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FISHERY INDEPENDENT MONITORING OF LARGE COASTAL SHARKS IN SOUTH CAROLINA (1993-95)

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by

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ABSTRACT

The purpose of this study was to evaluate techniques for conducting fisheries-independent assessments of large coastal sharks and to determine what changes have occurred in their populations in the coastal waters of South Carolina, in response to increased commercial exploitation. The present survey is a continuation of efforts to develop data on the status of these stocks on a regional basis. This report combines data from the 1993-94 and 1994-95 projects and compares it to catch composition and CPUE data collected during 1983-84.

Sampling was carried out using cable, bottom longline gear to allow comparison with a longline survey done in 1983-84 (Low and Ulrich, 1984). Substantial changes were noted during both recent sampling years, in the species composition, size composition and catch per unit effort compared to data collected in 1983-84. The sandbar shark was the numerically dominant shark in the 83-84 sampling, comprising 58.9 % of the catch, whereas during recent sampling it made up only 8.7 and 11.0 % of the catch in 1993-94 and 1994-95, respectively. Atlantic sharpnose were the most abundant sharks in year 1 and 2 of the current surveys at 42.1 and 49.2 % . Tiger sharks were second in abundance during recent sampling at 41.3 % of the catch in year 1 and 37.3 % in year 2. These species were much less abundant in the 83-84 catches; with tigers and Atlantic sharpnose making up 13.5 and 10.4 % of the catches, respectively.

The majority of tiger sharks (85.7 %), captured during the current surveys averaged 92 cm FL (range 56-132 cm FL). Tiger sharks in this size class were rarely encountered in the previous study, with catches dominated by large individuals (3-4 m TL). The largest tiger shark captured during the 1993-94 survey was 1.5 m FL. During 1994-95 sampling, 6.8 % of the tiger sharks exceeded 1.9 m FL. Although few sandbar sharks were caught, the size composition of current catches was comparable to those caught during 83-84.

Catch per unit effort values also exhibited substantial downward trends from those in the earlier study. CPUE for all species combined, was 8.03 sharks/ 100 hook set in 1983-84, 4.67 sharks/ 100 hooks in 93-94 and 3.5 sharks/ 100 hooks in 94-95. Large coastal species' CPUE declined from 6.22 sharks/ 100 hook set in 83-84 to 2.44 sharks/ 100 hook set in 93-94 and 1.75 large coastals/set in 94-95. The most dramatic decline in CPUE was for sandbar sharks; decreasing from 4.73 to 0.41 sandbars/ 100 hook set in 93-94 and 0.39 in 94-95. The only exception to the declines in CPUE between the 83-84 and current surveys, was for the small coastal species (Atlantic sharpnose and smoothhound); with catch rates increasing from 1.81 to 2.22 small coastals/ 100 hook set during 1993-94 sampling. Small coastal catch rates declined during 1994-95 to 1.75 sharks/ 100 hook set.

INTRODUCTION

Shark resources in U.S. waters have undergone an exponential

increase in exploitation between 1984 and 1988 (NMFS, 1992). The life history strategies of sharks; long-lived, advanced age at maturity and low reproductive potential make these species particularly vulnerable to unmanaged exploitation. In response to rapidly expanding shark fisheries and the vulnerability of shark stocks to recruitment overfishing, a Fishery Management Plan (FMP) based on the best existing data was developed by the Secretary of Commerce through the National Marine Fisheries Service (NMFS). Although this plan initiated the management process and provided a framework for collection of necessary data, many of the elements needed for effective management remained unavailable. Fishery independent indices of population abundance over time were cited as critical information needs in the Secretarial FMP. The FMP recommends that longline surveys be conducted to determine trends in abundance and distribution. Such surveys can also provide valuable information on size and sex composition, ecological relationships and habitat requirements. Tagging studies conducted in conjunction with longline surveys were also recommended, to provide information on stock identification, migration, growth and fishing mortality rates. The FMP emphasized the need for state participation in the data collection necessary for effective management.

The purpose of this project was to collect data that could be used as part of an expanded, regional longline survey, to assess the present status of shark resources (large coastal species) off the southeastern United States. Sampling methods used in this project were the same as those used in a study conducted in 1983-84 (Low and Ulrich, 1984). This enabled us to make comparative determinations of what changes have occurred in species/size composition and catch per unit effort within the sampled area. Other objectives were to increase the number of tagged sharks at large, to add to the data-base on stock identification and migratory behavior.

This report includes the results of the 93-94 and 94-95 projects and compares them to results obtained in the earlier survey.

METHODS AND MATERIALS

Quarterly longline sampling was conducted from the SCDNR vessel, Lady Lisa, a 72 foot shrimp trawler equipped with hydraulic longline reel and aft steering station. The mainline of the bottom longline gear was made up of 4.0 mm (5/32 inch) galvanized cable with aluminum stop sleeves placed at 12 m intervals. The mainline was 1200 m long. Buoy cables (60 m), of the same material as the mainline were attached to sleeved eyes at each end of the mainline. Twenty five kilogram lead anchors were attached with longline clips to the eyes at each end of the mainline when the line was set. Two inflatable net buoys were attached to each buoy line with longline clips. The hooks were 12/0 Superior Mustad O'Shaughnessy (#3407) shark hooks and were attached to swiveled (4/0), 3 mm longline clips with 4 m of 2.4 mm (3/32 inch), galvanized, 7/7 strand cable. Nicopress- style sleeves were used for all connections. Hooks were

baited with approximately 0.22 kg chunks of cut fresh-frozen Atlantic mackerel (Scomber scombrus). Hook gangions were kept coiled in baskets prior to setting and were all baited prior to starting a set. Each set consisted of 100 hooks attached to the mainline near a stop sleeve. Sets were made at idle speed with the vessel on autopilot on a course perpendicular to the prevailing wind and/or current. Whenever possible we avoided setting the gear on live bottom because of problems of gear hangs and rapid bait loss from reef associated species.

Sampling depth strata were: 10-19 m, 20-29 m, and 30-39 m. Sampling effort was equally distributed by season with 4 sampling days per quarter. Set locations and catch data are found in Appendix 1 and 2.

Most sets were made overnight with soak times of about 12 hours. Afternoon sets were also made which averaged 4 hours of soak time.

Captured sharks were tagged and released whenever possible. Sharks < 1.5 m TL were brought aboard the vessel where the hook was removed, measurements taken, sex recorded and the tag was applied at the base of the first dorsal fin. Tags were obtained from the NMFS Cooperative Shark Tagging Project and tag information was sent to their headquarters for inclusion in their long term data base. Larger sharks were tagged in the water using a tagging needle attached to a long pole. Length of these sharks was estimated and sex was recorded if possible. After tagging, the leader was cut as close to the shark's mouth as possible.

Because of the low catch rates and the preponderance of small tiger sharks, the planned sacrifice of 20 sharks per quarter for collection of carcass weight/ fin weight ratios and bio-profile data was not attempted.

RESULTS AND DISCUSSION

The 1993-94, total catch from 27, 100 hook sets was 126 sharks of the following species: 53 Atlantic sharpnose, 52 tiger, 11 sandbar, 7 smoothhound, 1 scalloped hammerhead, 1 sand tiger, and 1 dusky. Catch and location data are listed in Appendix 1.

In 1994-95, 34 longline sets produced a total shark catch of 118 individuals comprised of the following species: 58 Atlantic sharpnose, 44 tiger, 13 sandbar, 1 scalloped hammerhead, 1 dusky and 1 blacknose. Hook and line fishing during longline soak time, produced 1 blacktip, 1 dusky and 15 Atlantic sharpnose.

Species Composition: Comparison with 1983-84 Survey

Comparative species composition for the 1983-84 and current surveys are presented in Table 1.

Table 1.

Comparative Species Composition of longline Shark catches (all species); 1983-84, 1993-94 and 1994-95.

SPECIES/GROUP	PERCENT OF CATCH					
	1983-84 (Low and Ulrich)		1993-94		1994-95	
	%	n	%	n	%	n
Sand bar	58.9	175	8.7	11	11	13
Tiger	13.5	40	41.3	52	37.3	44
Smooth hound	12.1	36	5.5	7		
Atlantic Sharpnose	10.4	31	42.1	53	49.2	58
Scalloped Hammerhead	3.0	9	0.8	1	0.8	1
Dusky	0.7	2	0.8	1	0.8	1
Sand Tiger	0.7	2	0.8	1		
Silky	0.3	1				
Lemon	0.3	1				
Blacknose					0.8	1
Large Coastal	77.4	230	52.4	66	50.0	59
Small Coastal	22.5	67	47.6	60	50.0	59

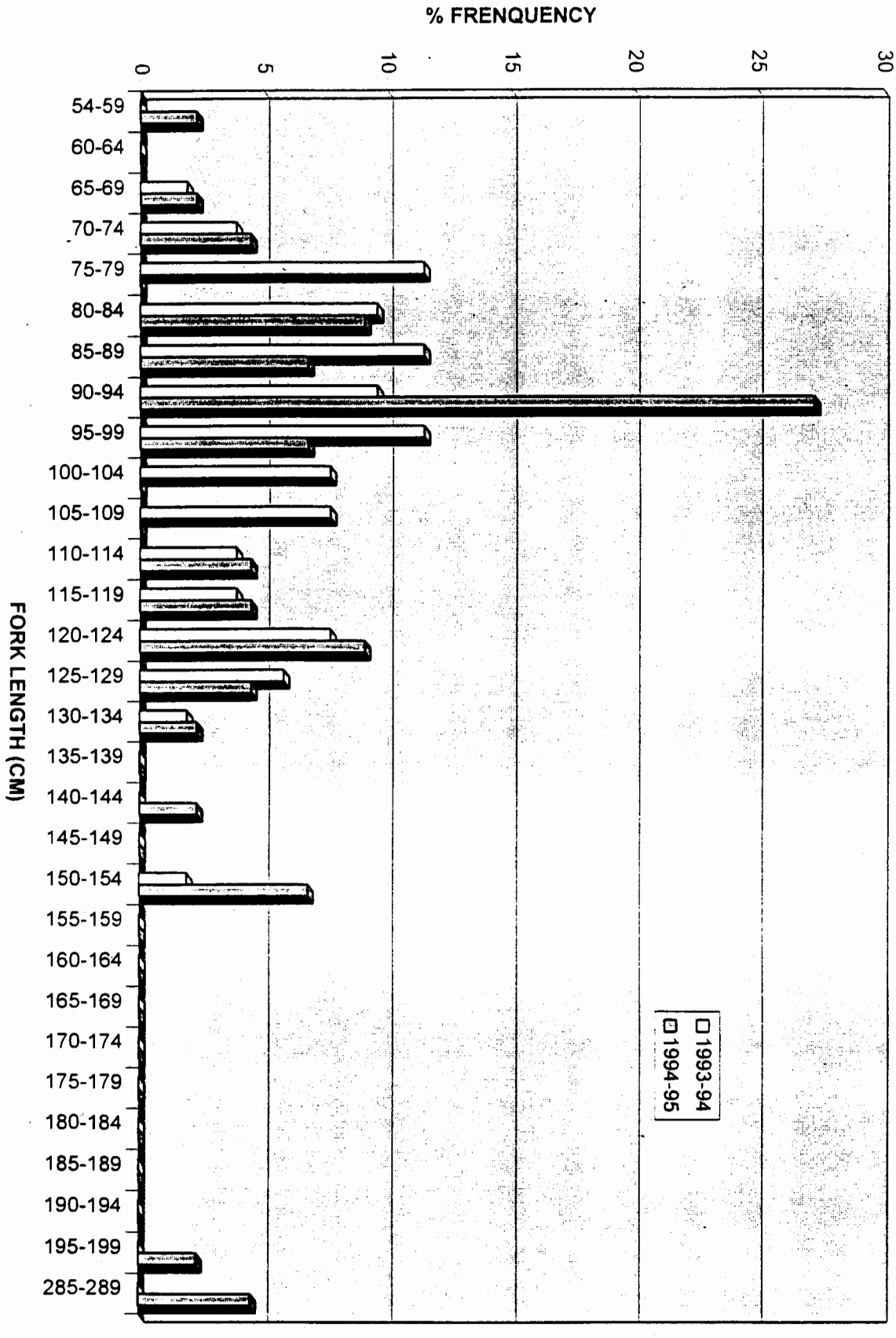
The Atlantic sharpnose, a member of the small coastal species category was the numerically dominant shark in the longline catches of 93-94 and 94-95. It made up 42.1 and 49.2 % respectively, of the 93-94 and 94-95 longline catches, whereas in 83-84 this species only comprised 10.4 % of the catch. The Atlantic sharpnose also made an increasing contribution to the overall catch of small coastal species from the earlier survey to the present. In 1983-84 the sharpnose made up 76.3 % of the small coastal catch and 88.3 % and 98.3 % respectively, in 93-94 and 94-95. The smoothhound was the only other small coastal species to make a significant contributuion to the catch at 53.7 and 11.7 % in 83-84 and 93-94, respectively. The smoothhound was absent in the 94-95 sampling, but 1 blacknose was caught. Smoothhounds are caught in our area primarily in the winter and their abundance seems primarily determined by the severity of the winter in areas to the north. It is doubtful if their declining contribution to the catch is a reflection of changes in abundance.

Catches of small coastal species were primarily large sub-adults and adults. Atlantic sharpnose do not survive well on a longline and the majority of individuals were dead when brought aboard. In many cases only the heads remained on the hook gangions and in some instances large coastal species were caught on these hooks.

Tiger sharks were the second most abundant species during the 83-84 sampling, making up 13.5 % of the overall shark catch and 17.5% of large coastal species (Table 2.). In 1993-94 and 94-95 tiger sharks made up 78.8 and 74.6 % respectively, of the catch of large coastals. In addition to the major increase in their relative contribution to the catches in recent surveys, the size composition of this species also shifted substantially. The mean fork length of "small" tiger sharks caught during 93-95 was 92 cm (range 56-132 cm). Tiger sharks in this size category made up 85.7 % of the catch of this species during the most recent surveys. The size frequency distribution of tiger sharks caught from 93-95 is shown in Figure 1. During sampling in 83-84, sharks of this size were rare in the catch. Large tigers, (3-4 m TL) were common in the catch from the earlier project but were not encountered during the 1993-94 sampling and were represented by only one individual in 94-95.

Sandbar sharks exhibited a marked reduction in relative abundance from 83-84 sampling to the current surveys. Sandbar sharks were the numerically dominant shark in the 83-84 samples, making up 58.9 % of the total shark catch (Table 1.) and 76.1 % of the large coastal group catch (Table 2.). Sandbar contribution to the total shark catch in 93-94 was 8.7 % and 11.0 % in 94-95. In 93-94 and 94-95, they made up 16.7 and 22.0 % respectively, of the large coastal catch.

Although their contribution to current catches is substantially lower, the size composition was closely comparable. The average total length of sandbars in 83-84 was 1.8 m which was the same as the estimated lengths of the 93-95 samples.



TIGER SHARK LENGTH FREQUENCY, 1993-94 AND 1994-95

Table 2.

Comparative Species Composition of longline Catches of large coastal species; 1983-84, 1993-94 and 1995-95.

PERCENT OF CATCH						
SPECIES	1983-84 (Low and Ulrich)		1993-94		1994-95	
	%	n	%	n	%	n
Sand bar	76.1	175	16.7	11	22.0	13
Tiger	17.4	40	78.8	52	74.6	44
Scalloped HammerHead	3.9	9	1.5	1	1.7	1
Dusky	0.9	2	1.5	1	1.7	1
Sand Tiger	0.9	2	1.5	1		
Silky	0.4	1				
Lemon	0.4	1				
TOTAL LARGE COASTALS		230		66		59

Scalloped hammerheads were slightly more abundant during 83-84 sampling making up 3.0 % of the catch versus 0.8 % during recent years. Other large coastal species, individually made up < 1.0 % of the total shark catch (Table 1.), during all sampling periods. Table 2 suggests a reduced species diversity over time, with 7 large coastal species caught in 83-84, 5 in 93-94 and 4 in 94-95. Dusky sharks occurred in all sampling periods and the sandtiger in both the 83-84 and 93-94 samples. The silky and lemon shark were absent from the current catches.

In aggregate, the large coastal group showed a substantial drop in percent occurrence in the earlier research catches and the current surveys; declining from 77.4 % in 1983-84 to 52.4 and 50.0 % respectively, in 93-94 and 94-95. These declines are apparently in response to the large increase in commercial exploitation that occurred over this time period.

Comparative CPUE for 1983-84 and 1993-95

Comparative data on the 1983-84 and 1993-95 sampling is shown in Table 3.

The 1983-84 and 1993-95 shark monitoring projects used identical gear and bait and fished comparable seasons, depths and locations. Catch per unit effort declined during the recent surveys in all categories except the small coastal species in 93-94 and the tiger and Atlantic sharpnose in both 93-94 and 94-95 (Table 3.) The cumulative shark catch per 100 hook set declined from 8.03 in 83-84 to 4.67 in 93-94 and 3.50 in 94-95. The CPUE for large coastal species, declined more markedly between the earlier and recent surveys, dropping from 6.22 sharks/100 hook set to 2.44 and 1.75 sharks in 1993-94 and 94-95, respectively. The large coastal species are the primary targets of the commercial fishery for meat and fins. The most valuable species in the large coastal, commercial fishery is the sandbar because of it's large fins and optimal carcass size for meat. This species exhibited the most dramatic drop in CPUE between 83-84 and 93-95; declining from 4.73 to 0.41 sandbar/100 hook set in 93-94 and 0.39/set in 94-95.

Tiger shark CPUE was 1.08/set in 1983-84, increasing to 1.93 in 93-94 and 1.29 tigers/set in 94-95. As previously noted this increase was effected by tigers in the small (< 1.2 m FL) category. The decline in large coastal shark CPUE in terms of potentially saleable catch, was more pronounced than the catch rates indicate, because of the dominance of these small sharks. Small tiger sharks made up 87 percent of the 93-95 catches of large coastal species. Tiger sharks in this size category are considered to be of little commercial value because of their small fins and low meat yield. Commercial fishermen seldom retain tiger sharks of this size and in many cases have been tagging them (The Shark Tagger,1994 Summary. NMFS Cooperative Shark Tagging Program).

In the small coastal group, the Atlantic sharpnose showed an increase in CPUE between 83-84 and 93-95. CPUE for this species

Table 3.

Comparative Catch Per Unit Effort, 1983-84, 1993-94, and 1994-95.

SPECIES OR GROUP	CATCH/ 100 HOOK SET		
	1983-84 (Low & Ulrich)	1993-94	1994-95
All Sharks	8.03 (n=297)	4.67 (n=126)	3.50 (n=118)
Large Coastal	6.22 (n=230)	2.44 (n=66)	1.75 (n=59)
Small Coastal	1.81 (n=67)	2.22 (n=60)	1.75 (n=59)
Sand Bar	4.73 (n=175)	0.41 (n=11)	0.39 (n=13)
Tiger	1.08 (n=40)	1.93 (n=52)	1.29 (n=44)
Atlantic Sharpnose	0.84 (n=31)	1.96 (n=53)	1.71 (n=58)

increased from 0.84 sharks /100 hook set during the early survey to 1.96 and 1.71/set in 93-94 and 94-95, respectively. The increased numbers of Atlantic sharpnose and small tiger sharks encountered in the current sampling may be the result of decreased predation on these species, as numbers of large coastal species have declined.

Tagging Results

A total of 104, longline-caught, large coastal sharks of the following species,have been tagged by this project between 1993 and 95 : 82 tiger, 19 sandbar, 2 dusky, and 1 sandtiger. In addition, 1 dusky and 1 blacktip caught on hook and line gear were tagged. We have recaptured two previously tagged tiger sharks and two of the sharks tagged by this project were recaptured by commercial longliners. To date no recaptures of other species have been reported.

CONCLUSION AND RECOMMENDATIONS

The survey conducted in 1983- 84, occurred before any significant commercial exploitation of the shark resources in the Carolinas. A primary objective of that study was to determine the potential for development of a directed shark fishery in this region. Since this time, an intensive fishery has developed for the large coastal species. High prices for shark fins, increased acceptance and prices for shark meat, in conjunction with decreased opportunities in other fisheries (snapper-grouper and tilefish) have contributed to the major expansion in directed fisheries for the large coastal species. Our results support the conclusion that the expansion of the commercial shark fishery has produced significant changes in the species composition and abundance of coastal shark populations. In addition, the size composition of tiger sharks in the catch has undergone a substantial reduction from that prior to the expansion of the commercial fishery. Increased abundance of small tiger sharks and Atlantic sharpnose is thought to be related to increased survival of these species due to lower levels of predation from the now less abundant, sandbar and large tiger sharks.

It is recommended that continued fishery-independent sampling be conducted and that sampling levels be expanded and extended over a wider geographic area. Additional, regional sampling effort would increase confidence in the results reported here, provide baseline, fishery-independent data for monitoring the rebuilding schedule of the Secretarial FMP and increase the number of tagged sharks for continuing growth,stock identification and migration studies.

Literature Cited

Low, R. A. and G. F. Ulrich. 1984. Survey of the shark resource in shelf waters off South Carolina. South Carolina Marine Resources Center Technical Report Number 61. 27p.

NMFS. 1992. Fishery management plan for sharks of the Atlantic Ocean. NMFS, U. S. Department of Commerce. 160p.

APPENDIX 1. STATION DATA

DATE	LOCATION (LORAN, 7980 CHAIN)	DEPTH(M)	SET DURATION (HR.)	CATCH
6 Jul 93	45296.7/60237.8	35	12	1 Sharpnose 1 Sandbar 2 Tiger
6 Jul 93	45286.7/60225.2	35	12	4 Tiger 1 Sharpnose
7 Jul 93	45343.2/60370.0	24	4.5	1 Tiger 1 Sharpnose
7 Jul 93	45337.3/60345.3	24	12	1 Tiger 1 Sandbar 3 Sharpnose
7 Jul 93	45320.3/60322.2	29	12	1 Sandbar 3 Sharpnose
8 Jul 93	45384.8/60430.5	18	12	4 Tiger 1 Sandbar 3 Sharpnose
8 Jul 93	45395.3/60444.7	18	12	1 Tiger 2 Sandbar 1 Dusky 1 Sharpnose
28 Sep 93	45324.7/60620.7	29	4	9 Tiger 1 Sharpnose
28 Sep 93	45328.8/60636.8	29	12	6 Tiger 1 Sharpnose
28 Sept 93	45328.1/60649.8	29	12	3 Tiger 1 Sharpnose
17 Nov 93	45415.2/60522.4	16	12	1 Sandbar 1 Sharpnose
17 Nov 93	45423.9/60537.2	15	12	1 Tiger 1 Sandbar 6 Sharpnose
18 Nov 93	45471.9/60516.3	15	3	0
18 Nov 93	45470.8/60532.3	13	12	1 Sharpnose 1 Smoothhound
18 Nov 93	45470.8/60532.3	13	12	1 Sharpnose

7 Feb 94	45320.7/60323.1	29	12	2 Tiger 1 Sharpnose
7 Feb 94	45315.4/60302.9	29	12	1 Tiger
14 Feb 94	45321.0/60613.0	31	12	1 Tiger 1 Sc.Hammer- head 4 Sharpnose 5 Smoothhound
14 Feb 94	45320.1/60596.2	31	12	1 Sand tiger 2 Sharpnose
15 Feb 94	45335.9/60558.0	29	4	2 Sharpnose 1 Smoothhound
15 Feb 94	45328.0/60544.0	29	4	1 Tiger 5 Sharpnose
11 Apr 94	45291.4/60208.6	33	12	3 Tiger 1 Sandbar 2 Sharpnose
11 Apr 94	45301.1/60211.3	33	12	2 Tiger 4 Sharpnose
12 Apr 94	45327.1-60268.0	33	4	6 Sharpnose
24 May 94	45344.2/60644.7	29	12	6 Tiger 1 Sandbar
25 May 94	45355.0/60658.3	29	12	4 Tiger 1 Sandbar
25 May 94	45381.9/60442.5	18	4	2 Sharpnose

APPENDIX 2.

Station and catch data for 1994-95 longline sampling

DATE	LOCATION (Loran, 7980 Chain)	DEPTH (m)	SET DURAT -ION (hrs)	CATCH
8/23/94	45317.0 - 60220.0	28	12	0
8/23/94	45305.3 - 60218.8	28	12	2 Tiger 1 Dusky
8/24/94	45351.4 - 60337.3	21	4	3 Tiger 1 Sharpnose
8/24/94	45360.4 - 60368.5	19	12	1 Tiger 1 Sharpnose
8/24/94	45349.5 - 60371.7	19	12	1 Sharpnose
8/25/94	45425.5 - 60504.5	12	4	1 Tiger
8/25/94	45465.2 - 60503.8	12	12	1 SC Hammerhead
8/25/94	45475.3 - 60528.5	11	12	0
9/26/94	45218.7 -60451.7	42	12	4 Sharpnose
9/26/94	45230.0 - 60454.4	40	12	3 Tiger 2 Sharpnose
9/27/94	45351.5 - 60549.6	27	4	1 Tiger 1 Sharpnose
9/27/94	45350.6 - 60598.9	27	12	1 Sandbar 2 Sharpnose
9/27/94	45359.3 - 60599.2	26	12	1 Tiger 1 Sharpnose
9/28/94	45377.6 - 60357.0	18	4	1 Tiger 4 Sharpnose
9/28/94	45372.9 - 60365.0	20	12	5 Sharpnose
9/28/94	45356.3 - 60349.1	22	12	1 Sand bar

1/17/95	45313.9 - 60611.2	30	12	2 Tiger 2 Sand bar 3 Sharpnose
1/17/95	45307.7 - 60597.6	32	12	2 Tiger 1 Sand bar 3 Sharpnose 1 Blacknose
1/18/95	45331.1 - 60577.7	26	12	6 Tiger 2 Sharpnose
1/18/95	45343.1 - 60601.7	27	12	1 Tiger 2 Sharpnose
1/25/95	45314.2 - 60249.0	28	12	3 Sharpnose
1/25/95	45321.5 - 60240.1	28	12	1 Sharpnose
6/12/95	45291.9 - 60225.7	33	4	1 Sharpnose
6/12/94	45298.5 - 60204.3	31	12	1 Tiger 1 Sand bar 1 Sharpnose
6/12/95	45304.8 - 60217.0	35	12	2 Tiger
6/13/95	45389.5 - 60624.1	24	12	1 Tiger 1 Sand bar 6 Sharpnose
6/13/95	45383.2 - 60610.8	24	12	4 Tiger 3 Sand bar 1 Sharpnose
6/14/95	45398.9 - 60474.3	20	4	2 Tiger 1 Sharpnose
6/14/95	45391.7 - 60462.4	20	4	1 Tiger 1 Sharpnose
6/20/95	45412.4 - 60576.8	18	12	1 Tiger 1 Sharpnose
6/20/95	45417.9 - 60591.0	16	12	1 Tiger 1 Sharpnose
6/21/95	45333.9 - 60647.3	29	12	2 Tiger
6/21/95	45331.1 - 60660.6	29	12	4 Tiger 1 Sand bar 1 Sharpnose

6/22/95	45332.8 - 60610.8	29	1	1 Tiger 1 Sand bar 1 Sharpnose