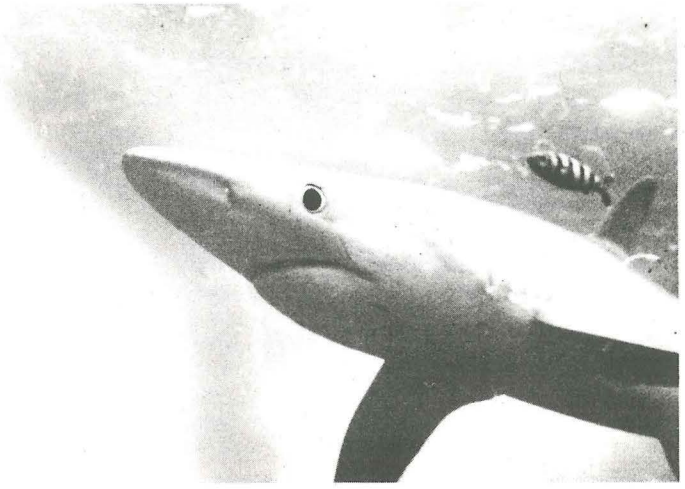
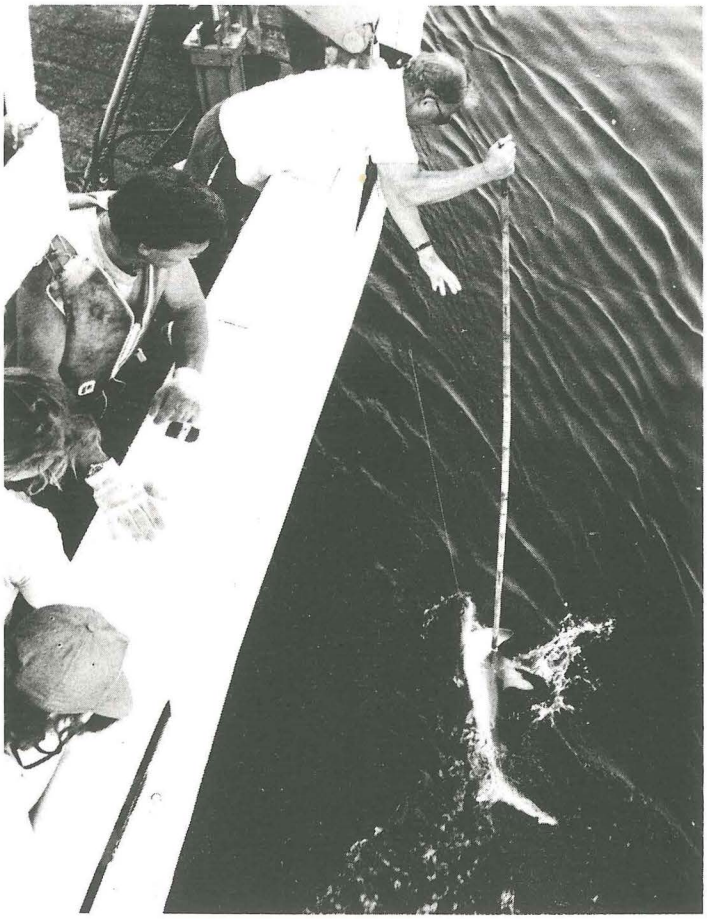
THE SHARK TAGGER 1989 SUMMARY



J. Casey, H. W. Pratt, N. Kohler and C. Stillwell

PHOTO BY H. W. PRATT



1989 OVERVIEW

- OVER 5,000 SHARKS TAGGED AND RECORD NUMBER RECAPTURED
- LONGEST TIME AT LIBERTY SET FOR SANDBAR (24.1 YRS), PORBEAGLE (6.0 YRS), AND OCEANIC WHITETIP SHARKS (3.3 YRS).
- FURTHEST DISTANCE RECORDED FOR BIGEYE THRESHER (1,400+ MILES) AND OCEANIC WHITETIP SHARKS (1,200+ MILES)
- FASTEST RATE OF TRAVEL SET FOR BLUE SHARKS (44 MILES PER DAY)
- MAKO SHARK TAGGED OFF NORTH CAROLINA AND RECAPTURED OFF MEXICO
- SHARK LONGLINE SURVEY CRUISE COMPLETED ALONG ATLANTIC COAST

OVERVIEW

A total of 5,623 sharks representing 33 species were tagged in 1989. Blue and sandbar sharks were the major species tagged (Table 1). Anglers accounted for 66% of the releases followed by NMFS biologists (11%), the RV *Geronimo* biologists (10%), commercial fishermen (9%), and other biologists (4%). During the past several years U.S. Foreign Fisheries Observers tagged up to 2,400 sharks per year from Japanese tuna longline vessels fishing in the U.S. economic zone (200 miles). In 1989, the Japanese did not fish in U.S. waters. The

Overview continues on Page 2

Distribution of this newsletter is limited to active participants in the NMFS Cooperative Shark Tagging Program. This information is preliminary and subject to revision.

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Cooperative Shark Tagging Program
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Center
Narragansett, Rhode Island 02882

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Table 1. Summary of sharks and teleosts tagged, January-December 1989.

SPECIES	TAGGED BY COOPERATIVE TAGGERS	NARRAGANSETT BIOLOGISTS	TOTALS
Blue shark	2,276	50	2,326
Sandbar shark	848	321	1,169
Tiger shark	365	32	397
Dusky shark	300	12	312
Shortfin mako	134	1	135
Scalloped hammerhead	24	93	117
Blacktip shark	101	6	107
Lemon shark	95	2	97
Nurse shark	73	1	74
Sand tiger	35	20	55
Reef shark	52	0	52
Atlantic sharpnose shark	45	5	50
Bull shark	43	0	43
Silky shark	16	4	20
Basking shark	18	0	18
Bonnethead	12	0	12
Spinner shark	11	0	11
Smooth dogfish	5	4	9
Porbeagle	7	0	7
Spiny dogfish	6	1	7
Great hammerhead	7	0	7
Bignose shark	3	3	6
Smooth hammerhead	6	0	6
Common thresher shark	5	0	5
Blacknose shark	4	0	4
Finetooth shark	3	0	3
White shark	0	2	2
Atlantic angel shark	2	0	2
Bigeye thresher	1	1	2
Oceanic whitetip shark	1	0	1
Hammerhead unspecified	36	0	36
Brown/Dusky unspecified	13	0	13
Carcharhinus unspecified	5	0	5
Thresher unspecified	3	0	3
Miscellaneous sharks and rays	25	28	53
Total sharks	4,580	586	5,166
Swordfish	45	2	47
Bluefin tuna	10	0	10
Sailfish	13	0	13
White marlin	11	0	11
Blue marlin	3	0	3
Bigeye tuna	1	0	1
Miscellaneous	12	0	12
Total teleosts	95	2	97
Grand Total	4,675	588	5,263

(Overview continued)

absence of tagging aboard foreign vessels, however, did not significantly reduce the number of sharks tagged, primarily because of the hundreds of new fishermen who joined the tagging program last year. The number of blue sharks tagged by anglers over the past 27 years is shown in the figure on Page 3. The amount of sport fishing effort (days, trips, lines fished, etc.) required to tag this many sharks is not known. However, if the growing interest in the tagging program is any indication, then the fishing effort on sharks has certainly increased in recent years. A prevailing opinion among many fishermen is that some species of sharks have declined and that others are in jeopardy from overfishing. This concern, resulted in the development of a draft Fishery Management Plan for Atlantic Sharks. Additional data on sharks to be collected under this plan will provide the basis for further evaluating the status of the stocks.

Cover Photo—NMFS biologist tags a sandbar shark from the rail of the NOAA ship *Delaware II* (see Field Studies). *Photo by Lisa J. Natanson*

Recaptures

A total of 328 tags were returned from 19 species of sharks and four species of bony fishes (Table 2). This is the highest number of recaptures for any year since the start of the Program. Most of the returns came from blue (136), sandbar (61), mako (27), and tiger sharks (27). Seven tags were returned from swordfish. Tags were received from fishermen from fifteen different countries and island territories. U.S. fishermen accounted for 82% of the returns with 268, followed by Canada (13), Mexico (13), Spain (10), Cuba (5), the Faeroe Islands (5), Colombia (2), Taiwan (2), Japan (2), Venezuela (2), and one each from Barbados, Portugal, Puerto Rico, Italy, St. Lucie, and St. John.

The sources of recaptures were about evenly divided between sport (45%) and commercial fishermen (51%), with Fisheries Observers and biologists accounting for the remainder. With respect to fishing gear, 151 (46%) of the recaptures were taken on longline, and 139 (42%) on rod and reel. Other fishing gear from which tagged sharks were recaptured included gillnet (17), trawl net (8), handline (6), harpoon (3), traps, and other sources (4).

The value of having sharks tagged by a wide variety of fishermen is apparent, considering that only thirteen of this year's 328 returns came from NMFS biologist's tagging efforts, eight of which were tagged during cooperative cruises aboard the Polish research vessel Wieczno between 1984-1986. (This vessel is no longer in commission.) Forty-four of the 1989 returns came from U.S. Foreign Fisheries Observer's releases between 1983 and 1988. An additional 31 returns came from releases by Captain Stephen Connett from the RV Geronimo between 1976 and 1989. While U.S. recreational fishermen continue to tag the great majority of the sharks, U.S. commercial fishermen tag significant numbers and have been extremely helpful in returning tags and providing good recapture data.

BLUE SHARKS (136 RETURNS)

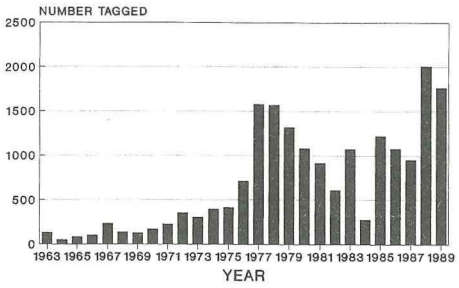
Blue sharks accounted for 41% of the total recaptures for 1989. These were returned after being at liberty from 1 to a maximum of 2,234 days (6.1 years). This latter recapture is the second longest time at large for any blue shark tagged in our program (the current record is 8.5 years). Many (76%) of the returns were at liberty for less than 1 year and nearly all (93%) were at liberty for less than 3 years. Returns demonstrated a wide range of distances travelled and days at liberty. Tagged blue sharks free for less than 1 month travelled distances up to 216 miles. Alternately, 3 of the 5 blue sharks at liberty for more than 4 years were recaptured in the same general area (i.e., less than 33 miles from their tagging location). Some pairs of blue sharks, tagged at about the same time and place, were recaptured thousands of miles apart. For instance, two were tagged within 3 days and 2 miles of each other off the coast of Maine and recaptured 5 days apart—one off Venezuela (1,972 miles south) and one north of the Azores (1,974 miles east). Two other blue sharks tagged on the same date, off Block Island, were recaptured within 7 days of each other—one off of Cape Fear, N.C. (698 miles SW) and the other off of Grenada, West Indies (1,823 miles south). These are examples from blue shark returns that do not fit into a well defined pattern. The different recapture locations are very likely due, in part, to the influence of environmental features (such as ocean currents) and a reproductive cycle

that affects adults and juveniles in different ways. As we have reported previously, adult female blues and pups are common off Europe and Africa, while adult males are more abundant off North America. The many blue sharks that have been tagged and recaptured have provided a wealth of information but the fact remains that we are still a long way from fully understanding their complex movements that extend over the entire North Atlantic.

Ten percent of the blue sharks were recaptured more than 1,000 miles from their tagging sites; the longest distance travelled was 2,751 miles. Areas of recapture included the waters off the Azores, the Canary Islands, Portugal, French Guiana, West Indies, Cuba, and Venezuela. Information was received on two blue sharks that were tagged and recaptured in the Eastern Atlantic. One was tagged off Spain and recaptured off of Madeira Island, and the other was tagged and recaptured in the Adriatic Sea by Italian sportfishermen. A record rate of travel in maximum miles per day was demonstrated by another blue shark that swam 44 miles in 1 day. This is consistent with other reported speeds of 38 and 41 mi/day from previous recaptures.

Backbone samples were collected from 14 recaptured blue sharks (10%), including one that was at liberty for 5.9 years. These samples are vital to our research on age and growth (see Pg. 10) and we greatly appreciate all the time and effort required to secure the vertebrae. Thirty-two percent of the blue sharks from which recapture information was received are still at liberty, having been either retagged, released with the same tag or released without a tag.

BLUE SHARKS
TAGGED BY SPORT FISHERMEN



SANDBAR SHARKS (61 RETURNS)

A male sandbar shark tagged with a fin tag by NMFS biologists in Delaware Bay on June 29, 1965, was recaptured 24.1 years later on August 5, 1989, by a commercial longline fisherman in the Gulf of Mexico (a distance of 1,506 miles). This return is the record time at liberty for a shark tagged under the NMFS Program (and for any shark tagged in the Atlantic Ocean). The sandbar measured 52 inches total length at release and was estimated at 72 inches total length at recapture. The average growth of approximately one inch per year is consistent with the findings of slow growth from previous sandbar shark tag returns (see 1981 Shark Tagger). Over 75% of all of the sandbar returns reported in 1989 were at liberty for more than one year and over 33% were at liberty from 4-14 years. Over 50% of the sandbar sharks were recaptured more than 500 miles from their tagging locations providing more information on their long-distance migrations. Two fish, both tagged off Long Island, N.Y., and recaptured off Mexico (distances of 1,997 and 2,013 miles) travelled the second and third longest distance of any sandbar shark tagged in the NMFS program. Overall, 44 (72%) of the sandbar shark returns were recovered in the Gulf of Mexico or off the eastern coast of Florida. Many of these recaptures were received from commercial fishermen who not only provided accurate recapture locations but also length measurements and backbones. Four of the six vertebrae were collected by commercial fishermen, and two by other biologists, from sandbar sharks at liberty from 0.1 to 13.5 years. Three sandbar sharks tagged within 3 days of each other in late August 1986 by NMFS biologists off Georgia and South Carolina were recaptured this past year: one in January recovered off Ponce Inlet, Fla. (a distance of 113 miles), another in March off Naples, Fla. (723 miles), and one in May off of the Mississippi River (1,142 miles). A maximum number of miles travelled per day (11.7) was reported for a sandbar shark tagged off Long Island, N.Y., and recaptured south of Naples, Fla., in the Gulf of Mexico after 116 days. Speeds approaching 10 miles per day have been reported from sandbar shark returns in previous years.

MAKO SHARKS (27 RETURNS)

Mako sharks were at liberty from one to 2,045 days (5.6 years) with 63% out for more than 1 year. The 5.6 year recapture is the second-longest time reported from our Program. Two mako sharks were recaptured in the Gulf of Mexico: one was tagged by NMFS biologists off Oregon Inlet, N.C., in 1985 and recovered by a Mexican fisherman north of Progreso, Yucatan (a distance of 1,229 miles in 3.9 years). This is the first recapture of a mako shark that shows movements from U.S. to Mexican waters. The other mako shark, tagged in Powell Canyon (Georges Bank) by a Foreign Fisheries Observer, was recaptured SSW of Galveston, Tex. (a distance of 2,021 miles). This latter return is the second longest distance travelled by any mako shark in our Program. Previously, only seven makos have shown movements between the Atlantic and Gulf of Mexico. Other interesting returns include two from makos recaptured in the Mid-Atlantic, approximately 300 miles southeast of the Flemish Cap. These sharks had travelled 330 and 1,230 miles due east from their tagging sites. Another mako was tagged south of Georges Bank and recaptured off the Florida Keys after 5.6 years. One backbone was obtained at a shark sportfishing tournament from a mako at liberty for 1 year. This is only the 16th vertebrae from a tagged mako we have received to date and thus will provide valuable age verification information.

TIGER SHARKS (27 RETURNS)

Tiger sharks that were at liberty from 13 to 2,245 days (6.1 years) were recaptured in 1989. This latter recapture is 1 day short of the record days free for any tiger shark tagged in our Program. This fish travelled 862 miles from Ponce, Puerto Rico, to Key Largo, Fla. Another tiger shark at liberty for 4.9 years was tagged and recaptured off the coast of Cuba. Most of the tiger shark returns were from fish that had travelled less than 500 miles with only one travelling greater than 1,000 miles. This shark was tagged east of New Jersey and recaptured east of Andros Island in the Bahamas (a distance of 1,039 miles in 2.2 years). Another return showed movements of a tiger shark covering 364 miles in 17 days from Ponce Inlet, Fla., to an area southwest of Sanibel Island in the Gulf of Mexico. This represents a maximum rate of travel of 33 miles per day, which is over twice the speed previously reported for tiger sharks. Seven tiger sharks were measured at both tagging and recapture to provide accurate growth information, and of these, four were released with their tags in place. Three backbones were also collected for age studies. These samples and information were obtained largely through the efforts of commercial longline fishermen off Florida.

OTHER SPECIES (77 RETURNS)

Recaptures from other species provided valuable information including many long distance and maximum time at liberty records. Seven **PORBEAGLE** sharks were all tagged by U.S. Foreign Fisheries Observers aboard Japanese or Polish vessels and were recaptured primarily by Canadian Foreign Fisheries Observers on longline vessels from the Faeroe Islands. These sharks were at liberty for a maximum of 6.0 years

Continued on page 12.

Table 2. Tag recoveries: January-December 1989

	GENERAL LOCATIONS		MONTHS AT LIBERTY	DIST. (MI) AND DIR.		CAPTURE METHOD		TAGGED BY	
	TAGGED	RECAPTURED				TAG	REC.	TAGGER	RESIDENCE
Blue shark	S Corsair Canyon	S Cape Sable, NS, Canada	26	201	SE	LL	LL	David Gallagher, NMFS Obs.	MA
" "	SE Block Is, RI	S Grenada, WI	19	1,823	S	RR	LL	Andy Dangelo	RI
" "	S Munson Canyon	N Cayena, Fr. Guiana	13	2,157	SE	LL	LL	Walter Quinn, NMFS Obs.	MA
" "	SW Montauk Pt, NY	SE Pt Pleasant, NJ	NR	NR		RR	LL	Stret Whitting	NY
" "	E Cape Elizabeth, ME	W Cumana, Venezuela	7	1,972	S	HL	GN	Paul Okerholm	ME
" "	SE Block Is, RI	SE Cape Fear, NC	18	698	SW	RR	LL	Andy Dangelo	RI
" "	S Cabo Finisterre, Spain	N Madeira Is	18	502	SW	LL	LL	Stephen Connett	RI
" "	S Munson Canyon	S Siboney, Cuba	25	1,293	SW	LL	LL	Jay Cartner, NMFS Obs.	MA
" "	SE Oceanographer Canyon	S Atlantis Canyon	<1	110	W	LL	LL	Linda Craig, NMFS Obs.	MA
" "	S Corsair Canyon	W Horta, Azores	25	1,478	E	LL	LL	Martha Rowan, NMFS Obs.	MA
" "	ENE Pesaro, Italy	NE Rimini, Italy	<1	20	NE	RR	RR	Giorgio Lucenti	Italy
" "	E Montauk Pt, NY	S Oceanographer Canyon	1	128	E	RR	LL	Alan Kapuse	CT
" "	SE Munson Canyon	S Moriches Inl, NY	18	294	W	LL	RR	Steven Slota, NMFS Obs.	MA
" "	SE Montauk Pt, NY	S Moriches Inl, NY	11	88	SW	RR	RR	Frank Braddick	NY
" "	E Cape May, NJ	SE Pt Judith, RI	12	181	NE	RR	RR	Chuck Stulz	NJ
" "	SE Montauk Pt, NY	S Sable Is, Canada	6	500	E	RR	LL	Joe McBride	NY
" "	SE Pt Judith, RI	SE Montauk Pt, NY	11	23	SW	RR	RR	Fred Gallagher	RI
" "	SW Powell Canyon	S Montauk Pt, NY	16	194	W	LL	RR	Micah Kieffer, NMFS Obs.	MA
" "	SE Pt Judith, RI	SE Pt Judith, RI	<1	17	NE	HL	RR	Stephen Connett	RI
" "	NW Block Canyon	E Corsair Canyon	2	267	E	HL	LL	Stephen Connett	RI
" "	SE Nantucket Is, MA	S Moriches Inl, RI	11	134	W	HL	RR	Stephen Connett	RI
" "	S Munson Canyon	SE Montauk Pt, NY	17	215	W	LL	RR	Georg Hinteregger, NMFS Obs.	MA
" "	S Montauk Pt, NY	S Montauk Pt, NY	<1	5	S	FS	RR	Mike Plaia	CT
" "	S Montauk Pt, NY	SE Montauk Pt, NY	<1	9	E	RR	RR	Bill Ricca	NY
" "	SE Cape May, NJ	SE Shinnecock Inl, NY	11	159	NE	RR	RR	Bill Garrison	NJ
" "	ESE Block Is, RI	SW Montauk Pt, NY	10	73	SW	RR	RR	Andy Dangelo	RI
" "	SE Shinnecock Inl, NY	SE Fire Is Inl, NY	<1	44	SW	RR	RR	Robert Scattergood	NY
" "	E Fire Is Inl, NY	SE Moriches Inl, NY	12	23	SE	RR	RR	Michael Townsend	NY
" "	S Pt Judith, RI	SW Fire Is Inl, NY	<1	101	W	RR	RR	Tom Birch	MA
" "	S Martha's Vineyard, MA	S Pt Judith, RI	11	51	W	HL	RR	Stephen Connett	RI
" "	SW Montauk Pt, NY	E Manasquan Inl, NJ	<1	45	SW	RR	RR	Tom Cashman	NY
" "	SSE Montauk Pt, NY	SE Pt Judith, RI	70	33	E	RR	RR	John R. Wolf	NY
" "	S Fire Is Inl, NY	S Fire Is Inl, NY	<1	13	SE	RR	RR	Ray Lewis	NJ
" "	SE Pt Judith, RI	S Fire Is Inl, NY	12	107	W	RR	RR	Al Anderson	RI
" "	SE Fire Is Inl, NY	S Pt Judith, RI	<1	80	NE	RR	RR	Steve Cogan	NY
" "	S Pt Judith, RI	SE Montauk Pt, NY	<1	12	S	RR	RR	Andy Dangelo	RI
" "	SE Pt Judith, RI	S Fire Is Inl, NY	11	115	W	RR	RR	Jim Humphrey	CT
" "	ESE Montauk Pt, NY	SE Pt Judith, RI	<1	14	E	RR	RR	Bill Ricca	NY
" "	SE Pt Judith, RI	SE Pt Judith, RI	12	2	W	RR	RR	George Hehner	RI
" "	SE Pt Judith, RI	SE Pt Judith, RI	<1	0		RR	RR	Fred Gallagher	RI
" "	SE Pt Judith, RI	SE Pt Judith, RI	<1	3	SE	RR	RR	Andy Dangelo	RI
" "	S Pt Judith, RI	S Martha's Vineyard, MA	1	50	E	RR	RR	Doug Fogg	CT
" "	Hudson Canyon	S Martha's Vineyard, MA	24	106	NE	RR	RR	Chet Young	NJ
" "	S Oceanographer Canyon	SE Flemish Cap	20	1,328	NE	LL	LL	K. Joyce, NMFS Obs.	MA
" "	SE Moriches Inl, NY	SW Las Palmas, Canary Is	35	2,751	E	RR	LL	Dan Scotto	NY
" "	SE Martha's Vineyard, MA	SE Montauk Pt, NY	<1	67	W	HL	RR	Stephen Connett	RI
" "	S Pt Judith, RI	SE Moriches Inl, NY	1	65	W	RR	RR	Andy Dangelo	RI
" "	S Montauk Pt, NY	SE Montauk Pt, NY	2	23	NE	RR	RR	Pete Kazura	NY
" "	S Martha's Vineyard, MA	SE Pt Judith, RI	<1	22	NW	HL	RR	Stephen Connett	RI
" "	S Martha's Vineyard, MA	SE Pt Judith, RI	<1	30	NW	HL	RR	Stephen Connett	RI
" "	S Martha's Vineyard, MA	S Martha's Vineyard, MA	2	6	SW	HL	RR	Stephen Connett	RI
" "	SE Moriches Inl, NY	S Montauk Pt, NY	1	36	E	RR	RR	Robert Sassok	NY
" "	S Martha's Vineyard, MA	SW Nantucket Is, MA	1	13	NE	HL	RR	Stephen Connett	RI
" "	SE Moriches Inl, NY	S Pt Judith, RI	1	55	NE	RR	RR	Frank Daley	NY
" "	SE Nantucket, MA	SE Montauk Pt, NY	10	91	W	HL	RR	Stephen Connett	RI
" "	NW Hydrographer Canyon	SW Nantucket Is, MA	11	36	W	HL	RR	Stephen Connett	RI
" "	SE Pt Judith, RI	SE Pt Judith, RI	<1	2	S	RR	RR	Lionel Lavalee	MA
" "	S Pt Judith, RI	S Pt Judith, RI	<1	0		RR	RR	James Levy	RI
" "	SE Nantucket, MA	S Montauk Pt, NY	11	93	W	HL	RR	Stephen Connett	RI
" "	SE Pt Judith, RI	SE Montauk Pt, NY	1	25	W	RR	RR	Tom Mort	RI
" "	SE Fire Is Inl, NY	E Ocean City, MD	28	153	S	RR	LL	Joe Wind	NY
" "	S Pt Judith, RI	SSE Pt Judith, RI	<1	8	E	RR	RR	David Laurie	RI
" "	SE Martha's Vineyard, MA	S Pt Judith, RI	1	65	NW	HL	RR	Stephen Connett	RI
" "	SE Hydrographer Canyon	SE Nova Scotia, Canada	35	NR		LL	GN	Martha Rowan, NMFS Obs.	MA
" "	SE Pt Judith, RI	E Manasquan Inl, NJ	11	120	SW	RR	RR	Al Anderson	RI
" "	S Montauk Pt, NY	E Pt Pleasant, NJ	<1	71	SW	RR	RR	Michael Panos	NY
" "	SE Pt Judith, RI	S Pt Judith, RI	1	56	SW	HL	LL	Stephen Connett	RI
" "	SE Pt Judith, RI	S Pt Judith, RI	1	7	S	RR	RR	James Noon	RI
" "	Baltimore Canyon	SE Martha's Vineyard, MA	32	238	NE	TN	TN	Mark Biercevicz, NMFS Obs.	MA
" "	S Pt Judith, RI	SE Pt Judith, RI	25	16	NE	RR	RR	Stephen Tombs	RI
" "	SE Pt Judith, RI	E Montauk Pt, NY	<1	27	NW	FS	RR	Charlie Donilon	RI
" "	S Montauk Pt, NY	S Montauk Pt, NY	73	17	SE	RR	RR	Murray Roth	NY
" "	SE Pt Judith, RI	SE Pt Judith, RI	<1	9	NW	RR	RR	Frank Mazza	RI
" "	S Martha's Vineyard, MA	W Atlantis Canyon	<1	71	S	LL	LL	Stephen Connett	RI
" "	ESE Montauk Pt, NY	S Nantucket Is, MA	1	57	E	RR	RR	Bill Ricca	NY
" "	SE Fire Is Inl, NY	SE Moriches Inl, NY	1	25	NE	FS	RR	Bob McReynolds	NY
" "	S Moriches Inl, NY	E Manasquan Inl, NJ	1	20	W	RR	RR	Carl Safina	NY
" "	S Montauk Pt, NY	SE Martha's Vineyard, MA	1	73	E	RR	HL	Jeff Eckert	CT
" "	SE Nantucket Is, MA	SW Oceanographer Canyon	1	65	SE	HL	LL	Stephen Connett	RI
" "	SE Pt Judith, RI	E Manasquan Inl, NJ	<1	111	SW	RR	RR	Andy Dangelo	RI
" "	SE Pt Judith, RI	SE Pt Judith, RI	<1	8	NE	RR	RR	Ed Correia	RI
" "	S Pt Judith, RI	S Montauk Pt, NY	NR	NR		RR	RR	Fran Ramella	RI
" "	S Pt Judith, RI	Hudson Canyon	<1	98	S	RR	LL	Fred Gallagher	RI
" "	SE Block Is, RI	SW Martha's Vineyard, MA	<1	19	SE	RR	RR	Bruce Dubois	RI

Table 2 continued.

	GENERAL LOCATIONS		MONTHS AT LIBERTY	DIST. (MI) AND DIR.		CAPTURE METHOD		TAGGED BY	
	TAGGED	RECAPTURED				TAG	REC.	TAGGER	RESIDENCE
Blue shark	SW Shinnecock Inl, NY	NE Munson Canyon	2	284	E	RR	GN	B. B. Bernstein	NY
" "	S Moriches Inl, NY	Hudson Canyon	1	72	S	RR	LL	Ron Woodward	NY
" "	S Pt Judith, RI	SE Pt Judith, RI	1	24	E	RR	RR	Al Anderson	RI
" "	S Martha's Vineyard, MA	SE Pt Judith, RI	37	26	NE	HL	TN	Stephen Connett	RI
" "	S Montauk Pt, NY	SE Pt Judith, RI	<1	39	NE	RR	RR	Zac Grossman	NY
" "	SW Martna's Vineyard, MA	S Pt Judith, RI	2	29	S	RR	RR	Ralph Carlson	RI
" "	SE Montauk Pt, NY	SE Pt Judith, RI	9	32	NE	RR	RR	Bill Ricca	NY
" "	SE Shinnecock Inl, NY	S Martha's Vineyard, MA	NR	78	E	RR	RR	Bill Williams	NY
" "	E Ocean City, MD	SE Pt Judith, RI	13	227	NE	RR	RR	Mark Shephard	DE
" "	SE Cape Elizabeth, ME	SE Cape Elizabeth, ME	NR	2	NE	RR	RR	Clint Vanorman	ME
" "	S Martha's Vineyard, MA	S Montauk Pt, NY	1	46	W	LL	RR	Stephen Connett	RI
" "	S Montauk Pt, NY	S Martha's Vineyard, MA	2	63	E	RR	RR	Skip Gula	NY
" "	S Pt Judith, RI	S Montauk Pt, NY	<1	18	W	RR	RR	Ralph Carlson, Jr.	RI
" "	Corsair Canyon	SW of Tobago	38	1,389	S	LL	LL	Biologist (NMFS)	RI
" "	S Moriches Inl, NY	SE Fire Is Inl, NY	<1	16	SW	RR	RR	Dick Haug	NY
" "	N Norfolk Canyon	SE Fire Is Inl, NY	7	205	N	LL	RR	Charles Bergman	NJ
" "	S Moriches Inl, NY	S Montauk Pt, NY	2	66	NE	RR	RR	Ted Bingham	NY
" "	ESE Montauk, NY	S Pt Judith, RI	<1	13	NW	RR	RR	Warren Hader	NY
" "	SE Cape Elizabeth, ME	N Sao Miguel, Azores	7	1,974	E	LL	LL	Stephen Connett	RI
" "	SE Pt Judith, RI	SE Pt Judith, RI	2	11	S	RR	RR	Martin Thurston	NY
" "	S Pt Judith, RI	S Pt Judith, RI	3	79	S	RR	LL	Bob Weaver	NY
" "	SE Pt Judith, RI	Corsair Canyon	<1	216	E	RR	LL	Bob Fish	RI
" "	Oceanographer Canyon	Corsair Canyon	9	108	NE	LL	LL	Roger Dow, NMFS Obs.	MA
" "	SW Martha's Vineyard, MA	S Veatch Canyon	3	79	S	HL	LL	Stephen Connett	RI
" "	S Block Is, RI	S Pt Judith, RI	49	17	S	FS	TN	Rodman Sykes	RI
" "	S Pt Judith, RI	S Moriches Inl, NY	NR	NR		RR	RR	Dave Tyrell	RI
" "	S Montauk Pt, NY	S Pt Judith, RI	<1	103	S	RR	LL	Bill Williams	NY
" "	N Veatch Canyon	SW Veatch Canyon	2	48	S	HL	LL	Stephen Connett	RI
" "	SW Montauk Pt, NY	S Moriches Inl, NY	<1	NR		RR	RR	George Kazdin	NY
" "	SE Shinnecock Inl, NY	SE Montauk Pt, NY	2	38	E	RR	RR	Bill Williams	NY
" "	NR	E Hydrographer Canyon	NR	NR		RR	GN	George Gardner	ME
" "	E Manasquan Inl, NJ	W Sable Is, Canada	51	576	NE	RR	LL	Bob Baltrunas	NY
" "	E Montauk Pt, NY	S Pt Judith, RI	2	29	SW	RR	RR	Vincent Isinga	CT
" "	NR	S Montauk Pt, NY	NR	NR		RR	RR	Harold Albinder	NY
" "	SE Montauk Pt, NY	SSE Montauk Pt, NY	1	3	SE	RR	RR	Gary Rackliffe	CT
" "	SE Montauk Pt, NY	S Pt Judith, RI	<1	17	NE	RR	RR	Harry McAllister	NY
" "	E Ocean City, MD	E Atlantic City, NJ	NR	NR		RR	RR	Gary Rantz	MD
" "	E Plymouth, MA	E Plymouth, MA	<1	1	SW	RR	RR	Thomas Shipman	CT
" "	SE Montauk Pt, NY	E Corsair Canyon	3	272	E	RR	LL	Tom McLoughlin	CT
" "	SE Montauk Pt, NY	SE Cape Sable, NS, Canada	4	392	E	FS	LL	Bob Weaver	NY
" "	S Shinnecock Inl, NY	W Porto, Portugal	61	2,688	E	RR	RR	Robin Lehman	NY
" "	S Pt Judith, RI	SE Pt Judith, RI	NR	22	E	RR	RR	Paul Nachtwey	MA
" "	E Gloucester, MA	NE Munson Canyon	47	155	SE	LL	GN	Biologist (NMFS)	RI
" "	S Martha's Vineyard, MA	S Sable Is, Canada	16	422	E	HL	LL	Stephen Connett	RI
" "	S Montauk Pt, NY	Georges Banks	5	NR		RR	LL	Tom Federico	NY
" "	S Munson Canyon	W St Lucia, W Indies	25	1,566	S	LL	RR	Linda Craig, NMFS Obs.	MA
" "	S Montauk Pt, NY	SW Horta, Azores	6	1,971	E	RR	LL	Tom Federico	NY
" "	SE Munson Canyon	SW Barbados	40	1,686	S	LL	LL	Linda Craig, NMFS Obs.	MA
" "	SE Montauk Pt, NY	N Horta, Azores	27	1,878	E	RR	LL	Fred Riege	NY
" "	W Veatch Canyon	NR	<1	NR		LL	LL	Roger Byrne, NMFS Obs.	MA
" "	E Montauk Pt, NY	S Pt Judith, RI	<1	77	S	RR	LL	Bill Hornbeck	NY
Sandbar shark	Chesapeake Bay, MD	SE Ponce Inl, FL	99	540	SW	LL	LL	Jack Musick	VA
" "	S Ponte Vedra Bch, FL	NE Ponce Inl, FL	18	50	SE	RR	LL	Danny Mercier	FL
" "	Delaware Bay, DE	NE Ponce Inl, FL	161	657	SW	RR	LL	Peter Del Rossi	PA
" "	SE Fire Is Inl, NY	E Savannah, GA	16	614	SW	RR	LL	Bill Martin	NY
" "	SE Fire Is Inl, NY	SE Savannah, GA	40	654	SW	RR	LL	Phil Bruckner	NY
" "	E Manasquan Inl, NJ	E Cape Canaveral, FL	126	774	SW	RR	LL	George McCord	NY
" "	SW Cape May, NJ	E Cape Canaveral, FL	18	672	SW	LL	LL	Jackson Andrews	MD
" "	E Fernandina Bch, FL	ESE Ponce Inl, FL	29	113	S	LL	LL	Biologist (NMFS)	RI
" "	S Fire Is Inl, NY	W Naples, FL	91	1,290	SW	RR	LL	Edward Rindfleisch	Canada
" "	S Ponte Vedra Bch, FL	NE Ponce Inl, FL	45	57	SE	RR	LL	Mike Bowmer	FL
" "	E Fernandina Bch, FL	W Naples, FL	68	656	S	LL	LL	Stephen Connett	RI
" "	SW Fire Is Inl, NY	E Ponce Inl, FL	104	750	SW	LL	LL	Biologist (NMFS)	RI
" "	E Jacksonville Bch, FL	NE Ponce Inl, FL	74	38	S	LL	LL	Stephen Connett	RI
" "	Delaware Bay, DE	SW Destin, FL	289	1,506	SW	LL	LL	Biologist (NMFS)	RI
" "	E Ocean City, MD	SE Montauk Pt, NY	37	207	NE	RR	RR	Mark Sampson	MD
" "	SSE Jones Inl, NY	W Sanibel Is, FL	156	1,360	SW	RR	LL	Jack Swift	NY
" "	NE Lewes, DE	SE Panama City Bch, FL	22	1,424	SW	RR	RR	Marlin Longenecker	PA
" "	S Montauk Pt, NY	NE Veracruz, Mexico	24	1,997	SW	RR	LL	Zac Grossman	NY
" "	S Montauk Pt, NY	W Naples, FL	71	1,382	SW	RR	LL	Pete Hines	NY
" "	N Lewes, DE	SE Ponce Inl, FL	34	666	SW	LL	LL	Jackson Andrews	MD
" "	E Jacksonville, FL	E St Augustine, FL	23	29	SE	RR	LL	R. A. Sargent	FL
" "	Dry Tortugas, FL	NE Ponce Inl, FL	159	298	NE	LL	LL	Stephen Connett	RI
" "	Wachapreague, VA	SW Morehead City, NC	10	231	S	RR	LL	Jeffrey Pitts	VA
" "	SSE Montauk Pt, NY	E Cape Fear, NC	58	500	SW	RR	LL	John Wolf	NY
" "	NE Oregon Inl, NC	E Port Mansfield, TX	113	1,702	SW	TN	LL	William Fazio, NMFS Obs.	MA
" "	SE Oregon Inl, NC	N Progreso, Mexico	49	1,268	SW	LL	LL	Stephen Connett	RI
" "	E Hatteras Inl, NC	SW Mobile, AL	NR	1,357	SW	RR	LL	Frank Freer	NJ
" "	SE Little Egg Inl, NJ	E Barnegat Inl, NJ	1	27	N	RR	GN	Doug Cochran	NJ
" "	E Oregon Inl, NC	E Cape Fear, NC	47	158	SW	LL	LL	Biologist (NMFS)	RI
" "	S Fire Is Inl, NY	SE Mobile, AL	NR	1,606	SW	RR	LL	Herman Kornahrens	NY
" "	NE Jacksonville Bch, FL	ENE Charleston, SC	72	160	NE	LL	RR	Stephen Connett	RI
" "	SE Montauk Pt, NY	S Mobile, AL	44	1,620	SW	RR	LL	Bob Bozek	NY
" "	NW Cape Henlopen, DE	N Cape Henlopen, DE	24	4	S	RR	LL	Jackson Andrews	MD

Table 2 continued.

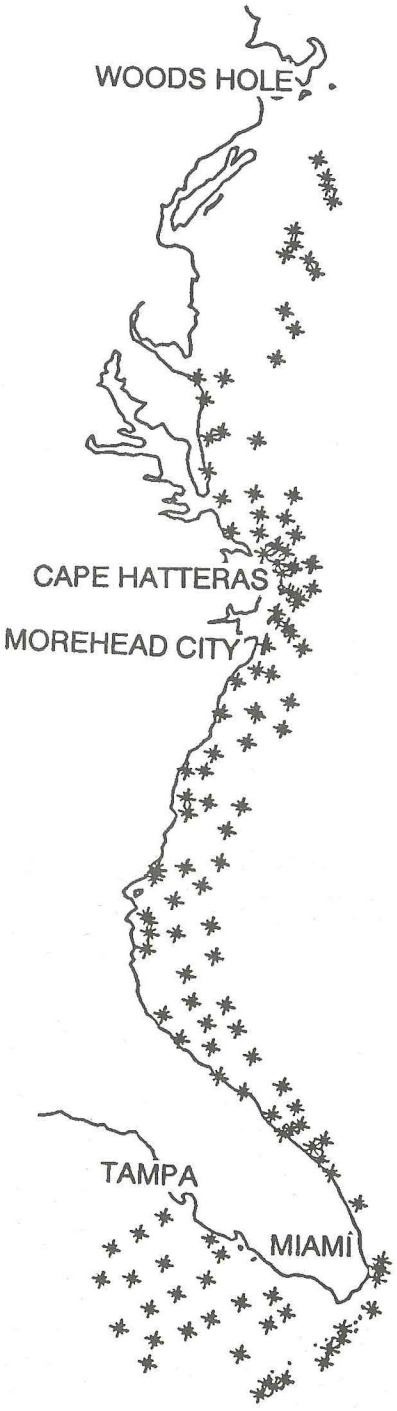
	GENERAL LOCATIONS		MONTHS AT LIBERTY	DIST. (MI) AND DIR.		CAPTURE METHOD		TAGGED BY	
	TAGGED	RECAPTURED				TAG	REC.	TAGGER	RESIDENCE
Sandbar shark	E Rudee Inl, VA	SE Key West, FL	42	832	SW	TN	RR	Nick Hindman, NMFS Obs.	MA
" "	SE Lewes, DE	E Rudee Inl, VA	1	115	SW	RR	GN	Pete Floyd	DE
" "	SE Shinnecock, Inl, NY	SE Mississippi River	NR	NR		RR	LL	Al Ronner	NY
" "	Longboat Key, FL	SW Sarasota, FL	1	42	SW	LL	LL	Peter Hull	FL
" "	SE Ocean City, MD	Powell Canyon	1	368	NE	RR	GN	Mark Sampson	MD
" "	SW Fire Is Inl, NY	E Cape Lookout, NC	29	365	S	LL	LL	Biologist (NMFS)	RI
" "	S Montauk Pt, NY	NE Veracruz, Mexico	95	1,974	SW	RR	LL	Edward Anker	NY
" "	S Jacksonville Bch, FL	NE Ponce Inl, FL	NR	47	SE	RR	LL	Chuck Scholl	FL
" "	SE Shinnecock Inl, NY	ENE Tampico, Mexico	127	2,013	SW	RR	LL	Edward Anker	NY
" "	E Charleston, SC	S Mississippi River, MS	32	1,142	W	LL	LL	Biologist (NMFS)	RI
" "	S Beaufort, NC	SW Mobile, AL	15	1,293	SW	LL	LL	Jackson Andrews	MD
" "	SE Fire Is Inl, NY	S Mobile, AL	66	1,628	SW	RR	LL	Phil Bruckner	NY
" "	S Fire Is Inl, NY	SE Cape Hatteras, NC	NR	NR		RR	LL	Barry Turano	NY
" "	S Wilmington River, GA	W Naples, FL	30	723	SW	LL	LL	Biologist (NMFS)	RI
" "	SE Shinnecock Inl, NY	W Naples, FL	37	1,360	SW	RR	LL	Ed Lopez	NY
" "	E Ocean City, MD	SE Mississippi River	NR	NR		RR	LL	Mark Sampson	MD
" "	SE Shinnecock Inl, NY	S Naples, FL	3	1,356	SW	RR	LL	Bill Williams	NY
" "	E Manasquan Inl, NJ	E Redfish Bay, LA	NR	NR		RR	LL	John Martel	NJ
" "	E Rudee Inl, NY	SE Destin, FL	74	1,351	SW	RR	LL	Bill Moffett, Jr.	VA
" "	E Atlantic City, NJ	SW Panama City, FL	121	1,524	SW	RR	LL	Dave Moss	FL
" "	NE Lewes, DE	SE Hatteras, NC	27	235	S	RR	TN	Marlin Longenecker	DE
" "	SE Block Is, RI	SW Cape Lookout, NC	111	489	SW	RR	LL	Charlie Donilon	RI
" "	SE Montauk Pt, NY	SW Cape Lookout, NC	147	473	SW	RR	LL	Al Ristori	NJ
" "	S Moriches Inl, NY	S Morehead City, NC	NR	NR		RR	LL	Peter Van Alst	NY
" "	E Oregon Inl, NC	NE Veracruz, Mexico	53	1,676	SW	LL	LL	Biologist (NMFS)	RI
" "	E Charleston, SC	E Port Canaveral, FL	25	257	S	RR	LL	Joyce Schultz	SC
" "	SE Ocean City, MD	SE Cape Lookout, NC	NR	249	S	RR	LL	Richard Arnold	MD
" "	E Cape Henlopen, DE	NE Tecoluth, Mexico	74	1,874	SW	RR	LL	Thomas Lyons	NJ
Mako shark	S Hydrographer Canyon	S Cape Hatteras, NC	32	415	SW	LL	LL	Walter Quinn, NMFS Obs.	MA
" "	E Lewes, DE	S Cape Hatteras, NC	45	232	S	RR	LL	Pete Floyd	DE
" "	S Hydrographer Canyon	S Islamorada, FL	67	1,062	SW	LL	RR	Walter Quinn, NMFS Obs.	MA
" "	S Corsair Canyon	E Ocean City, MD	29	375	SW	LL	LL	Jerzy Cygler, NMFS Obs.	MA
" "	E Ocean City, MD	E Little Egg Inl, NJ	12	105	NE	RR	RR	Al Knepper	PA
" "	E Little Egg Inl, NJ	E Little Egg Inl, NJ	<1	9	S	RR	RR	Ralph Leyrer	NJ
" "	S Montauk Pt, NY	SE Montauk Pt, NY	1	23	NE	RR	RR	Fred Wedley	NY
" "	SE Powell Canyon	SE Flemish Cap	21	1,230	E	LL	LL	Linda Craig, NMFS Obs.	MA
" "	S Block Canyon	Wilmington Canyon	23	122	SW	LL	RR	Jerzy Cygler, NMFS Obs.	MA
" "	E Little Egg Inl, NJ	Wilmington Canyon	<1	73	S	RR	RR	Bob Harrington	NJ
" "	S Moriches Inl, NY	SE Moriches Inl, NY	<1	8	E	RR	RR	John Ficarelli	NY
" "	SE Shinnecock Inl, NY	SE Munson Canyon	10	300	E	RR	LL	Tony Viscewtin	NY
" "	S Veatch Canyon	E Ocean City, MD	19	210	W	LL	RR	Georg Hinteregger, NMFS Obs.	MA
" "	SE Munson Canyon	E Georgetown, SC	31	662	SW	LL	LL	Charlie Yustin, NMFS Obs.	MA
" "	S Block Canyon	SW Dakar, Senegal	NR	NR		LL	LL	Ralph Tegge, NMFS Obs.	MA
" "	E Powell Canyon	W Sable Is, Canada	35	324	NE	LL	HP	Jerzy Cygler, NMFS Obs.	MA
" "	E Little Egg Inl, NJ	Lydonia Canyon	14	273	E	RR	GN	Alex Gawron	NJ
" "	SE Cape Henlopen, DE	E Atlantic City, NJ	12	67	N	RR	RR	Tom Collier	NJ
" "	S Fire Is Inl, NY	S Fire Is Inl, NY	<1	21	NE	RR	RR	Frank Daddio	NJ
" "	SE Manasquan Inl, NJ	SE Indian River Inl, DE	12	94	S	RR	RR	Matt Muzslay	NJ
" "	S Powell Canyon	SE Moriches Inl, NY	8	219	W	LL	RR	Georg Hinteregger, NMFS Obs.	MA
" "	NE Oregon Inl, NC	Lydonia Canyon	4	435	NE	LL	GN	Stephen Connett	RI
" "	S Powell Canyon	SSW Galveston, TX	NR	2,021	SW	LL	RR	Georg Hinteregger, NMFS Obs.	MA
" "	S Flemish Cap	SE Flemish Cap	<1	330	E	LL	LL	Charlie Johnson	ME
" "	SE Munson Canyon	E Hatteras Inl, NC	57	502	SW	LL	LL	Georg Hinteregger, NMFS Obs.	MA
" "	E Oregon Inl, NC	N Progreso, Mexico	46	1,229	SW	LL	LL	Biologist (NMFS)	RI
Tiger shark	E Ponce Inl, FL	E Ponce Inl, FL	10	10	E	LL	LL	Tris Colket	FL
" "	SE Ponce Inl, FL	ENE Ponce Inl, FL	1	20	NE	LL	LL	Eric Sander	FL
" "	S Morehead City, NC	E Morehead City, NC	8	45	E	LL	LL	Jackson Andrews	MD
" "	E Ponce Inl, FL	NE Ponce Inl, FL	7	37	N	LL	LL	Tris Colket	FL
" "	NE Ponce Inl, FL	NE Ponce Inl, FL	7	26	SE	LL	LL	Tris Colket	FL
" "	E Norfolk, VA	SE Ocean City, MD	38	75	N	RR	RR	Bill Moffett, Jr.	VA
" "	NE Ponce Inl, FL	N Ponce Inl, FL	2	35	SW	LL	LL	Tris Colket	FL
" "	E Ponce Inl, FL	NE St. Augustine, FL	21	84	N	LL	LL	Tris Colket	FL
" "	E Manasquan Inl, NJ	SE Ocracoke, NC	16	331	S	RR	LL	Dave Solpan	NJ
" "	E Indian River Inl, DE	SE Cape Hatteras, NC	34	223	S	RR	LL	Pete Floyd	DE
" "	E Indian River Inl, DE	SE Cape Hatteras, NC	19	219	S	RR	LL	Pete Floyd	DE
" "	E Rudee Inl, VA	E Barnegat Inl, NJ	27	216	NE	RR	SD	Bill Moffett, Jr.	VA
" "	NW Cabo San Antonio, Cuba	SE Trinidad, Cuba	58	335	E	LL	LL	Ken Winter	FL
" "	NNE Ponce Inl, FL	ENE St. Augustine, FL	1	10	E	LL	LL	Tris Colket	FL
" "	E Virginia Bch, VA	E Rudee Inl, VA	<1	12	SE	RR	RR	Richard Dusch	VA
" "	E Ponce Inl, FL	NE Ponce Inl, FL	5	37	N	LL	LL	Eric Sander	FL
" "	SE Ponce Inl, FL	SW Sanibel Is, FL	<1	564	SW	LL	LL	Eric Sander	FL
" "	NE Ponce Inl, FL	E St Augustine Bch, FL	8	12	NW	LL	TN	Tris Colket	FL
" "	E Cape Canaveral, FL	NE Ponce Inl, FL	NR	NR		RR	LL	Robert Welch	FL
" "	SE Puerto Rico	SE Key Largo, FL	73	862	NW	LL	RR	V. Padila	Puerto Rico
" "	SE Ponce Inl, FL	NE Ponce Inl, FL	9	25	NW	LL	LL	Tris Colket	FL
" "	E Norfolk, VA	NE Ponce Inl, FL	16	518	SW	RR	LL	Bill Moffett, Jr.	VA
" "	Panama City Bch, FL	SW Panama City Bch, FL	3	29	SW	RR	LL	Terry Brown	FL
" "	E Norfolk, VA	W Wilmington Canyon	NR	NR		RR	RR	Jim Wheeler	VA
" "	E Manasquan Inl, NJ	E Andros Is, Bahamas	26	1,039	S	RR	LL	Edmund Honley	NY
" "	E Rudee Inl, VA	SE Cape Lookout, NC	24	146	S	RR	LL	John Thurston, Jr.	VA
" "	E Rudee Inl, VA	SE Cape Hatteras, NC	NR	NR		RR	LL	John Thurston, Jr.	VA
Lemon shark	Big Pine Key, FL	Big Pine Key, FL	13	0		RR	GN	William Botten	FL
" "	Big Pine Key, FL	Big Pine Key, FL	4	1	W	RR	RR	William Botten	FL
" "	Long Point Key, FL	Fat Deer Key, FL	4	1	W	RR	RR	William Botten	FL

Table 2 continued.

	GENERAL LOCATIONS		MONTHS AT LIBERTY	DIST. (MI) AND DIR.		CAPTURE METHOD		TAGGED BY	
	TAGGED	RECAPTURED				TAG	REC.	TAGGER	RESIDENCE
Lemon shark	Racoon Key, FL	Racoon Key, FL	1	0		RR	NT	William Botten	FL
" "	Big Pine Key, FL	Big Pine Key, FL	13	0		RR	GN	William Botten	FL
" "	No Name Key, FL	No Name Key, FL	<1	0		RR	NT	William Botten	FL
" "	No Name Key, FL	No Name Key, FL	6	0		NT	NT	William Botten	FL
" "	Racoon Key, FL	Racoon Key, FL	4	0		RR	GN	William Botten	FL
" "	Crawl Key, FL	Grassy Key, FL	10	1	E	RR	RR	William Botten	FL
" "	Crawl Key, FL	Channel Key, FL	<1	51	W	RR	RR	William Botten	FL
" "	Key Vaca, FL	Marathon, FL	6	18	W	RR	RR	William Botten	FL
" "	Grassy Key, FL	Grassy Key, FL	1	0		RR	RR	William Botten	FL
" "	Bimini, Bahamas	NR	NR	NR		BR	RR	Samuel Gruber	FL
" "	Bimini, Bahamas	Bimini, Bahamas	23	1	S	BR	RR	Samuel Gruber	FL
" "	Bimini, Bahamas	SE Plantation Key, FL	48	85	SW	LL	RR	Samuel Gruber	FL
Nurse shark	Key Vaca, FL	Vaca Key Bight, FL	22	2	SW	RR	RR	William Botten	FL
" "	N Key West, FL	NE Ft Pierce, FL	10	219	NE	RR	HL	Roy Lovell	FL
" "	Long Point Key, FL	Long Point Key, FL	48	0		NT	RR	William Botten	FL
" "	Fat Deer Key, FL	Fat Deer Key, FL	26	0		RR	RR	William Botten	FL
" "	Padre Is, TX	Padre Is, TX	9	12	N	RR	NT	Steve Honc	TX
" "	Long Point Key, FL	Ceasars Creek, FL	13	56	NE	RR	RR	William Botten	FL
" "	Key Vaca, FL	Vaca Cut, FL	25	3	NE	RR	RR	William Botten	FL
" "	Bamboo Key, FL	Grassy Cut, FL	22	3	E	RR	RR	William Botten	FL
" "	Key Vaca, FL	Grassy Key, FL	25	1	W	RR	RR	William Botten	FL
" "	Long Point Key, FL	S Pigeon Key, FL	4	11	SW	RR	FT	William Botten	FL
" "	Marathon, FL	Grassy Key, FL	NR	NR		RR	RR	Buddy Baron	FL
" "	E Virginia Beach, VA	Long Key Bridge, FL	NR	NR		RR	RR	Bill Moffett, Jr.	VA
Dusky shark	SE Jones Inl, NY	ESE Cape Lookout, NC	138	389	S	RR	LL	Bob Schavel	NY
" "	NE Manasquan Inl, NJ	E Ponce Inl, FL	19	757	SW	RR	LL	John A. McShane	NY
" "	E Cape Hatteras, NC	W Campeche, Mexico	53	1,436	SW	TN	LL	David Gallagher, NMFS Obs.	MA
" "	E Manasquan Inl, NJ	E Surf City, NJ	14	33	SW	RR	GN	Rich Bokay	NJ
" "	E Little Egg Inl, NJ	E Barnegat Light, NJ	1	45	NW	RR	GN	Bruce Miller	NJ
" "	SE Manasquan Inl, NJ	SW Cape Lookout, NC	8	372	SW	RR	RR	David Foley	NY
" "	S Destin, FL	NE Progreso, Mexico	5	408	S	LL	GN	Gregory Werham	FL
" "	S Moriches Inl, NY	E Port Canaveral, FL	NR	NR		RR	LL	Joseph Kenny	NY
Porbeagle	NW Powell Canyon	SW Sable Is, Canada	71	268	NE	TN	LL	Arv Poshkus, NMFS Obs.	MA
"	S Hydrographer Canyon	NE Corsair Canyon	4	309	NE	LL	LL	Linda Craig, NMFS Obs.	MA
"	E Munson Canyon	NE Corsair Canyon	17	89	NE	LL	LL	Micah Kieffer, NMFS Obs.	MA
"	S Powell Canyon	NE Corsair Canyon	63	168	NE	LL	LL	Martin Williamowsky,NMFS Obs.	MA
"	NW Oceanographer Canyon	NE Corsair Canyon	48	160	NE	TN	LL	Paul Jones, NMFS Obs.	MA
"	NE Block Canyon	Hermitage Bay, Canada	16	773	NE	TN	TN	Andy Dolan, NMFS Obs.	MA
"	NE Munson Canyon	SW Cape Sable,NS, Canada	20	143	N	LL	RR	Georg Hinteregger, NMFS Obs.	MA
Blacktip shark	SW Port Aransas, TX	S Tampico, Mexico	<1	328	S	RR	NT	Darrell Mostella	TX
" "	Marathon, FL	Marathon, FL	NR	1	S	RR	FD	William Botten	FL
" "	SE Rudee Inl, VA	SE Ft Pierce Inl, FL	18	606	S	RR	GN	Bill Moffett, Jr.	VA
" "	E Boca Raton, FL	Chub Cay, Bahamas	NR	NR		RR	RR	Chad Perlyn	FL
" "	N Port Mansfield, TX	NE Veracruz, Mexico	<1	426	S	RR	NT	Frank Eicholz	TX
Sand tiger	E Ocean City, MD	E Cape Lookout, NC	26	240	SW	RR	RR	Ben Gilbreath	MD
"	NE Ponce Inl, FL	N Ponce Inl, FL	37	7	N	LL	LL	Tris Colket	FL
"	S Cape May, NJ	SE Ocracoke, NC	5	209	S	RR	LL	Sean M. Geary	MD
"	SE Lewes, DE	Cape Point, NC	21	208	S	RR	RR	Pete Floyd	DE
Sc hammerhead	N Cape May, NJ	SE Oregon Inl, NC	56	220	S	LL	LL	Biologist (NMFS)	RI
"	SE Fire Is Inl, NY	SE Ocracoke, NC	55	353	SW	RR	LL	Phil Bruckner	NY
"	E Cape Lookout, NC	S Hydrographer Canyon	44	446	NE	LL	GN	Biologist (NMFS)	RI
Bignose shark	E Oregon Inl, NC	NE Ponce Inl, FL	66	466	SW	LL	LL	Phil Ruhle, Jr.	RI
BE Thresher	S Oceanographer Canyon	W St Petersburg, FL	23	1,494	SW	LL	LL	Steve Slota, NMFS Obs.	MA
Galapagos	SE St Davids Is, Bermuda	SE Cape Fear, NC	42	656	W	LL	RR	Stephen Connett	RI
Night shark	Bimini, Bahamas	NE Cayo Cruz, Cuba	74	217	S	LL	LL	Samuel Gruber	FL
Ocean whitetip	Hudson Canyon	SSE Trinidad, Cuba	39	1,226	S	RR	LL	Jesse York	NY
Silky shark	NE Yucatan, Mexico	N Yucatan, Mexico	3	24	NW	LL	LL	Ramon Bonfil	Mexico
Reef shark	E Eleuthera Pt, Bahamas	SE Key West, FL	13	269	W	LL	LL	Stephen Connett	RI
Spinner	E Cape Florida, FL	SE Puerto Rico	9	899	SE	RR	RR	Mark Quartiano	FL
Shark	Delaware Bay, DE	N Matanzas, Cuba	NR	NR		RR	LL	Graham Macmillan	NJ
"	S Moriches Inl, NY	NE Tampico, Mexico	NR	NR		RR	LL	Tom Montalbano	NY
"	S Mobile, AL	Empire, LA	NR	NR		LL	TN	Chris Brannon	AL
"	S Jones Inl, NY	Montauk, NY	NR	NR		RR	TO	Robert Weisz	NY
Swordfish	E Munson Canyon	SW Cape Sable,NS, Canada	31	111	N	LL	HP	Georg Hinteregger, NMFS Obs.	MA
"	S Oceanographer Canyon	Corsair Canyon	7	129	NE	LL	HP	Walter Quinn, NMFS Obs.	MA
"	E Powell Canyon	E Palm Beach, FL	5	1,018	SW	LL	LL	Walter Quinn, NMFS Obs.	MA
"	SE Munson Canyon	Lydonia Canyon	32	44	W	LL	GN	Jerzy Cygler, NMFS Obs.	MA
"	SW Munson Canyon	Corsair Canyon	20	108	NE	LL	LL	Randall Raeder, NMFS Obs.	MA
"	E Ocean City, MD	Georges Bank	13	NR		LL	LL	Charles Bergman	NJ
"	SE Munson Canyon	E Palm Beach, FL	27	1,034	SW	LL	LL	Georg Hinteregger, NMFS Obs.	MA
Sailfish	E Ft Pierce, FL	West Palm Bch, FL	10	52	S	LL	RR	Jack Morton	FL
Yellowfin Tuna	NR	Wilmington Canyon	NR	NR		NR	RR	Jackson Andrews	MD
Blue Marlin	E Charleston, SC	SW Cartagena, Colombia	NR	NR		RR	RR	Woody McCord	SC

NOTE: BR=Block Rig; FD=Found Dead; FS=Free Swimming; FT=Fish Trap; GN=Gillnet; HL=Handline; LL=Longline; NT=Net; RR=Rod & Reel; SD=Scallop Dredge; TN=Trawl Net; TO=Tag Only; Obs.=Foreign Fisheries Observer; NR=Not Reported.

FIELD STUDIES 1989



Locations of longline sets fished during the spring shark survey cruise.

Field work for staff biologists included a seven-week research cruise from Tampa, Florida, to Southern New England and attendance at nine shark fishing tournaments held at various ports between New Jersey and Massachusetts from June through August. Catch data from an additional six shark tournaments were also reported by non-staff biologists and tournament officials.

Cruise Activities

Our research cruise this year was conducted aboard the NOAA ship *Delaware II*. The cruise lasted 45 days (April 18-June 1) and began off Tampa, Florida, and ended in Block Canyon south of Montauk, N.Y. (see Figure). This was our second survey cruise in four years, covering approximately the same area with the addition of the continental shelf from Miami to Tampa, Florida.

The primary cruise objectives were to obtain data on shark distribution, abundance, and species diversity, as well as biological information for life history studies. A standard fishing station consisted of 100 hooks of Yankee longline gear baited with whole mackerel. The gear was set over a distance of 3 miles and was fished for approximately 3 hours from setout to end of haulback.

Fishing was conducted at all times of the day and on several occasions the gear was allowed to fish overnight for up to 8 hours. A maximum of six sets per day were completed, depending on steaming times, weather conditions, and the presence of lobster pots and other fixed gear. An attempt was made to maintain a minimum distance of 30 miles between each fishing station. The fishing strategy on the third leg of the cruise (North Carolina to Southern New England) was to fish northward on the continental shelf to where the absence of sharks in the catches suggested a northern limit of the spring distribution of inshore species such as the sandbar shark. Fishing was then shifted to offshore areas to survey for blue and mako sharks along the edge of the Gulf Stream, in canyon areas, and in a warm core ring located near Hudson Canyon.

Fish caught were either brought aboard for examination or measured, tagged and released. Larger sharks were tagged in the water while alongside the vessel and their sizes estimated. Subsequent handling of the catch included sampling vertebrae, reproductive organs, blood, muscle, skin, hearts, jaws, and craniums for later examination.

A total of 723 fish, representing 32 species were caught on 137 longline sets. Nineteen species of sharks were caught along with 13 species of bony fish and rays. The overall catch rate was 5.0 fish per 100 hooks. The shark catch was 4.4 per 100 hooks (640 sharks on 14,522 hooks). Sharks represented 88% of the total catch. Sandbar sharks were the most common (48%), followed by scalloped hammerhead (16%), blue (8%), and tiger sharks (5%). The catch of other species included sting rays (22), bluefish (14), dolphin (fish) (10), and swordfish (10). The lowest catch was in the Gulf of Mexico where 0.6 fish per 100 hooks were taken (16 fish on 2,490 hooks). The catch in the area from the Dry Tortugas to Beaufort, North Carolina, was 2.1 fish per 100 hooks (245 fish on 11,184 hooks). The highest catch, 10.5 fish per 100 hooks (509 fish on 4,851 hooks), was in the area between Cape Hatteras and New England. The overall catch values are preliminary and contain biases in that there were repeat longline sets for tagging and sampling at some stations where good catches of sharks were made. Although the catches of sharks appeared higher in the northern area, very few makos were taken; blue sharks were less abundant than in some of our catches in previous years, and the warm core ring that we fished near Hudson Canyon had cooled so that it probably had little or no effect in concentrating sharks. Catches in the ring were low, while the highest catch rate for blue sharks (25 per 100 hooks) was outside the ring on the northeastern side of Hudson Canyon where surface temperatures were about the same as those in the ring. The scarcity of makos and blue sharks in the catches can only be considered in general terms because of the low number of offshore fishing stations between Cape Hatteras and Block Canyon. Blue sharks had not yet moved onto the shelf east of Block Canyon in areas where this species is traditionally abundant after mid-June.

During the cruise, a limited comparison between two gear types (monofilament versus Yankee gear) was made, but showed no difference in the catch rates, although at one station where blue sharks were numerous there were several missing hooks due to "bite-offs" on the mono-gear. Contrary to our findings, many commercial fishermen including some shark fishermen, have shown that monofilament produces higher catch rates. Our reason for using some monofilament was to determine if the standard Yankee gear might be completely missing some species. That was not the case based on these trials. Another modification of the gear

involved attaching five pound weights to the mainline to ensure that the gear fished on the bottom in similar fashion to commercial shark gear being used in some areas, particularly in the Gulf of Mexico. These trials did not result in higher catches. Prior to the cruise we contacted commercial shark fishermen who were extremely helpful in providing information on fishing grounds in their regions.

A total of 588 sharks representing 17 species were tagged and released. Of these, 64 were brought aboard, measured, and injected with a small amount of the antibiotic oxytetracycline (for age studies) prior to release. The most common species tagged were sandbar (321), scalloped hammerhead (93), blue (50), and tiger sharks (32). Two swordfish were also tagged. Ninety-four fish were retained on deck and 41 were lost at the rail.

Vertebral samples collected from 56 sharks of mixed species have been processed for age and growth analysis. In addition, any vertebrae returned in the future from tagged sharks injected with tetracycline, will be valuable for validating age estimates. An important discovery during the cruise with respect to sandbar shark reproduction was that mature males and non-pregnant adult females were confined to Florida waters. Both sexes were in peak reproductive development with the females ready to begin a cycle of alternate year pregnancy. Further north, toward Cape Hatteras, N.C., mature, pregnant, and immature females were common in the catches. One female was close to releasing full-term pups and probably on her journey to the estuarine nursery grounds in North Carolina or Virginia prior to being caught.

Forty-three stomachs from 13 species of sharks were examined for food studies, with scalloped hammerhead, bigeye thresher, and bignose sharks being most common. The scalloped hammerhead stomachs contained octopus, squid, goosefish, bluefish, and unidentified fish remains, indicating this species feeds opportunistically throughout the water column once they move from deep water onto the shallower continental shelf.

The biological samples collected during the cruise by staff biologists have been processed for use in ongoing life history studies at the Narragansett Laboratory. Data and biological samples collected by visiting scientists will become part of their studies or archived at their respective research facilities including: the Museum of Natural History in New York City; State of Florida Marine Research Institute, St. Petersburg, Fla.; University of Nebraska, Lincoln, Neb.; and the National Institute of Fisheries, Yucatan, Mexico.

The timeliness of the cruise was especially important in view of the expand-

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Sandbar shark being brought aboard *Delaware II* for examination. *Photo by Jose I. Castro*

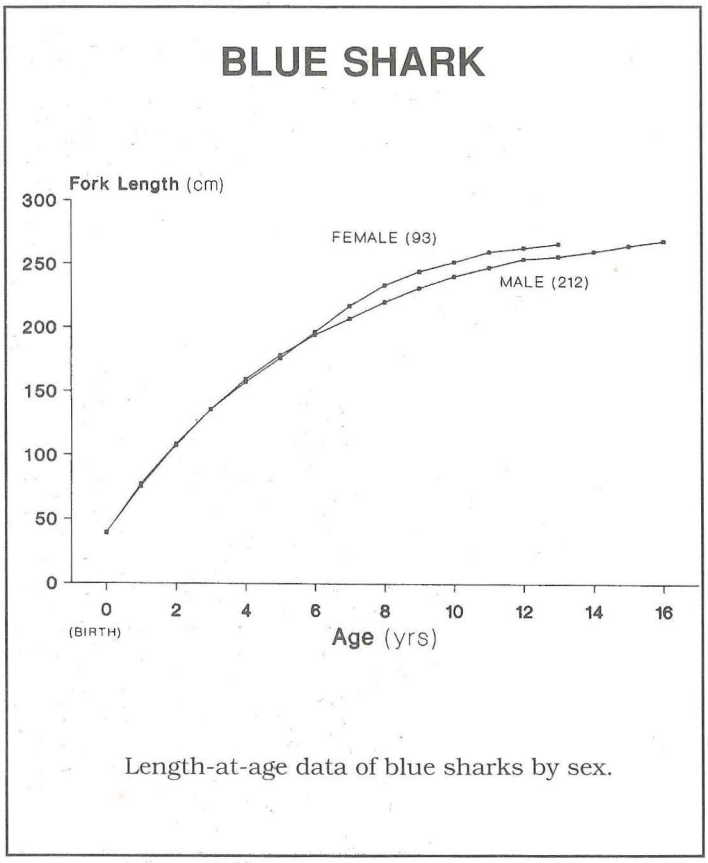
UNIVERSITY—NMFS COOPERATIVE RESEARCH

Over the years University graduate students working with the NMFS have made important contributions to the advancement of knowledge on the biology of sharks. In May 1990 the University of Rhode Island awarded Gregory Skomal his Masters degree and Lisa Natanson her Ph.D. degree based on research completed at the NMFS Narragansett Laboratory. The following are abstracts of these intensive studies.

AGE AND GROWTH OF THE BLUE SHARK, *PRIONACE GLAUCA*, IN THE NORTH ATLANTIC

by Gregory B. Skomal

Age and growth estimates for the blue shark (*Prionace glauca*) were derived from 305 vertebral centra, 480 tag-recaptures, and 6,544 size-frequencies collected in the North Atlantic. Analysis of marginal increments and the vertebrae of two oxytetracycline-injected recaptures support an annual spring deposition of growth rings in the vertebrae. Males and females were aged to 16 and 13 years, respectively, with the former living longer and attaining a larger adult size. Size and sex dependent differences in mortality were attributed to natural and fishing pressures. Growth rates from tag-recaptures agreed with those derived from vertebral annuli for smaller sharks but appeared overestimated for larger sharks. The age and rate of growth calculations based on comparisons of three methods (i.e., length-frequency analysis, interpretation of rings in vertebrae, and tag and recapture data) provided new information on growth of blue sharks. Based on these studies the species grows faster and has a shorter life span than previously reported for the North Atlantic.



Length-at-age data of blue sharks by sex.

RELATIONSHIP OF VERTEBRAL BAND DEPOSITION TO AGE AND GROWTH IN THE DUSKY SHARK, *CARCHARHINUS OBSCURUS*, AND THE LITTLE SKATE, *RAJA ERINACEA*

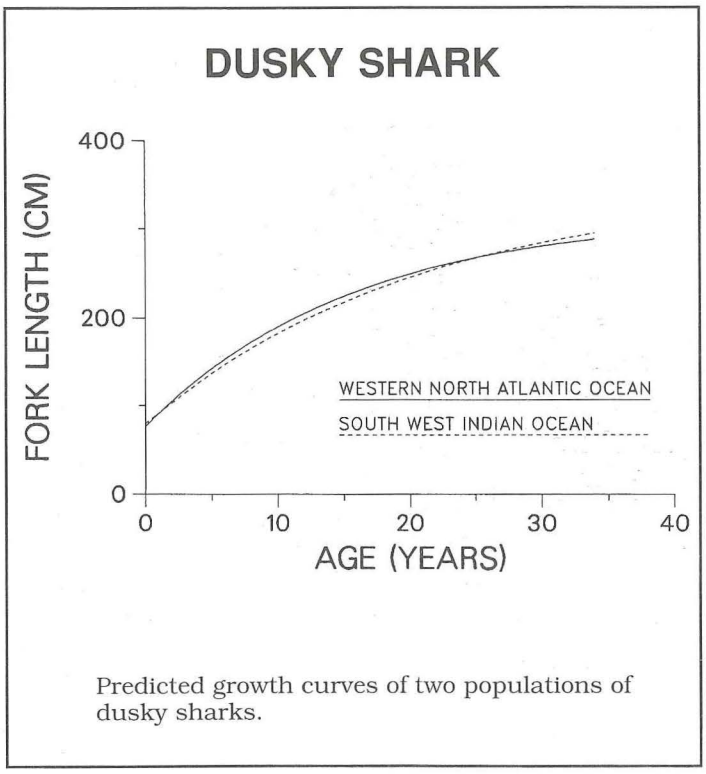
by Lisa J. Natanson

Age and growth of the dusky shark from the Western North Atlantic was determined from bands in vertebrae of 124 individuals, tagging data from six sharks at liberty for up to 11.6 years, and length-frequency data from 341 individuals. Age to maturity was estimated at 17 years for both sexes.

For comparison with Indian Ocean dusky sharks, one of the most abundant sharks in coastal waters off South Africa, age and growth was determined from bands in vertebrae of 42 individuals. Age to maturity was estimated at 17.8 years for males and between 14.5 and 20.8 years for females. Comparisons of growth parameters between dusky shark populations from the South West Indian Ocean and the Western North Atlantic indicated that they grow at the same rate.

A laboratory experiment was conducted to determine the effect of temperature on the timing of vertebral band deposition in the little skate. The antibiotic tetracycline, which marks the vertebrae, was injected into skates that were maintained in aquaria for one year. Band deposition patterns past the tetracycline mark from skates kept under environmentally fluctuating temperature conditions were compared to deposition patterns of skates kept under constant temperature conditions, all other factors being the same. No effects of temperature on band deposition were apparent.

This study is the first to use tetracycline to confirm that bands in the vertebrae of the little skate are deposited annually. Since there is no evidence that band formation can be explained by changes in water temperature, formation may prove to be related to feeding, daylight period, migrations, or other parameters that have yet to be studied in this species.



Predicted growth curves of two populations of dusky sharks.

DRAFT SECRETARIAL SHARK FISHERY MANAGEMENT PLAN FOR THE ATLANTIC OCEAN

In June 1989 the five Atlantic Fishery Management Councils requested the Secretary of Commerce through the NMFS to prepare a Fisheries Management Plan (FMP) for Sharks. Between July 1989 and February 1990, a draft plan was prepared, distributed, and reviewed for comment at 22 public hearings. As a result of those hearings the Plan is being revised for additional public comment and is scheduled to go into effect in the summer of 1990. The following information relates to the draft Plan that is currently being revised.

The Magnuson Fishery Conservation and Management Act authorizes the Secretary of Commerce to prepare a fishery management plan (FMP) for any fishery in need of conservation and management. While Regional Fishery Management Councils established under the Magnuson Act would normally prepare FMPs, they jointly requested the Secretary to do so for the shark fishery, fearing that the inordinate amount of time it would take to prepare a Council FMP would further jeopardize shark resources already in danger of long-term damage. The Secretarial Shark FMP will remain in effect until it is replaced by a Regional Fishery Management Council FMP.

Shark Resources are Valuable

Shark resources are valuable to many user groups, ranging from consumers of shark meat in the U.S. to consumers of sharkfin soup in the Orient, from recreational fishermen who enjoy catching sharks on rod and reel to medical researchers searching for answers to cancer.

Problems in the Fishery

At present there is no management of shark resources in U.S. waters (except for Texas). The unique biology of sharks coupled with sustained high mortality rates are the principal reasons why a collapse of the fishery is likely without management.

Sharks are unlike most fish which produce millions of eggs. They are slow growing, take many years to reach maturity, and produce only a few young (generally 2-25 pups) after long reproductive cycles. Shark mortality (landings and dead discards) resulting from both the commercial and recreational fisheries have for 10 years exceeded the best available estimate of maximum sustainable yield (MSY).

Since sharks are quite migratory in nature they cross international jurisdictional boundaries. In the western North Atlantic including the waters off Canada, Cuba, Mexico, and Venezuela, shark resources are also being overexploited

A problem known as "finning"—removing shark fins and discarding the remainder of the shark to the sea—has evolved in recent years in response to a strong fin demand in the Orient. While legal, the practice results in waste of the carcass.

Finally, the shark information base is extremely limited. Until more is known, conservative measures are both prudent and necessary.

Management Objectives

1) To prevent overfishing of shark resources;
2) To encourage the management of shark stocks throughout their ranges.
3) To establish data collection, research, and monitoring program;
4) To optimize the benefits derived from shark resources to the U.S. while minimizing waste, consistent with the other objectives.

Proposed Management Measures

Commercial Quota—A commercial quota of 5,800 mt is established for the first year of regulation. When that level of landings is reached, the fishery will be closed for the remainder of the calendar year in all U.S. waters.

***Recreational Bag Limit**—A bag limit is established at one shark per person per day in Federal waters, the Exclusive Economic Zone. States are urged to adopt uniform measures in state waters.

***Finning Prohibited**—Fins may only be landed in proper proportion to carcass number and size, i.e., no more than four fins per carcass.

Sale of Recreational Fish Prohibited—Shark meat or shark fins caught recreationally in U.S. waters may not be sold.

Adjustments to Commercial Quotas and Recreational Bag Limits—A framework procedure is established that provides for annual adjustments of quotas and bag limits.

Permit Requirements—Federal permits will be required by fishermen who sell shark meat and fins and by dealers who buy shark meat and fins.

***Eligibility for Commercial Shark Fishing Permits**—Fishermen must prove at least 50 percent of their income for any year from 1985-1989 was derived from sales of fish. After 1990 the preceding year's sales must meet the 50 percent criterion.

Reporting Requirements—Selected persons holding Federal permits to sell or buy shark meat and fins will be required to submit reports to NMFS on their operations.

Tournament Reporting—Directors of shark tournaments must notify NMFS of tournaments and submit reports on them.

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*These and other measures, including a minimum size for mako sharks, are being reevaluated and will likely be changed as a result of public hearings that were completed in February 1990.

Field Studies - continued from page 9.

ing fisheries for sharks in the Gulf of Mexico and along the U.S. east coast in recent years. Future cruises are planned for monitoring shark populations along the Atlantic coast.

Tournament Activities

At the nine shark tournaments attended by the staff, 329 sharks were measured, weighed, and examined for reproduction, food habits, and age and growth studies. Blue sharks were most prevalent in tournament catches (207) followed by mako (80), sandbar (25), and common thresher sharks (9). Dusky, tiger, scalloped hammerhead, and great hammerhead sharks were less common in tournament catches. While some stomachs were empty, an increase in the occurrence of spiny dogfish in blue shark stomachs in 1989 was noted and may be an indication of an increase in the abundance of spiny dogfish off the northeast coast.

The tournaments attended by non-staff people included three from Florida and three from the northeast area (Long Island, N.Y., two; Martha's Vineyard, Mass., one). The Florida catches (27) included tiger, dusky, and scalloped

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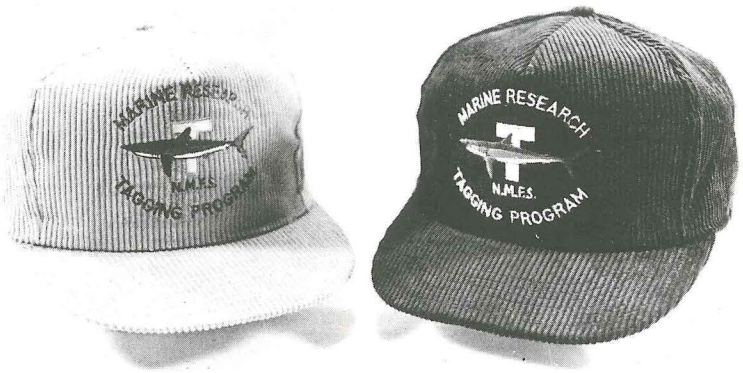
Wes Pratt and Jack Casey measure a small tiger shark prior to tagging.
Photo by Jose I. Castro

Overview - continued from page 3.

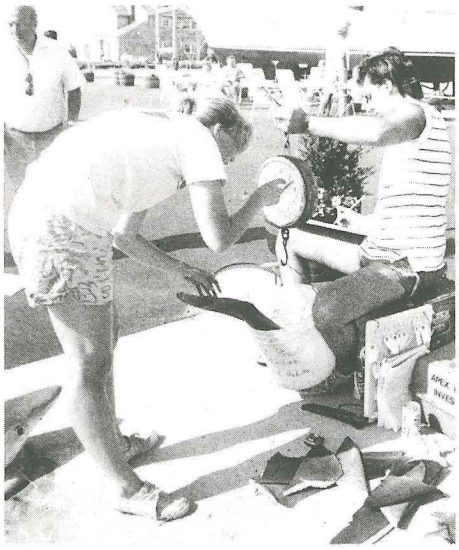
and travelled a maximum distance of 773 miles (both time and distance records). An **OCEANIC WHITETIP SHARK** set both time and distance records for that species by travelling from Hudson Canyon to Cuba in 3.3 years (a distance of 1,226 miles). The majority of the **LEMON** and **NURSE SHARKS** moved less than 5 miles from the tagging site and were at liberty for up to 4.0 years. An exception was a nurse shark that swam 219 miles from Key West, Fla., to Ft. Pierce, Fla. (a new distance record). A **BIGNOSE SHARK** that was originally tagged in 1980 by a U.S. Foreign Fisheries Observer was recaptured in 1983 by a commercial swordfisherman who subsequently retagged it. The same fish was recaptured again in 1989 after a total of 3,386 days (9.3 years) at liberty for a new record number of days free. Other interesting returns include: a **DUSKY SHARK** at liberty for 11.6 years; two **BLACKTIP SHARKS** tagged off Texas and recaptured off Mexico (over 300 miles); a **BIGEYE THRESHER** which travelled 1,494 miles from Georges Bank to off St. Petersburg, Fla. (a new distance record); three **SCALLOPED HAMMERHEAD** sharks recaptured after 3.7 to 4.7 years at liberty, and travelling distances of 221 to 446 miles.

In the coming years, it may be more difficult to tag large numbers of sharks, perhaps because they will be too valuable to release or because they are far less abundant than they are today. In the meantime, the Cooperative Tagging Program is enjoying remarkable success because of the interest of participating fishermen. The value of this information to future generations may prove to be far greater than we can even imagine today.



In 1988, the NMFS Cooperative Shark Tagging Program initiated a new reward procedure for tag returns. In lieu of a $5.00 reward for the return of a tag, a light blue hat with an embroidered shark logo is sent to the person who returns a tag and one is also sent to the fisherman who originally tagged the shark. The hats are donated to NMFS by the New Jersey edition of **The Fisherman** magazine with funds generated by their annual Shark Tag Tournament. The hats have been an overwhelming success because for the first time in 25 years, NMFS is able to give something tangible to the person who tags a shark that is subsequently recaptured.

One problem with the hat rewards is that there have been "discussions" among anglers, captains, crews, etc. as to who should lay claim to the single hat that is provided for releasing or recapturing a tagged shark. NMFS cannot send additional hats to crews, nor are the light blue versions for sale. However, in response to fishermen's interest in the shark program, and to help defray costs, a dark blue hat with the same logo can be purchased for $10.00. The price includes shipping and handling and a portion of the purchase price will be donated to **The Fisherman**'s fund for shark research. Anyone interested can order the hats through National Embroidery Inc., 3384 East Main Road, Portsmouth, RI 02871, Attention Dale Wood (telephone 401-683-4724; FAX 401-683-0012).



Patricia Manning and a volunteer weigh shark fins at a tournament to determine the fin-to-body weight relationship . *Photo by Lisa J. Natanson*

Field studies - continued from page 11.

hammerhead sharks, as well as nurse, lemon, bull, and blacknose sharks. The Martha's Vineyard and Long Island reports (40 sharks) consisted almost entirely of blue, mako, and sandbar sharks.

In addition to species composition and size data, tournaments have been an important source of vertebrae from tag recaptures and other biological samples for our studies of reproduction, age and growth, food habits and migrations. Please call us collect (401-782-3200) anytime you catch a tagged shark.