern*	21	20	45.6	19	79
BONY FISHES					
Anchovy	3	3	9.0	9	9
Batfish, Polka-dot	1	1	22.0	22	22
Blue Runner	2	2	21.5	17	26
Bluefish	11	11	37.7	22	53
Bumper	9	9	16.1	14	23
Burrfish, Striped	57	57	21.8	15	31
Catfish, Gafftopsail	1593	1267	39.7	14	53
Catfish, Hardhead	916	662	33.7	17	42
Cobia	30	30	67.7	48	87
Cowfish, Scrawled	14	14	22.4	15	27
Croaker, Atlantic	3	3	24.3	20	27
Drum, Black	7	7	34.6	32	37
Drum, Red	16	16	49.1	30	60
Filefish, Orange	13	13	32.6	26	41
Filefish, Planehead	1	1	21.0	21	21
Flounder, Gulf	50	49	32.8	27	44
Flounder, Southern	1	1	32.0	32	32
Gar, Longnose	4	4	103.5	87	114
Harvestfish	127	94	16.9	11	21
Herring, Atlantic Thread	70	56	16.0	14	19
Jack, Crevalle	45	45	35.3	19	49
Jack, Horse-eye	1	1	35.0	35	35
Ladyfish	223	214	33.1	21	50
Leatherjacket	7	7	17.4	12	21
Lizardfish, Inshore	2	2	30.5	29	32

Table 16 Continued

COMMON NAME	N captured	N measured	Average	Minimum	Maximum
Lookdown	16	16	17.3	15	20
Mackerel, Spanish	159	158	51.8	23	68
Menhaden, Yellowfin	107	92	23.3	15	30
Mojarra, Striped	2	2	23.5	23	24
Mojarra, Yellowfin	2	2	22.0	21	23
Moonfish, Atlantic	1	1	12.0	12	12
Perch, Silver	2	2	17.0	17	17
Permit	150	144	23.4	15	55
Pigfish	12	12	17.7	14	22
Pinfish	27	27	16.1	8	19
Pompano	104	104	27.3	17	38
Porgy, Littlehead	1	1	23.0	23	23
Sardine, Scaled	5	5	11.4	8	13
Scad, Round	2	2	19.5	18	21
Searobin	1	1	19.0	19	19
Seatrout, Sand	44	44	26.4	18	42
Seatrout, Spotted	55	55	50.1	29	64
Sharksucker	5	5	47.8	30	65
Sheepshead	25	25	26.8	21	37
Spadefish	137	135	17.6	11	30
Tunny, Little	23	22	63.4	53	88
SEA TURTLES					
Sea Turtle, Green**	3	3	32.7	30	38
Sea Turtle, Kemp's Ridley**	3	3	25.7	23	28
MARINE MAMMALS					
Dolphin, Atlantic Bottlenosed	1	1	225.0	225	225

Table 17. Total catch from all fishery-independent surveys using 5 inch stretch mesh gill nets showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width). NA = not available.

TOTAL CATCH FROM 5" FISHERY-INDEPENDENT GILL NET SURVEYS					
			152 Sets	297.1 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Blacknose	1	1	42.0	42	42
Shark, Blacktip	16	16	59.6	46	83
Shark, Bonnethead	17	17	62.7	41	79
Shark, Nurse	1	1	53.0	53	53
OTHER ELASMOBRANCHS					
Ray, Cownose*	40	30	44.6	26	84
Ray, Smooth Butterfly*	3	3	30.7	24	37
Ray, Spotted Eagle*	2	2	62.5	57	68
Skate, Clearnose*	1	0	NA	NA	NA
Stingray, Atlantic*	47	38	23.0	16	56
Stingray, Bluntnose*	3	3	30.3	18	47
Stingray, Southern*	12	7	39.9	25	50
BONY FISHES					
Bumper	1	1	15.0	15	15
Burrfish, Striped	6	4	24.3	17	32
Catfish, Gafftopsail	54	54	42.5	22	50
Catfish, Hardhead	37	37	31.2	22	40
Cobia	1	0	NA	NA	NA
Cowfish, Scrawled	2	2	28.5	20	37
Drum, Red	2	2	34.0	23	45
Flounder, Gulf	6	6	42.0	37	55
Herring, Atlantic Thread	8	8	15.9	15	16
Jack, Crevalle	9	9	31.6	21	46
Ladyfish	16	16	30.1	25	37
Leatherjacket	1	1	17.0	17	17
Lookdown	1	1	17.0	17	17
Mackerel, Spanish	1	1	30.0	30	30
Menhaden, Yellowfin	14	12	22.1	20	25
Mojarra, Striped	7	7	26.7	25	28
Perch, Silver	1	1	18.5	18.5	18.5
Permit	22	22	26.5	23	32
Pigfish	1	1	23.0	23	23
Pinfish	1	1	16.0	16	16
Pompano	19	17	29.4	24	41
Puffer, Southern	3	0	NA	NA	NA
Remora	1	1	58.0	58	58
Seatrout, Sand	1	1	25.0	25	25
Seatrout, Spotted	1	1	31.0	31	31
Sharksucker	1	1	37.0	37	37
Sheepshead	4	4	32.8	31	35
Snapper, Gray	1	1	24.0	24	24
Spadefish	157	79	20.4	13	38
Spot	1	1	22.0	22	22

Table 18. Total catch from all fishery-independent gill net surveys conducted during the winter (January 1 through March 31) showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width). NA = not available.

TOTAL CATCH FROM ALL WINTER FISHERY-INDEPENDENT GILL NET SURVEYS						
	1/1-3/31		124 Sets	175.4 hrs Effort		
COMMON NAME	**N captured**	**N measured**	**Average**	**Minimum**	**Maximum**	
SHARKS						
Shark, Atlantic Sharpnose	1	1	52.0	52	52	
Shark, Blacknose	1	1	65.0	65	65	
Shark, Blacktip	21	21	66.1	59	72	
Shark, Bonnethead	97	96	58.3	30	89	
Shark, Bull	1	1	84.0	84	84	
Shark, Florida Smoothhound	1	1	61.0	61	61	
Shark, Great Hammerhead	1	1	74.0	74	74	
OTHER ELASMOBRANCHS						
Guitarfish, Atlantic	7	4	55.8	53	57	
Ray, Cownose*	26	13	61.1	46	81	
Ray, Smooth Butterfly*	2	2	27.0	23	31	
Skate, Clearnose*	2	1	34.0	34	34	
Stingray, Atlantic*	6	6	29.2	23	39	
Stingray, Southern*	14	5	39.4	25	50	
BONY FISHES						
Batfish, Polka-dot	1	1	22.0	22	22	
Bluefish	12	12	33.8	31	37	
Bumper	2	2	17.0	17	17	
Burrfish, Striped	15	11	20.1	12	25	
Catfish, Gafftopsail	319	199	39.2	14	53	
Catfish, Hardhead	61	51	32.3	22	38	
Cobia	15	14	69.6	59	87	
Cowfish, Scrawled	8	7	23.0	17	26	
Filefish, Orange	2	2	32.0	30	34	
Filefish, Scrawled	1	0	NA	NA	NA	
Flounder, Gulf	8	5	33.8	31	41	
Gar, Longnose	2	2	94.5	87	102	
Harvestfish	71	55	17.0	12	21	
Herring, Atlantic Thread	1	1	16.0	16	16	
Jack, Crevalle	9	9	31.4	22	45	
Ladyfish	20	15	34.2	23	45	
Lizardfish, Inshore	1	1	26.0	26	26	
Mackerel, Spanish	72	67	51.9	23	68	
Menhaden, Yellowfin	188	64	23.8	19	30	
Permit	13	13	19.6	17	22	
Pigfish	1	1	14.0	14	14	
Pinfish	2	1	12.0	12	12	
Pompano	32	22	27.3	17	36	
Puffer, Southern	6	2	19.0	19	19	
Scad, Round	1	1	21.0	21	21	
Searobin	2	1	19.0	19	19	
Seatrout, Sand	28	22	25.4	18	38	
Seatrout, Spotted	8	6	47.8	34	58	
Sharksucker	2	2	58.0	56	60	
Sheepshead	3	3	27.3	26	29	
Spot	1	1	23.0	23	23	
Tunny, Little	17	17	63.7	53	88	

Table 19. Total catch from all fishery-independent gill net surveys conducted during the spring (April 1 through June 30) showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width; ** measurements are straight carapace length).

CATCH FROM ALL SPRING FISHERY-INDEPENDENT GILL NET SURVEYS					
	3/1-6/30		241 Sets	385.8 hrs Effort	
COMMON NAME	**N captured**	**N measured**	**Average**	**Minimum**	**Maximum**
SHARKS					
Shark, Atlantic Sharpnose	14	14	57.8	46	78
Shark, Blacknose	7	7	63.0	60	67
Shark, Blacktip	166	166	56.2	42	110
Shark, Bonnethead	618	618	65.0	34	94
Shark, Bull	2	2	79.0	78	80
Shark, Great Hammerhead	1	1	77.0	77	77
Shark, Lemon	7	7	55.3	51	61
Shark, Nurse	3	1	53.0	53	53
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	11	10	59.7	51	72
Ray, Cownose*	48	37	47.9	26	84
Ray, Smooth Butterfly*	4	4	30.5	24	37
Ray, Spotted Eagle*	10	10	61.3	51	68
Stingray, Atlantic*	79	70	24.7	15	56
Stingray, Bluntnose*	6	6	17.3	14	26
Stingray, Southern*	21	20	47.7	16	120
BONY FISHES					
Blue Runner	1	1	17.0	17	17
Bluefish	6	6	36.2	32	44
Bumper	5	5	19.6	17	23
Burrfish, Striped	44	44	21.2	13	32
Catfish, Gafftopsail	565	490	39.0	19	50
Catfish, Hardhead	1097	764	33.0	19	48
Cobia	7	7	59.0	47	76
Cowfish, Scrawled	4	4	23.8	22	26
Drum, Red	7	7	49.3	43	60
Filefish, Orange	11	11	32.7	26	41
Flounder, Gulf	47	46	33.3	20	51
Gar, Longnose	1	1	111.0	111	111
Grouper, Red	1	1	21.0	21	21
Harvestfish	42	25	17.2	11	19
Herring, Atlantic Thread	34	34	15.7	12	17
Houndfish	2	2	80.5	73	88
Jack, Crevalle	81	61	28.1	17	49
Kingfish, Gulf	1	1	23.0	23	23
Kingfish, Southern	11	11	30.1	24	35
Ladyfish	105	100	32.9	25	57
Leatherjacket	4	4	19.5	17	22
Lizardfish, Inshore	4	4	26.8	19	36
Lookdown	10	10	17.0	15	19
Mackerel, Spanish	49	49	50.6	34	59

Table 19 Continued

COMMON NAME	N captured	N measured	Average	Minimum	Maximum
Menhaden, Yellowfin	298	176	22.3	15	26
Mojarra, Striped	3	3	23.0	22	24
Mojarra, Yellowfin	2	2	22.0	21	23
Mullet, Striped	11	11	30.4	26	33
Mullet, White	2	2	29.0	28	30
Needlefish, Atlantic	1	1	40.0	40	40
Perch, Silver	4	4	17.4	16	18.5
Permit	92	87	21.3	18	33
Pigfish	54	50	21.7	16	26
Pinfish	94	82	16.0	11	27
Pompano	84	82	26.7	18	41
Puffer, Southern	2	2	16.5	16	17
Remora	1	1	58.0	58	58
Searobin	5	5	19.4	17	23
Seatrout, Sand	19	19	28.6	22	42
Seatrout, Spotted	53	53	47.5	30	64
Sheepshead	27	27	27.4	18	37
Snapper, Gray	2	2	24.5	24	25
Snook	1	1	43.0	43	43
Spadefish	159	135	18.6	11	34
Spot	31	31	22.0	14	27
SEA TURTLES					
Sea Turtle, Green**	2	2	30.0	30	30
Sea Turtle, Kemp's Ridley**	1	1	23.0	23	23

Table 20. Total catch from all fishery-independent gill net surveys conducted during the summer (July 1 through September 30) showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width; ** measurements are straight carapace length).

CATCH FROM ALL SUMMER FISHERY-INDEPENDENT GILL NET SURVEYS					
	7/1-9/30		243 Sets	370.1 hrs Effort	
COMMON NAME	**N captured**	**N measured**	**Average**	**Minimum**	**Maximum**
SHARKS					
Shark, Atlantic Sharpnose	16	16	43.4	37	56
Shark, Blacknose	38	38	56.8	36	92
Shark, Blacktip	127	127	60.4	45	94
Shark, Bonnethead	358	358	64.8	30	91
Shark, Bull	53	52	67.0	56	106
Shark, Great Hammerhead	11	9	78.0	62	104
Shark, Lemon	2	2	68.5	68	69
Shark, Nurse	2	1	88.0	88	88
Shark, Scalloped Hammerhead	9	9	49.2	47	54
Shark, Spinner	1	1	60.0	60	60
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	9	9	52.7	32	61
Ray, Cownose*	441	213	45.3	30	79
Ray, Smooth Butterfly*	3	3	33.7	28	40
Ray, Spotted Eagle*	3	1	55.0	55	55
Stingray, Atlantic*	31	31	24.6	15	31
Stingray, Bluntnose*	2	2	44.0	41	47
Stingray, Southern*	12	11	61.1	19	103
BONY FISHES					
Anchovy	3	3	9.0	9	9
Blue Runner	15	15	24.5	23	27
Bluefish	22	22	38.4	22	49
Bumper	59	54	17.7	12	32
Burrfish, Striped	27	27	20.4	13	26
Catfish, Gafftopsail	895	729	39.9	16	51
Catfish, Hardhead	609	541	30.8	16	42
Cobia	10	10	57.0	47	68
Cowfish, Scrawled	6	6	21.3	15	37
Croaker, Atlantic	3	3	27.3	20	32
Drum, Red	18	18	43.9	23	57
Filefish, Planehead	2	2	15.5	10	21
Flounder, Gulf	27	27	32.7	19	55
Gar, Longnose	1	1	114.0	114	114
Harvestfish	15	15	15.1	11	18
Herring, Atlantic Thread	73	59	15.8	14	19
Jack, Crevalle	110	95	26.9	19	47
Jack, Horse-eye	1	1	35.0	35	35
Ladyfish	174	140	33.1	21	50
Leatherjacket	13	13	17.9	12	22
Lizardfish, Inshore	2	2	25.5	22	29
Lookdown	9	9	17.7	16	20

Table 20 Continued

COMMON NAME	N captured	N measured	Average	Minimum	Maximum
Mackerel, Spanish	317	146	39.9	15	58
Menhaden, Yellowfin	598	179	22.5	14	30
Mojarra, Striped	39	18	23.7	15	28
Mullet, Striped	6	6	32.8	31	34
Perch, Silver	3	3	17.3	14	21
Permit	83	82	27.0	12	55
Pigfish	64	57	21.7	15	25
Pinfish	110	99	15.7	8	20
Pompano	27	27	27.4	17	32
Porgy, Grass	3	3	18.3	18	19
Sardine, Scaled	5	5	11.4	8	13
Scad, Round	1	1	18.0	18	18
Searobin	1	1	19.0	19	19
Seatrout, Sand	10	10	25.3	18	37
Seatrout, Spotted	37	37	40.7	29	60
Sharksucker	8	8	42.9	30	65
Sheepshead	15	15	25.6	17	31
Snapper, Gray	15	15	26.2	24	34
Snook	5	5	36.4	34	40
Spadefish	171	112	18.5	12	38
Spot	12	12	21.5	16	27
Tarpon	1	1	44.0	44	44
Tripletail	1	1	50.0	50	50
SEA TURTLES					
Sea Turtle, Green**	1	1	38.0	38	38
Sea Turtle, Kemp's Ridley**	2	2	27.0	26	28

Table 21. Total catch from all fishery-independent gill net surveys conducted during the fall (October 1 through December 31) showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width).

CATCH FROM ALL FALL FISHERY-INDEPENDENT GILL NET SURVEYS					
	10/1-12/31		50 Sets	88.2 hrs Effort	
COMMON NAME	**N captured**	**N measured**	**Average**	**Minimum**	**Maximum**
SHARKS					
Shark, Atlantic Sharpnose	4	4	49.5	46	51
Shark, Blacknose	1	1	63.0	63	63
Shark, Blacktip	3	3	65.7	63	70
Shark, Bonnethead	30	30	52.2	36	74
Shark, Florida Smoothhound	3	3	60.3	57	63
Shark, Great Hammerhead	1	1	70.0	70	70
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	1	1	53.0	53	53
Ray, Cownose*	4	4	57.5	45	64
BONY FISHES					
Bluefish	5	5	44.6	39	53
Burrfish, Striped	3	3	19.3	16	21
Catfish, Gafftopsail	40	37	38.9	31	52
Catfish, Hardhead	21	21	35.4	31	40
Cobia	7	7	71.6	61	83
Cowfish, Scrawled	2	2	27.5	27	28
Croaker, Atlantic	2	2	26.5	26	27
Drum, Black	7	7	34.6	32	37
Drum, Red	1	1	39.0	39	39
Flounder, Southern	1	1	32.0	32	32
Harvestfish	1	1	16.0	16	16
Jack, Crevalle	11	11	37.5	27	40
Ladyfish	22	21	33.2	24	43
Mackerel, Spanish	25	24	51.4	40	59
Menhaden, Yellowfin	34	24	25.9	21	30
Moonfish, Atlantic	1	1	12.0	12	12
Permit	4	4	30.5	28	32
Pinfish	6	6	16.8	14	19
Pompano	12	12	29.3	19	38
Porgy, Littlehead	1	1	23.0	23	23
Seatrout, Sand	2	2	35.5	35	36
Sheepshead	4	4	27.5	22	32
Tunny, Little	7	6	64.0	60	73
MARINE MAMMALS					
Dolphin, Atlantic Bottlenosed	1	1	225.0	225	225

Table 22. Total catch from all fishery-independent longline surveys showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width). NA = not available.

TOTAL CATCH FROM FISHERY-INDEPENDENT LONGLINE SURVEYS					
			108 Sets	488.5 hrs Effort	
COMMON NAME	**N captured**	**N measured**	**Average**	**Minimum**	**Maximum**
SHARKS					
Shark, Atlantic Sharpnose	2	2	50.0	44	56
Shark, Blacknose	39	38	67.9	37	99
Shark, Blacktip	36	35	72.2	60	91
Shark, Bull	2	1	82.0	82	82
Shark, Finetooth	1	1	74.0	74	74
Shark, Great Hammerhead	1	1	90.0	90	90
Shark, Nurse	5	3	110.7	95	132
Shark, Sandbar	1	1	156.0	156	156
OTHER ELASMOBRANCHS					
Ray, Cownose*	1	0	NA	NA	NA
Ray, Spotted Eagle*	1	1	3.0	3	3
Skate, Clearnose*	60	56	39.0	31	53
Stingray, Atlantic*	2	2	41.5	38	45
Stingray, Southern*	57	45	65.2	31	100
BONY FISHES					
Burrfish, Striped	1	0	NA	NA	NA
Catfish, Gafftopsail	346	326	38.9	20	53
Catfish, Hardhead	107	107	30.8	2	43
Cobia	4	3	61.3	42	82
Eel	1	1	60.0	60	60
Flounder, Gulf	1	0	NA	NA	NA
Grouper, Black	2	2	30.0	28	32
Grouper, Red	1	1	35.0	35	35
Mackerel, Spanish	2	1	56.0	56	56
Menhaden, Yellowfin	44	0	NA	NA	NA
Pinfish	1	1	15.0	15	15
Pompano	2	2	27.5	26	29
Seatrout, Sand	1	0	NA	NA	NA
Sharksucker	2	1	44.0	44	44
Spot	1	0	NA	NA	NA
Tripletail	2	2	61.5	57	66

Table 23. Total catch from all fishery-dependent commercial surveys showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width; * numbers were estimated in a few instances). NA = not available.**

TOTAL CATCH FROM ALL FISHERY-DEPENDENT COMMERCIAL SURVEYS					
			48 Sets	58.3+ hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Atlantic Sharpnose	3	3	55.0	50	65
Shark, Blacktip	6	6	58.8	54	68
Shark, Bonnethead	3	3	61.3	38	86
Shark, Florida Smoothhound	5	4	70.8	59	93
Shark, Lemon	1	1	93.0	93	93
Shark, Nurse	1	0	NA	NA	NA
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	1	1	56.0	56	56
Ray, Cownose*	12	1	71.0	71	71
Ray, Spotted Eagle*	4	1	102.0	102	102
Stingray, Atlantic*	12	3	23.3	18	31
Stingray, Southern*	6	5	49.2	38	62
BONY FISHES					
Anchovy	10	0	NA	NA	NA
Batfish, Polka-dot	6	1	30.0	30	30
Blue Runner	8	8	24.6	23	26
Bluefish	14	13	38.7	35	45
Bumper	45	2	15.5	15	16
Burrfish, Striped	26	2	24.0	21	27
Butterfish, Gulf	10	10	15.9	15	17
Catfish, Gafftopsail	22	22	32.6	23	48
Catfish, Hardhead	130	36	31.6	25	37
Cichlid	4	4	32.0	23	36
Cobia	8	7	49.1	42	65
Cowfish, Scrawled	37	9	21.9	19	27
Croaker, Atlantic	1	1	42.0	42	42
Drum, Black	6	5	42.4	29	47
Drum, Red	4	2	38.5	37	40
Eel	9	0	NA	NA	NA
Filefish, Orange	5	1	16.0	16	16
Flounder, Gulf	36	17	24.7	10	34
Grunt	10	0	NA	NA	NA
Hake, Southern	11	0	NA	NA	NA
Herring, Atlantic Thread***	57252	43	14.8	8	18
Jack, Crevalle	132	25	35.3	23	50
Kingfish, Gulf	5	0	NA	NA	NA
Ladyfish	116	23	37.5	14	47
Lizardfish, Inshore	8	3	20.0	14	25
Lookdown	5	5	15.2	8	18
Mackerel, King	1	0	NA	NA	NA
Mackerel, Spanish	97	44	44.5	29	61
Menhaden, Yellowfin	20	10	26.0	23	28
Mojarra, Striped	27	1	12.0	12	12
Mojarra, Yellowfin	50	10	7.8	6	10
Mullet, Striped	979	191	34.2	26	45

Table 23 Continued

COMMON NAME	N captured	N measured	Average	Minimum	Maximum
Mullet, White	24	20	28.4	24	35
Parrotfish, Emerald	10	0	NA	NA	NA
Perch, Sand	19	6	13.8	4	18
Perch, Silver	7	2	24.0	22	26
Permit	1	1	52.0	52	52
Pigfish	84	4	23.5	21	26
Pinfish***	2130	24	11.9	6	17
Pipefish	219	10	11.5	9	13
Pompano	35	34	30.4	24	36
Razorfish, Pearly	6	0	NA	NA	NA
Sardine, Scaled	140	1	9.0	9	9
Sardine, Spanish***	910	10	15.9	15	17
Scad, Round***	1550	30	16.1	14	18
Scorpionfish	11	0	NA	NA	NA
Sea Bass, Black	45	0	NA	NA	NA
Seahorse	9	0	NA	NA	NA
Searobin	184	16	15.5	13	19
Seatrout, Sand	3	3	50.3	14	75
Seatrout, Spotted	19	14	20.7	11	49
Sheepshead	67	62	29.0	6	49
Snapper, Gray	2	2	26.0	24	28
Snook	3	2	66.0	64	68
Spadefish	36	19	26.6	16	38
Spot	9	9	19.7	17	23
Toadfish, Gulf***	200	10	13.0	11	18
Tonguefish	20	0	NA	NA	NA
Triggerfish, Gray	15	0	NA	NA	NA
Tunny, Little	1	0	NA	NA	NA

Table 24. Total catch from all commercial baitfish purse seine surveys from Tampa Bay showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width; * numbers were estimated in some instances). NA = not available.**

TOTAL CATCH FROM TAMPA BAY BAITFISH PURSE SEINE FISHERY					
			5 Sets	8.1 hrs Effort	
COMMON NAME	**N captured**	**N measured**	**Average**	**Minimum**	**Maximum**
OTHER ELASMOBRANCHS					
Skate, Clearnose*	2	2	32.5	30	35
Stingray, Southern*	5	5	49.2	38	62
BONY FISHES					
Batfish, Polka-dot	1	1	30.0	30	30
Blue Runner	4	4	25.3	25	26
Bumper	35	2	15.5	15	16
Burrfish, Striped	3	0	NA	NA	NA
Catfish, Hardhead	3	0	NA	NA	NA
Cowfish, Scrawled	14	9	21.9	19	27
Filefish, Orange	1	1	16.0	16	16
Flounder, Gulf	3	1	17.0	17	17
Flounder, Southern	3	3	21.7	21	23
Herring, Atlantic Thread***	57240	40	14.9	8	18
Ladyfish	4	4	44.3	41	47
Lizardfish, Inshore	3	3	20.0	14	25
Mackerel, Spanish	19	14	41.4	29	55
Perch, Sand	8	5	15.8	14	18
Pinfish	35	1	11.0	11	11
Sardine, Scaled	140	1	9.0	9	9
Sardine, Spanish***	910	10	15.9	15	17
Scad, Round***	1550	30	16.1	14	18
Searobin	155	16	15.5	13	19
Triggerfish, Gray	3	0	NA	NA	NA

Table 25. Total catch from all commercial bait shrimp roller frame trawl surveys from Charlotte Harbor/Pine Island Sound showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* numbers were estimated in some instances). NA = not available.**

TOTAL CATCH FROM CHARLOTTE HARBOR BAIT SHRIMP TRAWL FISHERY					
			2 Sets	9.8 hrs Effort	
COMMON NAME	**N captured**	**N measured**	**Average**	**Minimum**	**Maximum**
SHARKS					
Shark, Nurse	1	0	NA	NA	NA
BONY FISHES					
Blenny, Florida	1	1	8.0	8	8
Burrfish, Striped	10	0	NA	NA	NA
Catfish, Hardhead	13	5	28.2	25	33
Cowfish, Scrawled	10	0	NA	NA	NA
Eel	9	0	NA	NA	NA
Flounder, Gulf	18	4	19.8	10	34
Grunt	10	0	NA	NA	NA
Hake, Southern	10	0	NA	NA	NA
Ladyfish	6	3	36.7	32	40
Mojarra, Striped	16	0	NA	NA	NA
Mojarra, Yellowfin	50	10	7.8	6	10
Parrotfish, Emerald	10	0	NA	NA	NA
Perch, Sand	1	1	4.0	4	4
Perch, Silver	5	0	NA	NA	NA
Pigfish	10	0	NA	NA	NA
Pinfish***	2014	10	7.8	6	9
Pipefish	219	10	11.5	9	13
Puffer, Southern	50	10	7.5	3	13
Razorfish, Pearly	6	0	NA	NA	NA
Scorpionfish	11	0	NA	NA	NA
Seahorse	3	0	NA	NA	NA
Searobin	10	0	NA	NA	NA
Seatrout, Sand	1	1	14.0	14	14
Seatrout, Spotted	15	10	13.0	11	17
Sheepshead	11	6	10.0	6	20
Snook	1	0	NA	NA	NA
Spadefish	7	0	NA	NA	NA
Toadfish, Gulf***	200	10	13.0	11	18
Tonguefish	10	0	NA	NA	NA
Triggerfish, Gray	12	0	NA	NA	NA

Table 26. Total catch from all commercial food shrimp otter trawl surveys from Charlotte Harbor/Pine Island Sound showing the number captured by species (measurements were not available).

TOTAL CATCH FROM CHARLOTTE HARBOR FOOD SHRIMP TRAWL FISHERY					
			1 Set	9.8 hrs Effort	
COMMON NAME	**N captured**	**N measured**	**Average**	**Minimum**	**Maximum**
OTHER ELASMOBRANCHS					
Stingray, Southern	1	0	NA	NA	NA
BONY FISHES					
Anchovy	10	0	NA	NA	NA
Batfish, Polka-dot	5	0	NA	NA	NA
Bumper	10	0	NA	NA	NA
Burrfish, Striped	10	0	NA	NA	NA
Catfish, Hardhead	10	0	NA	NA	NA
Cowfish, Scrawled	13	0	NA	NA	NA
Drum, Black	1	0	NA	NA	NA
Filefish, Orange	4	0	NA	NA	NA
Flounder, Gulf	2	0	NA	NA	NA
Hake, Southern	1	0	NA	NA	NA
Herring, Atlantic Thread	9	0	NA	NA	NA
Kingfish, Gulf	5	0	NA	NA	NA
Lizardfish, Inshore	5	0	NA	NA	NA
Mojarra, Striped	10	0	NA	NA	NA
Perch, Sand	10	0	NA	NA	NA
Seahorse	6	0	NA	NA	NA
Searobin	19	0	NA	NA	NA
Tonguefish	10	0	NA	NA	NA

Table 27. Total catch from all commercial mullet gill net surveys from Tampa Bay and from Charlotte Harbor/Pine Island Sound showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width). NA = not available.

TOTAL CATCH FROM TAMPA BAY MULLET GILL NET FISHERY					
			13 Sets	7.6+ hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Lemon	1	1	93.0	93	93
OTHER ELASMOBRANCHS					
Stingray, Atlantic*	4	0	NA	NA	NA
BONY FISHES					
Catfish, Hardhead	38	16	34.4	32	37
Cichlid	4	4	32.0	23	36
Croaker, Atlantic	1	1	42.0	42	42
Drum, Black	1	1	29.0	29	29
Drum, Red	4	2	38.5	37	40
Flounder, Gulf	1	1	27.0	27	27
Menhaden, Yellowfin	20	10	26.0	23	28
Mullet, Striped	535	68	35.6	27	45
Mullet, White	20	16	28.1	24	31
Seatrout, Sand	2	2	68.5	62	75
Seatrout, Spotted	1	1	49.0	49	49
Sheepshead	28	28	31.0	19	49
Snook	2	2	66.0	64	68

TOTAL CATCH FROM CHARLOTTE HARBOR MULLET GILL NET FISHERY					
			9 Sets	5.5+ hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
OTHER ELASMOBRANCHS					
Stingray, Atlantic*	8	3	23.3	18	31
BONY FISHES					
Burrfish, Striped	1	1	27.0	27	27
Catfish, Gafftopsail	1	1	43.0	43	43
Drum, Black	4	4	45.8	45	47
Jack, Crevalle	25	11	43.8	27	50
Ladyfish	100	10	36.0	34	42
Mullet, Striped	180	52	33.9	30	41
Perch, Silver	2	2	24.0	22	26
Pigfish	4	4	23.5	21	26
Sheepshead	6	6	39.3	28	48
Snapper, Gray	2	2	26.0	24	28
Spadefish	26	16	25.6	16	38

Table 28. Total catch from all commercial gill net surveys for Spanish mackerel and pompano from Tampa Bay and pompano from Charlotte Harbor/Pine Island Sound showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width). NA = not available.

TOTAL CATCH FROM TAMPA BAY MACKEREL GILL NET FISHERY					
			4 Sets	7.7 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Atlantic Sharpnose	3	3	55.0	50	65
Shark, Blacktip	6	6	58.8	54	68
Shark, Bonnethead	3	3	61.3	38	86
Shark, Florida Smoothhound	4	4	70.8	59	93
OTHER ELASMOBRANCHS					
Guitarfish, Atlantic	1	1	56.0	56	56
Ray, Spotted Eagle*	1	1	102.0	102	102
BONY FISHES					
Blue Runner	4	4	24.0	23	
Bluefish	14	13	38.7	35	
Burrfish, Striped	1	0	NA	NA	NA
Cobia	8	7	50.6	42	65
Flounder, Gulf	1	0	NA	NA	NA
Jack, Crevalle	13	0	NA	NA	NA
Ladyfish	3	3	40.3	38	44
Mackerel, King	1	0	NA	NA	NA
Mackerel, Spanish	68	20	42.4	38	50
Pigfish	70	0	NA	NA	NA
Pompano	3	3	24.7	24	25
Sea Bass, Black	45	0	NA	NA	NA
Tunny, Little	1	0	NA	NA	NA

TOTAL CATCH FROM TAMPA BAY POMPANO GILL NET FISHERY					
			5 Sets	3 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
SHARKS					
Shark, Florida Smoothhound	1	0	NA	NA	NA
OTHER ELASMOBRANCHS					
Ray, Cownose*	11	0	NA	NA	NA
Ray, Spotted Eagle*	3	0	NA	NA	NA
BONY FISHES					
Butterfish, Gulf	10	10	15.9	15	17
Catfish, Gafftopsail	20	20	31.4	23	43
Catfish, Hardhead	2	2	27.5	27	28
Flounder, Gulf	4	4	26.3	23	28
Herring, Atlantic Thread	3	3	14.7	14	16
Jack, Crevalle	1	1	45.0	45	45
Ladyfish	3	3	31.3	14	43
Lookdown	5	5	15.2	8	18
Mackerel, Spanish	10	10	53.2	40	61
Pompano	31	30	30.7	25	35

TOTAL CATCH FROM CHARLOTTE HARBOR POMPANO GILL NET FISHERY					
			1 Set	6 hrs Effort	
COMMON NAME	N captured	N measured	Average	Minimum	Maximum
BONY FISHES					
Catfish, Gafftopsail	1	1	48.0	48	48
Pompano	1	1	36.0	36	36

Table 29. Total catch from all commercial trammel net surveys for mullet, seatrout, and Crevalle jack from Tampa Bay showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm (* measurements are disc width). NA = not available.

TOTAL CATCH FROM TAMPA BAY MULLET TRAMMEL NET FISHERY					
			2 Sets	NA hrs Effort	
COMMON NAME	**N captured**	**N measured**	**Average**	**Minimum**	**Maximum**
BONY FISHES					
Catfish, Hardhead	**61**	**10**	**30.9**	**28**	**33**
Flounder, Gulf	2	2	31.0	30	32
Jack, Crevalle	3	3	23.0	23	23
Mullet, Striped	146	20	34.9	32	38
Permit	1	1	52.0	52	52
Pinfish	78	10	15.1	13	17
Seatrout, Spotted	1	1	35.0	35	35
Sheepshead	2	2	24.5	24	25
Spadefish	3	3	32.0	31	33
Spot	9	9	19.7	17	23

TOTAL CATCH FROM TAMPA BAY SEATROUT TRAMMEL NET FISHERY					
			5 Sets	2.7 hrs Effort	
COMMON NAME	**N captured**	**N measured**	**Average**	**Minimum**	**Maximum**
OTHER ELASMOBRANCHS					
Ray, Cownose*	1	1	71.0	71	71
Skate, Clearnose*	1	1	19.0	19	19
BONY FISHES					
Burrfish, Striped	1	1	21.0	21	21
Flounder, Gulf	2	2	28.0	23	33
Mullet, Striped	108	41	32.5	28	37
Mullet, White	4	4	29.5	24	35
Pinfish	3	2	15.5	14	17
Sheepshead	20	20	29.1	24	41

TOTAL CATCH FROM TAMPA BAY CREVALLE JACK TRAMMEL NET FISHERY					
			1 Set	NA hrs Effort	
COMMON NAME	**N captured**	**N measured**	**Average**	**Minimum**	**Maximum**
BONY FISHES					
Catfish, Hardhead	3	3	27.0	26	28
Jack, Crevalle	90	10	28.6	24	32
Mojarra, Striped	1	1	12.0	12	12
Mullet, Striped	10	10	35.6	26	43
Seatrout, Spotted	2	2	38.0	35	41

Table 30. Sharks captured during the 1992 and the 1993 shark census tournaments by species and by region. North = Tampa Bay and adjacent coastal areas (Hillsborough, Pinellas, Manatee, and Sarasota Counties). South = Charlotte Harbor and adjacent coastal areas (Charlotte, Lee, Collier, and Monroe Counties). Number of participating anglers = 147 (1992) and 180 (1993).

92-93 SHARK CENSUS BY SPECIES AND REGION						
COMMON NAME	92 TOTAL	92 NORTH	92 SOUTH	93 TOTAL	93 NORTH	93 SOUTH
Shark, At. Sharpnose	3	3	0	0	0	0
Shark, Blacknose	311	301	7	427	418	9
Shark, Blacktip	153	104	48	270	51	219
Shark, Bonnethead	30	22	0	26	25	1
Shark, Bull	57	49	8	15	8	7
Shark, Hammerheads	26	23	3	18	9	9
Shark, Lemon	4	2	1	23	12	11
Shark, Nurse	43	36	7	109	65	44
Shark, Silky	18	18	0	10	5	5
Shark, Spinner	6	5	1	39	20	19
Shark, Tiger	1	1	0	1	1	0
Unidentified	0	0	0	20	19	1
YEAR TOTALS	649	564	75	958	633	325

Table 31. Sharks captured during the 1992 and the 1993 shark census tournaments by species, total length category, and region. North = Tampa Bay and adjacent coastal areas (Hillsborough, Pinellas, Manatee, and Sarasota Counties). South = Charlotte Harbor and adjacent coastal- areas (Charlotte, Lee, Collier, and Monroe Counties).

92-93 SHARK CENSUS BY TOTAL LENGTH CATEGORY AND REGION							
COMMON NAME	92 TOTAL	92 NORTH	92 SOUTH	93 TOTAL	93 NORTH	93 SOUTH	TOTALS
At. Sharpnose 0-2'	1	1	0	0	0	0	**1**
At. Sharpnose 2-4'	2	2	0	0	0	0	**2**
Blacknose 0-2'	39	32	7	36	34	2	**75**
Blacknose 2-4'	261	258	0	307	302	5	**568**
Blacknose 4-6'	11	11	0	84	82	2	**95**
Blacktip 0-2'	13	8	5	14	1	13	**27**
Blacktip 2-4'	107	64	42	231	29	202	**338**
Blacktip 4-6'	33	32	1	24	20	4	**57**
Blacktip 6-8'	0	0	0	1	1	0	**1**
Bonnethead 0-2'	5	5	0	7	6	1	**12**
Bonnethead 2-4'	23	15	0	18	18	0	**41**
Bonnethead 4-6'	2	2	0	1	1	0	**3**
Bull 0-2'	0	0	0	1	1	0	**1**
Bull 2-4'	38	35	3	6	2	4	**44**
Bull 4-6'	15	12	3	5	3	2	**20**
Bull 6-8'	4	2	2	3	2	1	**7**
Hammerhead 2-4'	2	2	0	2	1	1	**4**
Hammerhead 4-6'	7	7	0	9	2	7	**16**
Hammerhead 6-8'	9	8	1	5	4	1	**14**
Hammerhead 8-10'	7	6	1	2	2	0	**9**
Hammerhead 10-12'	1	0	1	0	0	0	**1**
Lemon 0-2'	0	0	0	1	1	0	**1**
Lemon 2-4'	2	1	0	13	8	5	**15**
Lemon 4-6'	0	0	0	7	3	4	**7**
Lemon 6-8'	1	1	0	1	0	1	**2**
Lemon 8-10'	0	0	0	1	0	1	**1**
Lemon 10-12'	1	0	1	0	0	0	**1**
Nurse 2-4'	11	8	3	15	11	4	**26**
Nurse 4-6'	12	9	3	27	8	19	**39**
Nurse 6-8'	15	15	0	49	35	14	**64**
Nurse 8-10'	5	4	1	14	9	5	**19**
Nurse 10-12'	0	0	0	4	2	2	**4**
Silky 2-4'	18	18	0	6	3	3	**24**
Silky 4-6'	0	0	0	4	2	2	**4**
Spinner 2-4'	4	4	0	33	18	15	**37**
Spinner 4-6'	1	0	1	6	2	4	**7**
Spinner 6-8'	1	1	0	0	0	0	**1**
Tiger 4-6'	1	1	0	1	1	0	**2**

Table 32. Sharks captured during the 1992 and the 1993 shark census tournaments by species, sex, and region. Unk = sex unknown. North = Tampa Bay and adjacent coastal areas (Hillsborough, Pinellas, Manatee, and Sarasota Counties). South = Charlotte Harbor and adjacent coastal areas (Charlotte, Lee, Collier, and Monroe Counties).

92-93 SHARK CENSUS BY SPECIES AND SEX						
COMMON NAME	92 TOTAL	92 NORTH	92 SOUTH	93 TOTAL	93 NORTH	93 SOUTH
At. Sharpnose Fem	3	3	0	0	0	0
M:F Ratio	****	****	****	****	****	****
Blacknose Female	188	184	3	236	228	8
Blacknose Male	107	101	4	101	101	0
Blacknose Unk	16	16	0	88	88	0
M:F Ratio	**1:1.757**	**1:1.823**	**1:0.75**	**1:2.337**	**1:2.257**	****
Blacktip Female	87	62	24	102	19	83
Blacktip Male	51	32	19	98	23	75
Blacktip Unk	15	10	5	70	9	61
M:F Ratio	**1:1.706**	**1:1.938**	**1:1.263**	**1:1.041**	**1:0.826**	**1:1.107**
Bonnethead Fem	23	15	0	6	6	0
Bonnethead Male	5	5	0	12	12	0
Bonnethead Unk	2	2	0	8	7	1
M:F Ratio	**1:4.600**	**1:3.000**	****	**1:0.500**	**1:0.500**	****
Bull Female	34	31	3	9	5	4
Bull Male	17	12	5	3	3	0
Bull Unk	6	6	0	3	0	3
M:F Ratio	**1:2.000**	**1:2.583**	**1:0.600**	**1:300**	**1:1.667**	****
Hammerhead Fem	14	12	2	10	4	6
Hammerhead Male	4	3	1	3	1	2
Hammerhead Unk	8	8	0	5	4	1
M:F Ratio	**1:3.500**	**1:4.000**	**1:2.000**	**1:3.333**	**1:4.000**	**1:3.000**
Lemon Female	1	1	0	2	1	1
Lemon Male	0	0	0	13	4	9
Lemon Unk	3	1	1	8	7	1
M:F Ratio	****	****	****	**1:0.154**	**1:0.250**	**1:0.111**
Nurse Female	13	9	4	21	11	10
Nurse Male	18	16	2	59	31	28
Nurse Unk	12	11	1	29	23	6
M:F Ratio	**1:0.722**	**1:0.563**	**1:02**	**1:0.356**	**1:0.355**	**1:0.357**
Silky Female	1	1	0	6	4	2
Silky Male	3	3	0	2	1	1
Silky Unk	14	14	0	2	0	2
M:F Ratio	**1:0.333**	**1:0.333**	****	**1:3.000**	**1:4.000**	**1:2.000**
Spinner Female	2	2	0	18	10	8
Spinner Male	2	2	0	16	9	7
Spinner Unk	2	1	1	5	1	4
M:F Ratio	**1:1.000**	**1:1.000**	****	**1:1.125**	**1:1.111**	**1:1.143**
Tiger Female	1	1	0	1	1	0
M:F Ratio	****	****	****	****	****	****
**** = inadequate data to calculate						

Table 33. Shark catches by month of the year from all surveys combined.

TOTAL SHARK CATCH BY MONTH												
Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Shark, Atlantic Sharpnose			1	4	7	11	1		15	2		4
Shark, Blacknose			1	1	5	65	96	9	6	3		1
Shark, Blacktip			22	16	37	127	63	28	81	7	5	1
Shark, Bonnethead	4	5	88	100	224	295	161	106	94	12	13	16
Shark, Bull			1	2	1	1	27	19	8			1
Shark, Finetooth							1					
Shark, Florida Smoothhound	1			1							4	3
Shark, Great Hammerhead			1	1		1	5	7	4	1		
Shark, Lemon					5	2		1	1			1
Shark, Nurse	1		1		1	4	4		1	1		
Shark, Sandbar				1								
Shark, Scalloped Hammerhead									9			
Shark, Spinner								1		1		
TOTALS	6	5	114	122	273	495	357	171	204	25	22	23

Table 34. Catch by month of the year for bonnethead and blacktip sharks showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm.

BONNETHEAD CATCH BY MONTH					
Month	N captured	N measured	Average	Minimum	Maximum
Jan	4	4	57.5	34	72
Feb	5	4	46.0	30	66
Mar	88	88	58.8	31	89
Apr	100	100	67.4	34	93
May	224	224	67.9	36	91
Jun	295	295	61.9	36	94
Jul	161	160	65.5	40	91
Aug	106	106	66.0	41	87
Sep	94	94	61.9	30	84
Oct	12	12	63.8	50	84
Nov	13	13	54.8	45	86
Dec	16	16	50.5	36	62
Totals	1118	1116	63.9	30	94

BLACKTIP CATCH BY MONTH					
Month	N captured	N measured	Average	Minimum	Maximum
Jan	0				
Feb	0				
Mar	22	22	66.4	59	72
Apr	16	16	69.5	61	85
May	37	37	63.3	46	93
Jun	127	126	54.4	42	110
Jul	63	62	62.6	45	91
Aug	28	28	61.4	50	94
Sep	81	80	67.4	50	95
Oct	7	7	62.4	60	70
Nov	5	5	57.0	54	60
Dec	1	1	63.0	63	63
Totals	387	384	61.3	42	110

Table 35. Catch by month of the year for blacknose and bull sharks showing the number captured, number measured, and the average, minimum, and maximum fork lengths in cm.

BLACKNOSE CATCH BY MONTH					
Month	N captured	N measured	Average	Minimum	Maximum
Jan	0				
Feb	0				
Mar	1	1	65.0	65	65
Apr	1	1	60.0	60	60
May	5	5	87.6	62	99
Jun	65	52	74.9	37	107
Jul	96	86	71.5	36	99
Aug	9	9	74.3	42	92
Sep	6	6	53.3	41	81
Oct	3	3	47.3	40	53
Nov	0				
Dec	1	1	63.0	63	63
Totals	187	164	71.9	36	107

BULL SHARK CATCH BY MONTH					
Month	N captured	N measured	Average	Minimum	Maximum
Jan	0				
Feb	0				
Mar	1	1	84.0	84	84
Apr	2	2	80.0	78	82
May	1	0			
Jun	1	1	80.0	80	80
Jul	27	26	64.9	56	106
Aug	19	19	65.2	57	71
Sep	8	8	77.3	72	96
Oct	0				
Nov	0				
Dec	1	0			
Totals	60	57	67.9	56	106

Table 36. Average, minimum, and maximum temperature (°C), salinity (o/oo), and depth (ft) at which each shark species was captured.

TEMPERATURE, SALINITY, AND DEPTH BY SHARK SPECIES				
Common Name	**N**	**Ave T**	**Minimum**	**Maximum**
Atlantic Sharpnose	45	27.22	17.2	32.9
Blacknose	187	30.24	17.3	34.0
Blacktip	387	29.00	18.5	33.0
Bonnethead	1118	27.94	15.9	33.3
Bull	60	30.51	21.5	34.0
Finetooth	1	33.80	33.8	33.8
Florida Smoothhound	9	17.55	17.0	19.0
Great Hammerhead	20	29.48	20.9	32.9
Lemon	10	27.10	22.0	33.0
Nurse	13	28.00	17.5	30.0
Sandbar	1	21.30	21.3	21.3
Scalloped Hammerhead	9	29.42	26.6	29.9
Spinner	2	27.40	24.8	30.0
Common Name	**N**	**Ave S**	**Minimum**	**Maximum**
Atlantic Sharpnose	45	32.18	28.6	35.5
Blacknose	187	31.75	25.0	37.0
Blacktip	387	31.43	24.0	37.0
Bonnethead	1118	30.81	22.8	36.1
Bull	60	25.66	3.0	28.5
Finetooth	1	11.50	11.5	11.5
Florida Smoothhound	9	31.53	31.1	32.5
Great Hammerhead	20	31.76	27.5	35.9
Lemon	10	31.17	26.8	38.5
Nurse	13	32.46	28.5	36.0
Sandbar	1	35.60	35.6	35.6
Scalloped Hammerhead	9	33.60	28.2	34.3
Spinner	2	32.35	28.5	36.2
Common Name	**N**	**Ave D**	**Minimum**	**Maximum**
Atlantic Sharpnose	45	9.10	2.0	29.0
Blacknose	187	14.94	2.0	24.0
Blacktip	387	7.08	1.0	30.0
Bonnethead	1118	5.58	0.0	30.0
Bull	60	4.28	1.0	10.0
Finetooth	1	19.00	18.0	20.0
Florida Smoothhound	9	18.17	4.0	30.0
Great Hammerhead	20	9.21	1.0	22.0
Lemon	10	3.80	1.0	9.0
Nurse	13	7.88	1.0	17.0
Sandbar	1	7.00	5.0	9.0
Scalloped Hammerhead	9	5.33	1.0	9.0
Spinner	2	7.75	3.0	20.0

Table 37. Shark catches by life stage (stage of maturity) from all surveys combined.

TOTAL OF ALL SHARKS CATCHES				
COMMON NAME	# NEONATES	# JUVENILES	# ADULTS	TOTAL
Shark, Atlantic Sharpnose	0	40	3	45
Shark, Blacknose	2	144	29	187
Shark, Blacktip	86	296	2	387
Shark, Bonnethead	0	535	583	1118
Shark, Bull	21	39	0	60
Shark, Finetooth	0	1	0	1
Shark, Florida Smoothhound	0	0	9	9
Shark, Great Hammerhead	0	19	1	20
Shark, Lemon	5	5	0	10
Shark, Nurse	0	11	1	13
Shark, Sandbar	0	0	1	1
Shark, Scalloped Hammerhead	0	9	0	9
Shark, Spinner	0	2	0	2
TOTALS	114	1061	626	1817

Table 38. Life stages of species of sharks collected in this study or otherwise known to occur in the study area. (?) = suggested to occur in the study area but not captured in the surveys.

LIFE STAGES OF SHARKS INHABITING TAMPA BAY/ CHARLOTTE HARBOR REGION

COMMON NAME	SCIENTIFIC NAME	Neonates?	Juveniles?	Adults?
Bonnethead	*Sphyrna tiburo*	No (?)	Yes	Yes
Blacktip	*Carcharhinus limbatus*	Yes	Yes	Yes
Blacknose	*C. acronotus*	Yes	Yes	Yes
Bull	*C. leucas*	Yes	Yes	Yes*
Atl. sharpnose	*Rhizoprionodon terraenovae*	No	Yes	Yes
Gt. hammerhead	*Sphyrna mokarran*	No (?)	Yes	Yes*
Sc. hammerhead	*S. lewini*	No (?)	Yes	Yes*
Nurse	*Ginglymostoma cirratum*	No (?)	Yes	Yes
Fl. smoothhound	*Mustelus norrisi*	No	No	Yes
Lemon	*Negaprion brevirostris*	Yes	Yes	Yes*
Finetooth	*C. isodon*	No	Yes	No
Spinner	*C. brevipinna*	No (?)	Yes	Yes*
Sandbar	*C. plumbeus*	No	No	Yes

*Known from other collections

Table 39. Monthly catch of each shark species by life stage for all surveys combined.

NEONATE SHARK CATCH BY MONTH													
Common Name	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
Shark, Atlantic Sharpnose													0
Shark, Blacknose						2							2
Shark, Blacktip					12	74							86
Shark, Bonnethead													0
Shark, Bull							16	5					21
Shark, Finetooth													0
Shark, Florida Smoothhound													0
Shark, Great Hammerhead													0
Shark, Lemon					5								5
Shark, Nurse													0
Shark, Sandbar													0
Shark, Scalloped Hammerhead													0
Shark, Spinner													0
TOTAL	**0**	**0**	**0**	**0**	**17**	**76**	**16**	**5**	**0**	**0**	**0**	**0**	**114**

JUVENILE SHARK CATCH BY MONTH													
Common Name	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
Shark, Atlantic Sharpnose			1	4	5	8	1		15	2		4	40
Shark, Blacknose			1	1	1	52	73	6	6	3		1	144
Shark, Blacktip			22	16	25	50	61	28	81	7	5	1	296
Shark, Bonnethead	2	4	48	40	68	180	80	53	35	3	9	13	535
Shark, Bull			1	2	1	1	11	14	8	1		1	40
Shark, Finetooth							1						1
Shark, Florida Smoothhound													0
Shark, Great Hammerhead			1	1		1	5	7	4	1			20
Shark, Lemon						2		1	1			1	5
Shark, Nurse	1		1		1	3	3		1	1			11
Shark, Sandbar													0
Shark, Scalloped Hammerhead									9				9
Shark, Spinner								1		1			2
TOTAL	**3**	**4**	**75**	**64**	**101**	**297**	**235**	**110**	**160**	**19**	**14**	**21**	**1063**

ADULT SHARK CATCH BY MONTH													
Common Name	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
Shark, Atlantic Sharpnose					1	2							3
Shark, Blacknose					4	3	19	3					29
Shark, Blacktip							2						2
Shark, Bonnethead	2	1	40	60	156	115	81	53	59	9	4	3	583
Shark, Bull													0
Shark, Finetooth													0
Shark, Florida Smoothhound	1			1							4	3	9
Shark, Great Hammerhead													0
Shark, Lemon													0
Shark, Nurse						1							1
Shark, Sandbar				1									1
Shark, Scalloped Hammerhead													0
Shark, Spinner													0
TOTAL	**3**	**1**	**40**	**62**	**161**	**121**	**102**	**56**	**59**	**9**	**8**	**6**	**625**

Table 40. Information on sharks for which stomach contents data were analyzed including number evaluated and the average, minimum, and maximum fork lengths in cm by species.

SHARK DATA FOR STOMACH CONTENTS ANALYSIS					n=546
Common Name	N Evaluated	Average	Minimum	Maximum	N Empty
Shark, Atlantic Sharpnose	15	50.0	41	78	5
Shark, Blacknose	33	64.2	36	94	20
Shark, Blacktip	144	61.9	45	94	79
Shark, Bonnethead	332	60.6	34	91	18
Shark, Bull	11	62.0	56	70	5
Shark, Great Hammerhead	5	68.6	63	90	0
Shark, Scalloped Hammerhead	5	48.7	47	50	1
Shark, Spinner	1	60.0	60	60	0

Table 41. Stomach contents identification and indices for bonnethead and blacktip sharks (%W = gravimetric index; %N = numerical index; %0 = frequency of occurrence; IRI = index of relative importance; %IRI = index of relative importance expressed as a percentage of total IRI for the species).

BONNETHEAD SHARK STOMACH CONTENTS ANALYSIS					n=314
Common name	**%W**	**%N**	**%O**	**IRI**	**%IRI**
Algae, Green	<0.01	0.11	0.30	0.03	0.00
Crab, Blue	73.14	54.65	69.88	8929.93	85.93
Crab, Hermit	0.02	0.11	0.30	0.04	0.00
Crab, Stone	0.44	0.75	2.11	2.50	0.02
Crab, Unidentifiable	7.34	4.49	12.65	149.69	1.44
Eel	0.10	0.21	0.60	0.19	0.00
Grass, Shoal	2.50	11.23	31.63	434.38	4.18
Grass, Manatee	3.95	11.12	31.33	472.17	4.54
Grass, Turtle	0.71	5.45	15.36	94.74	0.91
Material, Mangrove	0.02	0.64	1.81	1.20	0.01
Material, Non-food	0.43	0.75	2.11	2.49	0.02
Material, Unidentifiable	7.37	6.84	19.28	273.99	2.64
Mollusc, Unidentifiable	0.01	0.43	1.20	0.53	0.01
Shrimp, Mantis	3.08	2.14	5.42	28.28	0.27
Shrimp, Pink	0.09	0.32	0.90	0.37	0.00
Shrimp, Unidentifiable	0.14	0.43	1.20	0.69	0.01
Teleost, Unidentifiable	0.66	0.32	0.90	0.88	0.01
BLACKTIP SHARK STOMACH CONTENTS ANALYSIS					n=65
Common name	**%W**	**%N**	**%O**	**IRI**	**%IRI**
Algae, Green	0.01	1.23	1.54	1.92	0.02
Catfish, Hardhead	8.45	2.47	3.08	33.59	0.36
Filefish, Planehead	0.50	1.23	1.54	2.67	0.03
Grass, Shoal	0.21	7.41	9.23	70.27	0.76
Grass, Manatee	0.17	3.70	4.62	17.86	0.19
Grass, Turtle	0.08	2.47	3.08	7.84	0.08
Herring, Atlantic Thread	0.00	1.23	1.54	1.90	0.02
Material, Non-food	0.01	1.23	1.54	1.91	0.02
Material, Unidentifiable	10.41	4.94	6.15	94.42	1.02
Menhaden	10.42	1.23	1.54	17.93	0.19
Pigfish	2.81	1.23	1.54	6.23	0.07
Pinfish	4.61	2.47	3.08	21.80	0.24
Sardine, Scaled	1.56	2.47	3.08	12.40	0.13
Seatrout, Sand	6.14	1.23	1.54	11.35	0.12
Shrimp, Unidentifiable	0.09	1.23	1.54	2.03	0.02
Teleost, Unidentifiable	54.54	64.20	75.38	8951.24	96.71

Table 42. Stomach contents identification and indices for blacknose, Atlantic sharpnose, bull, great hammerhead, scalloped hammerhead and spinner sharks (%W = gravimetric index; %N = numerical index; %0 = frequency of occurrence; IRI = index of relative importance; %IRI = index of relative importance expressed as a percentage of total IRI for the species).

BLACKNOSE SHARK STOMACH CONTENTS ANALYSIS					n=13
Common Name	**%W**	**%N**	**%O**	**IRI**	**%IRI**
Crab, Unidentifiable	<0.01	7.14	7.69	54.95	0.57
Eel	0.82	7.14	7.69	61.22	0.63
Herring, Atlantic Thread	<0.01	7.14	7.69	54.95	0.57
Material, Unidentifiable	4.62	7.14	7.69	90.45	0.94
Mollusc, Unidentifiable	<0.01	7.14	7.69	54.95	0.57
Shrimp, Pink	0.82	7.14	7.69	61.22	0.63
Teleost, Unidentifiable	93.75	57.14	61.54	9285.90	96.09
ATLANTIC SHARPNOSE SHARK STOMACH CONTENTS ANALYSIS					n=10
Common Name	**%W**	**%N**	**%O**	**IRI**	**%IRI**
Anchovy	1.13	8.33	10.00	94.58	0.87
Material, Unidentifiable	37.83	25.00	30.00	1885.00	17.26
Teleost, Unidentifiable	61.04	66.67	70.00	8939.57	81.87
BULL SHARK STOMACH CONTENTS ANALYSIS					n=6
Common Name	**%W**	**%N**	**%O**	**IRI**	**%IRI**
Eel	8.07	14.29	16.67	372.66	2.73
Ray, Cownose	8.29	14.29	16.67	376.29	2.75
Teleost, Unidentifiable	83.63	71.43	83.33	12921.94	94.52
GREAT HAMMERHEAD SHARK STOMACH CONTENTS ANALYSIS					n=5
Common Name	**%W**	**%N**	**%O**	**IRI**	**%IRI**
Eel	12.34	16.67	20.00	580.16	5.26
Material, Unidentifiable	8.79	16.67	40.00	1018.08	9.23
Menhaden	11.88	25.00	20.00	737.58	6.69
Teleost, Unidentifiable	66.99	41.67	80.00	8692.89	78.82
SCALLOPED HAMMERHEAD SHARK STOMACH CONTENTS ANALYSIS					n=4
Common Name	**%W**	**%N**	**%O**	**IRI**	**%IRI**
Material, Unidentifiable	9.65	33.33	50.00	2148.98	21.81
Seatrout, Sand	64.78	16.67	25.00	2036.05	20.66
Teleost, Unidentifiable	25.58	50.00	75.00	5668.37	57.53
SPINNER SHARK STOMACH CONTENTS ANALYSIS					n=1
Common Name	**%W**	**%N**	**%O**	**IRI**	**%IRI**
Anchovy	100.00	100.00	100.00	20000.00	100.00

Table 43. Bycatch CPUE (fish per set-hour) by various arbitrary classes of shark CPUE (sharks per set-hour, all shark species combined) from all fishery-independent gill net surveys.

ASSOCIATED BYCATCH FROM ALL F-I GILL NET SURVEYS (CPUE)					
COMMON NAME	0 SHARKS	0-3 SHARKS	3-5 SHARKS	5-10 SHARKS	>10 SHARKS
Catfish, Gafftopsail	1.493	4.689	2.002	2.766	4.061
Catfish, Hardhead	1.269	2.230	1.770	1.351	4.710
Menhaden, Yellowfin	1.033	1.538	0.332	0.159	0.717
Ray, Cownose	0.382	0.774	0.498	0.270	0.034
Mackerel, Spanish	0.362	0.551	0.852	0.191	0.102
Spadefish	0.316	0.242	0.420	0.334	0.688
Ladyfish	0.291	0.299	0.420	0.334	0.307
Jack, Crevalle	0.245	0.123	0.354	0.080	
Pinfish	0.178	0.315	0.089	0.080	0.068
Stingray, Atlantic	0.156	0.066	0.055	0.064	
Pompano	0.133	0.201	0.133	0.064	0.068
Harvestfish	0.122	0.186	0.011		0.068
Burrfish, Striped	0.087	0.085	0.066	0.111	0.034
Permit	0.085	0.192	0.409		0.273
Pigfish	0.082	0.182	0.133	0.032	0.068
Flounder, Gulf	0.075	0.088	0.044	0.095	0.137
Mojarra, Striped	0.073	0.006			
Seatrout, Spotted	0.060	0.113	0.122	0.159	0.341
Seatrout, Sand	0.058	0.050	0.111		0.034
Sheepshead	0.055	0.044	0.011	0.064	
Stingray, Southern	0.049	0.041	0.033	0.064	
Bluefish	0.047	0.050	0.033		
Herring, Atlantic Thread	0.044	0.123	0.177	0.127	0.990
Drum, Red	0.036	0.019			

Table 44. Bycatch CPUE (fish per set-hour) by various arbitrary classes of shark CPUE (sharks per set-hour, all shark species combined) from all fishery-independent gill net surveys in Tampa Bay.

ASSOCIATED BYCATCH FROM TAMPA BAY F-I GILL NET SURVEYS (CPUE)					
COMMON NAME	0 SHARKS	0-3 SHARKS	3-5 SHARKS	5-10 SHARKS	>10 SHARKS
Catfish, Hardhead	1.434	2.853	3.166	3.626	8.790
Menhaden, Yellowfin	1.149	0.318	0.025		
Catfish, Gafftopsail	1.027	1.525	1.231	2.473	1.847
Mackerel, Spanish	0.530	0.261	0.327		
Spadefish	0.504	0.330	0.528	0.879	1.274
Ladyfish	0.352	0.381	0.528	0.220	0.255
Ray, Cownose	0.255	1.366	1.030	0.714	
Harvestfish	0.207	0.133			
Pinfish	0.207	0.451	0.151	0.055	0.127
Stingray, Atlantic	0.194	0.083	0.101	0.055	
Jack, Crevalle	0.145	0.038	0.226		
Pompano	0.136	0.153			
Permit	0.126	0.235	0.578	0.714	0.255
Pigfish	0.097	0.248	0.251		0.127
Flounder, Gulf	0.077	0.108	0.050	0.110	0.127
Sheepshead	0.068	0.057			
Seatrout, Spotted	0.065	0.089	0.126	0.385	0.573
Seatrout, Sand	0.055	0.025	0.126		
Drum, Red	0.052	0.019			
Burrfish, Striped	0.048	0.070		0.110	0.064
Bumper	0.045	0.013			
Stingray, Southern	0.045	0.019		0.055	
Cobia	0.039	0.057	0.025		
Guitarfish, Atlantic	0.039	0.051	0.025		
Tunny, Little	0.032	0.089			

Table 45. Bycatch CPUE (fish per set-hour) by various arbitrary classes of shark CPUE (sharks per set-hour, all shark species combined) from all fishery-independent gill net surveys in Charlotte Harbor/Pine Island Sound.

ASSOCIATED BYCATCH FROM CHARLOTTE HARBOR F-I GILL NET SURVEYS					
					(CPUE)
COMMON NAME	0 SHARKS	0-3 SHARKS	3-5 SHARKS	5-10 SHARKS	>10 SHARKS
Catfish, Gafftopsail	1.960	1.750	2.539	2.886	4.039
Catfish, Hardhead	0.986	1.548	0.654	0.425	
Menhaden, Yellowfin	0.826	2.613	0.558	0.224	1.923
Ray, Cownose	0.511	0.185	0.077	0.090	
Jack, Crevalle	0.351	0.196	0.442	0.112	
Ladyfish	0.199	0.208	0.327	0.380	0.481
Mojarra, Striped	0.152	0.006			
Mackerel, Spanish	0.136	0.798	1.231	0.269	0.289
Pinfish	0.133	0.173	0.039	0.090	
Burrfish, Striped	0.129	0.095	0.115	0.112	
Pompano	0.121	0.208	0.231	0.090	0.192
Stingray, Atlantic	0.101	0.048	0.019	0.067	
Herring, Atlantic Thread	0.078	0.214	0.212	0.179	2.789
Spadefish	0.070	0.149	0.327	0.112	
Bluefish	0.066	0.083			
Flounder, Gulf	0.066	0.066	0.039	0.090	0.192
Pigfish	0.058	0.113	0.039	0.045	
Seatrout, Sand	0.058	0.071	0.096		0.096
Seatrout, Spotted	0.051	0.131	0.115	0.067	0.096
Stingray, Southern	0.051	0.060	0.058	0.067	
Sheepshead	0.035	0.030	0.019	0.090	
Spot	0.035	0.048	0.250		
Mullet, Striped	0.027	0.012			
Permit	0.027	0.143	0.269		0.385
Lookdown	0.023	0.012		0.022	

Table 46. Significance of association between shark CPUE (sharks per set-hour, all shark species combined) and other fish CPUE (fish per set-hour) utilizing the Spearman Rank Order Correlation.

ASSOCIATED BYCATCH SIGNIFICANCE			n = 829 sets
Common Name	**Coefficient**	**P value**	**Significance**
Catfish, Gafftopsail	0.255	P < 0.001	***
Catfish, Hardhead	0.173	P < 0.001	***
Herring, Atlantic Thread	0.090	P = 0.010	**
Mackerel, Spanish	0.051	P = 0.139	n.s.
Ray, Cownose	-0.038	P = 0.279	n.s.
Menhaden, Yellowfin	0.045	P = 0.198	n.s.

Table 47. Data on all sharks tagged in this study and recaptured prior to December 7, 1993 (TZ is primary sampling area [tagging zone] where tagged; RZ is primary sampling area [recapture zone] where recaptured; NM is estimated shortest possible water route distance from TZ to RZ in nautical miles). Total number of sharks recaptured = 52 (4.2% of all tagged).

DATA ON RECAPTURES OF TAGGED SHARKS									
COMMON NAME	DATE TAGGED	SEX	FL (cm)	TZ	RECAP DATE	RECAP BY	RZ	NM MOVED	DAYS AT LIBERTY
Blacknose	28-Jul-92	M	80	T4	20-Jul-93	Rec. Angler	T4	2	358
Blacknose	29-Jun-93	M	84	T4	03-Jul-93	MML	T4	2	4
Blacknose	29-Jun-93	F	88	T4	05-Jul-93	Rec. Angler	T3	0	6
Blacktip	21-May-92	F	49	C2	13-Jun-92	Rec. Angler	C2	9	22
Blacktip	30-Mar-93	F	61	C8	23-Jul-93	Rec. Angler	C8	<1	115
Blacktip	06-May-93	F	66	C8	17-May-93	Rec. Angler	C7	10.5	11
Blacktip	02-Jun-93	F	48	C8	05-Aug-93	MML	C8	0	64
Blacktip	02-Jun-93	F	49	C8	17-Aug-93	MML	C8	1	76
Blacktip	02-Jun-93	F	51	C8	06-Sep-93	Rec. Angler	C8	<1	96
Blacktip	02-Jul-93	F	77	T5	27-Jul-93	MML	T5	1	25
Blacktip	02-Jul-93	M	51	C8	07-Jul-93	MML	C8	0	5
Blacktip	01-Sep-93	M	54	C2	06-Sep-93	Rec. Angler	C8	14	6
Bonnethead	30-Mar-93	F	55	C8	15-Jun-93	Rec. Angler	C8	2	78
Bonnethead	30-Mar-93	F	62	C8	16-Jun-93	MML	C8	0	78
Bonnethead	02-Apr-93	F	70	C8	05-May-93	MML	C8	0	33
Bonnethead	02-Apr-93	F	73	C8	15-Jun-93	Rec. Angler	C1	8	74
Bonnethead	02-Apr-93	F	86	C8	21-Jul-93	MML	C8	1	110
Bonnethead	12-Apr-93	F	53	C8	20-Apr-93	Rec. Angler	C8	0	8
Bonnethead	12-Apr-93	F	55	C8	07-Jul-93	MML	C8	1	86
Bonnethead	12-Apr-93	F	57	C8	04-Jul-93	Rec. Angler	C3	17	83
Bonnethead	12-Apr-93	F	59	C8	06-May-93	MML	C8	2	24
Bonnethead	12-Apr-93	F	70	C8	21-Jul-93	MML	C8	0	100
Bonnethead	14-Apr-93	F	70	C8	17-Aug-93	MML	C8	<1	125
Bonnethead	30-Apr-93	F	87	T3	14-May-93	MML	T3	<1	15
Bonnethead	05-May-93	F	75	C8	27-Jul-93	Rec. Angler	T1	100	83
Bonnethead	06-May-93	F	80	C8	01-Sep-93	MML	C8	<1	119
Bonnethead	12-May-93	F	65	T3	10-Jun-93	MML	T3	0	29
Bonnethead	12-May-93	F	72	T3	14-May-93	MML	T3	0	2
Bonnethead	12-May-93	F	85	T3	14-May-93	MML	T3	0	2
Bonnethead	12-May-93	F	78	T3	17-Nov-93	MML	T3	0	189
Bonnethead	14-May-93	F	78	T3	17-Sep-93	Rec. Angler	T3	0	126
Bonnethead	27-May-93	F	73	T3	31-May-93	Rec. Angler	T3	4.5	4
Bonnethead	02-Jun-93	F	53	C8	16-Jun-93	MML	C8	<1	14
Bonnethead	02-Jun-93	F	62	C8	17-Aug-93	MML	C8	1	76
Bonnethead	02-Jun-93	F	70	C8	16-Jun-93	MML	C8	1	14
Bonnethead	10-Jun-93	F	70	T3	12-Jun-93	Rec. Angler	T3	0	2
Bonnethead	10-Jun-93	F	70	T3	24-Jun-93	MML	T3	0	14
Bonnethead	10-Jun-93	F	72	T3	15-Jul-93	MML	T3	0	35
Bonnethead	24-Jun-93	F	70	T3	16-Jul-93	MML	T3	0	22
Bonnethead	08-Jul-93	F	64	C3	03-Aug-93	Rec. Angler	C3	<1	26
Bonnethead	21-Jul-93	F	68	C8	06-Aug-93	MML	C8	0	16
Bonnethead	21-Jul-93	F	87	C8	17-Aug-93	MML	C8	1	27
Bonnethead	12-Aug-93	F	63	T3	28-Sep-93	MML	T3	<1	47
Bonnethead	12-Aug-93	F	68	T3	25-Aug-93	MML	T3	0	13
Bull	29-Jul-93	F	59	T8	22-Sep-93	Rec. Angler	T8	3	56
Bull	29-Jul-93	F	66	T8	23-Sep-93	FL DEP	T8	4	56
Bull	29-Jul-93	F	69	T8	06-Dec-93	Rec. Angler	C9	105	130
Bull	11-Aug-93	F	67	T8	03-Dec-93	Rec. Angler	T8	5	113
Bull	11-Aug-93	M	61	T8	18-Sep-93	Rec. Angler	T8	4	38
Bull	11-Aug-93	M	65	T8	23-Sep-93	FL DEP	T8	3	43
Bull	11-Aug-93	M	67	T8	05-Sep-93	Rec. Angler	T8	3	25
Lemon	14-May-92	F	51	T3	31-May-92	Rec. Angler	T3	<1	15

Table 48. At-the-boat mortality observed in fishery-independent gill net surveys between August 17, 1993 and October 1, 1993 (* indicates mortality throughout the entire study).

OBSERVED GILL NET MORTALITY			
	100 SETS	8/17-10/1/93	
Common Name	**N counted**	**N dead**	**Mortality**
SHARKS			
Shark, Atlantic Sharpnose*	38	13	34.21%
Shark, Blacknose*	47	16	34.04%
Shark, Blacktip*	323	122	37.77%
Shark, Bonnethead*	1115	350	31.39%
Shark, Bull*	56	1	1.79%
Shark, Florida Smoothhound*	9	0	0.00%
Shark, Great Hammerhead*	14	4	28.57%
Shark, Lemon*	10	0	0.00%
Shark, Nurse*	6	0	0.00%
Shark, Scalloped Hammerhead*	9	5	55.56%
Shark, Spinner*	2	1	50.00%
OTHER ELASMOBRANCHS			
Ray, Cownose	246	0	0.00%
Ray, Smooth Butterfly	2	0	0.00%
Ray, Spotted Eagle	1	0	0.00%
Stingray, Southern	5	0	0.00%
Stingray, Atlantic	11	0	0.00%
BONY FISHES			
Anchovy	3	3	100.00%
Blue Runner	12	2	16.67%
Bluefish	21	13	61.90%
Bumper	35	10	28.57%
Burrfish, Striped	9	0	0.00%
Catfish, Gafftopsail	392	130	33.16%
Catfish, Hardhead	140	16	11.43%
Cobia	10	6	60.00%
Cowfish, Scrawled	3	0	0.00%
Croaker, Atlantic	1	0	0.00%
Drum, Red	6	1	16.67%
Filefish, Planehead	2	0	0.00%
Flounder, Gulf	10	0	0.00%
Guitarfish, Atlantic	5	0	0.00%
Harvestfish	3	0	0.00%
Herring, Atlantic Thread	38	13	34.21%
Jack, Crevalle	33	8	24.24%

Table 48 Continued

COMMON NAME	N counted	N dead	Mortality
Jack, Horse-eye	1	0	0.00%
Ladyfish	118	96	81.36%
Leatherjacket	2	0	0.00%
Lizardfish, Inshore	2	1	50.00%
Lookdown	9	1	11.11%
Mackerel, Spanish	198	185	93.43%
Menhaden, Yellowfin	78	41	52.56%
Perch, Sand	3	0	0.00%
Perch, Silver	1	1	100.00%
Permit	21	0	0.00%
Pigfish	5	0	0.00%
Pinfish	29	2	6.90%
Pompano	11	1	9.09%
Porgy, Grass	3	1	33.33%
Sardine, Scaled	5	3	60.00%
Scad, Round	10	0	0.00%
Searobin	6	0	0.00%
Seatrout, Sand	4	1	25.00%
Seatrout, Spotted	19	0	0.00%
Sharksucker	4	0	0.00%
Sheepshead	3	0	0.00%
Snapper, Gray	6	0	0.00%
Snook	4	0	0.00%
Spadefish	15	0	0.00%
Spot	3	0	0.00%
Tripletail	1	0	0.00%
SEA TURTLES			
Sea Turtles*	6	1	16.67%
MARINE MAMMALS			
Dolphin, Atlantic Bottlenosed*	1	1	100%

Table 49. Number of sharks tagged, number recaptured, and the significance of difference comparing all commercial fishery-dependent and all recreational fishery-dependent surveys with all fishery-independent surveys combined.

COMPARISON OF PROPORTION OF TAG RETURNS					
FISHERY	N tagged	N recaptured	% recaptured	Z statistic	Significance
Fishery-Independent	1181	49	4.15		
Commercial Fisheries	15	0	0.00	0.150	n.s.
Recreational Fisheries	129	4	3.10	0.339	n.s.

Table 50. Formulas and calculations for estimating delayed mortality of sharks after release from fishing gear based upon tag return information. Total delayed mortality estimated with this method was 34.8% of all sharks released under study conditions.

SHARK DELAYED MORTALITY ESTIMATES FROM TAG RETURNS--Formulas

SHARK CONDITION	# TAGGED & RATED	ACTUAL # TAG RETURNS	EXPECTED # TAG RETURNS	CONDITION MORTALITY (%)	PROPORTIONAL MORTALITY (%)
1 (Best)	T1	R1	E1 = (R1/T1)xT1 = R1	M1 = 0	P1 = 0
2	T2	R2	E2= (R1/T1)xT2	M2= 100(E2-R2)/E2	P2= M2x(T2/Tt)
3	T3	R3	E3= (R1/T1)xT3	M3= 100(E3-R3)/E3	P3= M3x(T3/Tt)
4	T4	R4	E4= (R1/T1)/T4	M4= 100(E4-R4)/E4	P4= M4x(T4/Tt)
	Tt				

Sharks rated and tagged

Tag returns received

Returns compared proportionally w/ releases

Relative mortality by condition calculated and totalled

SHARK DELAYED MORTALITY ESTIMATES FROM TAG RETURNS--Calculations

SHARK CONDITION	# TAGGED AND RATED	ACTUAL # TAG RETURNS	EXPECTED # TAG RETURNS	CONDITION MORTALITY (%)	PROPORTIONAL MORTALITY (%)
1 (Best)	443	28	28	0	0
2	312	17	20	15.0	3.8
3	237	5	15	66.7	12.8
4	240	1	15	93.3	18.2
	1232	51*			34.8

* 1 TAG RETURN WAS FROM AN UNRATED SHARK AND SO COULD NOT BE INCLUDED IN ANALYSIS

X. FIGURES

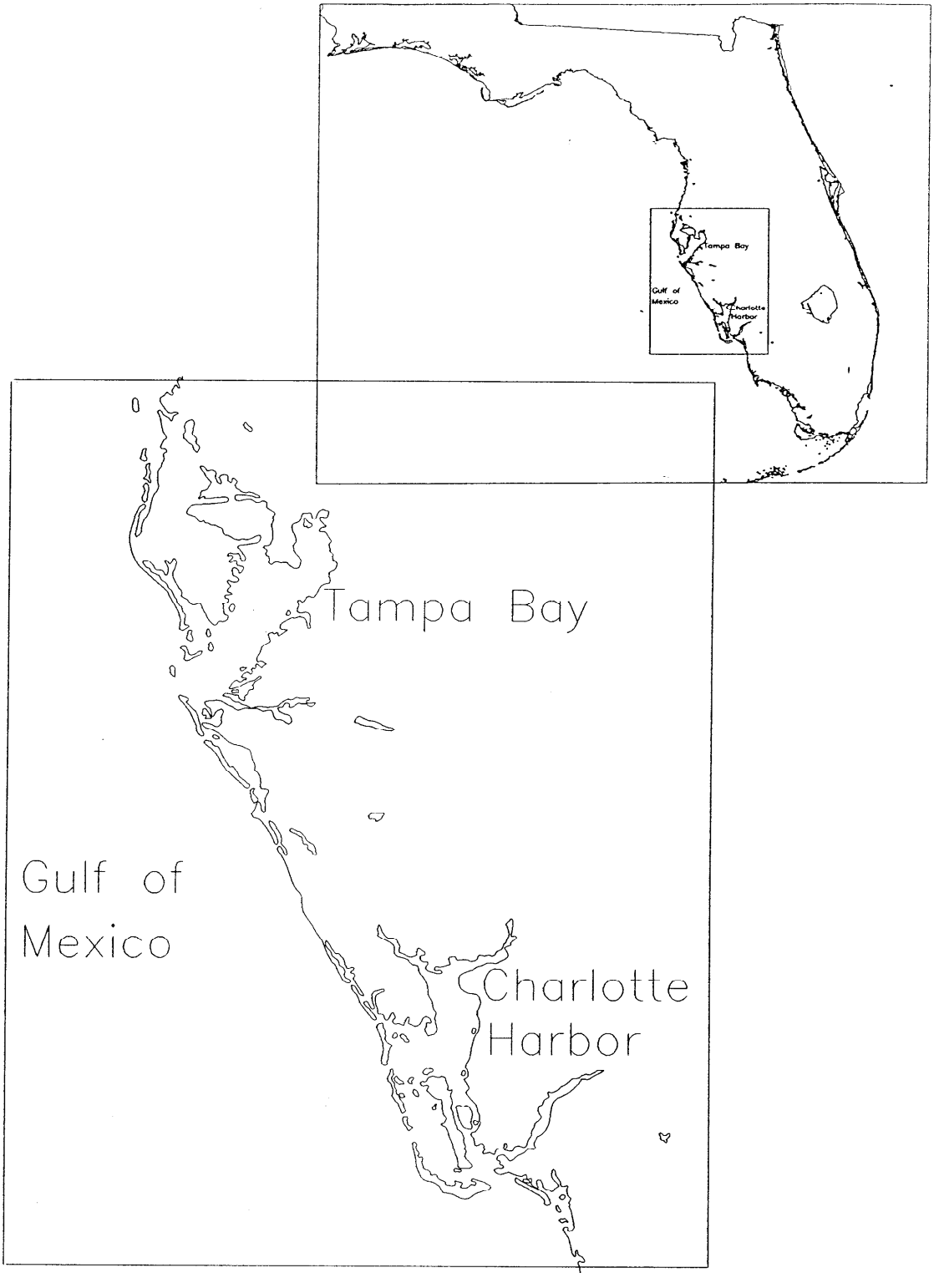


Figure 1. Map of study area for bycatch and shark nursery ground study.

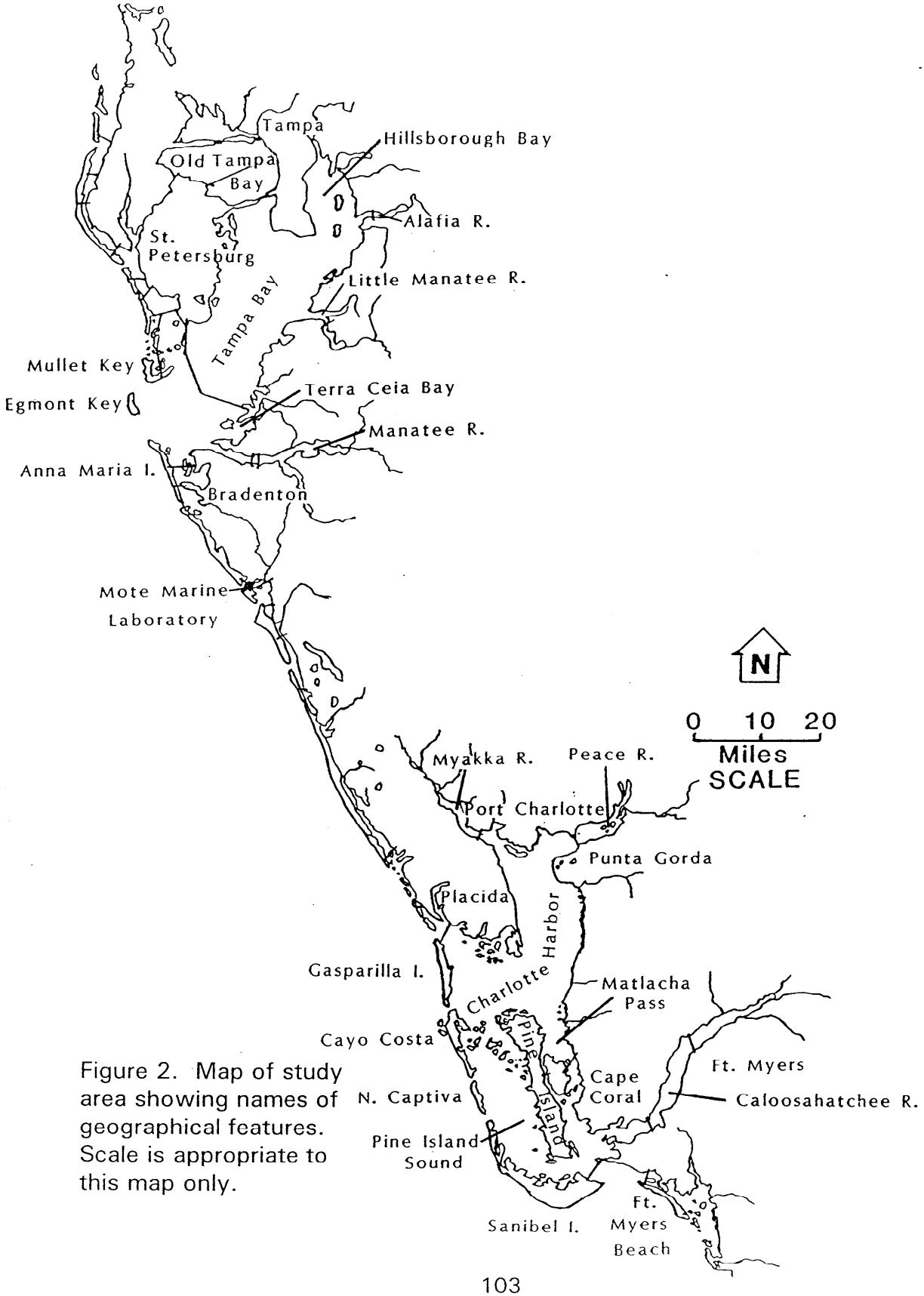


Figure 2. Map of study area showing names of geographical features. Scale is appropriate to this map only.

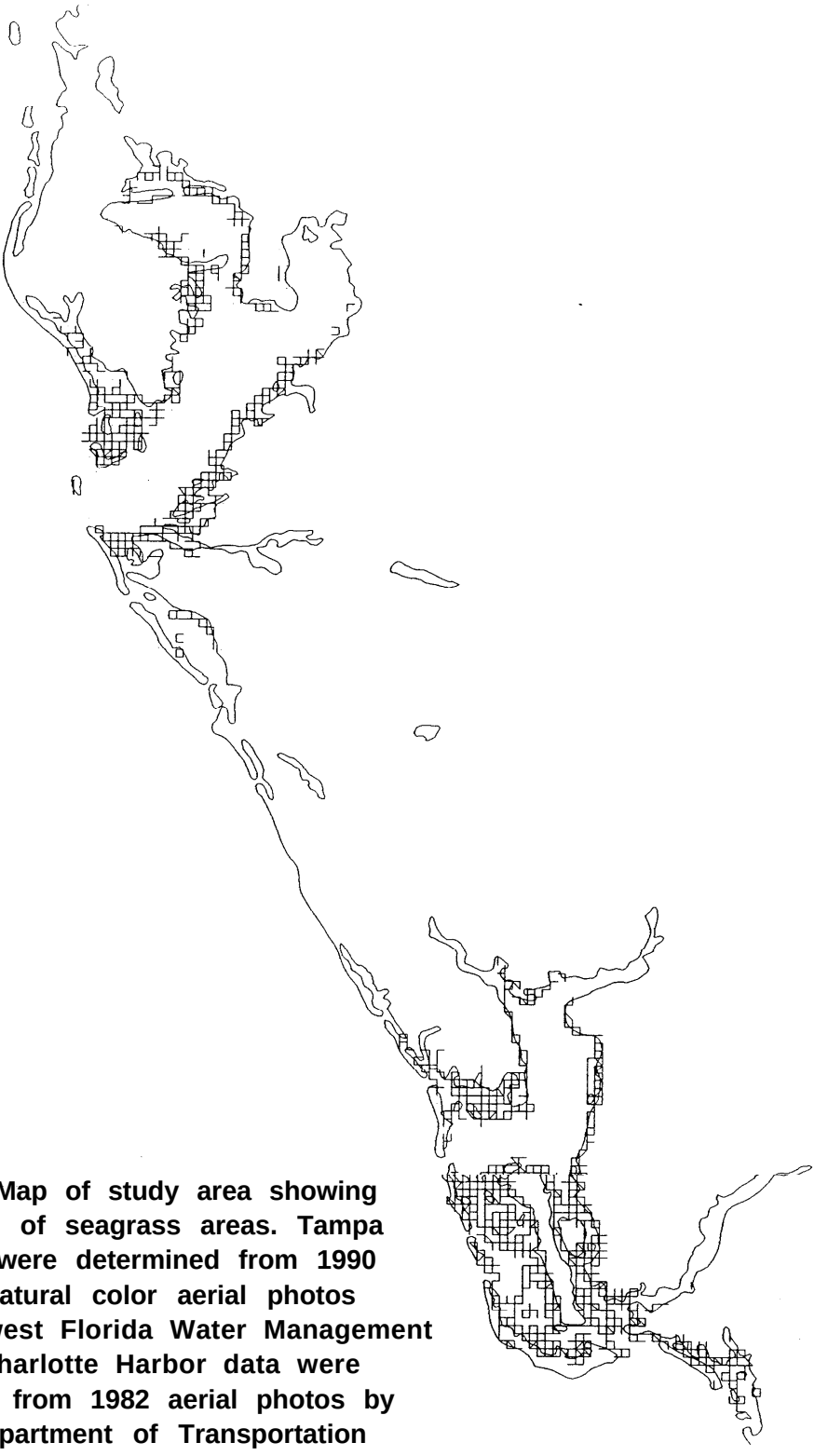


Figure 3. Map of study area showing distribution of seagrass areas. Tampa Bay data were determined from 1990 1:24,000 natural color aerial photos by Southwest Florida Water Management District. Charlotte Harbor data were interpreted from 1982 aerial photos by Florida Department of Transportation and Department of Natural Resources.

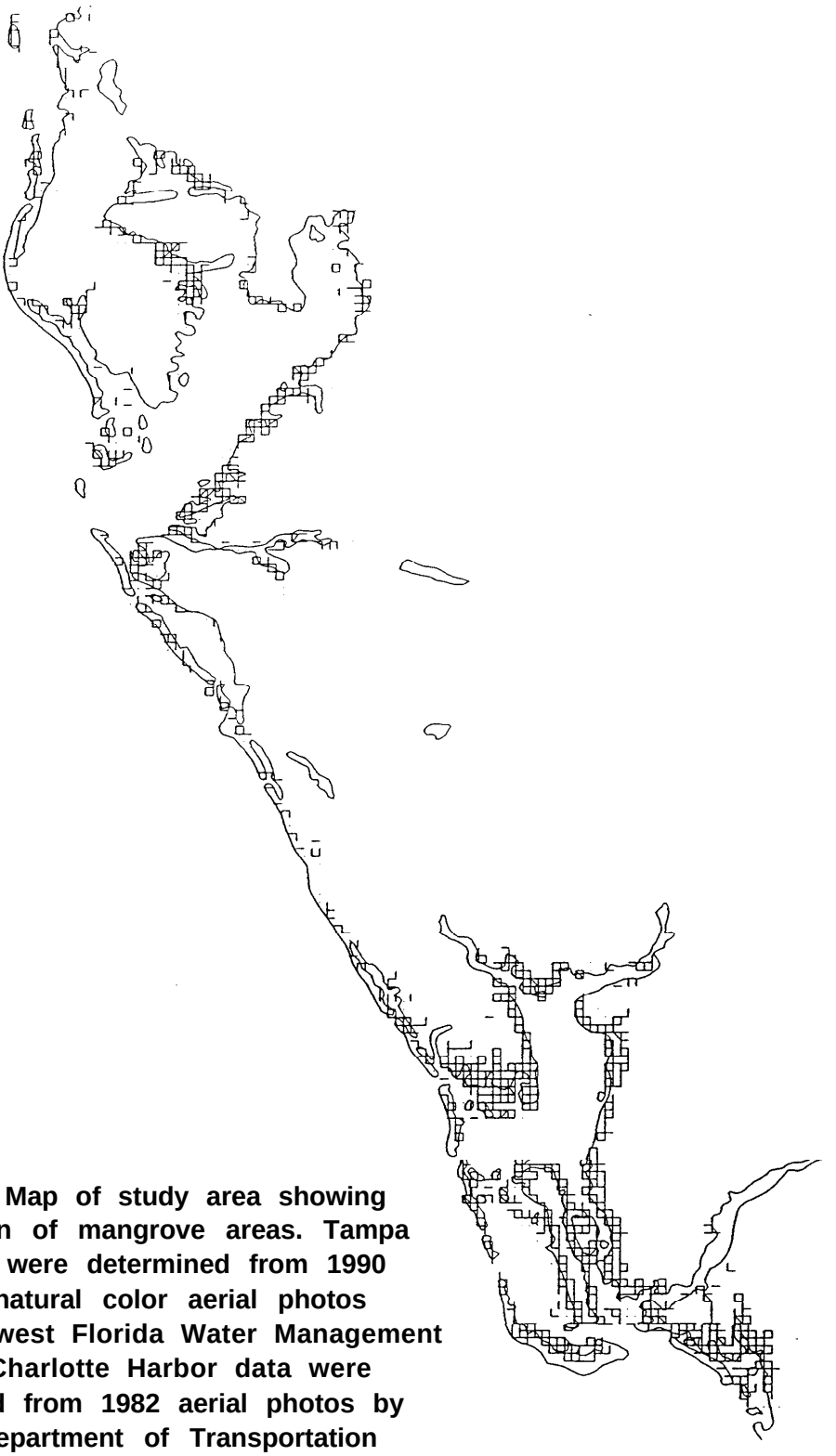


Figure 4. Map of study area showing distribution of mangrove areas. Tampa Bay data were determined from 1990 1:24,000 natural color aerial photos by Southwest Florida Water Management District. Charlotte Harbor data were interpreted from 1982 aerial photos by Florida Department of Transportation and Department of Natural Resources.

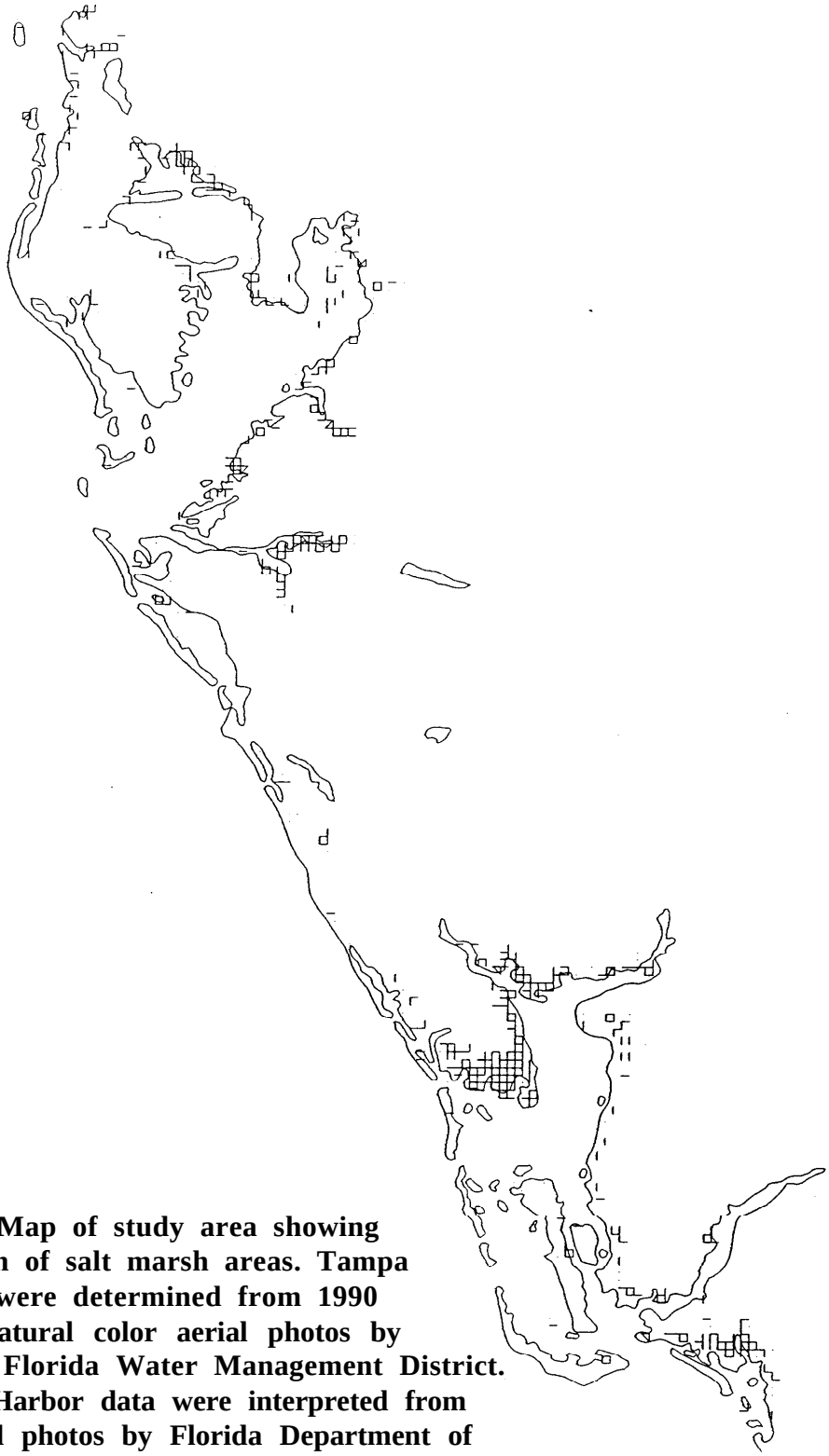


Figure 5. Map of study area showing distribution of salt marsh areas. Tampa Bay data were determined from 1990 1:24,000 natural color aerial photos by Southwest Florida Water Management District. Charlotte Harbor data were interpreted from 1982 aerial photos by Florida Department of Transportation and Department of Natural Resources.

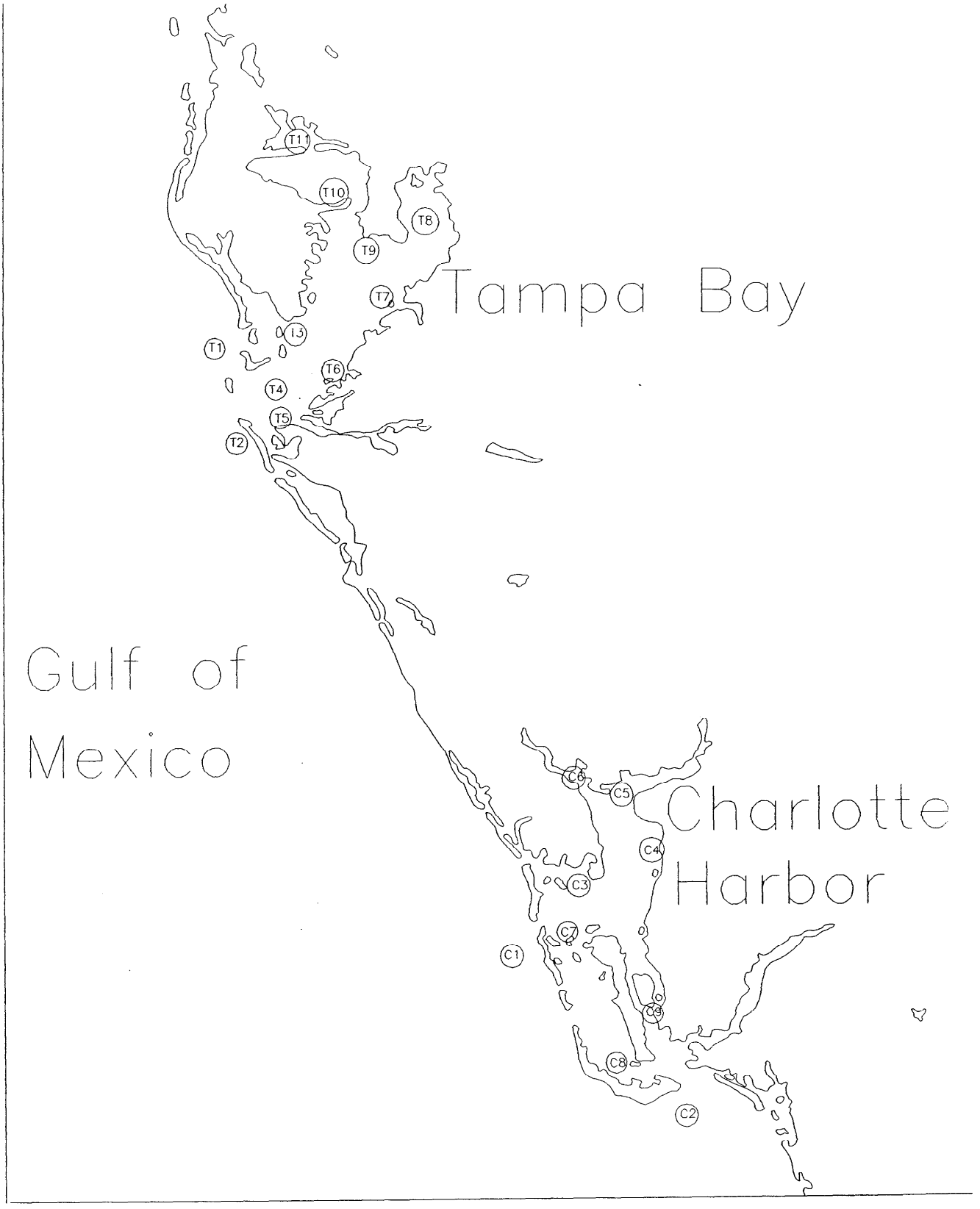


Figure 6. Map of study area showing primary sampling areas selected for this study based on shoreline features, habitat, depth, etc. See Table 2.

Figure 7. Map of study area showing sites of all surveys combined (fishery-independent, fishery-dependent, and shark census) during the course of the entire study.

Figure 8. Map of study area showing sites of all fishery-independent surveys.

Figure 9. Copy of field data sheet used during study to record physical and catch data in fishery-independent surveys.

DATE______ AREA______________________________ SAMPLE_____
SET______ LAT.______________ LONG.______________
GEAR TYPE_____ START TIME_____ END TIME_____ DEPTH_____ # HOOKS _____
BOTTOM____________________ WEATHER COND.____________________
SEA COND.____________________ TIDE_____ WIND________
CONDUCT.________ SAL.________ TEMP.____________
TOTAL NUMBER OF SHARKS CAPTURED________ PERSON RECORDING DATA__________

MESH/HOOK SIZE _____ | MESH/HOOK SIZE _____ | MESH/HOOK SIZE _____
SPECIES ___________ | SP. ___________ | SP. ___________
SIZE ___ | SIZE ___ | SIZE ___
___ ___ ___ | ___ ___ ___ | ___ ___ ___
___ ___ ___ | ___ ___ ___ | ___ ___ ___
___ ___ ___ TOTAL____ | ___ ___ ___ TOTAL____ | ___ ___ ___ TOTAL____

MESH/HOOK SIZE _____ | MESH/HOOK SIZE _____ | MESH/HOOK SIZE _____
SPECIES ___________ | SP. ___________ | SP. ___________
SIZE ___ | SIZE ___ | SIZE ___
___ ___ ___ | ___ ___ ___ | ___ ___ ___
___ ___ ___ | ___ ___ ___ | ___ ___ ___
___ ___ ___ TOTAL____ | ___ ___ ___ TOTAL____ | ___ ___ ___ TOTAL____

MESH/HOOK SIZE _____ | MESH/HOOK SIZE _____ | MESH/HOOK SIZE _____
SPECIES ___________ | SP. ___________ | SP. ___________
SIZE ___ | SIZE ___ | SIZE ___
___ ___ ___ | ___ ___ ___ | ___ ___ ___
___ ___ ___ | ___ ___ ___ | ___ ___ ___
___ ___ ___ TOTAL____ | ___ ___ ___ TOTAL____ | ___ ___ ___ TOTAL____

DATE______ AREA______________________________ SAMPLE_____
SET______ LAT.______________ LONG.______________
GEAR TYPE_____ START TIME_____ END TIME_____ DEPTH_____ # HOOKS _____
BOTTOM____________________ WEATHER COND.____________________
SEA COND.____________________ TIDE_____ WIND________
CONDUCT.________ SAL.________ TEMP.____________
TOTAL NUMBER OF SHARKS CAPTURED________ PERSON RECORDING DATA__________

MESH/HOOK SIZE _____ | MESH/HOOK SIZE _____ | MESH/HOOK SIZE _____
SPECIES ___________ | SP. ___________ | SP. ___________
SIZE ___ | SIZE ___ | SIZE ___
___ ___ ___ | ___ ___ ___ | ___ ___ ___
___ ___ ___ | ___ ___ ___ | ___ ___ ___
___ ___ ___ TOTAL____ | ___ ___ ___ TOTAL____ | ___ ___ ___ TOTAL____

MESH/HOOK SIZE _____ | MESH/HOOK SIZE _____ | MESH/HOOK SIZE _____
SPECIES ___________ | SP. ___________ | SP. ___________
SIZE ___ | SIZE ___ | SIZE ___
___ ___ ___ | ___ ___ ___ | ___ ___ ___
___ ___ ___ | ___ ___ ___ | ___ ___ ___
___ ___ ___ TOTAL____ | ___ ___ ___ TOTAL____ | ___ ___ ___ TOTAL____

MESH/HOOK SIZE _____ | MESH/HOOK SIZE _____ | MESH/HOOK SIZE _____
SPECIES ___________ | SP. ___________ | SP. ___________
SIZE ___ | SIZE ___ | SIZE ___
___ ___ ___ | ___ ___ ___ | ___ ___ ___
___ ___ ___ | ___ ___ ___ | ___ ___ ___
___ ___ ___ TOTAL____ | ___ ___ ___ TOTAL____ | ___ ___ ___ TOTAL____

Figure 10. Copy of field shark data sheet used during study to record data on each shark collected in both fishery-independent and fishery-dependent surveys.

MML SHARK DATA SHEET

PERSON RECORDING DATA______________ SAMPLES INCLUDED________

DATE_______ SAMPLE_______ SET____ GEAR TYPE____ GEAR SIZE____
SPECIES_______ SEX____ PCL____ FL____ TL____ STL____
TAG____ WT.____ REPRO. COND. 1.NEONATE CONDITION 1.GOOD
STOMACH CONT. TAKEN____ 2.IMMATURE 2.FAIR
COMMENTS______________ 3.MATURE 3.POOR
4.VERY POOR
5.DEAD

DATE_______ SAMPLE_______ SET____ GEAR TYPE____ GEAR SIZE____
SPECIES_______ SEX____ PCL____ FL____ TL____ STL____
TAG____ WT.____ REPRO. COND. 1.NEONATE CONDITION 1.GOOD
STOMACH CONT. TAKEN____ 2.IMMATURE 2.FAIR
COMMENTS______________ 3.MATURE 3.POOR
4.VERY POOR
5.DEAD

DATE_______ SAMPLE_______ SET____ GEAR TYPE____ GEAR SIZE____
SPECIES_______ SEX____ PCL____ FL____ TL____ STL____
TAG____ WT.____ REPRO. COND. 1.NEONATE CONDITION 1.GOOD
STOMACH CONT. TAKEN____ 2.IMMATURE 2.FAIR
COMMENTS______________ 3.MATURE 3.POOR
4.VERY POOR
5.DEAD

DATE_______ SAMPLE_______ SET____ GEAR TYPE____ GEAR SIZE____
SPECIES_______ SEX____ PCL____ FL____ TL____ STL____
TAG____ WT.____ REPRO. COND. 1.NEONATE CONDITION 1.GOOD
STOMACH CONT. TAKEN____ 2.IMMATURE 2.FAIR
COMMENTS______________ 3.MATURE 3.POOR
4.VERY POOR
5.DEAD

DATE_______ SAMPLE_______ SET____ GEAR TYPE____ GEAR SIZE____
SPECIES_______ SEX____ PCL____ FL____ TL____ STL____
TAG____ WT.____ REPRO. COND. 1.NEONATE CONDITION 1.GOOD
STOMACH CONT. TAKEN____ 2.IMMATURE 2.FAIR
COMMENTS______________ 3.MATURE 3.POOR
4.VERY POOR
5.DEAD

DATE_______ SAMPLE_______ SET____ GEAR TYPE____ GEAR SIZE____
SPECIES_______ SEX____ PCL____ FL____ TL____ STL____
TAG____ WT.____ REPRO. COND. 1.NEONATE CONDITION 1.GOOD
STOMACH CONT. TAKEN____ 2.IMMATURE 2.FAIR
COMMENTS______________ 3.MATURE 3.POOR
4.VERY POOR
5.DEAD

DATE_______ SAMPLE_______ SET____ GEAR TYPE____ GEAR SIZE____
SPECIES_______ SEX____ PCL____ FL____ TL____ STL____
TAG____ WT.____ REPRO. COND. 1.NEONATE CONDITION 1.GOOD
STOMACH CONT. TAKEN____ 2.IMMATURE 2.FAIR
COMMENTS______________ 3.MATURE 3.POOR
4.VERY POOR
5.DEAD

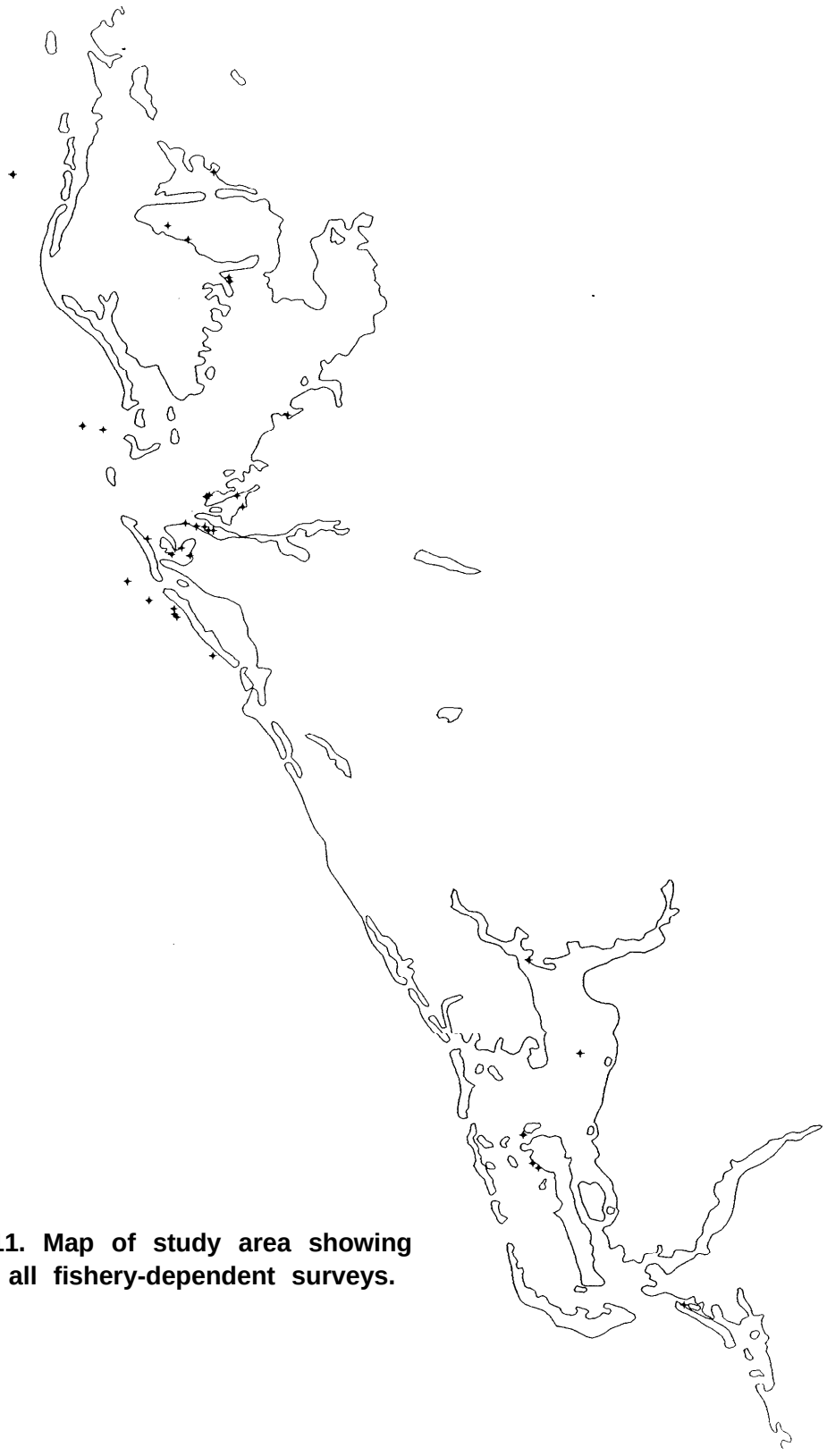


Figure 11. Map of study area showing sites of all fishery-dependent surveys.

Figure 12. Copy of fishery-dependent field data sheet used to record physical and catch data in fishery-dependent surveys.

MML FISHERIES-DEPENDENT CATCH DATA SHEET

CONTACT NAME__________________ PHONE NUMBER__________ SAMPLE____

DATE______ SET NO.____ AREA__________________________

BOAT/CAPTAIN'S NAME__________________ LAT.________ LONG.______

LAUNCH SITE__________ FISHERY__________ START TIME______ END______

GEAR TYPE__________ LENGTH______ WIDTH______ MESH SIZE_____ DEPTH______

WEATHER COND.__________________ SEA COND.__________________

BOTTOM__________________ TIDE__________

COMMENTS____

TOTAL NUMBER OF SHARKS__________ PERSON RECORDING DATA__________________

SPECIES __________ SP. __________ SP. __________
SIZE ___ SIZE ___ SIZE ___
___ ___ ___ ___ ___ ___ ___ ___ ___
___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____

SPECIES __________ SP. __________ SP. __________
SIZE ___ SIZE ___ SIZE ___
___ ___ ___ ___ ___ ___ ___ ___ ___
___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____

SPECIES __________ SP. __________ SP. __________
SIZE ___ SIZE ___ SIZE ___
___ ___ ___ ___ ___ ___ ___ ___ ___
___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____

SPECIES __________ SP. __________ SP. __________
SIZE ___ SIZE ___ SIZE ___
___ ___ ___ ___ ___ ___ ___ ___ ___
___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____

SPECIES __________ SP. __________ SP. __________
SIZE ___ SIZE ___ SIZE ___
___ ___ ___ ___ ___ ___ ___ ___ ___
___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____

SPECIES __________ SP. __________ SP. __________
SIZE ___ SIZE ___ SIZE ___
___ ___ ___ ___ ___ ___ ___ ___ ___
___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____

SPECIES __________ SP. __________ SP. __________
SIZE ___ SIZE ___ SIZE ___
___ ___ ___ ___ ___ ___ ___ ___ ___
___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____ ___ ___ ___ TOTAL____

Figure 13. Copy of shark census data sheet used to record physical and shark data during recreational fishery-dependent surveys.

SHARK TOURNAMENT TAGGING DATA SHEET

DATE________ AREA FISHED____________________________________ SAMPLE______
CONTACT NAME____________________________ PHONE NUMBER___________
BOAT NAME________________ CAPTAIN_________________ WATER DEPTH__________
START TIME______ END TIME_____ DEPTH FISHED______ # LINES FISHED ________
BOTTOM TYPE_______________________ WEATHER COND.__________________________
SEA COND.___________________________ TIDE______ WIND__________
TOTAL NUMBER OF SHARKS CAPTURED__________ PERSON RECORDING DATA____________

CATCH #____ ANGLER____________________ LAT.___________ LONG.____________
AREA____ RECAP?________
SPECIES_____________________ SEX (M or F) PCL____ FL_____ TL_____ STL____
TAG_______ WT._______ REPRO. COND. 1.NEONATE CONDITION 1.GOOD
TIME LANDED______________ 2.IMMATURE 2.FAIR
HOW LONG FOUGHT__________ 3.MATURE 3.POOR
COMMENTS____ 4.VERY POOR
____ 5.DEAD

CATCH #____ ANGLER____________________ LAT.___________ LONG.____________
AREA____ RECAP?________
SPECIES_____________________ SEX (M or F) PCL____ FL_____ TL_____ STL____
TAG_______ WT._______ REPRO. COND. 1.NEONATE CONDITION 1.GOOD
TIME LANDED______________ 2.IMMATURE 2.FAIR
HOW LONG FOUGHT__________ 3.MATURE 3.POOR
COMMENTS____ 4.VERY POOR
____ 5.DEAD

CATCH #____ ANGLER____________________ LAT.___________ LONG.____________
AREA____ RECAP?________
SPECIES_____________________ SEX (M or F) PCL____ FL_____ TL_____ STL____
TAG_______ WT._______ REPRO. COND. 1.NEONATE CONDITION 1.GOOD
TIME LANDED______________ 2.IMMATURE 2.FAIR
HOW LONG FOUGHT__________ 3.MATURE 3.POOR
COMMENTS____ 4.VERY POOR
____ 5.DEAD

CATCH #____ ANGLER____________________ LAT.___________ LONG.____________
AREA____ RECAP?________
SPECIES_____________________ SEX (M or F) PCL____ FL_____ TL_____ STL____
TAG_______ WT._______ REPRO. COND. 1.NEONATE CONDITION 1.GOOD
TIME LANDED______________ 2.IMMATURE 2.FAIR
HOW LONG FOUGHT__________ 3.MATURE 3.POOR
COMMENTS____ 4.VERY POOR
____ 5.DEAD

CATCH #____ ANGLER____________________ LAT.___________ LONG.____________
AREA____ RECAP?________
SPECIES_____________________ SEX (M or F) PCL____ FL_____ TL_____ STL____
TAG_______ WT._______ REPRO. COND. 1.NEONATE CONDITION 1.GOOD
TIME LANDED______________ 2.IMMATURE 2.FAIR
HOW LONG FOUGHT__________ 3.MATURE 3.POOR
COMMENTS____ 4.VERY POOR
____ 5.DEAD

Figure 14. Copy of stomach contents data sheet used to record information on stomach contents of sharks.

MML SHARK STOMACH CONTENTS DATA

SHARK #______ SAMPLE_____ SET_____ CATCH #____ DATE CAPTURED__________
METHOD OBTAINED______________________ HOW PRESERVED______________________
DATE EXAMINED________________________ PERSON EXAMINING___________________

CONTENTS	WEIGHT	% TOTAL	COMMENTS

TOTAL WT. ________

SHARK #______ SAMPLE_____ SET_____ CATCH #____ DATE CAPTURED__________
METHOD OBTAINED______________________ HOW PRESERVED______________________
DATE EXAMINED________________________ PERSON EXAMINING___________________

CONTENTS	WEIGHT	% TOTAL	COMMENTS

TOTAL WT. ________

SHARK #______ SAMPLE_____ SET_____ CATCH #____ DATE CAPTURED__________
METHOD OBTAINED______________________ HOW PRESERVED______________________
DATE EXAMINED________________________ PERSON EXAMINING___________________

CONTENTS	WEIGHT	% TOTAL	COMMENTS

TOTAL WT. ________

SHARK #______ SAMPLE_____ SET_____ CATCH #____ DATE CAPTURED__________
METHOD OBTAINED______________________ HOW PRESERVED______________________
DATE EXAMINED________________________ PERSON EXAMINING___________________

CONTENTS	WEIGHT	% TOTAL	COMMENTS

TOTAL WT. ________

Figure 15. Copy of tagging poster distributed around the study area to alert recreational and commercial fishermen about the tagged sharks.

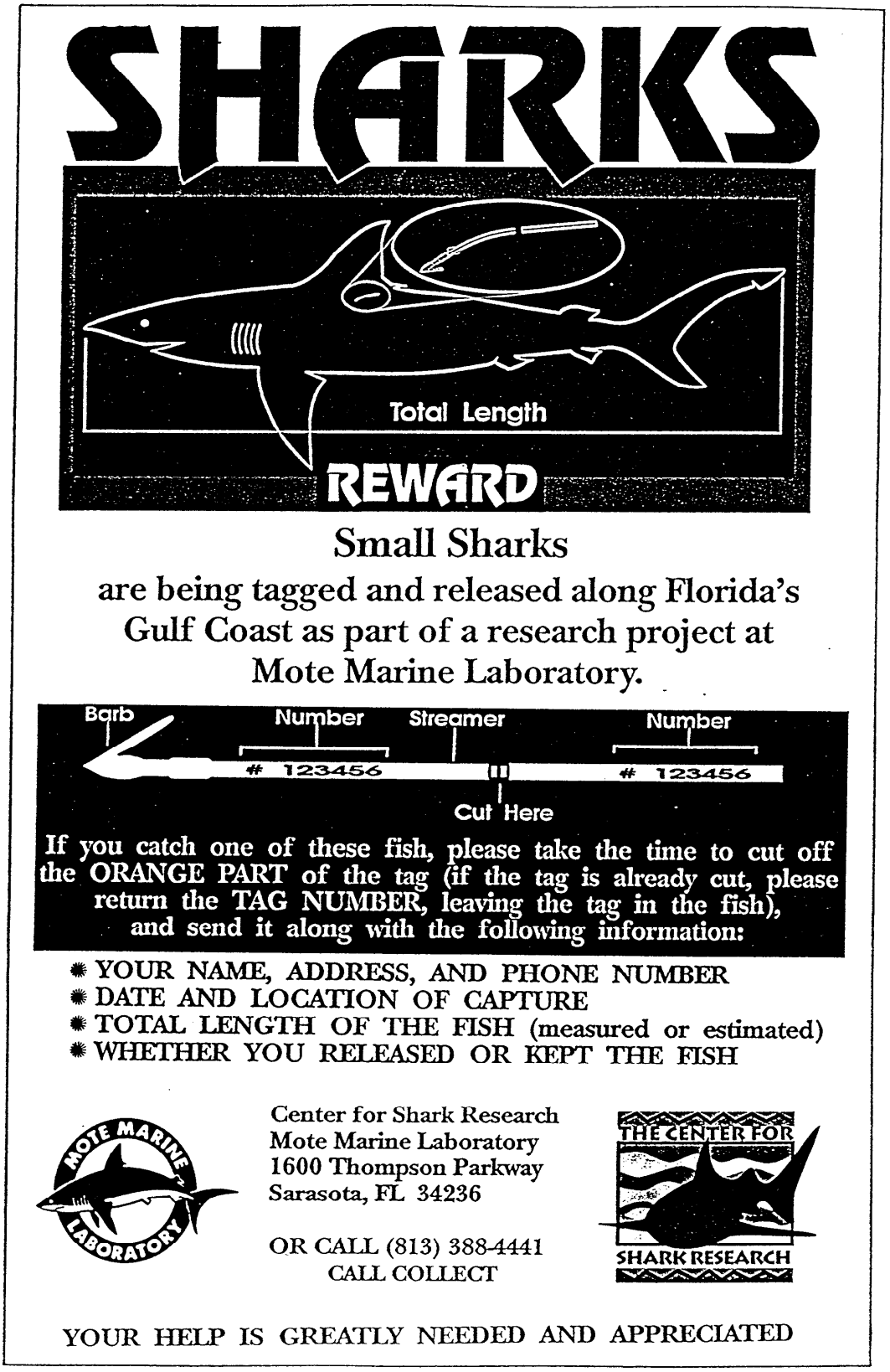


Figure 16. Map of study area showing sites where sharks were captured, all surveys combined.

Figure 17. Map of study area showing sites of samples where no sharks were captured, all surveys combined.

Figure 18. Shark species composition within the study area, ail surveys combined. Numbers of numerically predominant species are shown.

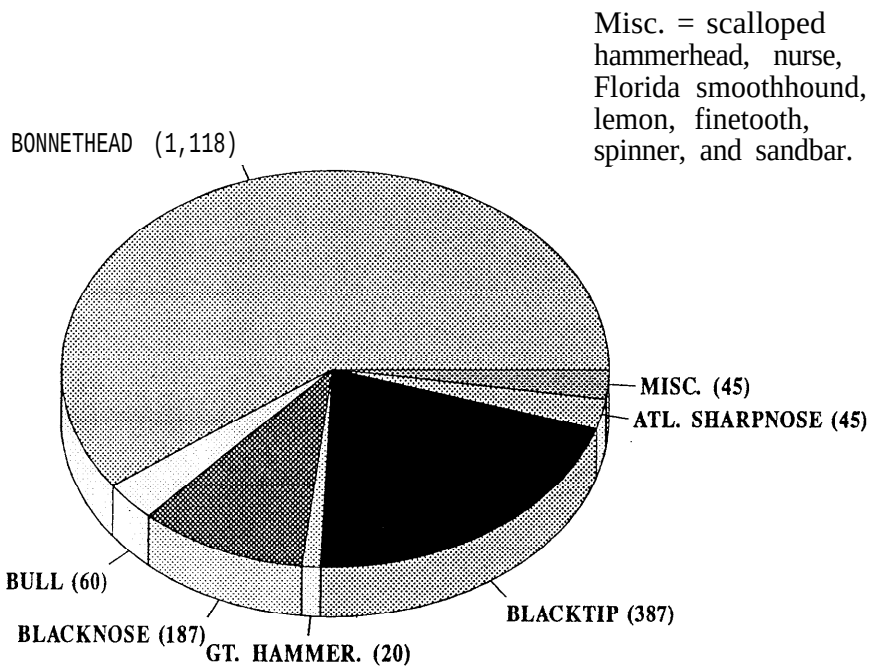
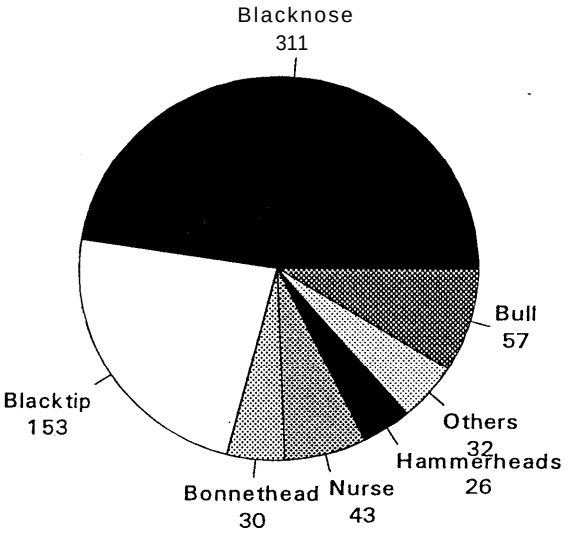


Figure 19. Species composition of total shark catch recorded during the 1992 and the 1993 shark census tournaments, with numbers of numerically predominant species shown.

1992 Shark Census



1993 Shark Census

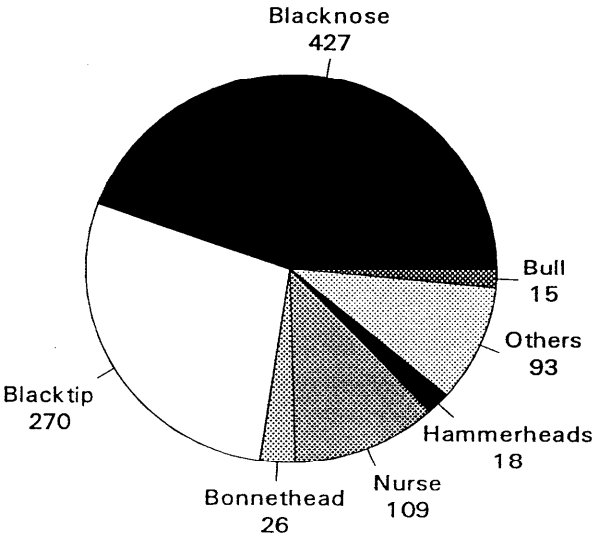
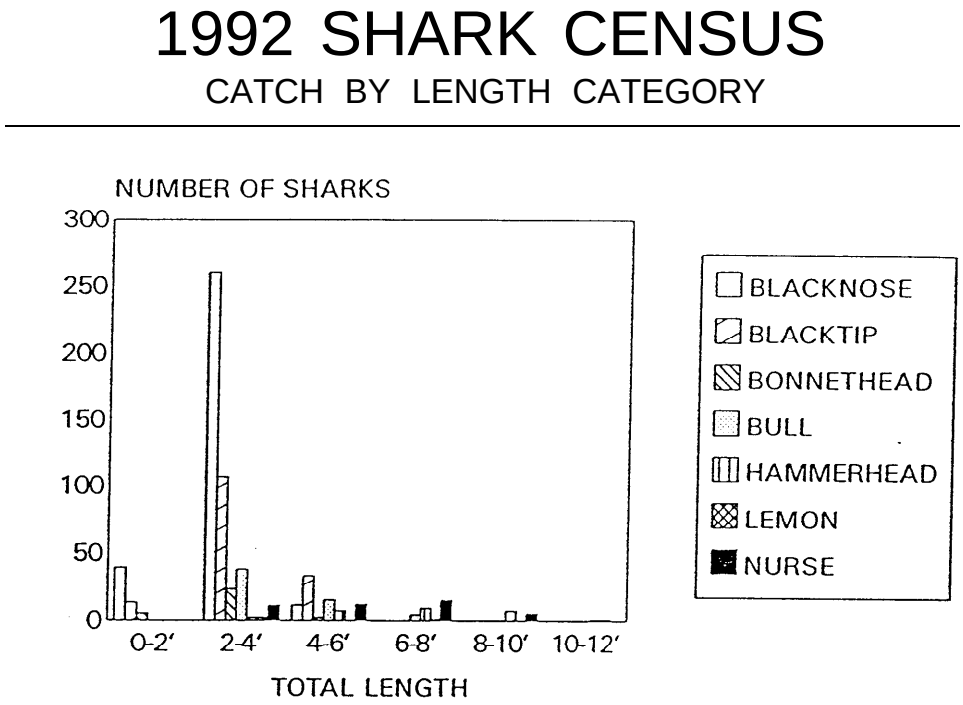


Figure 20. Number of sharks by total length category for the numerically predominant species caught during the 1992 and the 1993 shark census tournaments.



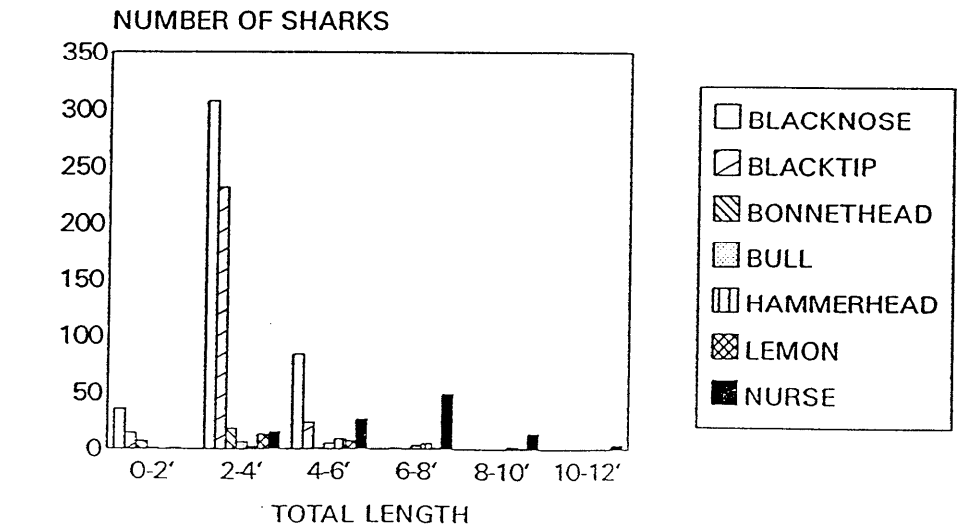


Figure 21. Map of study area showing sites of samples where blacknose sharks were captured, all surveys combined.

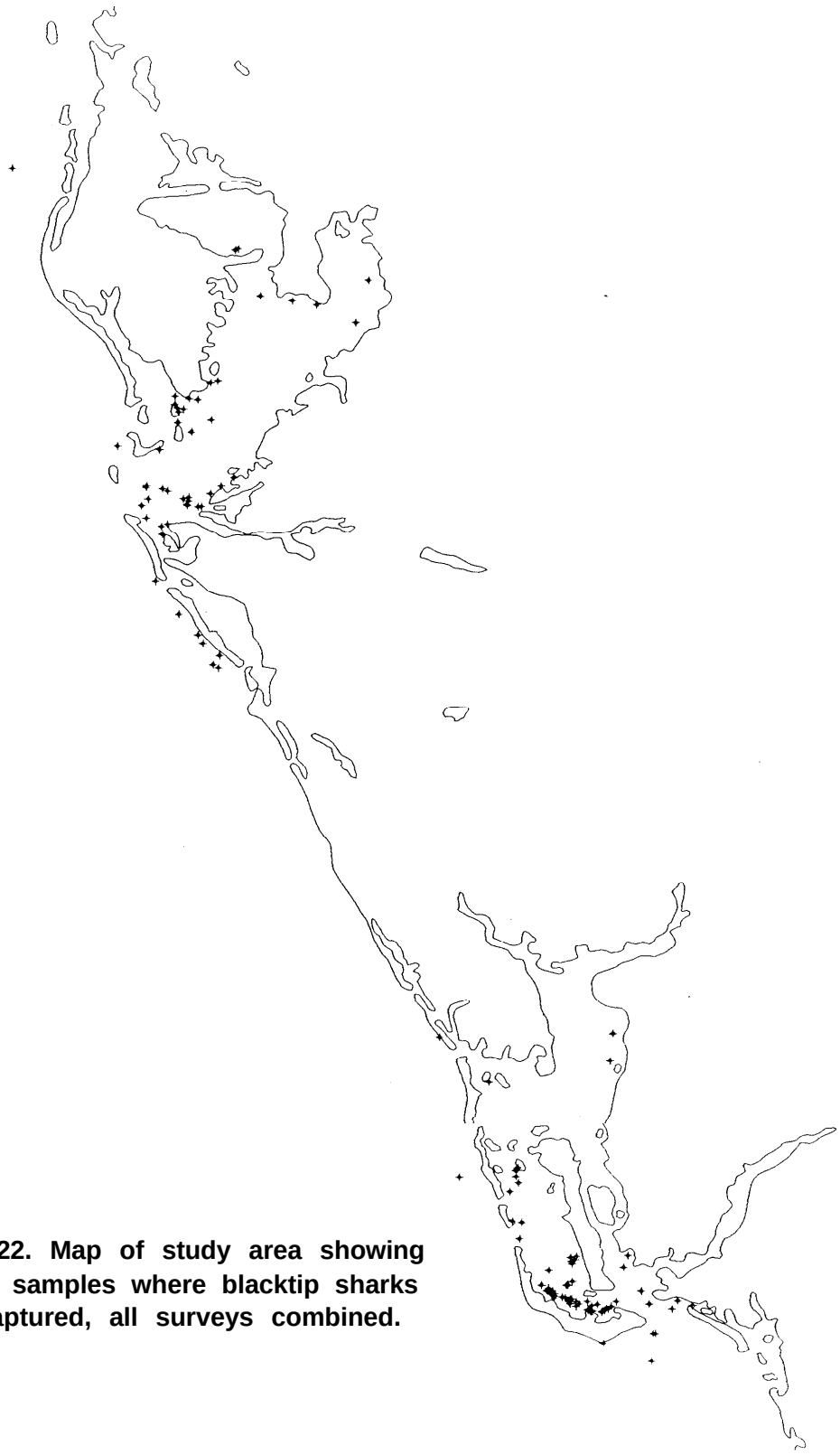


Figure 22. Map of study area showing sites of samples where blacktip sharks were captured, all surveys combined.

Figure 23. Map of study area showing sites of samples where bonnethead sharks were captured, all surveys combined.

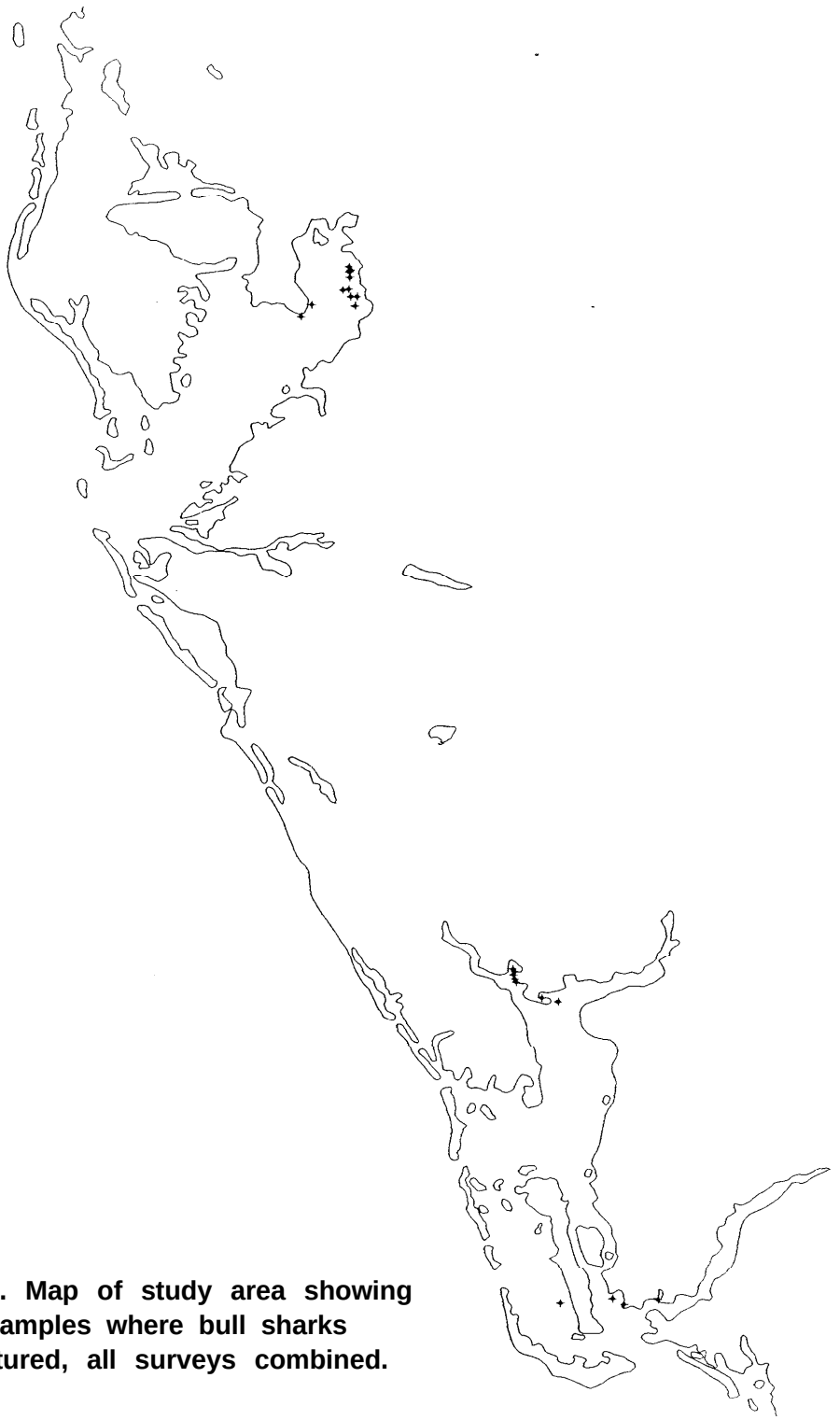


Figure 24. Map of study area showing sites of samples where bull sharks were captured, all surveys combined.

Figure 25. Map of study area showing sites of samples where finetooth sharks were captured, all surveys combined.

Figure 26. Map of study area showing sites of samples where great hammerhead sharks were captured, all surveys combined.

Figure 27. Map of study area showing sites of samples where scalloped hammerhead sharks were captured, all surveys combined.

Figure 28. Map of study area showing sites of samples where lemon sharks were captured, all surveys combined.

Figure 29. Map of study area showing sites of samples where nurse sharks were captured, all surveys combined.

Figure 30. Map of study area showing sites of samples where sandbar sharks were captured, all surveys combined.

Figure 31. Map of study area showing sites of samples where Atlantic sharpnose sharks were captured, all surveys combined.

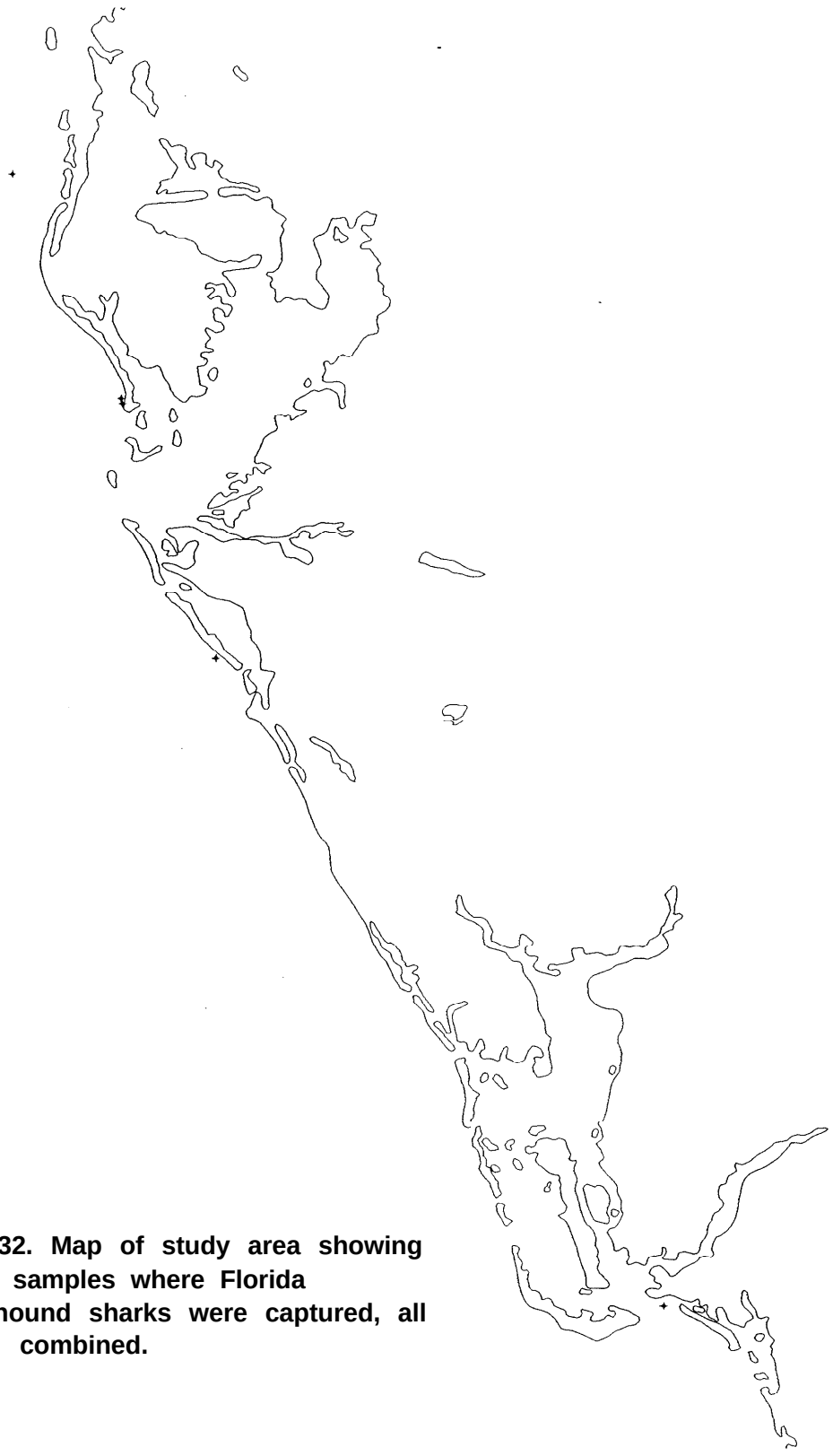
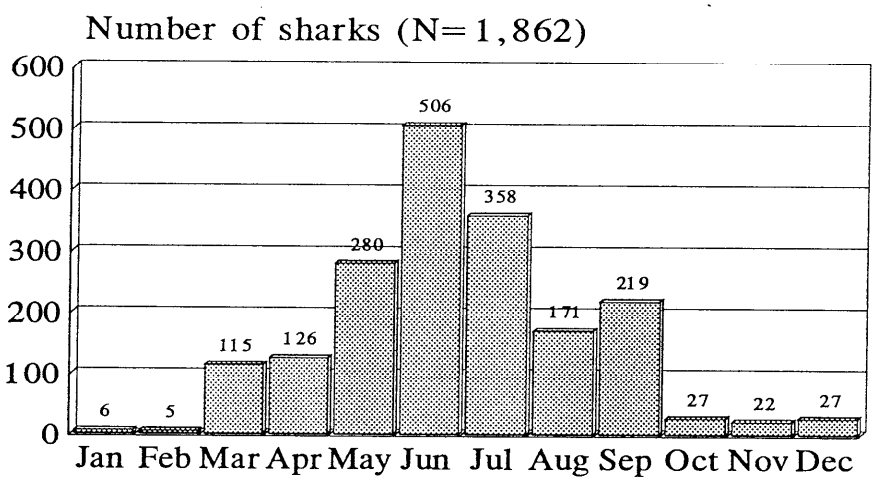


Figure 32. Map of study area showing sites of samples where Florida smoothhound sharks were captured, all surveys combined.

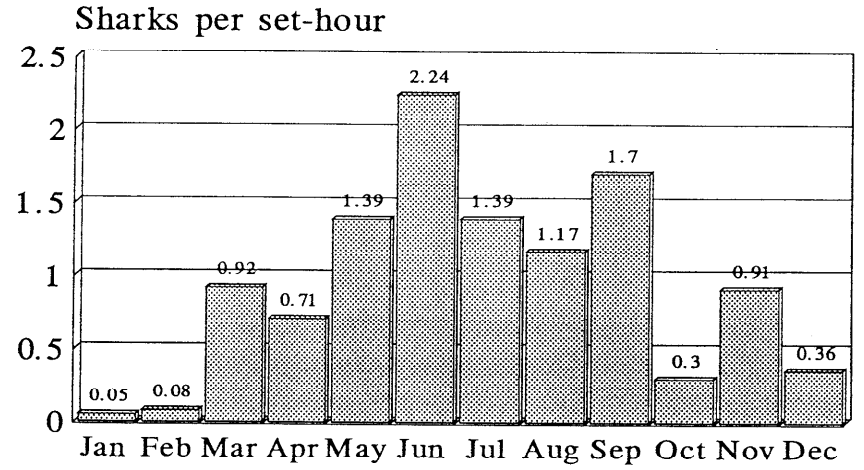
Figure 33. Map of study area showing sites of samples where spinner sharks were captured, all surveys combined.

Figure 34. Number of sharks caught by month of the year and the shark CPUE (sharks per set-hour) by month of the year during the course of the study, all surveys combined.

TOTAL SHARK CATCH BY MONTH
F-I and F-D Surveys for 1991-93 Combined



SHARK CATCH PER UNIT EFFORT BY MONTH
F-I and **F-D Surveys for 1991-93 Combined**



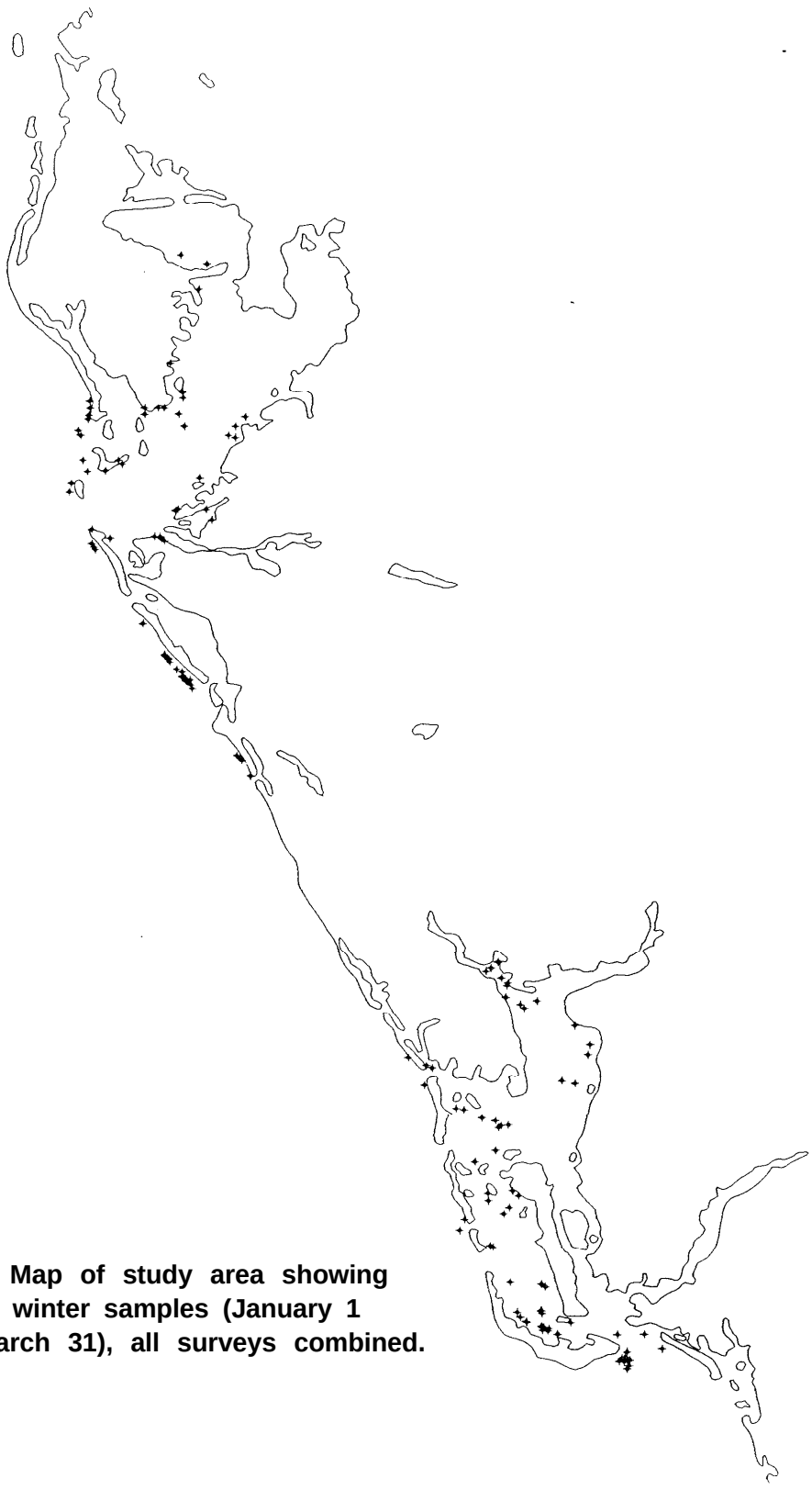


Figure 35. Map of study area showing sites of all winter samples (January 1 through March 31), all surveys combined.

Figure 36. Map of study area showing sites of all winter samples (January 1 through March 31) where sharks were captured, all surveys combined.

Figure 37. Map of study area showing sites of all winter samples (January 1 through March 31) where no sharks were captured, all surveys combined.

Figure 38. Map of study area showing sites of all winter samples (January 1 through March 31) where bonnethead sharks were captured, all surveys combined.

Figure 39. Map of study area showing sites of all winter samples (January 1 through March 31) where blacktip sharks were captured, all surveys combined.

Figure 40. Map of study area showing sites of all winter samples (January 1 through March 31) where blacknose sharks were captured, all surveys combined.

Figure 41. Map of study area showing sites of all winter samples (January 1 through March 31) where Atlantic sharpnose sharks were captured, all surveys combined.

Figure 42. Map of study area showing sites of all winter samples (January 1 through March 31) where bull sharks were captured, all surveys combined.

Figure 43. Map of study area showing sites of all winter samples (January 1 through March 31) where sharks other than bonnethead, blacktip, blacknose, Atlantic sharpnose and bull were captured, all surveys combined.

Figure 44. Map of study area showing sites of all spring samples (April 1 through June 30), all surveys combined.

Figure 45. Map of study area showing sites of all spring samples (April 1 through June 30) where sharks were captured, all surveys combined.

Figure 46. Map of study area showing sites of all spring samples (April 1 through June 30) where no sharks were captured, all surveys combined.

Figure 47. Map of study area showing sites of all spring samples (April 1 through June 30) where bonnethead sharks were captured, all surveys combined.

Figure 48. Map of study area showing sites of all spring samples (April 1 through June 30) where blacktip sharks were captured, all surveys combined.

Figure 49. Map of study area showing sites of all spring samples (April 1 through June 30) where blacknose sharks were captured, all surveys combined.

Figure 50. Map of study area showing sites of all spring samples (April 1 through June 30) where Atlantic sharpnose sharks were captured, all surveys combined.

Figure 51. Map of study area showing sites of all spring samples (April 1 through June 30) where bull sharks were captured, all surveys combined.

Figure 52. Map of study area showing sites of all spring samples (April 1 through June 30) where sharks other than bonnethead, blacktip, blacknose, Atlantic sharpnose, and bull were captured, all surveys combined.

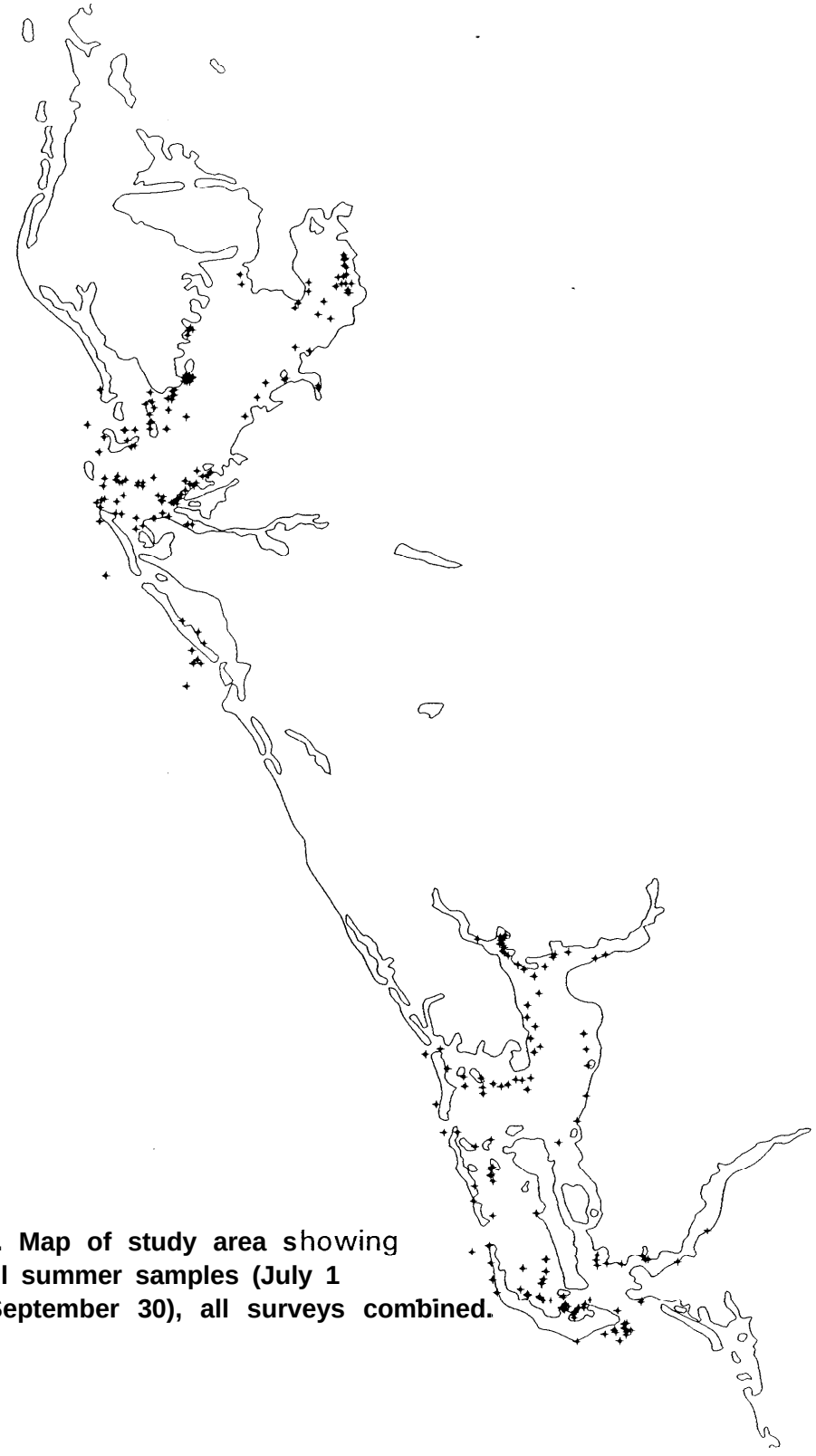


Figure 53. Map of study area showing sites of all summer samples (July 1 through September 30), all surveys combined.

Figure 54. Map of study area showing sites of all summer samples (July 1 through September 30) where sharks were captured, all surveys combined.

Figure 55. Map of study area showing sites of all summer samples (July 1 through September 30) where no sharks were captured, all surveys combined.

Figure 56. Map of study area showing sites of all summer samples (July 1 through September 30) where bonnethead sharks were captured, all surveys combined.

Figure 57. Map of study area showing sites of all summer samples (July 1 through September 30) where blacktip sharks were captured, all surveys combined.

Figure 58. Map of study area showing sites of all summer samples (July 1 through September 30) where blacknose sharks were captured, all surveys combined.

Figure 59. Map of study area showing sites of all summer samples (July 1 through September 30) where Atlantic sharpnose sharks were captured, all surveys combined.

Figure 60. Map of study area showing sites of all summer samples (July 1 through September 30) where bull sharks were captured, all surveys combined.

Figure 61. Map of study area showing sites of all summer samples (July 1 through September 30) where sharks other than bonnethead, blacktip, blacknose, Atlantic sharpnose and bull were captured, all surveys combined.

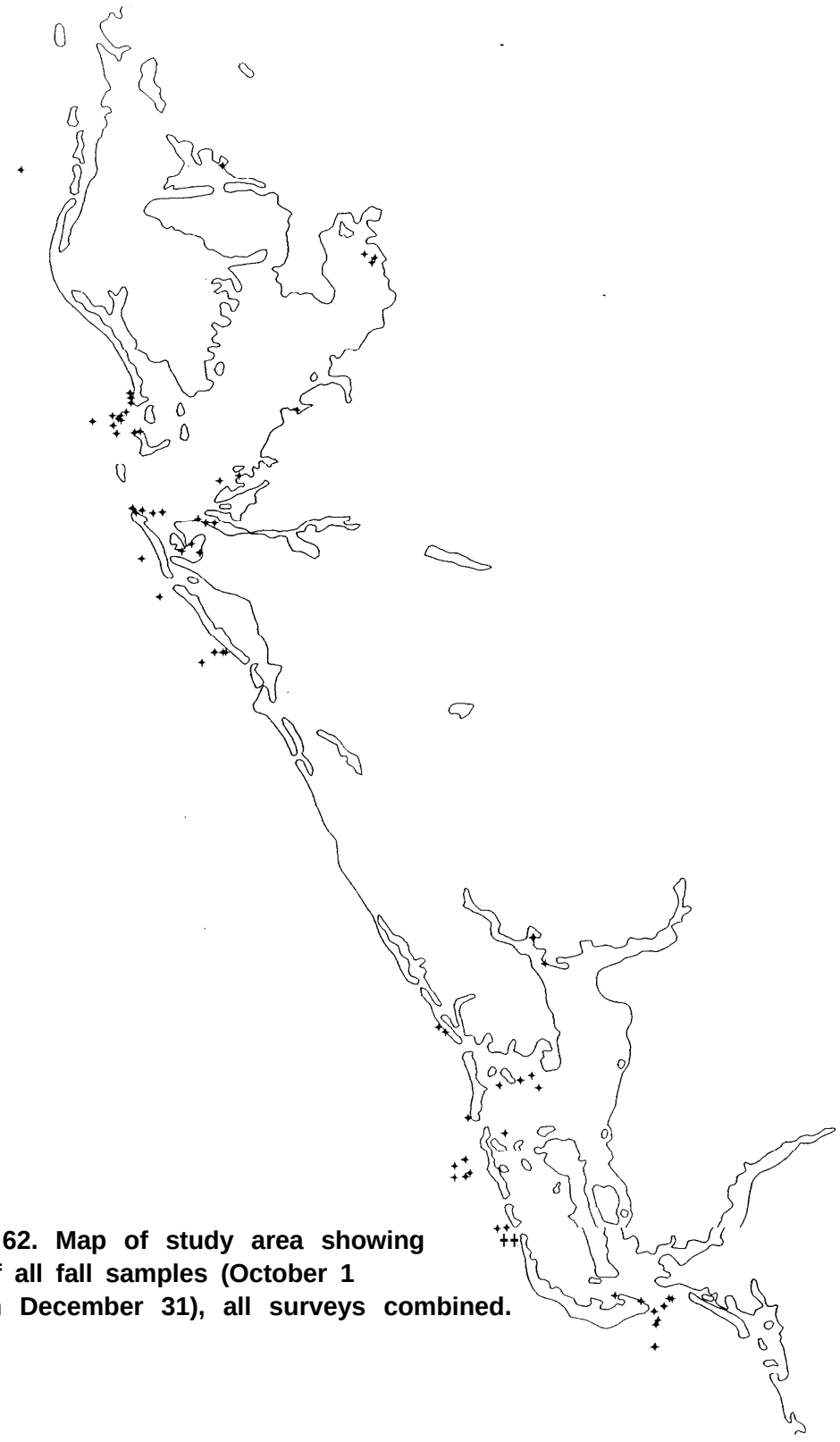


Figure 62. Map of study area showing sites of all fall samples (October 1 through December 31), all surveys combined.

Figure 63. Map of study area showing sites of all fall samples (October 1 through December 31) where sharks were captured, all surveys combined.

Figure 64. Map of study area showing Sites of all fall samples (October 1 through December 31) where no sharks were captured, all surveys combined.

Figure 65. Map of study area showing sites of all fall samples (October 1 through December 31) where bonnethead sharks were captured, all surveys combined.

Figure 66. Map of study area showing sites of all fall samples (October 1 through December 31) where blacktip sharks were captured, all surveys combined.

Figure 67. Map of study area showing sites of all fall samples (October 1 through December 31) where blacknose sharks were captured, all surveys combined.

Figure 68. Map of study area showing sites of all fall samples (October 1 through December 31) where Atlantic sharpnose sharks were captured, all surveys combined.

Figure 69. Map of study area showing sites of all fall samples (October 1 through December 31) where bull sharks were captured, all surveys combined.

Figure 70. Map of study area showing sites of all fall samples (October 1 through December 31) where sharks other than bonnethead, blacktip, blacknose, Atlantic sharpnose and bull were captured, all surveys combined.

Figure 71. Temperature and salinity profiles for shark species including minimum, maximum, and average (half-bar) temperature and salinity at which each species was captured, all surveys combined.

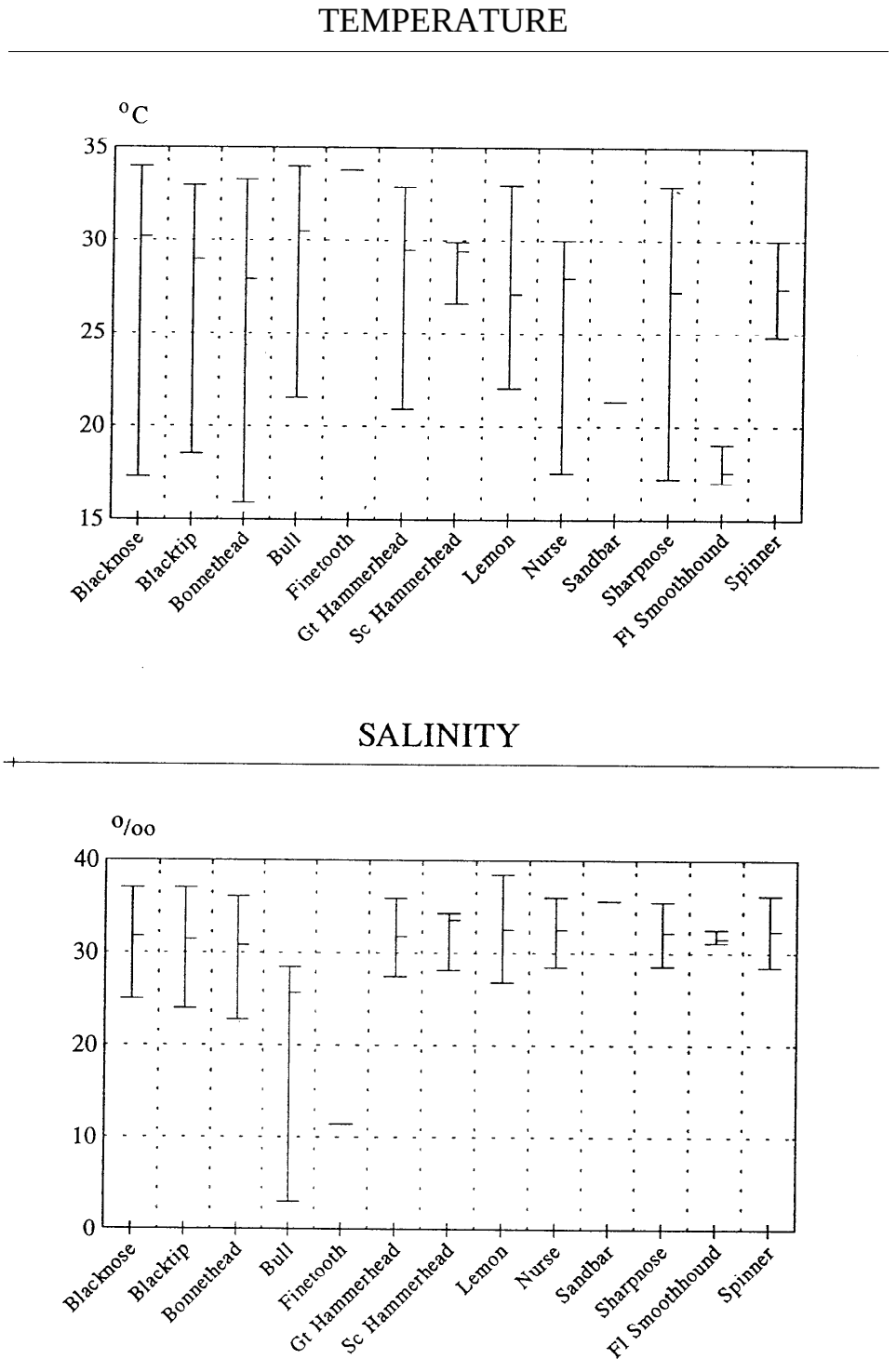


Figure 72. Depth profile for shark species including minimum, maximum, and average (half-bar) depth at which each species was captured, all surveys combined.

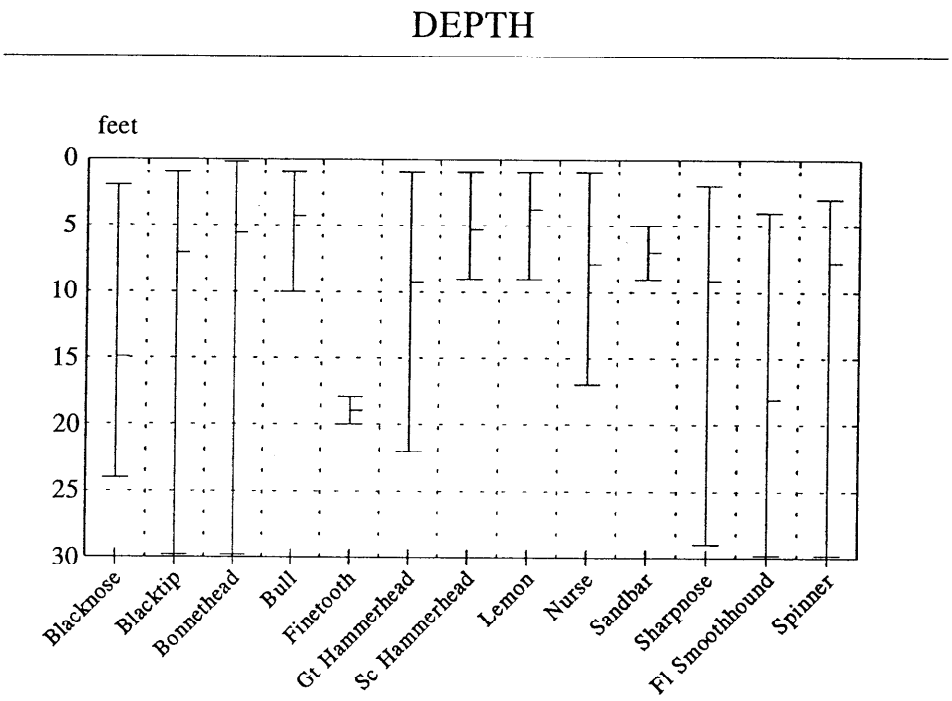


Figure 73. Habitat preferences of the four most abundant shark species by bottom type at location of capture, e.g. 93% of all bonnethead sharks were captured over seagrass bottom, etc.

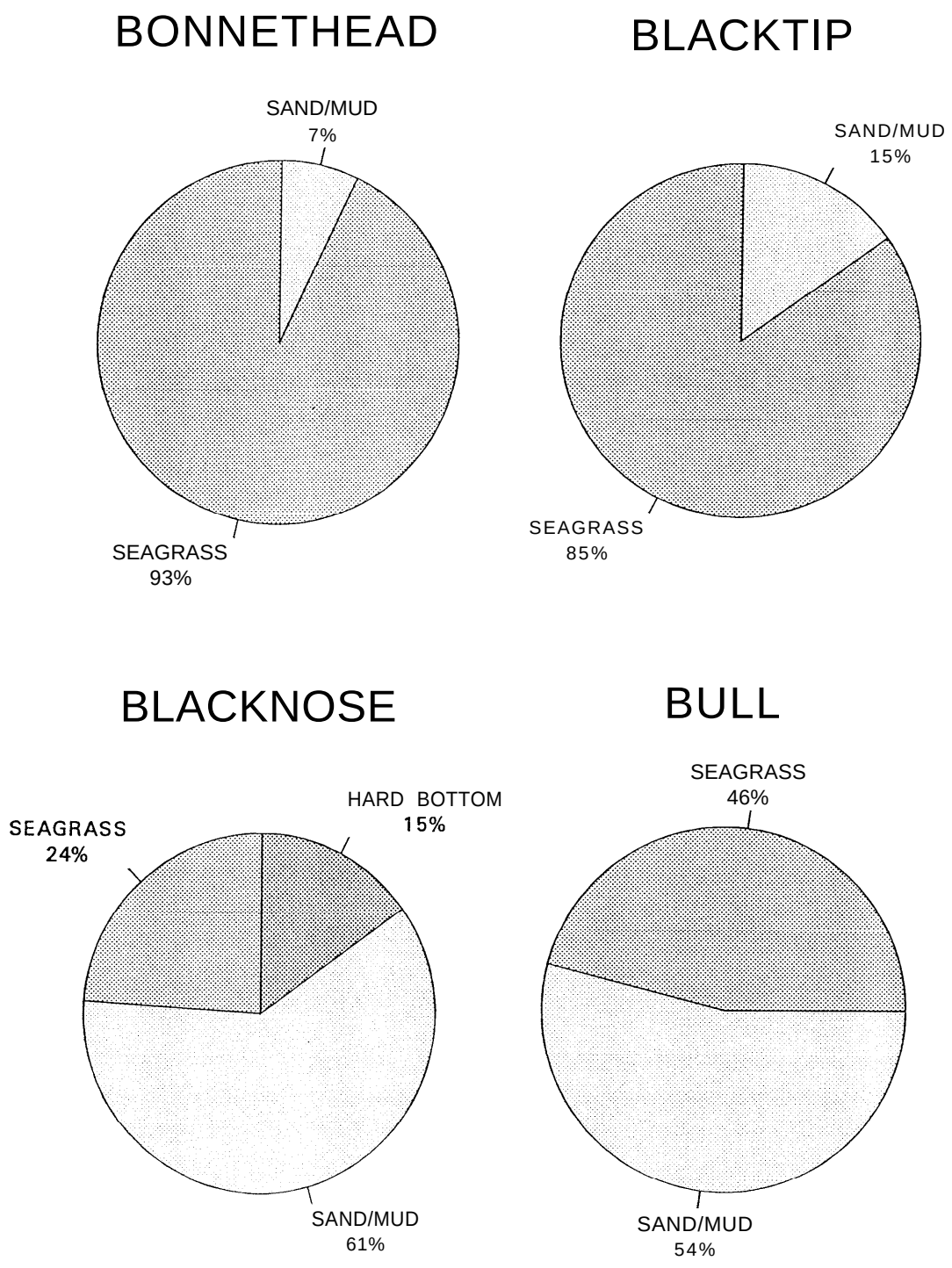


Figure 74. Map of study area showing sites of samples where neonate sharks were captured, all surveys combined.

Figure 75. Map of study area showing sites of samples where juvenile sharks were captured, all surveys combined.

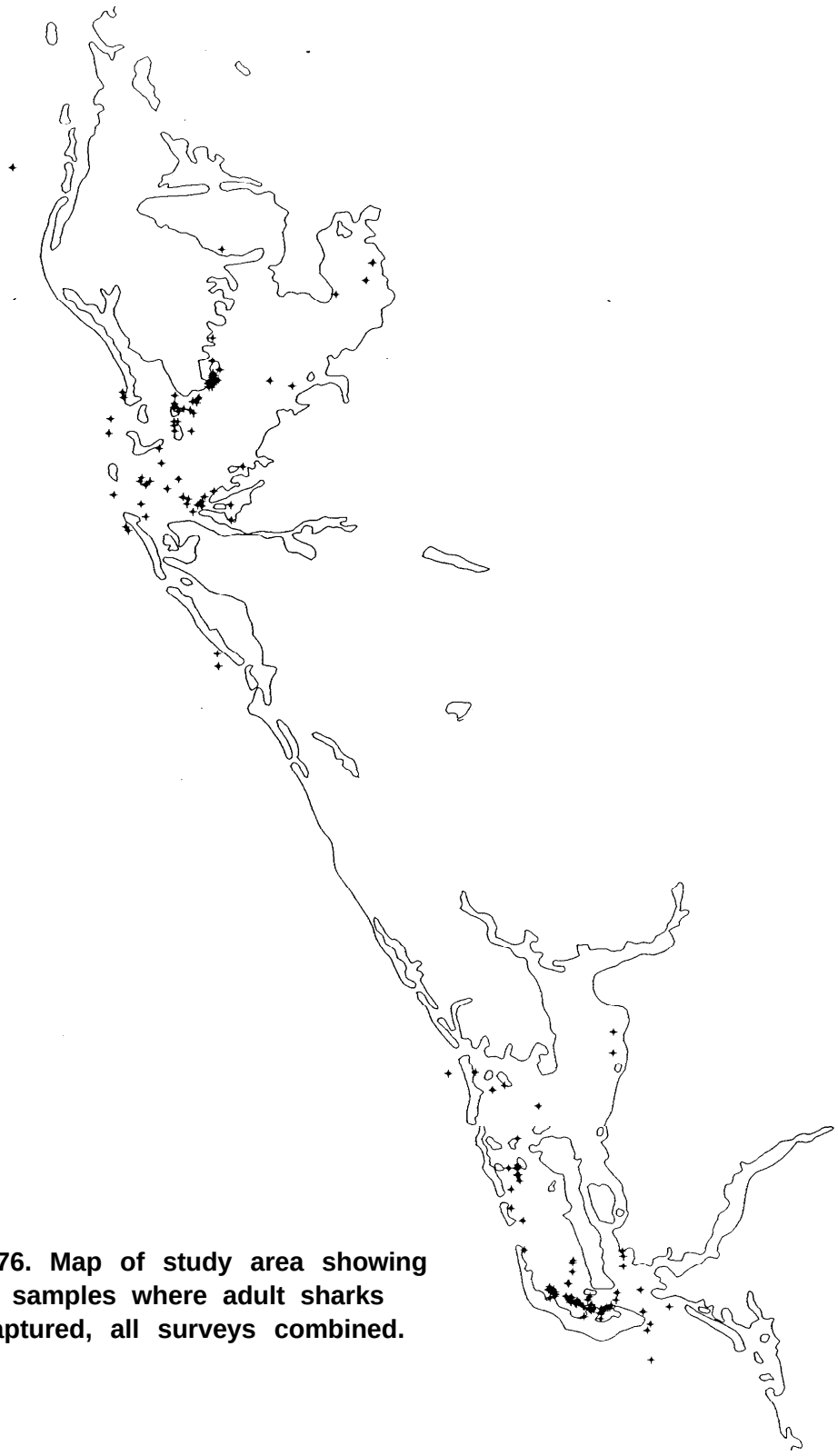


Figure 76. Map of study area showing sites of samples where adult sharks were captured, all surveys combined.

Figure 77. Map of study area showing sites of samples where adult sharks other than bonnethead sharks were captured, all surveys combined.

Figure 78. Monthly catches of juvenile sharks in the study area, showing the six species accounting for the most juveniles in the catch and the total catch of juveniles of all species (neonates not included).

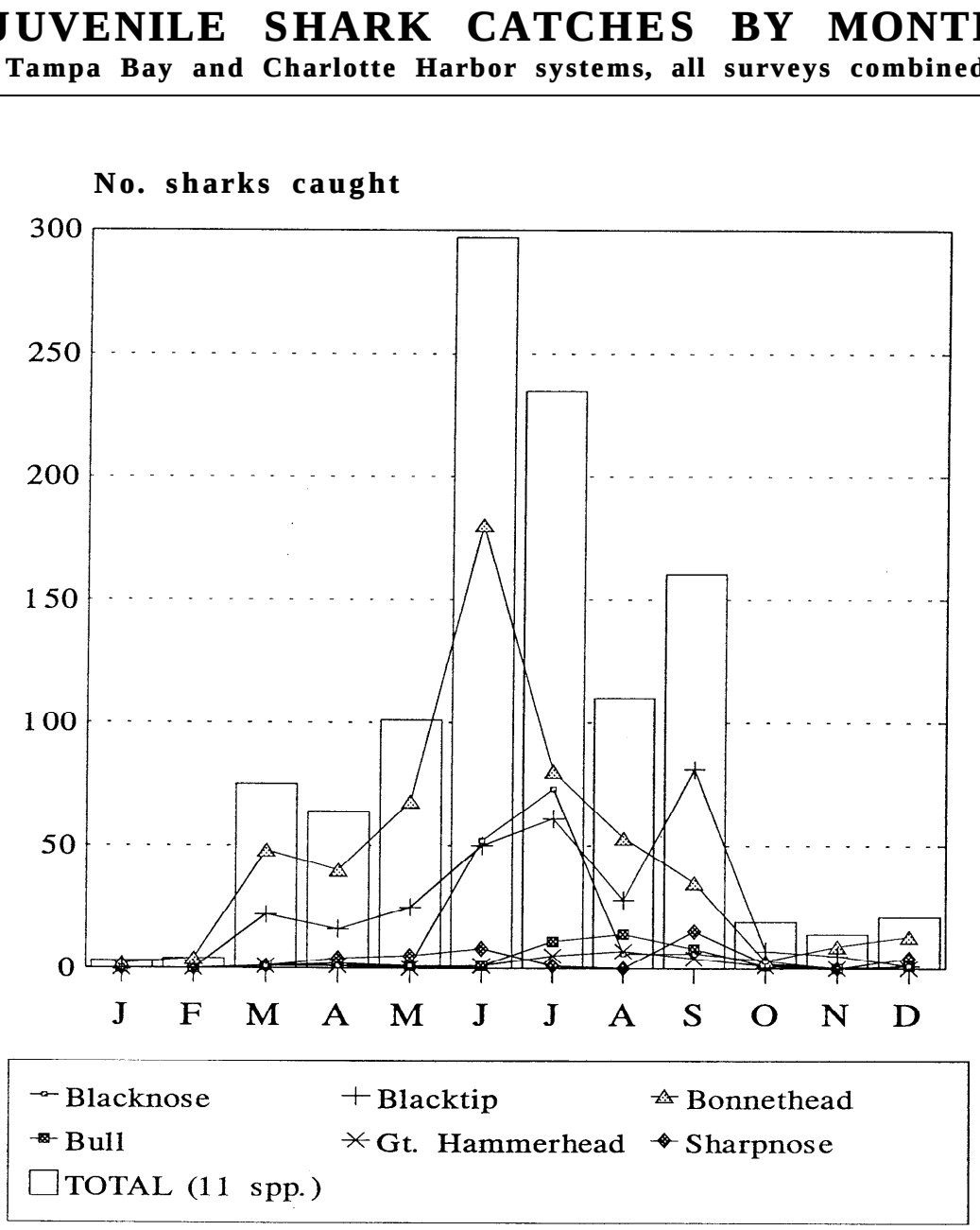


Figure 79. %IRI (Index of Relative Importance expressed as a percentage of total IRI for the species) of major components of stomach contents of bonnethead, blacktip, blacknose, and Atlantic sharpnose sharks.

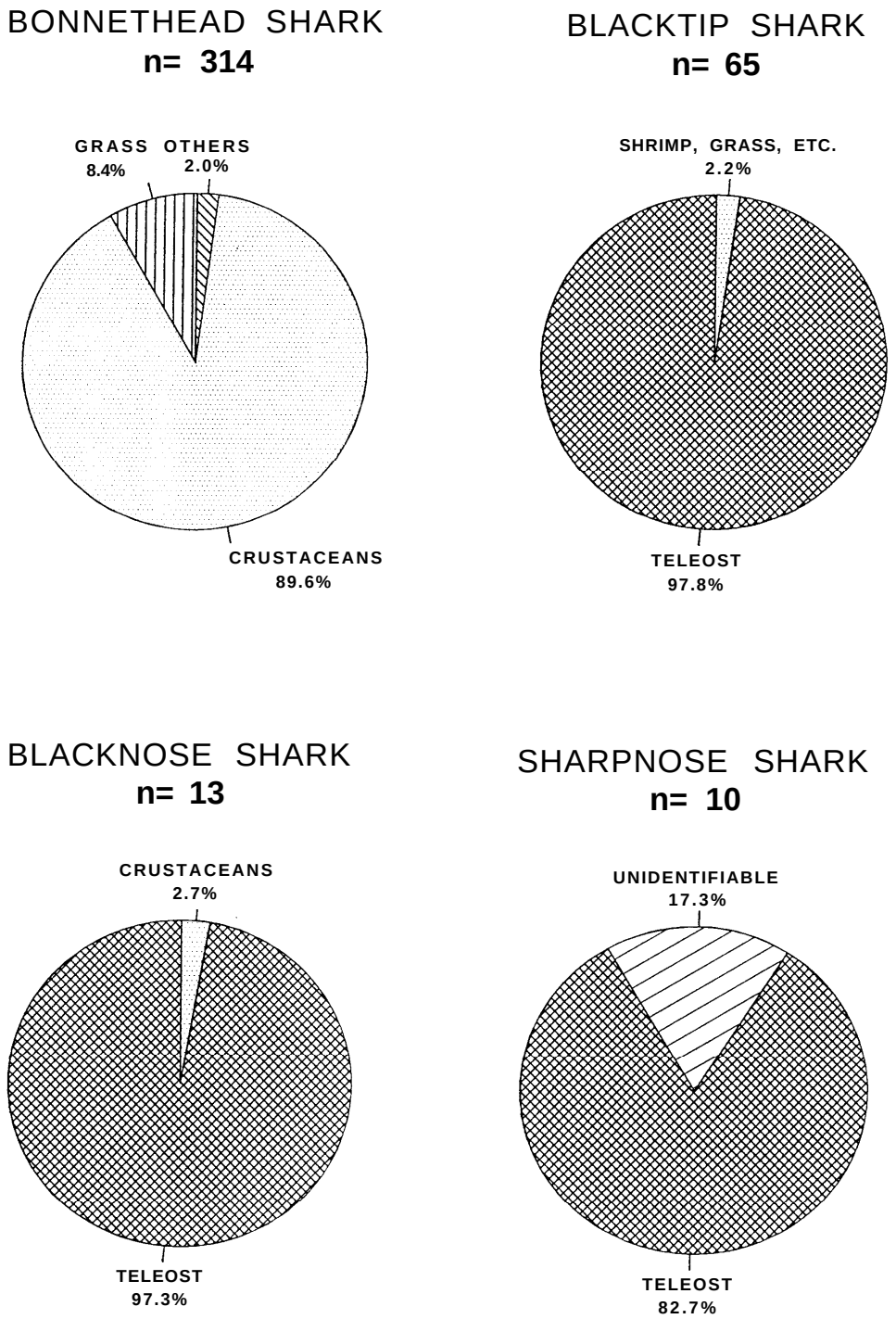


Figure 80. %IRI (Index of Relative Importance expressed as a percentage of total IRI for the species) of major components of stomach contents of bull, great hammerhead, scalloped hammerhead, and spinner sharks.

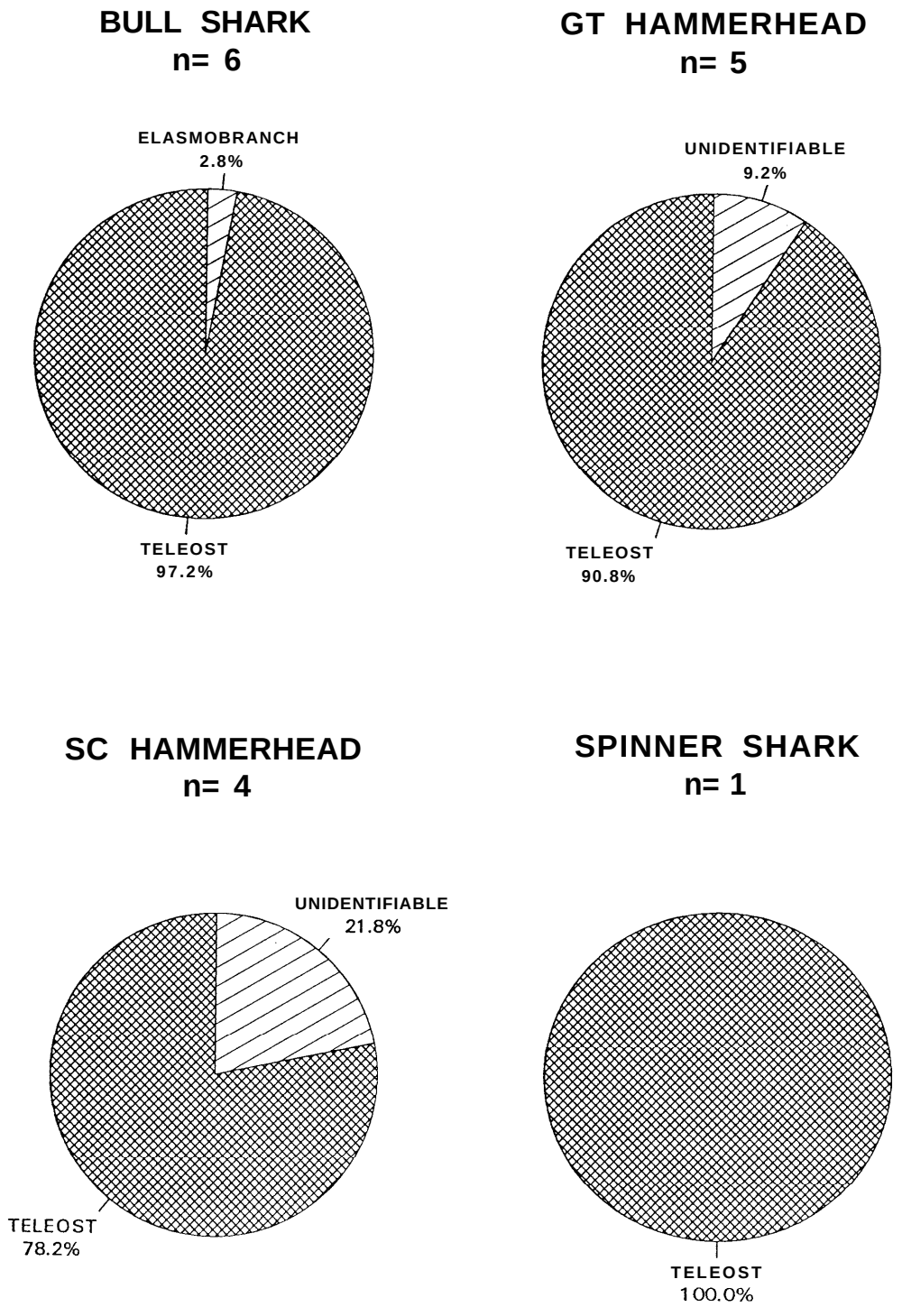
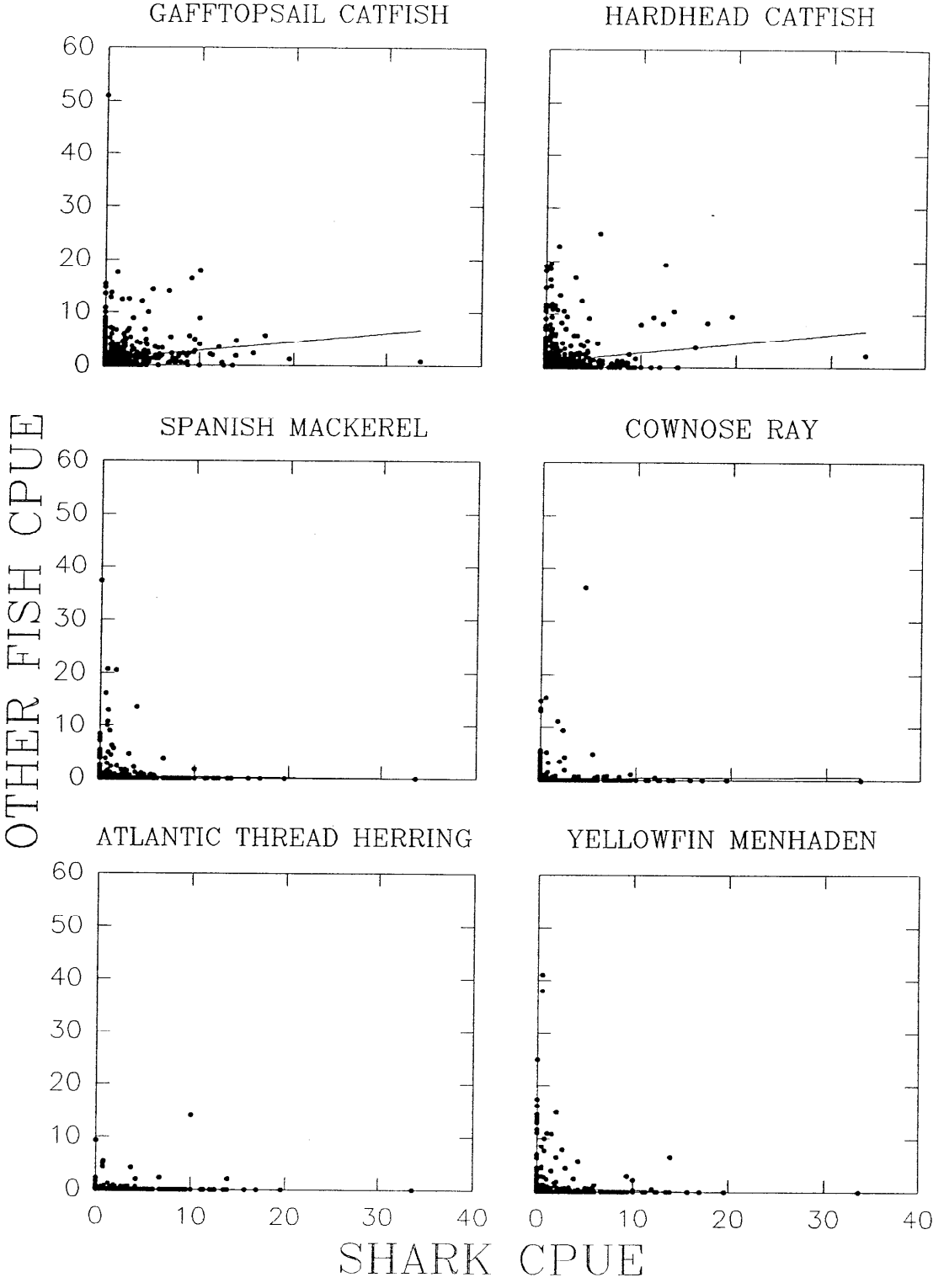


Figure 81. Shark CPUE (sharks per set-hour, all species combined) vs bycatch species CPUE (fish per set-hour) plotted for six bicatch species. All F-I and F-D surveys have been combined; each point represents results from one set. Regression lines are plotted (n = 830).



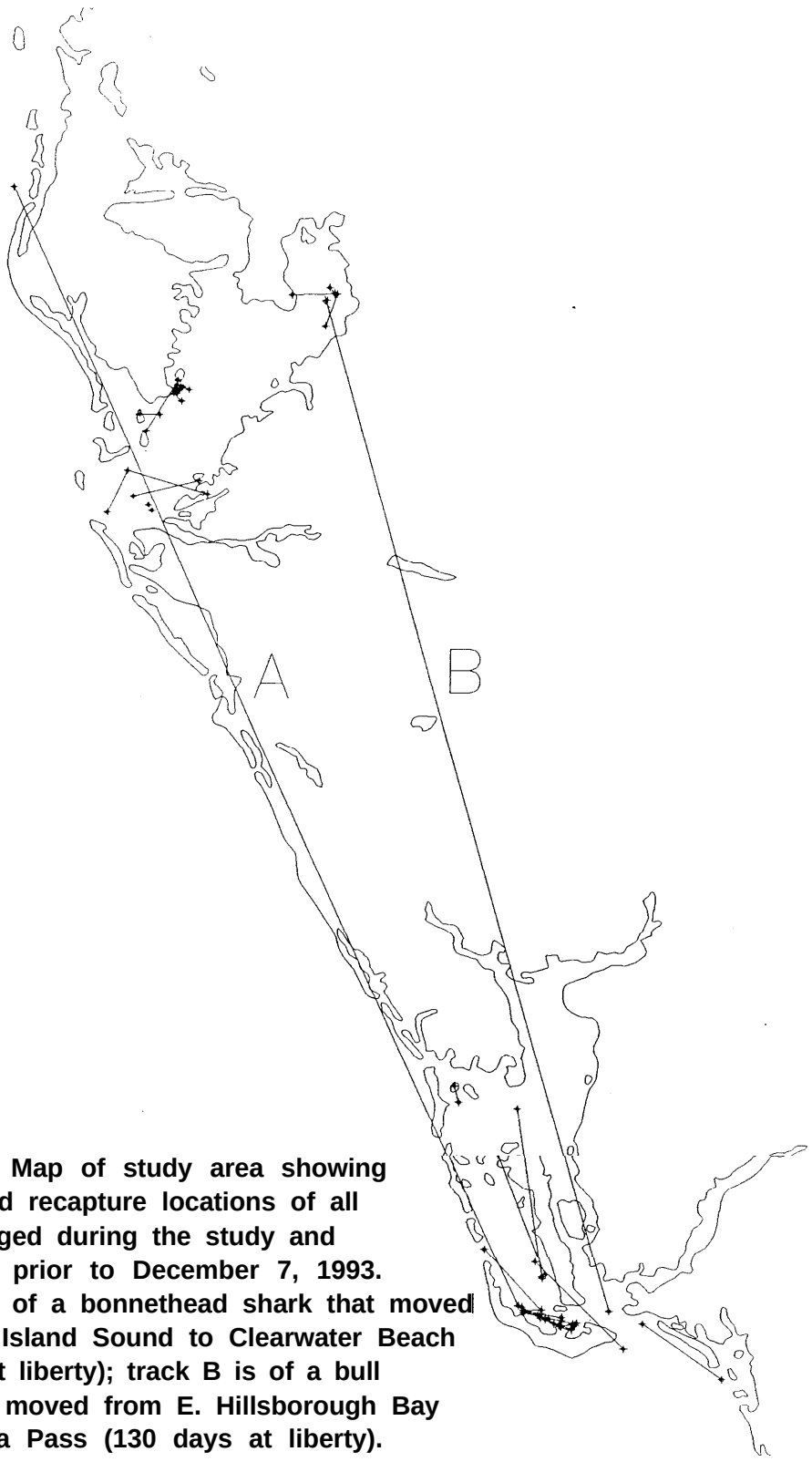


Figure 82. Map of study area showing tagging and recapture locations of all sharks tagged during the study and recaptured prior to December 7, 1993. Track A is of a bonnethead shark that moved from Pine Island Sound to Clearwater Beach (83 days at liberty); track B is of a bull shark that moved from E. Hillsborough Bay to Matlacha Pass (130 days at liberty).