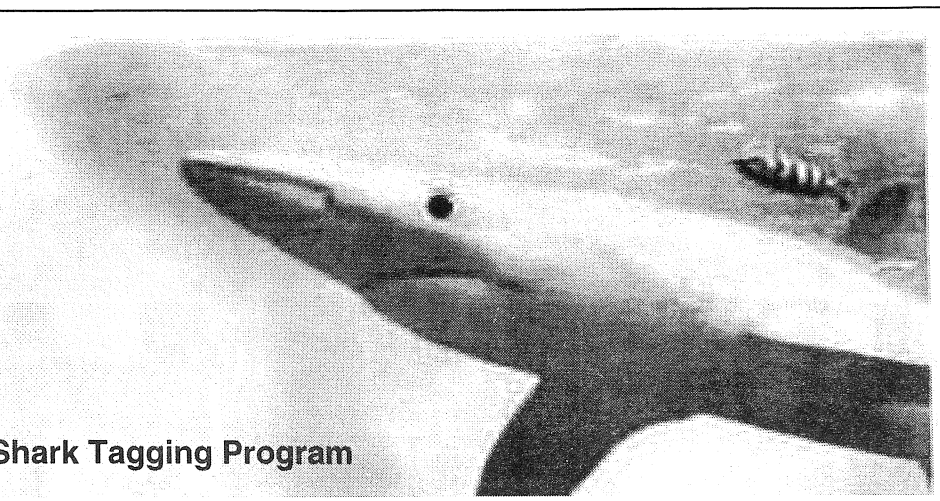
THE SHARK TAGGER 1998 SUMMARY



Newsletter of the Cooperative Shark Tagging Program

1998 Overview

This was an extremely successful year of biological field studies for the staff of the Apex Predators Program (APP) in conjunction with numerous biologists and fishermen. The research included a longline survey of the Atlantic coast (see page 15) and joint studies such as the Cooperative Shark Tagging Program (CSTP) and a new coast-wide pupping and nursery grounds initiative (see Page 17). Many thanks to all participants whose collaborative efforts led to outstanding results in 1998.

- **7,411 fish tagged, 721 recaptured**
- **Time at liberty records set for reef, blacknose and bigeye thresher sharks**
- **Long distance tiger shark returns**
- **Atlantic and Gulf longline surveys**
- **COASTSPAN update**
- **Sandbar shark tracking**
- **Putting the Bite on Sharks – parasite studies**
- **Management plan update**
- **Feature shark - Tiger**

Tags

Members of the Cooperative Shark Tagging Program tagged and released 7,411 fish including 38 species of sharks and rays and 13 species of teleosts (Table 1). Ninety-one percent of the releases were accounted for by 11 species of shark: blue (49%); sandbar (21%); tiger (4%), shortfin mako, blacktip, Atlantic sharpnose (3% each); bonnethead, dusky (2% each); porbeagle, spinner, and nurse shark (1% each). This brings the total number of tagged fish to over 155,000 tagged since 1962.

Anglers tagged the majority of fish (62%; 37 species) followed by NMFS and other biologists (32%; 31 species), commercial fishermen (3%; 23 species), and fisheries observers on commercial vessels (3%; 17 species). Fish to be tagged were caught by a variety of capture methods including rod and reel (60%), longline (25%), net (12%), and free swimming (3%) by fishermen representing eight countries: United States, England, Canada, Portugal, Germany, Italy, France, and Mexico.

Recaptures

In 1998, cooperators returned data on a record number 721 tags from 21 species of sharks and 3 species of teleosts (Table 2) bringing the total number of recaptures to 8,218 since 1962. Blue shark (532), sandbar shark (69), shortfin mako (41), tiger shark (21), and porbeagle (10) were the most numerous returns. Commercial fishermen (54%) and recreational anglers (43%) were the primary sources of recapture information. Fish were originally caught on rod and reel (72%), longline (18%), net (4%), handline (2%), and released free swimming (4%). Tags were returned from fishermen and scientists representing the following 18 nationalities: United States, Spain, Venezuela, Canada, Portugal, Japan, Cuba, Mexico, Taiwan, Brazil, Italy, England, Canary Islands, St. Lucia, Trinidad, Tobago, Grenada, and Guadeloupe.

Blue Sharks (532 Returns)

Distances traveled ranged from 1 to 3,438 nautical miles (nm) – A total of 225 (47%) of the blue shark returns showed distances traveled over 1,000 nm. Of these, 38 moved over 2,000 nm, and 1 over 3,000 nm. The latter return is the third longest distance recorded overall for any blue shark recaptured to date. This fish was tagged 13 nm southeast of Portsmouth, NH in September of 1997 and was recaptured off Brazil after only 6 months at liberty. Returns from fish that traveled over 2,000 nm showed movements from the New England and New York coast to: Flemish Cap, Azores, Canary Islands, Western Sahara, Cape Verde Islands, Suriname, and Guyana and from south of the Flemish Cap to: Cape Verde Islands, Senegal, and Venezuela. Additional recapture locations for blue sharks showing movements between 1,000 and 2,000 nm included Tobago, Lesser Antilles, and Cuba (see map).

Many times blue sharks were tagged in the same place and at the same time, and were then recaptured in close

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

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Narragansett, RI 02882-1199

Table 1. Summary of sharks and teleosts tagged, January to December, 1998

Species	Number Tagged by Cooperative Taggers
Sharks	
Blue shark	3638
Sandbar shark	1549
Tiger shark	259
Shortfin mako	255
Blacktip shark	231
Atlantic sharpnose shark	202
Bonnethead	188
Dusky shark	162
Nurse shark	102
Porbeagle shark	92
Spinner shark	77
Silky shark	57
Sand tiger	54
Finetooth shark	53
Lemon shark	39
Bull shark	37
Scalloped hammerhead	36
Caribbean reef shark	26
Smooth dogfish	24
Blacknose shark	23
Night shark	15
Tope	11
Smooth hammerhead	7
Common thresher shark	6
Atlantic angel shark	5
Basking shark	5
Great hammerhead	4
Bignose shark	4
Spiny dogfish	3
Longfin mako	3
Oceanic whitetip shark	2
White shark	1
Bigeye thresher shark	1
Leopard shark	1
Southern spiny dogfish	1
Brown/Dusky, unspecified	17
Hammerhead, unspecified	2
Dogfish	1
Thresher, unspecified	1
Miscellaneous sharks	63
Miscellaneous rays	9
Total Sharks	7266
Teleosts	
Swordfish	76
Bluefin tuna	25
White marlin	11
Blue marlin	8
Bigeye tuna	7
Yellowfin tuna	7
Atlantic sailfish	3
Miscellaneous teleosts	8
Total teleosts	145
Grand Total	7411

proximity to each other. For example, six blue sharks, tagged approximately 100 nm east of Provincetown, MA by NMFS Narragansett biologists on the same day, were all recaptured within 8 months of tagging after travelling directly east for distances ranging from 942 to 1,447 nm. One other blue shark, however, tagged just two days earlier in the same location, was recaptured off Venezuela (1,860 nm S) after 8.5 months at liberty. There are further examples of blue sharks that are tagged on the same date and location that show very diverse recapture locations. Three fish, tagged on the same day in June off Montauk, NY, were all recaptured within two months - one after 12 days 41 nm to the east, one after one month off Cape Sable, NS, Canada (273 nm E), and the third after two months, only 27 nm to the northeast. Two other fish tagged on the same day in September off New Hampshire were recaptured after 7 months at liberty - one south of the Flemish Cap (1,197 nm E) and the other off Brazil (3,438 nm SE). Similar divergent movement patterns exist in the Eastern Atlantic. Two blue sharks tagged in the same area off the southeast coast of Portugal in the summer of 1996 were recaptured within one day of each other hundreds of miles apart – one traveled 183 nm northwest and the other 1,379 nm to the west.

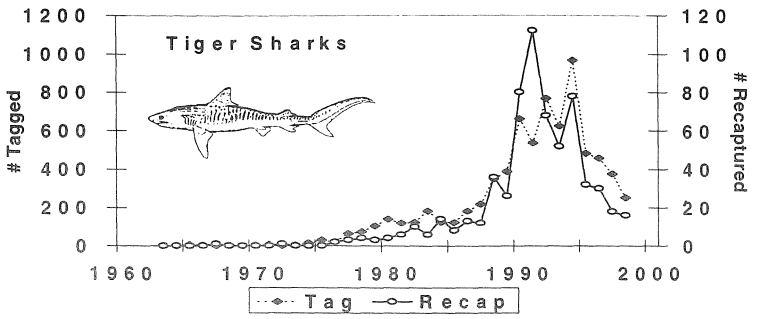
Information on **interesting returns** received in 1998 include four blue sharks that were recaptured approximately 475 nm northeast of the Flemish Cap within eight days of each other by a Portuguese longline fisherman. All were tagged off the New York and New Jersey coast and were at liberty for between 0.9 and 6.6 years. This is the northernmost recapture location for any blue shark in the history of our program. An example of an unusual tagging location for a blue shark was in mid-ocean approximately 800 nm east of Antigua Island. This fish was tagged by a US high seas fisherman and was recaptured by a Spanish longline fisherman northeast of the Cape Verde Islands (1,300 nm E). Although the straight line distance and direction traveled is known, the true migratory route is unknown during the this shark's 1.8 years at liberty.

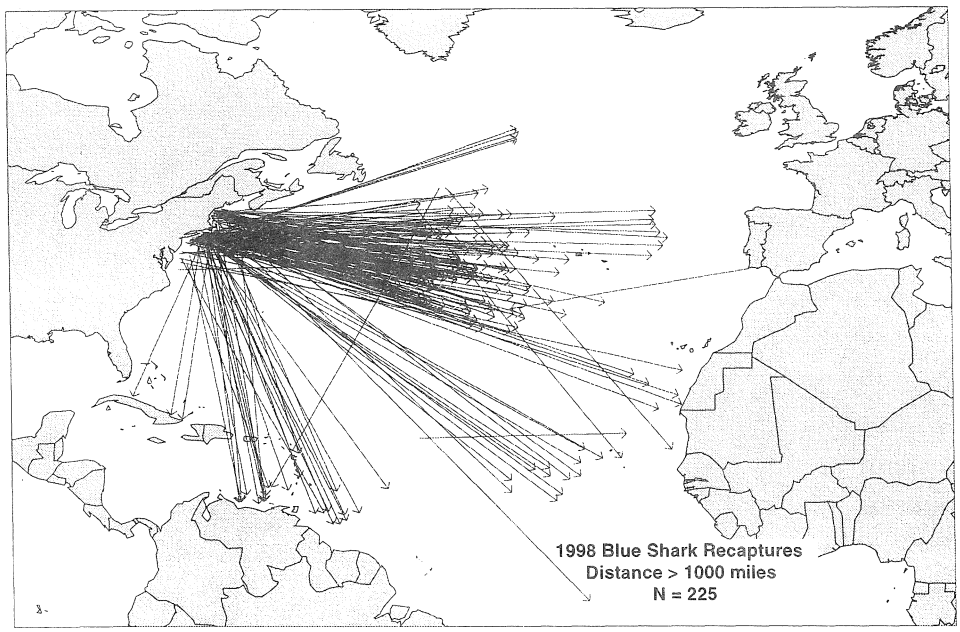
Multiple recaptures of the same fish provide detailed information on the migratory routes of individual sharks. One blue shark tagged south of Montauk, NY in June of 1995, was recaptured 2 years later, only 19 miles northeast of its original tagging location. This fish was re-tagged and recaptured again, 10 months later, after traveling almost 1,000 nm the east.

Overall, **times at liberty** for blue sharks ranged from 1 day to 7.4 years, with the majority at liberty for less than 2 years. Twenty-eight percent of the blue sharks for which recapture information was received are still at liberty, having been either re-tagged, released with the same tag, or released untagged.

Sandbar Sharks (69 Returns)

Distances traveled ranged from 0 to 1,437 nm. The majority (36) of sharks traveled less than 100 nm; 24 traveled between 100 and 1,000 nm; and 8 traveled greater than 1,000 nm. These long distance returns were all recaptured along the west coast of Florida after being at liberty from 5.6 to 13.6 years





with fork lengths at tagging between 35" and 50". An additional Gulf of Mexico recapture traveled 705 nm from Cape Fear, NC to Seminole Pt., FL after 8.6 years at liberty.

One sandbar shark tagged southwest of Apalachicola, FL was recovered off the Virginia coast after 9 months. This fish represents only the third tagged sandbar shark that moved outside the Gulf of Mexico. Another interesting return this year shows local movement off Cuba. Originally tagged by NMFS biologists in September of 1998, off Cairbarien, Cuba, this fish was recaptured 11 nm away after 26 days at liberty and is only the eighth sandbar shark returned from this region. Both of these recoveries underscore the need for additional tagging efforts in these areas.

Times at liberty ranged from 3 days to 13.6 years. Most (44) were returned after less than one year. Of these, 35 were tagged as young of the year sandbar sharks (<24" FL) in Delaware Bay as part of a comprehensive coastal shark pupping and nursery study (see Page 17). The majority of these fish (22) showed mostly local movements inside Delaware Bay (<8 nm) and were recaptured within 2 months of tagging. Three local recaptures, however, were recovered after 2 years at liberty. Ten additional Delaware Bay neonate (newborn) tags were recaptured this year: 5 off North Carolina, 3 off Virginia, and 1 each off Maryland and South Carolina after up to 1.2 years at liberty. Recoveries from neonates tagged outside of Delaware Bay include 4 fish tagged off North Carolina in 1996, 3 of which were returned within 57 nm of their tagging location after up to 2.2 years at liberty. The fourth return was recovered in Chesapeake Bay, Virginia (another significant sandbar shark pupping area). An additional young of the year was tagged and recaptured off New Jersey after traveling 8 nm in 25 days.

Shortfin Makos (41 Returns)

Shortfin makos were recaptured after **traveling distances** of 1,923 nm and **times at liberty** of up to 5.6 years. This is the second highest number of mako returns to date and highlights the cooperative efforts between biologists and recreational, commercial, and foreign fishermen. The longest distance return was from a fish tagged southeast of Saco River, ME and recaptured northwest of Venezuela after approximately 1.8 years at liberty. This is the fifth longest distance traveled for any shortfin mako previously reported to the CSTP; only the fourth recapture off Venezuela; and the first to be recaptured after being tagged in the Gulf of Maine. The 5.6 years at liberty is the sixth longest to date (current record of 12.8 years). Other **interesting returns** include two makos released SW of the Flemish Cap at the same time by an observer on a commercial vessel that were returned within 4 days of each other one year later. Both were recaptured near the Flemish Cap within 400 nm of each other. Another mako tagged in this vicinity 1 month earlier, was recaptured southeast of Block Island, RI 998 nm to the west after 1.1 years at liberty. A shortfin mako that was tagged for the first time off Montauk, NY and recovered 4 nm away 1 year later, was re-tagged, re-released and then recaptured again 6 months later south of the Flemish Cap approximately 1200 nm away. Three fish were tagged and recaptured with in a period of 4 months off Spain after traveling distances of up to 71 nm. One was originally tagged east of Gibraltar and recovered south of Cadiz, Spain.

Tiger Sharks (21 Returns)

Distances traveled ranged from 4 to 3,128 nm. The majority (13) showed movements of over 500 nm with five traveling more than 1,000 nm from their original tagging location. These fish showed movements from North Carolina to south and east of the Flemish Cap, and west of the Spanish Sahara; from Georgia to the Cape Verde Islands; and from Bimini to New York. Of these, the 3 furthest returns represent the second, fourth, and eighth longest distances traveled for any tiger shark previously reported to the CSTP. Other **interesting returns** include 3 fish recaptured off Cuba, and 3 fish tagged in U.S. waters that were recovered off Mexico (two in the Gulf and one in the Caribbean Sea). These 1998 trans-Atlantic and long distance recaptures for the tiger shark significantly enhance the information on the migratory habits of this coastal pelagic shark species (see map). Overall, **times at liberty** for tiger sharks ranged from 64 days to 6.0 years with the majority (12) out for less than two years.

Other Species (58 Returns)

Recaptures of other species included some long distance and maximum time at liberty records for the CSTP. A **Caribbean reef shark**, was recaptured, re-tagged and re-released within 2 nm of its release location after 9.2 years (record time at liberty). A **blacknose shark**, tagged and recaptured off Florida after 9.5 years, had traveled a distance of 196 nm, a distance and time at liberty record for this species. In addition, important return information was obtained on species of sharks with fewer than ten recaptures. The first two **finetooth shark** recaptures were made in 1998. Both were tagged in Bulls Bay, SC and were recaptured and re-released in less than 1 month, after traveling up to 12 nm. A **smooth hammerhead shark**, at liberty for 1 year, was recaptured 3 nm from its original tagging location off Ocean City, MD. This is one of only seven recaptures reported to date. A time at liberty record of 9.5 years and distance record of 2,067 nm was established for the **bigeye thresher shark**. This shark was tagged southwest of the Cape Verde Islands by Polish research scientists and recaptured off Venezuela and brings the total number of returns for this little known species to nine.

Table 2. Tag recoveries: January-December 1998.

	GENERAL LOCATIONS		MONTHS AT LIBERTY	DIST. (MI.) AND DIR.		CAPTURE METHOD		TAGGED BY	
	TAGGED	RECAPTURED				TAG.	REC.	TAGGER	RESIDENCE
Blue shark	NR	SW Saseno Isl., Albania	NR	NR	NR	RR	LL	E. Rossi	Italy
" "	SE Fire Isl. Inlet, NY	S Flemish Cap	36	1227	E	RR	LL	Bruce Dean	NY
" "	NR	S Nantucket Isl., MA	NR	NR	NR	RR	LL	Robert Durowitch	NJ
" "	SE Fire Isl. Inlet, NY	SSE Fire Isl. Inlet, NY	<1	13	N	RR	RR	Steve Rubin	NY
" "	S Fire Isl. Inlet, NY	SE Block Isl., RI	12	101	NE	RR	RR	Barry August	NY
" "	SE Atlantic City, NJ	E Pt. Pleasant, NJ	28	69	N	RR	RR	Ray Bergman, Sr.	MD
" "	NR	SE Jones Inlet, NY	NR	NR	NR	RR	RR	Michael Contessa	NY
" "	SE Shinnecock Inlet, NY	Ipswich Bay, MA	27	148	NE	RR	RR	Bill Mercado	NY
" "	SW Montauk Pt., NY	SSW Pt. Judith, RI	24	19	NE	RR	FS	George Sincox	NJ
" "	S Montauk Pt., NY	NE Flemish Cap	79	1647	NE	RR	LL	Paul Nachtwey	MA
" "	S Shinnecock Inlet, NY	N Caracas, Venezuela	85	1710	S	RR	RR	Charles Witek	NY
" "	SE Shinnecock Inlet, NY	SW Sao Miguel Isl., Azores	31	1648	E	RR	LL	Richard Torre	NY
" "	NR	SE Barnegat Inlet, NJ	NR	NR	NR	RR	RR	Gary Williams	NJ
" "	SE Montauk Pt., NY	SE Pt. Judith, RI	1	16	NE	RR	RR	Richard Hunter	NY
" "	SE Fire Isl. Inlet, NY	S Montauk Pt., NY	<1	39	E	RR	RR	Charlie Johnson	NY
" "	SE Montauk Pt., NY	NE Sao Miguel, Azores	NR	2317	E	RR	LL	Tom Shipman	CT
" "	SE Moriches Inlet, NY	SW Faial, Azores	7	1802	E	RR	LL	Paul Trovitch	NY
" "	SW Nantucket Isl., MA	SE Pt. Judith, RI	<1	42	W	RR	RR	Bill Brown	CT
" "	S Martha's Vineyard, MA	S Pt. Judith, RI	11	37	W	RR	RR	Chris Wolfington	MA
" "	SW Martha's Vineyard, MA	S Flemish Cap	9	1271	E	RR	LL	Peter Carchidi	CT
Blue shark	SE Pt. Judith, RI	SE Montauk Pt., NY	24	17	SW	RR	RR	Rocco D'Angelo	RI
" "	SE Shinnecock Inlet, NY	SE Flemish Cap	35	1370	E	RR	LL	Robert Timson	NY
" "	SE Cape Sable, NS, Canada	SE Montauk Pt., NY	74	492	W	LL	RR	D. Wurster, NMFS Obs.	MA
" "	SE Ocean City, MD	N Isl. de Marg., Venezuela	60	1571	S	RR	LL	Billy Verbanas	DE
" "	E Ocean City, MD	SE Shinnecock Inlet, NY	63	175	N	RR	HL	Billy Verbanas	DE
" "	S Montauk Pt., NY	S Cape Sable, NS, Canada	1	273	E	RR	LL	Dave Willis	CT
" "	S Montauk Pt., NY	SE Block Isl., RI	2	27	NE	RR	RR	David Willis	CT
" "	S Montauk Pt., NY	S Martha's Vineyard, MA	<1	41	E	RR	RR	Dave Willis	CT
" "	SE Ocean City, MD	SE Montauk Pt., NY	13	221	NE	RR	RR	Bill Shaprow	MD
" "	SE Montauk Pt., NY	SE Block Isl., RI	2	17	NE	RR	RR	Frank Noto	CT
" "	SE Pt. Judith, RI	SW Halifax, NS, Canada	14	363	NE	RR	RR	Al Anderson	RI
" "	NR	S Cape Race, NF, Canada	NR	NR	NR	RR	LL	Harry Weinblatt	NY
" "	SE Montauk Pt., NY	N Morawhanna, Guyana	32	1973	SE	RR	LL	George Drago	NY
" "	SE Cape Elizabeth, ME	S Flemish Cap	44	1323	E	RR	LL	Marc St. Pierre	ME
" "	E Provincetown, MA	S Flemish Cap	55	1175	E	RR	LL	David St. John	MA
" "	S Pt. Judith, RI	S Flemish Cap	22	1231	E	RR	LL	John Rainone	RI
" "	SE Newport, RI	SW Faial, Azores	15	1913	E	RR	LL	Jim Quinn	RI
" "	NR	E Flemish Cap	NR	NR	NR	RR	LL	Paul Difebo, Jr.	DE
" "	E Cape Elizabeth, ME	W Yarmouth, NS, Canada	12	124	E	RR	RR	Gerald J. Sullivan	ME
" "	E Manasquan Inlet, NJ	SW Faial, Azores	22	1893	E	RR	LL	Carl Horosz	NJ
Blue shark	SE Atlantic City, NJ	E Manasquan Inlet, NJ	<1	66	N	RR	RR	Bob Alfred	PA
" "	SSE Montauk Pt., NY	SW Faial, Azores	57	1550	E	RR	LL	Mike Brumm	NY
" "	SSE Montauk Pt., NY	S Pt. Judith, RI	60	17	N	RR	RR	Bill Ricca	NY
" "	SE Fire Isl. Inlet, NY	S Flemish Cap	35	1206	E	RR	LL	Bill Ostrower	NY
" "	SSW Montauk Pt., NY	SE Montauk Pt., NY	36	32	NE	RR	RR	Pat Cutrone	CT
" "	S Montauk Pt., NY	NR	58	NR	NR	RR	LL	Frank Noto	CT
" "	SE Cape Elizabeth, ME	SE Flemish Cap	35	1186	E	RR	LL	Peter Bastille	ME
" "	S Montauk Pt., NY	S Flemish Cap	19	1232	E	RR	LL	Terry Thomas	CT
" "	SE Barnegat Inlet, NJ	S Montauk Pt., NY	25	105	N	RR	RR	Scott Martindell	PA
" "	SW Flemish Cap	S Flemish Cap	10	235	E	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	S Flemish Cap	SW Faial, Azores	29	791	S	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	S Flemish Cap	S Flemish Cap	30	613	S	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	S Montauk Pt., NY	S Flemish Cap	33	1345	E	RR	LL	Frank Fasanella	CT
" "	S Montauk Pt., NY	S Montauk Pt., NY	23	9	S	RR	RR	Gary Thompson	CT
" "	NR	SW Faial, Azores	NR	NR	NR	RR	LL	Carl Stetz	NY
" "	E Isle of Shoals, ME	S Flemish Cap	7	1091	E	RR	LL	Paul Campbell	NH
" "	SE Cape Race, NFLD, Canada	E Bermuda	42	599	S	LL	LL	J. Symonds, NMFS Obs.	MA
" "	SE Flemish Cap	E Flemish Cap	35	190	E	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	SE Flemish Cap	SE Flemish Cap	11	97	SW	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	SE Nantucket Isl., MA	S Block Isl., RI	24	165	W	GN	RR	L. Morse, NMFS Obs.	MA
Blue shark	SE Martha's Vineyard, MA	S Martha's Vineyard, MA	13	101	NW	GN	RR	L. Morse, NMFS Obs.	MA
" "	SE Nantucket Isl., MA	S Martha's Vineyard, MA	10	105	NW	DN	RR	P. O'Donnell, NMFS Obs.	MA
" "	SE Flemish Cap	S Flemish Cap	34	488	S	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	SE Flemish Cap	NW St. Louis, Senegal	28	2154	SE	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	SW Flemish Cap	SE Cape Verde Isl.	39	2032	SE	LL	LL	J. Symonds, NMFS Obs.	MA
" "	S Montauk Pt., NY	W Faial, Azores	37	1642	E	RR	LL	William Gunter	CT
" "	E Cape May, NJ	S Flemish Cap	36	1415	E	RR	LL	Michael Brocco	NJ
" "	E Absecon Inlet, NJ	NR	22	NR	NR	RR	LL	Matt Muzslay	NJ
" "	E Barneget, NJ	S Cape Race, NF, Canada	11	1029	E	RR	LL	Bob Alfred	PA
" "	SE Ocean City, MD	SW Sao Miguel Isl., Azores	32	1716	E	RR	LL	Marty Moran	MD
" "	SE Fire Isl. Inlet, NY	SE Flemish Cap	14	2307	SE	RR	LL	Fred Deutcsh	NY
" "	SE Martha's Vineyard, MA	SE Montauk Pt., NY	48	50	W	RR	RR	Jerry Rubino	MA
" "	S Martha's Vineyard, MA	NW St. Lucia, W.I.	18	1687	S	RR	RR	Chuck Walker	MA
" "	SE Block Isl., RI	SE Montauk Pt., NY	35	220	S	RR	LL	Jim Walsh	CT
" "	S Montauk Pt., MA	W Faial, Azores	33	1492	E	RR	LL	Frank Braddick	NY
" "	SE Pt. Judith, RI	S Cape Race, NF, Canada	10	1090	E	RR	LL	Norman Jalbert	RI
" "	SE Portland, ME	E Provincetown, MA	14	134	SE	RR	LL	Mike Ellsmore	ME
" "	SE Portland, ME	W Faial, Azores	8	1441	E	RR	LL	Mike Ellsmore	ME
" "	E Cape Elizabeth, ME	SE Montauk Pt., NY	23	392	S	RR	LL	Thomas McNeil	ME
" "	S Montauk Pt., NY	S Flemish Cap	34	1330	E	RR	LL	Peter Jakits	NY
Blue shark	SW Martha's Vineyard, MA	N Faial Isl., Azores	35	1771	E	RR	LL	Bruce Moniz	RI
" "	SE Fire Isl. Inlet, NY	SW Dakhla, Western Sahara	20	2965	E	RR	LL	John Raguso	NY
" "	E Ocean City, MD	S Cape Sable, NS, Canada	27	446	NE	RR	LL	Jeff Powell	DE
" "	S Montauk Pt., NY	SW Cape Verde Isl.	20	2712	E	RR	LL	James Foley	NY
" "	SE Montauk Pt., NY	SE Flemish Cap	25	1317	E	RR	LL	Frank Braddick	NY
" "	SE Montauk Pt., NY	S Flemish Cap	33	1373	E	RR	LL	George Hettesheimer	NY
" "	E Ocean City, MD	NR	89	NR	NR	RR	LL	Gary Stamm	MD
" "	E Boston Harbor, MA	NR	31	NR	NR	RR	LL	Pete Missick	MA
" "	SE Gloucester, MA	W Vigo, Spain	11	2205	E	RR	LL	Pete Missick	MA

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	GENERAL LOCATIONS		MONTHS AT LIBERTY	DIST. (MI.) AND DIR.		CAPTURE METHOD		TAGGED BY	
	TAGGED	RECAPTURED				TAG.	REC.	TAGGER	RESIDENCE
Blue shark	SE Cape Elizabeth, ME	S Flemish Cap	45	1324	E	RR	LL	Ernest Johnson	ME
" "	E Gloucester, MA	SE Flemish Cap	33	1234	E	RR	LL	John Pirie	MA
" "	SE Montauk Pt., NY	SE Pt. Judith, RI	1	14	NE	RR	RR	John P. Henderson, Jr.	RI
" "	SE Gloucester, MA	S Flemish Cap	36	1275	E	RR	LL	Rick McLaughlin	MA
" "	S Flemish Cap	SW Pico Isl., Azores	41	912	SE	LL	LL	Barry Marx	FL
" "	SE Wood Isl. Light, ME	S Flemish Cap	33	1301	E	RR	LL	Dana Sevigny	ME
" "	SE Portsmouth, NH	S Flemish Cap	7	1204	E	RR	LL	Eric Bloomfield	NH
" "	SE Portsmouth, NH	SE Sao Paulo, Brazil	6	3438	SE	RR	LL	Eric Bloomfield	NH
" "	SE Gloucester, MA	S Cape Race, NF, Canada	7	995	E	RR	LL	Thomas Lukegord	MA
" "	SE Camp Ellis, ME	W Cape Verde Isl.	18	2538	SE	RR	LL	Todd Steward	ME
" "	SE Saco River, ME	S Flemish Cap	18	1293	E	RR	LL	Todd Stewart	ME
" "	SE Cape Elizabeth, ME	SW Faial Isl., Azores	30	1526	E	RR	LL	Merrill Robbins	ME
" "	SE Cape Elizabeth, ME	W Faial, Azores	20	1412	E	RR	LL	Joe Tufts	ME
" "	SE Cape Elizabeth, ME	S Flemish Cap	20	1258	E	FS	LL	Joe Tufts	ME
" "	S Martha's Vineyard, MA	S Flemish Cap	10	1224	E	RR	LL	Steven James	MA
" "	E Gloucester, MA	W Oporto, Portugal	32	2265	E	RR	LL	John Price	MA
" "	SE Absecon Inlet, NJ	NE P. Cabello, Venezuela	18	1661	S	RR	LL	Mark Schrenk	NJ
" "	SE Cape Elizabeth, ME	SE Shark River, NJ	9	272	SW	RR	RR	Donald Harris	ME
" "	SE Cape Elizabeth, ME	S Sequin Isl., ME	12	18	NE	RR	RR	Donald Harris	ME
" "	SSW Pt. Judith, RI	Coast of Central Venezuela	38	1811	S	FS	GN	Charlie Donilon	RI
Blue shark	SE Montauk Pt., NY	SSE Montauk Pt., NY	24	5	W	RR	RR	Jim Bohara	CT
" "	SE Fire Isl. Inlet, NY	NR	NR	NR	NR	RR	LL	George Maisch	NY
" "	SE Pt. Judith, RI	SE Moriches Inlet, NY	27	58	SW	RR	RR	Ken Benson	RI
" "	S Martha's Vineyard, MA	SSE Block Isl., RI	22	40	W	RR	RR	Laird Summerlin	MA
" "	S Cape Elizabeth, ME	S Flemish Cap	21	1250	E	RR	LL	Joseph Tufts	ME
" "	S Cape Elizabeth, ME	NE Morawhanna, Guyana	26	1988	SE	RR	LL	Joe Tufts	ME
" "	SE Cape Elizabeth, ME	S Flemish Cap	8	1273	E	RR	LL	Wayne Picard	ME
" "	SE Flemish Cap	S Flemish Cap	11	618	S	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	S Flemish Cap	NW Grenada	26	2222	SW	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	SE Faial, Azores	NW Faial, Azores	9	345	SE	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	S Montauk Pt., NY	W Faial, Azores	47	1481	E	RR	LL	Bill Cugno	CT
" "	SE Moriches Inlet, NY	NE Morawhanna, Guyana	43	1985	SE	RR	LL	Augustino Palladino	NY
" "	E Antigua Isl.	NE Cape Verde Isl.	22	1352	E	LL	LL	Barry Marx	FL
" "	SW Shinnecock Inlet, NY	S Flemish Cap	34	1464	E	RR	LL	Andy Becker	NY
" "	SE Montauk Pt., NY	NR	NR	NR	NR	RR	LL	Otto Haselman	NY
" "	SE Fire Isl. Inlet, NY	SW Faial, Azores	6	1860	E	RR	LL	Joe Garglulo	NY
" "	SE Montauk Pt., NY	W Faial, Azores	33	1476	E	RR	LL	Bill Ricca	NY
" "	SE Fire Isl. Inlet, NY	E Cape May, NJ	13	97	SW	RR	RR	Warren Heller	NY
" "	SE Fire Isl. Inlet, NY	NE Oregon Inlet, NC	7	271	S	RR	LL	Warren Heller	NY
" "	SE Fire Isl. Inlet, NY	SW Flemish Cap	10	1175	E	RR	LL	Warren Heller	NY
Blue shark	S Montauk Pt., NY	S Flemish Cap	35	1200	E	RR	LL	Al Phillips	NY
" "	SE Montauk Pt., NY	SE Flemish Cap	37	1578	E	RR	LL	Al Phillips	NY
" "	S Montauk Pt., NY	SW Faial, Azores	34	1938	E	RR	LL	Peter Jakits	NY
" "	SSE Pt. Judith, RI	W Faial, Azores	36	1450	E	FS	LL	Charlie Donilon	RI
" "	S Fire Isl. Inlet, NY	E Manasquan Inlet, NJ	<1	17	NW	RR	RR	Paul Recchione, Jr.	NY
" "	S Montauk Pt., NY	NR	NR	NR	NR	RR	LL	Charlie Avolio	NY
" "	SW Montauk Pt., NY	S Flemish Cap	35	1377	E	RR	LL	Scott Bayne	CT
" "	S Jones Inlet, NY	SE Montauk Pt., NY	27	103	NE	RR	RR	Sean Libby	NY
" "	S Shinnecock Inlet, NY	S Flemish Cap	22	1148	E	RR	LL	John Manarte	NY
" "	S Pt. Judith, RI	W Faial, Azores	35	1597	E	RR	LL	Andy Dangelo	RI
" "	S Pt. Judith, RI	S Flemish Cap	34	1229	E	RR	LL	Andy Dangelo	RI
" "	E Montauk Pt., NY	SW Cape Verde Isl.	31	2752	E	RR	LL	Donald Caddick	CT
" "	S Montauk Pt., NY	N Guardalavaca, Cuba	32	1194	S	RR	LL	Tom Federico	NY
" "	SE Montauk Pt., NY	NE Flemish Cap	34	1605	NE	RR	LL	Frank Braddick	NY
" "	SW Martha's Vineyard, MA	S Montauk Pt., NY	36	40	W	RR	RR	Tom Birch	MA
" "	SE Montauk Pt., NY	NW Grenada	36	1758	S	RR	RR	Terry Thomas	CT
" "	E Ocean City, MD	NE Morawhanna, Guyana	10	1905	SE	RR	LL	Matt Muzslay	NJ
" "	SE Moriches Inlet, NY	E Martha's Vineyard, MA	13	125	NE	RR	RR	Edward Carpenter, Jr.	NY
" "	S Shinnecock Inlet, NY	S Flemish Cap	21	1436	E	RR	LL	Michael Flynn	NY
" "	SE Fire Isl. Inlet, NY	SE Moriches Inlet, NY	23	25	NE	RR	RR	Lewis Liebetroth	NY
Blue shark	S Pt. Judith, RI	W Faial, Azores	22	1474	E	RR	LL	John Rainone	RI
" "	SE Fire Isl. Inlet, NY	W Faial, Azores	34	1479	E	RR	LL	George Maisch	NY
" "	SE Pt. Judith, RI	S Block Isl., RI	12	20	S	RR	RR	John Rainone	RI
" "	S Pt. Judith, RI	W Faial, Azores	32	1523	E	RR	LL	John Rainone	RI
" "	S Moriches Inlet, NY	S Fire Isl. Inlet, NY	26	28	W	RR	RR	Steve Marotta	NY
" "	S Pt. Judith, RI	SW Sao Miguel Isl, Azores	7	1604	E	RR	LL	Frederick E. Robinson	RI
" "	SE Moriches Inlet, NY	NR	15	NR	NR	RR	RR	Skip Rasso	NY
" "	SE Montauk Pt., NY	S Montauk Pt., NY	22	19	W	RR	RR	Barry Steinberg	NY
" "	SE Moriches Inlet, NY	W Oporto, Portugal	22	2329	E	RR	LL	Dick Haug	NY
" "	SE Pt. Judith, RI	NR	NR	NR	NR	FS	LL	Sandy Ballou	RI
" "	S Pt. Judith, RI	W Faial, Azores	22	1678	E	RR	LL	Alfed Ingulli	CT
" "	SE Absecon Inlet, NJ	W Faial, Azores	23	1495	E	RR	LL	Wayne Rotelle	PA
" "	E Cape May, NJ	SW Flemish Cap	23	1222	E	RR	LL	Wayne Rotelle	PA
" "	SE Barnegat Inlet, NJ	SE Pt. Judith, RI	12	146	NE	RR	RR	Bill Darney	NJ
" "	E Barnegat Inlet, NJ	SE Montauk Pt., NY	<1	112	NE	RR	RR	Bill Darney	NJ
" "	E Barnegat Inlet, NJ	S Montauk Pt., NY	<1	91	NE	RR	RR	Bill Darney	NJ
" "	S Pt. Judith, RI	S Montauk Pt., NY	27	26	SW	RR	RR	Jack Demers	RI
" "	S Pt. Judith, RI	SE Flemish Cap	26	1468	E	RR	LL	Robert Reichenberger	NY
" "	SE Montauk Pt., NY	SE Montauk Pt., NY	<1	2	S	RR	RR	Ilario Circosta	NH
" "	E Montauk Pt., NY	S Flemish Cap	20	1171	E	RR	LL	Jack Salisbury	CT
Blue shark	SE Moriches Inlet, NY	E Ocean City, MD	6	153	SW	RR	LL	John Manarte	NY
" "	S Martha's Vineyard, MA	S Cape Race, NF, Canada	10	961	E	RR	LL	Steven West	RI
" "	SE Pt. Judith, RI	E Sao Miguel Isl., Azores	21	2371	E	RR	LL	Ernest Dunphy	RI
" "	E Montauk Pt., NY	S Flemish Cap	33	1247	E	RR	LL	Al Phillips	NY
" "	S Pt. Judith, RI	S Flemish Cap	22	1034	E	RR	LL	Ryan Hogan	RI
" "	SE Shinnecock Inlet, NY	SSE Montauk Pt., NY	12	40	E	RR	RR	John Manarte	NY
" "	SE Pt. Judith, RI	N Paramaribo, Suriname	21	2101	SE	RR	LL	Ray Chappuis	CT
" "	NR	SE Montauk Pt., NY	NR	NR	NR	RR	RR	Richard Brocha	RI
" "	SE Pt. Judith, RI	S Cape Sable, NS, Canada	24	247	E	RR	LL	Tom Mort	RI

Table 2. Tag recoveries: January-December 1998.

	GENERAL LOCATIONS		MONTHS AT LIBERTY	DIST. (MI.) AND DIR.	CAPTURE METHOD		TAGGED BY	
	TAGGED	RECAPTURED			TAG.	REC.	TAGGER	RESIDENCE
Blue shark	SE Montauk Pt., NY	S Flemish Cap	22	1235 E	RR	LL	Jeff Eckert	CT
" "	NR	SW Faial, Azores	NR	NR NR	RR	LL	Rick McLaughlin	MA
" "	SW Martha's Vineyard, MA	NE Georgetown, Guyana	18	2044 SE	RR	LL	Rick McLaughlin	MA
" "	SE Pt. Judith, RI	SW Faial, Azores	9	1514 E	RR	LL	Robert Edward	RI
" "	S Pt. Judith, RI	S Flemish Cap	21	1120 E	RR	LL	Albert Woynar	CT
" "	S Montauk Pt., NY	NR	NR	NR NR	RR	LL	Fred Wedley	NY
" "	SE Montauk Pt., NY	SE Fire Isl. Inlet, NY	2	59 W	RR	RR	Dennis O'Rourke	NY
" "	S Montauk Pt., NY	NR	11	NR NR	RR	NR	Dennis O'Rourke	NY
" "	S Shinnecock Inlet, NY	NR	NR	NR NR	RR	RR	Kurt Hoffman	NY
" "	S Cape Elizabeth, ME	S Flemish Cap	32	1202 E	RR	LL	Brad MacDonald	ME
" "	S Lagos, Portugal	W Lisbon, Portugal	19	183 NW	RR	LL	George Burgum	Portugal
" "	SE Montauk Pt., NY	SE Ocean City, MD	11	218 SW	RR	RR	Jim Bohara	CT
" "	E Olhao, Portugal	SW Cadiz, Spain	<1	56 SE	RR	LL	Helder Ferriera	Azores
" "	S Cape Elizabeth, ME	NNE Bahia de Mata, Cuba	20	1391 S	RR	RR	John Lamirande	ME
" "	S Shinnecock Inlet, NY	E Cape Elizabeth, ME	26	220 NE	RR	RR	Edward Carpenter, Jr.	NY
" "	SE Pt. Judith, RI	NE Georgetown, Guyana	21	2068 SE	RR	LL	Al Anderson	RI
" "	SE Montauk Pt., NY	W Faial, Azores	22	1608 E	RR	LL	Robert Nowakowski	CT
" "	SE Cape Elizabeth, ME	NW Cumana, Venezuela	25	1952 S	RR	LL	Harry Adams	ME
" "	SE Gloucester, MA	SE Flemish Cap	23	1320 E	RR	LL	John Pirie	MA
" "	SW Montauk Pt., NY	SW Montauk Pt., NY	24	20 SW	RR	RR	Frank Braddick	NY
Blue shark	S Cape Elizabeth, ME	SE Faial, Azores	21	2154 E	RR	LL	Arnold Beleckis	ME
" "	SE Moriches Inlet, NY	SE Flemish Cap	27	1525 E	RR	LL	Wain Carlough	NY
" "	E Thatchers Isl., MA	ESE Thatchers Isl., MA	26	5 SW	FS	NR	Oscar Amorosa	NY
" "	E Portland Headlights, ME	W Faial, Azores	17	1670 E	RR	LL	Chuck Baker	ME
" "	E Cape Elizabeth, ME	S Flemish Cap	19	1142 E	RR	LL	Chuck Baker	ME
" "	E Isle of Shoals, ME	W Faial, Azores	7	1439 E	RR	LL	Paul Campbell	NH
" "	E Saco River, ME	S Flemish Cap	30	1236 E	FS	LL	Richard Provencher	ME
" "	E Cape Elizabeth, ME	SE Cape Elizabeth, ME	12	9 SE	RR	RR	Ian Bexon	ME
" "	S Pt. Judith, RI	SW Faial, Azores	5	1546 E	FS	LL	Rich Templeton	RI
" "	SE Cape Elizabeth, ME	S Flemish Cap	22	1115 E	RR	LL	Merrill T. Robbins	ME
" "	SE Cape Elizabeth, ME	SW Faial, Azores	17	1653 E	RR	LL	Mark Chase	ME
" "	SE Cape Elizabeth, ME	SE Flemish Cap	21	1333 E	RR	LL	Mark Chase	ME
" "	SE Cape Elizabeth, ME	SW Faial, Azores	24	1642 E	RR	LL	Mark Chase	ME
" "	S Montauk Pt., NY	S Montauk Pt., NY	9	18 N	RR	RR	Robert Sangster	RI
" "	S Pt. Judith, RI	SE Ocean City, MD	34	216 SW	FS	RR	Charlie Donilon	RI
" "	SE Pt. Judith, RI	SE Montauk Pt., NY	11	38 W	RR	RR	Rodman Sykes	RI
" "	S Lagos, Portugal	SW Sao Miguel Isl., Azores	18	1379 W	RR	LL	George Burgum	Portugal
" "	SE Nantucket Isl., MA	S Cape Race, NF, Canada	7	883 E	LL	LL	John Caldwell	FL
" "	SE Nantucket Isl., MA	SW Faial, Azores	12	1593 E	LL	LL	John Caldwell	FL
" "	SE Cape Race, NF, Canada	S Cape Race, NF, Canada	8	361 S	LL	LL	John Caldwell	FL
Blue shark	SE Cape Race, NF, Canada	NR	NR	NR NR	LL	LL	John Caldwell	FL
" "	SW Pt. Judith, RI	SW Sao Miguel Isl., Azores	29	2068 E	RR	LL	Robert Hogan Jr.	RI
" "	S Montauk Pt., NY	S Flemish Cap	24	1279 E	RR	LL	Frank Braddick	NY
" "	NR	E Ocean City, MD	NR	NR NR	RR	LL	Joshua T. Sheeny	NH
" "	NR	S Cape Race, NF, Canada	NR	NR NR	RR	LL	Michael Jancovic	ME
" "	S Cape Elizabeth, ME	S Flemish Cap	21	1180 E	RR	LL	Richard Provencher	ME
" "	E Beach Haven, NJ	NE Flemish Cap	11	1725 NE	RR	LL	Jeff Merrill	NJ
" "	E Barnegat Inlet, NJ	SE Shinnecock, NY	13	86 NE	RR	RR	Andrew Tuony	NJ
" "	E Ocean City, MD	SW Canary Islands	25	2980 E	RR	LL	Mark Sampson	MD
" "	SE Cape May, NJ	SE Montauk Pt., NY	16	200 NE	RR	RR	Bill Weisberg	NJ
" "	SW Montauk Pt., NY	SE Montauk Pt., NY	24	28 E	RR	RR	Frank Braddick	NY
" "	SE Montauk Pt., NY	NR	18	NR NR	RR	LL	Frank Braddick	NY
" "	SE Barnegat Inlet, NJ	SE Pt. Judith, RI	1	119 NE	RR	RR	Stash Lisowski	NJ
" "	S Pt. Judith, RI	N Cumana, Venezuela	18	1810 S	RR	LL	Charlie Donilon	RI
" "	SE Montauk Pt., NY	NE Paramaribo, Suriname	12	2020 SE	RR	LL	Joe McBride	NY
" "	SE Atlantic City, NJ	SW Faial, Azores	16	1954 E	RR	LL	Ray Bergman, Sr.	MD
" "	SE Flemish Cap	S Cape Race, NF, Canada	12	538 W	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	E Barnegat Inlet, NJ	S Pt. Judith, RI	11	105 NE	LL	RR	E. Nathanson, NMFS Obs.	MA
" "	SW Montauk Pt., NY	S Flemish Cap	21	1297 E	RR	LL	Steve DeMarco	CT
" "	SSE Jones Inlet, NY	W Faial, Azores	11	1556 E	RR	LL	Jim Krug	NY
Blue shark	S Shinnecock Inlet, NY	SE Pt. Judith, RI	<1	82 NE	RR	RR	Robert Tyree	NY
" "	SE Jones Inlet, NY	SW Faial, Azores	25	1713 E	RR	LL	Erik Hasenstab	NY
" "	E Block Isl., RI	SE Montauk Pt., NY	1	18 S	RR	RR	Jack Shupp	CT
" "	SE Fire Isl. Inlet, NY	SW Moriches Inlet, NY	<1	18 NW	RR	RR	Scott Shapiro	NY
" "	S Pt. Judith, RI	S Cape Race, NF, Canada	23	971 E	RR	LL	Al Anderson	RI
" "	S Montauk Pt., NY	S Flemish Cap	20	1228 E	RR	LL	Fred Wedley	NY
" "	SW Pt. Judith, RI	SE Cape May, NJ	10	186 SW	RR	RR	Jon Dodd	RI
" "	SE Montauk Pt., NY	SW Sao Miguel Isl., Azores	19	1604 E	RR	LL	Bill Ricca	NY
" "	SE Block Isl., RI	NR	28	NR NR	RR	LL	Ernest Dunphy	RI
" "	SE Pt. Judith, RI	SW La Palma Isl., Spain	30	2593 E	RR	LL	Ernest Dunphy	RI
" "	S Pt. Judith, RI	SE Flemish Cap	23	1526 E	FS	LL	Charlie Donilon	RI
" "	SSE Pt. Judith, RI	N Cumana, Venezuela	8	1765 S	FS	LL	Charlie Donilon	RI
" "	S Pt. Judith, RI	S Cape Race, NF, Canada	23	970 E	RR	LL	Andy Dangelo	RI
" "	SSE Pt. Judith, RI	SE Montauk Pt., NY	24	21 S	FS	RR	Charlie Donilon	RI
" "	E Manasquan Inlet, NJ	S Jones Inlet, NY	12	11 N	RR	RR	Tom Palchanes	NJ
" "	SE Montauk Pt., NY	S Pt. Judith, RI	<1	13 NE	RR	RR	Bob Mistina	NJ
" "	E Cape Elizabeth, ME	W Cape Verde Isl.	NR	2764 SE	RR	LL	Ben Garfield	ME
" "	SE Montauk Pt., RI	NR	25	NR NR	RR	RR	Lee Pepin	CT
" "	SE Pt. Judith, RI	E Flemish Cap	23	1391 E	RR	LL	Al Anderson	RI
" "	SE Montauk Pt., NY	E Monhegan, ME	14	211 NE	RR	RR	George Hettesheimer	NY
Blue shark	SE Montauk Pt., NY	SW Cape Verde Isl.	16	2752 SE	RR	LL	George Hettesheimer	NY
" "	S Fire Isl. Inlet, NY	S Fire Isl. Inlet, NY	<1	10 NW	RR	RR	Carl Stetz	NY
" "	S Montauk Pt., NY	S Cape Sable, NS, Canada	<1	270 E	RR	LL	Stret Whitting	NY
" "	SE Pt. Judith, RI	SE Barnegat Inlet, NY	24	143 SW	RR	RR	Ryan Hogan	RI
" "	NR	S Montauk Pt., NY	NR	NR NR	RR	RR	Richard Esposito	NY
" "	SE Pt. Judith, RI	SE Montauk Pt., NY	24	18 SW	RR	RR	Al Anderson	RI
" "	S Shinnecock Inlet, NY	SE Jones Beach, NY	<1	40 SW	RR	RR	Robert McReynolds	NY
" "	S Pt. Judith, RI	SE Montauk Pt., NY	23	10 SW	RR	RR	Robert Reichenberger	NY
" "	SW Shinnecock Inlet, NY	SE Montauk Pt., NY	11	334 SE	RR	LL	Tom Cashman	NY

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	TAGGED	RECAPTURED				TAG.	REC.	TAGGER	RESIDENCE
Blue shark	SE Montauk Pt., NY	S Flemish Cap	19	1312	E	RR	LL	Jim Bohara	CT
" "	S Pt. Judith, RI	S Montauk Pt., NY	25	8	W	RR	RR	Barry Bordner	MA
" "	SE Montauk Pt., NY	SE Cape Fear, NC	9	552	SW	RR	LL	Barry Bordner	MA
" "	SE Pt. Judith, RI	E Provincetown, MA	13	88	NE	RR	RR	Ed Abbenante	RI
" "	S Shinnecock Inlet, NY	SE Moriches Inlet, NY	15	68	E	RR	RR	Mike Poulin	NY
" "	S Martha's Vineyard, MA	S Fire Isl. Inlet, NY	12	130	SW	RR	RR	Fred Mason	MA
" "	SSW Pt. Judith, RI	S Cape Race, NF, Canada	22	1109	E	FS	LL	Charlie Donilon	RI
" "	SE Cape Elizabeth, ME	S Flemish Cap	20	1239	E	RR	LL	Arnold Beleckis	ME
" "	S Pt. Judith, RI	S Flemish Cap	22	1204	W	RR	LL	Andy Dangelo	RI
" "	SE Saco River, ME	W Vigo, Spain	18	2285	E	RR	LL	Todd Stewart	ME
" "	SE Shinnecock Inlet, NY	SE Cape May, NJ	5	149	SW	RR	LL	Keith Micallef	NY
" "	SE Montauk Pt., NY	SE Montauk Pt., NY	24	14	W	RR	RR	Mike Brumm	NY
" "	S Martha's Vineyard, MA	S Cape Race, NF, Canada	22	953	E	FS	LL	Laird Summerlin	MA
" "	S Martha's Vineyard, MA	S Flemish Cap	21	1112	E	RR	LL	Laird Summerlin	MA
" "	SE Pt. Judith, RI	S Montauk Pt., NY	<1	39	W	FS	RR	Sandy Ballou	RI
" "	SE Pt. Judith, RI	SE Pt. Judith, RI	23	10	NE	RR	RR	Jim Walsh	CT
" "	S Martha's Vineyard, MA	S Flemish Cap	20	1208	E	RR	LL	Robert Rowan	RI
" "	SE Jones Inlet, NY	SE Jones Inlet, NY	<1	6	SW	RR	RR	Charles Sporing	NY
" "	SE Montauk Pt., NY	E Sao Miguel Isl., Azores	NR	2349	E	RR	LL	Steve Szoke	NY
" "	NE Provincetown, MA	NE P. Cabello, Venezuela	12	1866	S	RR	LL	Clarence Olson	MA
Blue shark	SE Pt. Judith, RI	SE Montauk Pt., NY	11	23	SW	RR	RR	Don Mattera	RI
" "	E Cape Elizabeth, ME	E Guadeloupe	22	1667	S	RR	RR	Thomas McNeil	ME
" "	E Portland Headlights, ME	W Cape Verde Isl.	18	2712	SE	FS	LL	David Pecci	ME
" "	E Montauk Pt., NY	NE Flemish Cap	20	1596	NE	RR	LL	Bill Ricca	NY
" "	SW Nantucket Isl., MA	S Flemish Cap	19	1255	E	RR	LL	Deborah Valentine	MA
" "	SW Nantucket Isl., MA	S Flemish Cap	19	1192	E	RR	LL	Deborah Valentine	MA
" "	SE Martha's Vineyard, MA	SE Sable Isl., NS, Canada	21	913	E	RR	LL	Deborah Valentine	MA
" "	S Montauk Pt., NY	NW Cumana, Venezuela	10	1789	S	RR	LL	Mike Brumm	NY
" "	N Provincetown, MA	NR	NR	NR	NR	RR	LL	Eric Stewart	MA
" "	S Martha's Vineyard, MA	W Faial, Azores	19	1361	E	RR	LL	Chuck Walker	MA
" "	SE Block Island, RI	SE Martha's Vineyard, MA	24	36	NE	RR	RR	Laird Summerlin	MA
" "	S Pt. Judith, RI	S Montauk Pt., NY	21	22	SW	RR	RR	Andy Dangelo	RI
" "	S Pt. Judith, RI	NR	26	NR	NR	RR	LL	Andy Dangelo	RI
" "	S Pt. Judith, RI	S Cape Race, NF, Canada	20	1101	E	RR	LL	Andy Dangelo	RI
" "	SW Jones Inlet, NY	SW Moriches Inlet, NY	<1	40	E	RR	RR	Chris Bellinzoni	NY
" "	S Pt. Judith, RI	W Cape Verde Isl.	18	2453	SE	RR	LL	Ken Benson	RI
" "	SE Cape Elizabeth, ME	S Flemish Cap	21	1105	E	RR	LL	Ken Galanif, Jr.	ME
" "	SSW Pt. Judith, RI	S Moriches Inlet, NY	12	47	SW	FS	RR	Charlie Donilon	RI
" "	SSW Pt. Judith, RI	SE Montauk Pt., NY	13	23	E	FS	RR	Charlie Donilon	RI
" "	SSW Pt. Judith, RI	S Cape Race, NF, Canada	10	999	E	FS	LL	Charlie Donilon	RI
Blue shark	NE Provincetown, MA	S Flemish Cap	9	1105	E	RR	LL	John Pirie	MA
" "	N Provincetown, MA	S Cape Race, NF, Canada	10	969	E	RR	LL	Eric Stewart	MA
" "	Chatham, MA	W Faial, Azores	8	1439	E	RR	LL	Eric Stewart	MA
" "	SE Schoodic Pt., ME	ESE Montauk Pt., NY	11	238	SW	FS	RR	David Power	ME
" "	E Gloucester, MA	NR	NR	NR	NR	RR	LL	Richard Oliver	MA
" "	S Pt. Judith, RI	SW Cape Verde Isl.	13	2759	SE	RR	LL	Bob Veach	CT
" "	S Pt. Judith, RI	S Flemish Cap	7	1189	E	RR	LL	John Rainone	RI
" "	S Nantucket Isl., MA	S Flemish Cap	10	1091	E	HL	LL	Stephen Connett	RI
" "	SE Martha's Vineyard, MA	S Montauk Pt., NY	12	66	W	HL	RR	Stephen Connett	RI
" "	SE Martha's Vineyard, MA	S Cape Sable, NS, Canada	8	289	E	HL	LL	Stephen Connett	RI
" "	SE Martha's Vineyard, MA	SE Fire Isl. Inlet, NY	12	116	W	HL	RR	Stephen Connett	RI
" "	SW Nantucket Isl., MA	S Moriches Inlet, NY	11	114	W	HL	RR	Stephen Connett	RI
" "	SE Pt. Judith, RI	SE Montauk Pt., NY	23	37	W	HL	RR	Stephen Connett	RI
" "	S Martha's Vineyard, MA	S Flemish Cap	24	1265	E	HL	LL	Stephen Connett	RI
" "	S Martha's Vineyard, MA	SE Montauk Pt., NY	24	47	W	HL	RR	Stephen Connett	RI
" "	SW Nantucket Isl., MA	S Flemish Cap	21	1102	E	HL	LL	Stephen Connett	RI
" "	S Martha's Vineyard, MA	S Flemish Cap	22	1190	E	HL	LL	Stephen Connett	RI
" "	S Nantucket Isl., MA	SE Flemish Cap	24	1370	E	HL	LL	Stephen Connett	RI
" "	S Martha's Vineyard, MA	S Flemish Cap	9	1190	E	HL	LL	Stephen Connett	RI
" "	S Martha's Vineyard, MA	SW Faial, Azores	17	1451	E	HL	LL	Stephen Connett	RI
Blue shark	NE Provincetown, MA	W Faial, Azores	20	1540	E	LL	LL	Biologist (NMFS)	RI
" "	E Rockport, MA	SW Santa Maria Isl., Azores	18	1804	E	LL	LL	Biologist (NMFS)	RI
" "	E Provincetown, MA	S Brenton Pt., RI	22	140	W	LL	TR	Biologist (NMFS)	RI
" "	E Provincetown, MA	W Faial, Azores	18	1282	E	LL	LL	Biologist (NMFS)	RI
" "	E Provincetown, MA	S Flemish Cap	19	1074	E	LL	LL	Biologist (NMFS)	RI
" "	SE Cape Elizabeth, ME	SW Faial, Azores	14	1600	E	RR	LL	Ken Galanif	ME
" "	S Flemish Cap	SW Flemish Cap	19	246	SW	LL	LL	Barry Marx	FL
" "	S Pt. Judith, RI	SE Block Isl., RI	22	20	NE	RR	RR	Andy Dangelo	RI
" "	S Pt. Judith, RI	Shinnecock Inlet, NY	11	45	SW	RR	RR	Andy Dangelo	RI
" "	E Barnegat Inlet, NJ	SE Moriches Inlet, NY	<1	58	NE	RR	RR	Bud McArthur	NJ
" "	SE Fire Isl. Inlet, NY	S Shinnecock Inlet, NY	<1	28	NE	FS	RR	Bruce Dean	NY
" "	SE Moriches Inlet, NY	E Flemish Cap	10	1496	NE	RR	LL	Wain Carlough	NY
" "	SE Fire Isl. Inlet, NY	SE Barnegat Inlet, NJ	<1	68	S	RR	RR	Bill Mercado	NY
" "	S Pt. Judith, RI	S Flemish Cap	7	1338	E	RR	LL	Gary Thomspon	CT
" "	SE Montauk Pt., NY	S Cape Race, NF, Canada	18	1113	E	RR	LL	Gary Thompson	CT
" "	E Cape Elizabeth, ME	E Cape Elizabeth, ME	<1	14	NE	RR	RR	Russell Smith	ME
" "	SE Montauk Pt., NY	W Faial, Azores	NR	1566	E	RR	LL	John W. Salisbury	CT
" "	SW Montauk Pt., NY	W Cape Verde Isl.	15	2595	SE	RR	LL	Mike Flynn	NY
" "	E Portsmouth, NH	W Faial, Azores	7	1581	E	RR	LL	Steven Ladd	NH
" "	E Portsmouth, NH	S Flemish Cap	8	1230	E	RR	LL	Steven Ladd	NH
Blue shark	E Manasquan Inlet, NJ	SE Montauk Pt., NY	<1	24	NW	RR	RR	Peter Ernstberger	NJ
" "	Shinnecock Inlet, NY	S Flemish Cap	10	1277	E	RR	LL	Kenneth Schmieder	NY
" "	S Fire Isl. Inlet, NY	SE Montauk Pt., NY	12	79	NE	RR	RR	Pat Degennaro	NY
" "	NR	SE Pt. Judith, RI	NR	NR	NR	RR	RR	Alfred Barbery Jr.	RI
" "	S Martha's Vineyard, MA	S Flemish Cap	8	1230	E	RR	LL	William Dalton	MA
" "	SW Martha's Vineyard, MA	S Dakhla, Western Sahara	10	2938	E	RR	LL	Dave Preble	RI
" "	S Montauk Pt., NY	S Seguin Isl., ME	2	194	NE	RR	RR	Ken Kelmenson	NY
" "	SE Pt. Judith, RI	SE Montauk Pt., NY	12	10	SW	RR	RR	Rick Bellavance	RI
" "	SE Montauk Pt., NY	S Pt. Judith, RI	<1	9	E	RR	RR	Carl Safina	NY

Table 2. Tag recoveries: January-December 1998.

	GENERAL LOCATIONS		MONTHS AT LIBERTY	DIST. (MI.) AND DIR.		CAPTURE METHOD		TAGGED BY	
	TAGGED	RECAPTURED				TAG.	REC.	TAGGER	RESIDENCE
Blue shark	SW Montauk Pt., NY	S Jones Inlet, NY	12	65	SW	RR	RR	Bud Brandt	NY
" "	SW Montauk Pt., NY	SE Block Isl., RI	12	45	E	RR	RR	Bud Brandt	NY
" "	SE Montauk Pt., NY	S Fire Isl. Inlet, NY	11	81	W	RR	RR	Peter Jakits	NY
" "	SSE Kennebunkport, ME	S Flemish Cap	19	1261	E	RR	LL	Adam Littel	ME
" "	E Absecon Inlet, NJ	SE Montauk Pt., NY	12	126	NE	RR	RR	Joe Lucas	PA
" "	SE Pt. Judith, RI	S Flemish Cap	9	1345	E	RR	LL	James G. Walsh	CT
" "	Shinnecock Inlet, NY	SW Flemish Cap	12	1160	E	RR	LL	Fred Wedley	NY
" "	S Montauk Pt., NY	W Cape Verde Isl.	16	2655	E	RR	LL	Steven Costanzo	NY
" "	S Montauk Pt., NY	W Cape Verde Isl.	16	2506	SE	RR	LL	Ray Beck	NY
" "	S Montauk Pt., NY	S Shinnecock Inlet, NY	12	39	W	RR	RR	Al Kapuse	CT
" "	S Shinnecock Inlet, NY	SW Faial, Azores	10	1859	E	RR	LL	Ron Bertasi	CT
" "	SE Moriches Inlet, NY	NR	NR	NR	NR	RR	LL	Ron Bertasi	CT
" "	S Montauk Pt., NY	S Cape Sable, NS, Canada	15	272	E	RR	LL	Bill Ricca	NY
" "	S Montauk Pt., NY	SW Faial, Azores	8	1601	E	RR	LL	John Salisbury	CT
" "	S Montauk Pt., NY	S Flemish Cap	12	1223	E	RR	LL	Jack Salisbury	CT
" "	S Montauk Pt., NY	SE Jones Inlet, NY	12	50	W	RR	RR	John Salisbury	CT
" "	SE Moriches Inlet, NY	SE Flemish Cap	13	1318	E	RR	LL	Richard Haug	NY
" "	S Moriches Inlet, NY	E Block Isl., RI	10	83	NE	RR	RR	Ed Probst	NY
" "	S Fire Isl. Inlet, NY	NW Faial, Azores	14	1676	E	RR	LL	Anthony Testa	NY
" "	SE Jones Inlet, NY	E Saco Bay, ME	15	235	NE	RR	RR	Anthony Innamorato	NY
Blue shark	SE Fire Isl. Inlet, NY	SE Montauk Pt., NY	1	68	NE	RR	RR	Lawrence Festa	NY
" "	S Montauk Pt., NY	N Paramaribo, Suriname	8	2076	SE	RR	LL	Steve Roland	NY
" "	S Jones Inlet, NY	S Fire Isl. Inlet, NY	2	15	NE	RR	RR	James Sullivan	NY
" "	SE Pt. Judith, RI	S Cape Sable, NS, Canada	13	250	E	RR	LL	Al Anderson	RI
" "	SE Pt. Judith, RI	E Cape Elizabeth, ME	13	162	NE	RR	RR	Al Anderson	RI
" "	SE Pt. Judith, RI	E Barnegat Inlet, NJ	10	120	SW	RR	RR	Al Anderson	RI
" "	SE Moriches Inlet, NY	NR	NR	NR	NR	RR	RR	Ed Stypulkowski	NY
" "	S Martha's Vineyard, MA	W Faial, Azores	11	1443	E	RR	LL	Uldris Ozolins	MA
" "	S Shinnecock Inlet, NY	NR	NR	NR	NR	RR	TO	Dan Dantuono	NY
" "	S Pt. Judith, RI	SE Montauk Pt., NY	12	12	S	FS	RR	Charlie Donilon	RI
" "	S Pt. Judith, RI	SW Montauk Pt., NY	11	51	SW	FS	RR	Charlie Donilon	RI
" "	SE Montauk Pt., NY	S Flemish Cap	12	1277	E	RR	LL	Michael Terrier	CT
" "	SE Pt. Judith, RI	N P. Cabello, Venezuela	9	1808	S	RR	LL	John Rainone	RI
" "	E Barnegat Inlet, NJ	SE Block Isl., RI	2	110	NE	RR	RR	Tony Horling	NJ
" "	S Montauk Pt., NY	W Cape Verde Isl.	13	2620	SE	RR	LL	Gene Scheuring	NY
" "	S Moriches Inlet, NY	S Fire Isl. Inlet, NY	10	41	SW	RR	RR	Paul Lesiewicz	NY
" "	SE Montauk Pt., NY	SW Faial, Azores	9	1674	E	RR	LL	Tom Federico	NY
" "	S Fire Isl. Inlet, NY	SE Townsend's Inlet, NJ	<1	107	S	RR	RR	Andy Esposito	NY
" "	SW Shinnecock Inlet, NY	SE Montauk Pt., NY	11	284	SE	RR	LL	Eric Morrow	NY
" "	SE Fire Isl. Inlet, NY	SW Faial, Azores	8	1722	E	RR	LL	Steven Iannella	NY
Blue shark	NR	SE Jones Inlet, NY	NR	NR	NR	RR	RR	John Quigley	NY
" "	SE Montauk Pt., NY	SE Montauk Pt., NY	<1	8	SE	RR	RR	Mike Plaia	CT
" "	S Montauk Pt., NY	SW Flemish Cap	13	950	E	RR	LL	Alfred Dobras	CT
" "	S Montauk Pt., NY	W Faial, Azores	7	1428	E	RR	LL	Gary Savard	MA
" "	S Montauk Pt., NY	SE Moriches Inlet, NY	12	24	W	RR	RR	Jack Salisbury	CT
" "	S Montauk Pt., NY	S Montauk Pt., NY	<1	3	SE	RR	RR	Laird Summerlin	MA
" "	SW Montauk Pt., NY	S Flemish Cap	9	1198	E	RR	LL	Jim Kosinski	CT
" "	SW Montauk Pt., NY	SE Jones Inlet, NY	12	47	SW	RR	RR	Bud Brandt	NY
" "	S Martha's Vineyard, MA	S Shinnecock Inlet, NY	12	85	SW	RR	RR	Ernest Dunphy	RI
" "	SE Rye, NH	W Faial, Azores	8	1481	E	RR	LL	Arthur D'Auteuil	NH
" "	S Montauk Pt., NY	E Montauk Pt., NY	1	39	NE	RR	RR	Stephen Murphy	NY
" "	SE Pt. Judith, RI	S Montauk Pt., NY	11	39	SW	RR	RR	Ed Abbenante	RI
" "	SE Pt. Judith, RI	Mitchell's Bay, NS, Canada	13	419	NE	RR	LL	Ed Abbenante	RI
" "	E Manasquan Inlet, NJ	SSE Fire Isl. Inlet, NY	<1	29	NE	RR	RR	Jim Lynch	NJ
" "	SE Pt. Judith, RI	NR	13	NR	NR	RR	LL	Frank Toti	RI
" "	SE Pt. Judith, RI	S Montauk Pt., NY	12	40	SW	RR	RR	Vin Cleri	RI
" "	SE Montauk Pt., NY	E Ocean City, MD	11	207	SW	RR	RR	Al Mott	MA
" "	S Montauk Pt., NY	S Shinnecock Inlet, NY	11	32	W	RR	RR	Stephen Roland	NY
" "	E Montauk Pt., NY	E Cape May, NJ	9	170	SW	RR	RR	Bob Veach	CT
" "	S Montauk Pt., NY	S Cape Sable, NS, Canada	8	997	E	FS	LL	Robert Burgess	NY
Blue shark	SE Fire Isl. Inlet, NY	SE Jones Inlet, NY	1	30	W	RR	RR	George Maisch	NY
" "	S Pt. Judith, RI	S Montauk Pt., NY	11	37	SW	RR	RR	Jack Salisbury	CT
" "	SE Montauk Pt., NY	W Sao Miguel Isl., Azores	12	1936	E	RR	LL	Tom Federico	NY
" "	S Montauk Pt., NY	S Martha's Vineyard, MA	12	54	E	RR	RR	Tom Federico	NY
" "	NR	S Pt. Judith, RI	NR	NR	NR	RR	RR	Charlie Donilon	RI
" "	S Pt. Judith, RI	S Pt. Judith, RI	<1	9	NW	RR	RR	Rich Templeton	RI
" "	SE Pt. Judith, RI	SE Montauk Pt., NY	11	25	SW	RR	RR	Joe Pagano	RI
" "	E Ocean City, MD	SE Townsends Inlet, NJ	<1	29	N	RR	RR	Kurt Howell	MD
" "	SE Montauk Pt., NY	N La Isabela, Cuba	4	1154	SW	RR	LL	Mike Brumm	NY
" "	S Montauk Pt., NY	W Faial, Azores	8	1588	E	RR	LL	Mike Brumm	NY
" "	S Montauk Pt., NY	SE Montauk Pt., NY	10	12	NE	RR	RR	Mike Brumm	NY
" "	S Pt. Judith, RI	SW Montauk Pt., NY	<1	41	SW	RR	RR	Steve West	RI
" "	NR	SE Martha's Vineyard, MA	NR	NR	NR	RR	RR	Charles Bardelis, Jr.	MA
" "	S Martha's Vineyard, MA	SE Montauk Pt., NY	10	335	SE	RR	LL	Bill Tucker	MA
" "	SW Shinnecock Inlet, NY	SW Montauk Pt., NY	<1	20	E	RR	RR	Tom Cashman	NY
" "	S Moriches Inlet, NY	SE Jones Inlet, NY	<1	24	SW	RR	RR	Tom Cashman	NY
" "	SW Shinnecock Inlet, NY	SE Montauk Pt., NY	10	285	SE	RR	LL	Tom Cashman	NY
" "	SW Martha's Vineyard, MA	W Dakhla, Western Sahara	16	2692	E	RR	LL	Mike Goodwin	MA
" "	SW Shinnecock Inlet, NY	S Fire Isl. Inlet, NY	<1	20	SW	RR	RR	Brian Legerlotz	NY
" "	SE Shinnecock Inlet, NY	SE Fire Isl. Inlet, NY	<1	29	SW	RR	RR	Fred Wedley	NY
Blue shark	S Cape Elizabeth, ME	S Flemish Cap	7	1165	E	RR	LL	Wayne Picard	ME
" "	SE Pt. Judith, RI	W Faial, Azores	7	1447	E	RR	LL	Robert Hogan, Jr.	RI
" "	S Montauk Pt., NY	W Nouadhibou, Mauritania	9	2870	E	RR	LL	Gary Savard	MA
" "	SW Martha's Vineyard, MA	SE Nantucket Isl., MA	3	138	SE	RR	LL	Jim Walsh	CT
" "	S Fire Isl. Inlet, NY	S Pt. Judith, RI	3	96	NE	RR	RR	John McCauley	NY
" "	E Provincetown, MA	E Cape Sable, NS, Canada	5	638	E	LL	LL	Biologist (NMFS)	RI
" "	E Cape Elizabeth, ME	SW Sao Miguel Isl., Azores	12	1707	E	LL	LL	Biologist (NMFS)	RI
" "	SE Block Isl. RI	S Montauk Pt., NY	<1	26	W	RR	RR	Steve Roland	NY
" "	SE Montauk Pt., NY	SE Moriches Inlet, NY	<1	40	SW	RR	RR	Peter Jakits	NY

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	TAGGED	RECAPTURED			TAG.	REC.	TAGGER	RESIDENCE
Blue shark	SE Montauk Pt., NY	SE Fire Isl. Inlet, NY	1	72 SW	RR	RR	Peter Jakits	NY
" "	S Fire Isl. Inlet, NY	S Montauk Pt., NY	<1	80 NE	RR	RR	Larry Festa	NY
" "	E Montauk Pt., NY	S Shinnecock Inlet, NY	1	97 W	RR	RR	Jack Salisbury	CT
" "	NR	E Saco Bay, ME	NR	NR NR	RR	RR	Harry Adams	ME
" "	S Pt. Judith, RI	S Block Isl., RI	2	9 W	RR	RR	John Rainone	RI
" "	SE Montauk Pt., NY	SE Ocean City, MD	2	219 SW	RR	LL	Gary Thompson	CT
" "	SE Pt. Judith, RI	SW Martha's Vineyard, MA	<1	21 SE	RR	RR	Jim Walsh	CT
" "	SE Cape Elizabeth, ME	SW Faial, Azores	2	1699 E	LL	LL	Biologist (NMFS)	RI
" "	E Provincetown, MA	W Faial, Azores	7	1447 E	LL	LL	Biologist (NMFS)	RI
" "	E Provincetown, MA	S Flemish Cap	9	1073 E	LL	LL	Biologist (NMFS)	RI
" "	E Provincetown, MA	NW Cumana, Venezuela	9	1860 S	LL	LL	Biologist (NMFS)	RI
" "	E Provincetown, MA	S Cape Race, NF, Canada	7	942 E	LL	LL	Biologist (NMFS)	RI
" "	E Provincetown, MA	S Cape Race, NF, Canada	8	986 E	LL	LL	Biologist (NMFS)	RI
" "	E Gloucester, MA	S Flemish Cap	NR	1107 E	LL	LL	Biologist (NMFS)	RI
" "	E Provincetown, MA	S Flemish Cap	6	1120 E	LL	LL	Biologist (NMFS)	RI
" "	E Portland Headlights, ME	NR	9	NR NR	LL	LL	Biologist (NMFS)	RI
" "	E Cape Elizabeth, ME	S Cape Race, NF, Canada	7	1027 SE	LL	LL	Biologist (NMFS)	RI
" "	E Cape Elizabeth, ME	SSE Shinnecock Inlet, NY	9	223 SW	LL	RR	Biologist (NMFS)	RI
" "	SE Montauk Pt., NY	S Pt. Judith, RI	<1	3 SW	RR	RR	Robert Veach	CT
" "	S Moriches Inlet, NY	SE Block Isl., RI	<1	101 NE	RR	RR	Peter McClinchy	NY
Blue shark	SE Absecon Inlet, NJ	S Martha's Vineyard, MA	<1	175 NE	RR	RR	Keith Anderson	NJ
" "	NR	SE Montauk Pt., NY	NR	NR NR	RR	RR	Jerry Rubino	MA
" "	S Nantucket Isl., MA	S Flemish Cap	10	1311 E	FS	LL	Stephen Connett	RI
" "	SE Martha's Vineyard, MA	S Pt. Judith, RI	12	67 W	FS	RR	Stephen Connett	RI
" "	SE Martha's Vineyard, MA	S Cape Sable, NS, Canada	14	201 E	HL	LL	Stephen Connett	RI
" "	SE Pt. Judith, RI	SE Pt. Judith, RI	<1	2 NE	RR	RR	George Beauvais	CT
" "	SE Montauk Pt., NY	S Montauk Pt., NY	<1	19 SW	RR	RR	Bill Ricca	NY
" "	SE Montauk Pt., NY	SE Shinnecock Inlet, NY	3	41 SW	RR	RR	Bill Ricca	NY
" "	S Montauk Pt., NY	SE Moriches Inlet, NY	<1	22 W	RR	RR	Dan Desposito	NY
" "	S Montauk Pt., NY	S Pt. Judith, RI	<1	30 NE	RR	RR	Al Phillips	NY
" "	S Montauk Pt., NY	SE Montauk Pt., NY	<1	27 NE	RR	RR	Al Phillips	NY
" "	S Pt. Judith, RI	SE Montauk Pt., NY	1	8 E	RR	RR	Jon Dodd	RI
" "	SE Fire Isl. Inlet, NY	SE Montauk Pt., NY	<1	70 NE	RR	RR	John Tsesmelis	NY
" "	SE Fire Isl. Inlet, NY	SE Montauk Pt., NY	<1	77 E	RR	RR	Joseph Mifsud	NY
" "	SW Moriches Inlet, NY	S Fire Isl. Inlet, NY	<1	19 SW	RR	RR	Peter Scelfo	NY
" "	S Moriches Inlet, NY	S Shinnecock Inlet, NY	<1	18 SE	RR	RR	Richard Schlesinger	NY
" "	S Moriches Inlet, NY	SE Moriches Inlet, NY	3	16 N	RR	RR	Richard Schlesinger	NY
" "	SSE Jones Inlet, NY	SSE Fire Isl. Inlet, NY	2	18 N	RR	RR	James Bayrenther	NY
" "	S Montauk Pt., NY	SE Pt. Judith, RI	2	40 NE	RR	RR	Mike Brumm	NY
" "	SE Block Isl., RI	SW Nantucket Isl., MA	1	21 E	RR	RR	Floyd Genthner	MA
Blue shark	SSE Shinnecock Inlet, NY	SE Montauk Pt., NY	<1	37 E	RR	RR	Kim Zapien	NJ
" "	SE Shinnecock Inlet, NY	S Jones Inlet, NY	1	72 W	RR	RR	Bill Williams	NY
" "	S Fire Isl. Inlet, NY	SE Moriches Inlet, NY	1	39 NE	RR	RR	Francis Bingham	NY
" "	S Fire Isl. Inlet, NY	SE Pt. Judith, RI	2	101 NE	RR	RR	Francis Bingham	NY
" "	SE Fire Isl. Inlet, NY	E Barnegat Inlet, NJ	1	40 S	RR	RR	Robert Howard	NY
" "	S Montauk Pt., NY	SE Chincoteague Inlet, VA	<1	232 SW	RR	RR	Laird Summerlin	MA
" "	S Montauk Pt., NY	SW Martha's Vineyard, MA	<1	37 E	RR	RR	Bob Weaver	NY
" "	S Montauk Pt., NY	S Montauk Pt., NY	<1	2 E	RR	RR	Bob Weaver	NY
" "	SE Montauk Pt., NY	SE Montauk Pt., NY	<1	7 SW	RR	RR	Al Mott	NY
" "	SE Montauk Pt., NY	SE Montauk Pt., NY	<1	0	RR	RR	Mike Brumm	NY
" "	SE Pt. Judith, RI	SE Montauk Pt., NY	3	101 S	RR	LL	Ed Abbenante	RI
" "	SE Montauk Pt., NY	SE Pt. Judith, RI	1	27 E	RR	RR	James Little	CT
" "	SE Block Isl., RI	ESE Montauk Pt., NY	1	21 NW	RR	RR	Alfred Barbery	RI
" "	SE Montauk Pt., NY	SE Montauk Pt., NY	<1	15 SW	RR	RR	Richard Scolavino	RI
" "	S Pt. Judith, RI	SE Pt. Judith, RI	2	16 E	RR	RR	Rich Templeton	RI
" "	SE Montauk Pt., NY	S Montauk Pt., NY	<1	17 W	RR	RR	Otto Hasselman	NY
" "	SE Montauk Pt., NY	S Pt. Judith, RI	<1	5 NE	RR	RR	Al Mott	NY
" "	S Montauk Pt., NY	E Oregon Inlet, NC	2	329 SW	RR	LL	Al Mott	NY
" "	S Block Isl., RI	SE Montauk Pt., NY	<1	6 W	RR	RR	Al Mott	NY
" "	SE Montauk Pt., NY	NR	NR	NR NR	RR	FD	Al Mott	NY
Blue shark	NR	SE Montauk Pt., NY	NR	NR NR	RR	RR	Al Mott	NY
" "	SE Pt. Judith, RI	SW Nantucket Isl., MA	<1	35 E	RR	TN	Joe Pagano	RI
" "	NR	SW Montauk Pt., NY	NR	NR NR	RR	RR	Bob Weaver	NY
" "	SE Montauk Pt., NY	SSE Pt. Judith, RI	<1	14 E	RR	FS	Richard Scolavino	RI
" "	SE Block Isl., RI	SE Montauk Pt., NY	<1	8 S	RR	RR	Jim Walsh	CT
" "	E Cape Elizabeth, ME	SE Portland, ME	<1	22 SW	FS	RR	Dave Sinclair	ME
" "	SW Martha's Vineyard, MA	NR	<1	NR NR	RR	RR	Fred Mason	MA
" "	S Montauk Pt., NY	SE Montauk Pt., NY	15	36 E	RR	RR	Alfred Dobras	CT
" "	SSE Fire Isl. Inlet, NY	SSE Pt. Judith, RI	2	95 NE	RR	FS	Bob Winter	NY
" "	SSE Fire Isl. Inlet, NY	SE Jones Inlet, NY	<1	9 SW	RR	RR	Bob Winter	NY
" "	SE Moriches Inlet, NY	E Monhegan, ME	15	243 NE	RR	RR	Lou Pastore	NY
" "	E Cape Henry, VA	S Montauk Pt., NY	43	245 NE	LL	RR	B. Beliveau, NMFS Obs.	MA
" "	E Cape Henry, VA	S Cape Race, NF, Canada	43	1206 E	LL	LL	B. Beliveau, NMFS Obs.	MA
" "	S Flemish Cap	S Flemish Cap	45	232 S	LL	LL	NMFS Obs.	MA
" "	NR	S Flemish Cap	NR	NR NR	RR	LL	Peter Litvinoff	NY
" "	SE Montauk Pt., NY	SE Pt. Judith, RI	3	33 E	RR	TN	Frank Noto	CT
" "	SW Martha's Vineyard, MA	NE Georgetown, Guyana	33	2059 SE	RR	LL	Bill Tucker	MA
" "	SE Shinnecock Inlet, NY	NW Faial, Azores	27	1713	RR	LL	Spencer Fuchs	NY
" "	S Martha's Vineyard, MA	S Flemish Cap	45	1150 E	FS	LL	Gregg Skomal	MA
" "	NR	S Pt. Judith, RI	NR	NR NR	RR	RR	Tom O'Brien	NY
" "	SE Jones Inlet, NY	SE Pt. Judith, RI	2	106 NE	RR	RR	Ralph Drewes	NY
" "	S Montauk Pt., NY	NR	30	NR NR	RR	LL	Steve Szoke	NY
" "	NE Gloucester, MA	S Flemish Cap	57	1207 E	RR	LL	Dale Ormon	MA
" "	SE Pt. Judith, RI	SSE Montauk Pt., NY	22	41 W	RR	RR	Russell Blank	RI
" "	NE Provincetown, MA	S Flemish Cap	46	1088 E	HL	LL	Stephen Connett	RI
" "	S Martha's Vineyard, MA	SE Cape Race, NF, Canada	22	1077 E	HL	LL	Stephen Connett	RI
Sandbar Shark	SW Dennis Creek, NJ	NW Cape May Canal, NJ	<1	6 S	LL	RR	Biologist (NMFS)	RI
" "	Mispillian, DE	Slaughter Beach, Milford, DE	<1	1 SW	GN	RR	Biologist (NMFS)	RI
" "	Broadkill, DE	Avon Pier, Avon, NC	14	210 S	GN	RR	Biologist (NMFS)	RI

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	TAGGED	RECAPTURED			TAG.	REC.	TAGGER	RESIDENCE
Sandbar shark	Broadkill, DE	S Salvo, NC	8	203 S	GN	RR	Biologist (NMFS)	RI
" "	Broadkill, DE	Okatee River, SC	10	479 SW	LL	RR	Biologist (NMFS)	RI
" "	Primehook, DE	Broadkill, DE	11	1 E	GN	RR	Biologist (NMFS)	RI
" "	S. Primehook, DE	N Cape Henlopen, DE	24	6 E	GN	RR	Biologist (NMFS)	RI
" "	E Ocracoke, NC	E Cape Lookout, NC	27	35 S	GN	LL	Steve Branstetter	FL
" "	E Hatteras Inlet, NC	SE Cape Lookout Pt., NC	4	57 SW	GN	GN	Chris Jensen	RI
" "	W Cape Hatteras, NC	Chesapeake Bay, VA	21	112 N	GN	RR	Chris Jensen	RI
" "	Broadkill, DE	SE Wachapreague Inlet, VA	4	76 S	LL	GN	Biologist (NMFS)	RI
" "	Primehook, DE	NE Big Stone Bch., DE	<1	16 N	LL	RR	Biologist (NMFS)	RI
" "	Primehook, DE	E Rudee Inlet, VA	5	128 S	LL	GN	Biologist (NMFS)	RI
" "	Primehook, DE	Lewes, DE	<1	7 SE	LL	RR	Biologist (NMFS)	RI
" "	Primehook, DE	Broadkill, DE	1	1 NE	GN	RR	Biologist (NMFS)	RI
" "	Misspillion, DE	NE Fowler Bch., DE	<1	3 E	GN	RR	Biologist (NMFS)	RI
" "	Primehook, DE	Broadkill, DE	2	2 S	LL	RR	Biologist (NMFS)	RI
" "	Primehook, DE	Broadkill, DE	<1	2 SE	LL	RR	Biologist (NMFS)	RI
" "	Broadkill, DE	Roosevelt Inlet, DE	<1	3 NE	LL	RR	Biologist (NMFS)	RI
" "	Broadkill, DE	Broadkill, DE	<1	1 W	LL	RR	Biologist (NMFS)	RI
" "	Primehook, DE	ENE Mispillion Rvr. Inl., DE	<1	4 N	RR	RR	Biologist (NMFS)	RI
" "	Broadkill, DE	W Cape May Pt., NJ	<1	8 NE	LL	RR	Biologist (NMFS)	RI
" "	Broadkill, DE	Cape Point, NC	5	217 S	LL	RR	Biologist (NMFS)	RI
Sandbar shark	Broadkill, DE	Broadkill, DE	<1	0	LL	LL	Biologist (NMFS)	RI
" "	Broadkill, DE	NE Fowler Beach, DE	2	7 N	LL	RR	Biologist (NMFS)	RI
" "	Broadkill, DE	E Ocean City, MD	3	28 S	LL	TN	Biologist (NMFS)	RI
" "	Broadkill, DE	Primehook, DE	<1	3 NW	LL	RR	Biologist (NMFS)	RI
" "	Broadkill, DE	Broadkill, DE	<1	3 NW	GN	RR	Biologist (NMFS)	RI
" "	Broadkill, DE	NE Broadkill, DE	<1	3 N	GN	RR	Biologist (NMFS)	RI
" "	Broadkill, DE	Anchorage, DE	2	7 N	GN	RR	Biologist (NMFS)	RI
" "	Primehook, DE	Broadkill, DE	<1	6 SE	LL	RR	Biologist (NMFS)	RI
" "	Mispillion, DE	Broadkill, DE	11	7 SE	GN	RR	Biologist (NMFS)	RI
" "	Broadkill, DE	Lewes, DE	<1	4 NE	GN	RR	Biologist (NMFS)	RI
" "	Fishing Creek Shoal, DE	Villas, Cape May, NJ	<1	2 W	GN	RR	Biologist (NMFS)	RI
" "	Primehook, DE	E Mispillion, DE	<1	5 NW	GN	RR	Biologist (NMFS)	RI
" "	Primehook, DE	SE Wachapreague Inlet, VA	2	80 S	GN	GN	Biologist (NMFS)	RI
" "	Broadkill, DE	SW Hatteras Inlet, NC	2	223 S	LL	GN	Biologist (NMFS)	RI
" "	Broadkill, DE	Lewes, DE	<1	4 SE	GN	RR	Biologist (NMFS)	RI
" "	Broadkill, DE	Cape Henlopen, DE	<1	5 SE	GN	RR	Biologist (NMFS)	RI
" "	Big Stone, DE	E Hatteras Inlet, NC	1	226 SW	GN	GN	Biologist (NMFS)	RI
" "	E Barnegat Inlet, NJ	SW Cedar Key, FL	164	1437 SW	RR	LL	Angelo Polcari	NJ
" "	Chesapeake Bay, VA	E Cape Lookout, NC	67	146 S	LL	LL	Steve Branstetter	FL
" "	S Montauk Pt., NY	S Marathon, FL	162	1072 SW	RR	LL	Jack Blaisdell	GA
Sandbar shark	E Beach Haven, NJ	E Rudee Inlet, VA	106	174 S	RR	LL	Vic Berlotti	NJ
" "	SE Fire Isl. Inlet, NY	Cape Canaveral, FL	57	808 SW	RR	LL	Joseph Ferrari	NY
" "	E Avon, NC	W Mullet Key, FL	153	1131 SW	LL	LL	Biologist (NMFS)	RI
" "	SE Cape May, NJ	W Cedar Key, FL	121	1390 SW	RR	LL	Bob Vichko	NJ
" "	SE Montauk Pt., NY	E Ocracoke, NC	130	400 SW	RR	LL	Walter Kaprielian	NY
" "	S Pt. Judith, RI	NW Key West, FL	115	1201 SW	RR	LL	Fred Gallagher	RI
" "	E Cape Fear, NC	W Seminole Pt., FL	104	705 SW	LL	LL	Biologist (NMFS)	RI
" "	S Pt. Judith, RI	N Marquesas Keys, FL	NR	1198 SW	RR	LL	David Tyrell	RI
" "	S Martha's Vineyard, MA	W Ft. Myers, FL	68	1419 SW	RR	LL	Lee Pepin	CT
" "	Martha's Vineyard, MA	S Cosgrove Shoal, FL	89	1175 SW	RR	LL	Paul C. Brewer	MA
" "	SW Cape Hatteras, NC	E Hatteras Inlet, NC	13	7 W	GN	GN	Chris Jensen	RI
" "	E Cape Hatteras, NC	S Hatteras Inlet, NC	57	37 SW	LL	LL	Richard West	NC
" "	SE Stono Inlet, SC	S Wachapreague, VA	37	356 NE	RR	LL	Rick Stringer	SC
" "	SE Charleston, SC	SW Southport, NC	21	111 NE	LL	RR	Glenn Ulrich	SC
" "	S Moriches Inlet, NY	E Cape Hatteras, NC	28	322 SW	RR	RR	Scott Shapiro	NY
" "	E Lighthouse Inlet, SC	N Edisto River, SC	21	21 W	LL	LL	Glenn Ulrich	SC
" "	SW Cape Hatteras, NC	Chesapeake Bay, VA	18	129 N	GN	RR	Steve Branstetter	FL
" "	SE Fire Isl. Inlet, NY	NR	9	NR NR	RR	RR	James Bayrenther	NY
" "	S Moriches Inlet, NY	E Townsends Inlet, NJ	11	114 SW	RR	GN	Wain Carlough	NY
" "	SE Ocean City, MD	S Hatteras Inlet, NC	4	205 S	RR	LL	Mark Sampson	MD
Sandbar shark	SW Apalachicola, FL	Wreck Isl., Oyster, VA	9	674 NE	LL	GN	Biologist (NMFS)	RI
" "	SW Cape Lookout, NC	Salvo, NC	6	111 NE	LL	RR	Biologist (NMFS)	RI
" "	S Cape Lookout, NC	SW Chincoteague Inlet, VA	<1	239 N	LL	GN	Biologist (NMFS)	RI
" "	SE Cape Hatteras, NC	Margate, NJ	3	255 N	RR	RR	Biologist (NMFS)	RI
" "	SE Cape Hatteras, NC	E Great Egg Hbr. Inlet, NJ	NR	253 N	LL	GN	Biologist (NMFS)	RI
" "	NNE Cayo Fragoso, Cuba	N Caibarien, Cuba	<1	11 SW	LL	LL	Biologist (NMFS)	MS
Shortfin mako	SE Jones Inlet, NY	S Flemish Cap	44	1245 E	RR	LL	Hank Lunde	NY
" "	SE Cape Race, NF, Canada	E Flemish Cap	12	451 NE	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	SW Flemish Cap	SE Flemish Cap	12	368 E	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	S Montauk Pt., NY	SW Faial, Azores	67	1544 E	RR	LL	Peter Jakits	NY
" "	SE Cape May, NJ	W Faial, Azores	58	1641 E	RR	LL	Harry Nesbitt	PA
" "	S Fire Isl. Inlet, NY	E Montauk Pt., NY	<1	91 NE	RR	RR	Mike Earlie	NY
" "	SE Flemish Cap	S Flemish Cap	8	571 SW	LL	LL	P. O'Donnell, NMFS Obs.	MA
" "	SSE Saco River, ME	NW Maiquetia, Venezuela	22	1923 S	RR	LL	Jim Hinkley	ME
" "	SE Cape May, NJ	SE Absecon Inlet, NJ	<1	49 N	RR	RR	Jim Gatto	NJ
" "	E Wachapreague Inlet, VA	S Flemish Cap	34	1340 E	RR	LL	James Houser	MD
" "	SE Flemish Cap	W Pico Isl., Azores	31	574 S	LL	LL	Barry Marx	FL
" "	SSE Manasquan Inlet, NJ	E Virginia Beach, VA	17	198 S	RR	LL	John Williams	NJ
" "	S Jones Inlet, NY	S Fire Isl. Inlet, NY	10	29 NE	RR	RR	Brian Dempsey	NY
" "	SE Moriches Inlet, NY	E Flemish Cap	37	1409 NE	RR	LL	Glenn Edwards	NY
" "	SE Block Isl., RI	S Martha's Vineyard, MA	12	42 NE	RR	RR	Kelly Smith	CT
" "	SE Moriches Inlet, NY	SE Cape Hatteras, NC	29	356 S	RR	RR	Wain Carlough	NY
" "	SE Montauk Pt., NY	E Ocean City, MD	10	206 SW	RR	RR	Dennis O'Rourke	NY
" "	E Cabo Sta. Maria, Portugal	SE Cabo de Sta. Portugal	2	17 SW	RR	RR	Helder Ferreira	Azores
" "	E Olhao, Portugal	W Cadiz, Spain	<1	25 SE	RR	LL	Helder Ferreira	Azores
" "	SE Cape May, NJ	E Shark River Inlet, NJ	9	107 N	RR	RR	William Weisberg	NJ
Shortfin mako	SE Montauk Pt., NY	S Flemish Cap	7	1215 E	RR	LL	Frank Braddick	NY
" "	SE Montauk Pt., NY	SE Montauk Pt., NY	12	4 NW	RR	RR	Mike Brumm	NY
" "	SE Cape Race, NF, Canada	SE Block Isl., RI	13	998 W	LL	RR	Barry Marx	FL

Table 2. Tag recoveries: January-December 1998.

	GENERAL LOCATIONS		MONTHS AT LIBERTY	DIST. (MI.) AND DIR.		CAPTURE METHOD		TAGGED BY	
	TAGGED	RECAPTURED				TAG.	REC.	TAGGER	RESIDENCE
Shortfin mako	NR	SE Flemish Cap	NR	NR	NR	LL	LL	Barry Marx	FL
" "	SW Flemish Cap	SE Flemish Cap	12	327	E	LL	LL	Barry Marx	FL
" "	SE Jones Inlet, NY	SE Jones Inlet, NY	<1	4	SW	RR	RR	Barry Mack	NY
" "	SE Fire Isl. Inlet, NY	SE Ocean City, MD	13	156	SW	RR	RR	Chris Hoppner	NY
" "	S Shinnecock Inlet, NY	E Wachapreague Inlet, VA	10	214	SW	RR	RR	Mike Gilvary	NY
" "	SE Jones Inlet, NY	S Jones Inlet, NY	<1	11	W	RR	RR	Steven Stravitz	NY
" "	E Montauk Pt., NY	SE Shinnecock Inlet, NY	12	48	SW	RR	RR	Richard Aldinis	CT
" "	SE Montauk Pt., NY	S Flemish Cap	11	1122	E	RR	LL	Al Mott	NY
" "	NR	S Fire Isl. Inlet, NY	NR	NR	NR	RR	RR	Paul Sichler	NY
" "	E Gibraltar	S Cadiz, Spain	4	71	SW	RR	LL	Tony Triay	England
" "	SE Montauk Pt., NY	E Cape Sable, NS, Canada	12	394	NE	RR	LL	Stret Whitting	NY
" "	SE Ocean City, MD	S Fire Isl. Inlet, NY	2	151	NE	RR	RR	John Jacobs	MD
" "	SE Ocean City, MD	SE Indian River, DE	10	13	E	RR	RR	Mark Sampson	MD
" "	NR	S Flemish Cap	NR	NR	NR	LL	LL	Barry Marx	FL
" "	SE Ocean City, MD	SE Fire Isl. Inlet, NY	2	151	NE	RR	RR	Randy Rupli	MD
" "	SE Manasquan Inlet, NJ	SW Montauk Pt., NY	<1	88	NE	RR	RR	John Williams	NJ
" "	SE Ocean City, MD	SSE Jones Inlet, NY	2	157	NE	RR	RR	Mark Sampson	MD
Tiger shark	SE Charleston, SC	S Cape Fear, NC	18	112	NE	LL	RR	Steve Branstetter	FL
" "	SE Charleston, SC	N Caibarien, Cuba	21	571	S	LL	LL	Steve Branstetter	FL
" "	NE St. Augustine, FL	SE Montauk Pt., NY	72	805	NE	LL	LL	Tris Colket	FL
" "	S Dauphine Isl., AL	Yucatan, Mexico	6	504	S	RR	LL	Jerry W. Smith	AL
" "	E St. Augustine, FL	SE Montauk Pt., NY	63	807	NE	LL	LL	Tris Colket	FL
" "	SE Southport, NC	Cayo Romano, Cuba	34	664	S	LL	LL	Steve Branstetter	FL
" "	E Wilmington, NC	W Faial, Azores	39	1781	E	LL	LL	Steve Branstetter	FL
" "	SW Port Inglis, FL	E Mahaqual, Mexico	46	626	S	LL	HL	Steve Branstetter	FL
" "	SE Cape Fear, NC	S Flemish Cap	34	1478	E	LL	LL	Steve Branstetter	FL
" "	E Ponce Inlet, FL	SE Montauk Pt., NY	28	909	NE	LL	LL	Steve Branstetter	FL
" "	W Panama City Beach, FL	S Pascagoula, MS	5	109	W	LL	RR	Biologist (NMFS)	RI
" "	SW Cape Hatteras, NC	W El Aaiun, Spanish Sahara	18	3128	E	LL	LL	Steve Branstetter	FL
" "	S Bimini, Bahamas	Cayo Romano, Cuba	12	199	S	LL	LL	S. H. Gruber	FL
" "	E Southport, NC	E Southport, NC	12	12	SW	LL	LL	Steve Branstetter	FL
" "	E Cape Fear, NC	S Cape Fear, NC	<1	4	S	LL	LL	Biologist (NMFS)	RI
" "	E Savannah, GA	NW Cape Verde Isl.	9	3018	E	LL	LL	Biologist (NMFS)	RI
" "	ESE Bimini	SE Montauk Pt., NY	2	1002	NE	LL	LL	S. H. Gruber	FL
" "	E Brunswick, GA	NR	NR	NR	NR	LL	RR	Biologist (NMFS)	RI
" "	SE Cape Fear, NC	NR	2	NR	NR	LL	RR	Biologist (NMFS)	RI
" "	SE Cape Lookout, NC	SE Cape Lookout, NC	2	14	W	LL	LL	Biologist (NMFS)	RI
" "	SW Cedar Key, FL	E Punta Jerez, Mexico	16	822	W	LL	LL	Basil Arend	FL
Porbeagle shark	St. Catherines Deeps	Central English Channel	25	55	SE	RR	RR	Danny Vokins	Canada
" "	SE Halifax, NS, Canada	S Cape Sable, NS, Canada	52	186	SW	LL	LL	Andy Kingman	PA
" "	SW Grand Bank, NF, Canada	E Cape Sable, NS, Canada	41	324	SW	LL	LL	Albert Lawrence	Canada
" "	SW Grand Banks, NF, Canada	E Cape Breton Isl., Canada	44	33	W	LL	LL	Albert Lawrence	Canada
" "	SE Halifax, NS, Canada	S Cape Sable, NS, Canada	44	212	SW	LL	LL	Albert Lawrence	Canada
" "	S Sable Isl., NS, Canada	S Cape Sable, NS, Canada	59	270	W	LL	LL	Albert Lawrence	Canada
" "	SE Cape Sable, NS, Canada	Sable Island Bank, Canada	48	186	NE	LL	LL	Andy Kingman	PA
" "	SE Sydney, NS, Canada	SE Halifax, NS, Canada	9	204	W	LL	LL	Andy Kingman	PA
" "	E Provincetown, MA	SE Halifax, NS, Canada	6	280	E	LL	LL	Biologist (NMFS)	RI
" "	E Provincetown, MA	SW Cape Sable, NS, Canada	9	77	NE	LL	LL	Biologist (NMFS)	RI
Dusky shark	NR	NE Morehead City, NC	NR	NR	NR	RR	LL	John Henry David	FL
" "	SE Fire Isl. Inlet, NY	SE Pensacola Pass, FL	76	1625	SW	RR	RR	William Haya	NY
" "	NE Cape May, NJ	NE Oregon Inlet, NC	83	178	S	RR	LL	Robert Jack	NJ
" "	SE Jones Inlet, NY	E Marineland, FL	42	735	SW	RR	LL	Hank Lunde	NY
" "	NE Ocean City, MD	NR	NR	NR	NR	RR	LL	Timothy Howell	MD
" "	SE Ocean City, MD	E Ponce Inlet, FL	5	618	SW	RR	LL	Mark Sampson	MD
" "	Navarre Pier, FL	Navarre Beach, FL	<1	0		RR	FD	Earnest D. Polk III	FL
" "	SW Cape Fear, NC	SE Ocean City, MD	4	312	NE	LL	RR	Biologist (NMFS)	RI
Blacktip shark	Bob Hall Pier, TX	S Padre Isl., TX	<1	3	S	RR	RR	Chris Ruiz	TX
" "	Yanketown, FL	Crystal River, FL	32	6	E	RR	RR	Brian Gruber	FL
" "	Pine Isl. Sound, FL	Pine Isl. Sound, FL	3	0		RR	RR	Don Case	FL
" "	Alex's Beach, Stuart, FL	Jensen Beach, FL	8	1	N	RR	RR	Donald Perlmutter	FL
" "	Padre Isl, TX	Punta de Piedra, Mexico	2	394	S	RR	LL	R. David Williams	TX
" "	Padre Isl. TX	Galveston, TX	7	140	NE	RR	RR	Shawn Jones	TX
Atl. sharpnose	NW Oregon Inlet, NC	SW Cape Lookout, NC	4	93	SW	LL	RR	Chris Jensen	RI
" "	E St. Augustine, FL	E Jacksonville Bch., FL	21	29	N	LL	RR	Biologist (NMFS)	RI
Bonnethead shark	Crooked River, GA	Crooked River State Park, GA	<1	0		TN	RR	Matt Gilligan	GA
" "	Gullivan Bay, FL	Barfield Bay, FL	<1	4	NW	GN	RR	Erich Ritter	FL
Carribean reef shark	Cat Isl., Bermuda	Cat Island, Bermuda	110	2	N	LL	HL	Stephen Connett	RI
" "	Walkers Cay, Bahamas	Walkers Cay, Bahamas	28	0		FS	FS	Gary Adkison	FL
Finetooth shark	Bulls Bay, SC	Bull Isl., SC	<1	5	SW	GN	RR	Glenn Ulrich	SC
" "	Bulls Bay, SC	Murphy Isl., SC	<1	12	NE	GN	RR	Glenn Ulrich	SC
Silky shark	E Cape May, NJ	SSW Morehead City, NC	7	547	SW	LL	LL	G. Hinteregger, NMFS Obs.	RI
" "	NE Brownsville, TX	E Playa Bagdad, Mexico	22	40	SW	LL	RR	Biologist (NMFS)	RI
Spinner shark	NW Cape Fear, NC	NW Cape Fear, NC	1	2	W	GN	TN	Chris Jensen	RI
" "	E Shallotte Inlet, NC	E Shallotte Inlet, NC	<1	0		LL	LL	Teresa Thorpe	NC
Bigeye thresher	SW Cape Verde Isl.	N P. Cabello, Venezuela	114	2067	W	LL	LL	MIR Biologist	Poland
Blacknose shark	E Ponte Verda, FL	E St. Lucie Inlet, FL	114	196	S	RR	RR	Chuck Scholl	FL
Galapagos shark	E Bermuda	N Cojmar, Cuba	74	1087	SW	LL	LL	Stephen Connett	RI
Lemon shark	E Pt. N Bimini, Bahamas	Bimini Lagoon, Bahamas	24	4	NW	LL	HN	S. H. Gruber	FL
Longfin mako	NE Sinnamary, Fr. Guiana	NW Cumana, Venezuela	19	913	W	LL	LL	Barry Marx	FL
Nurse shark	Big Pine Key, FL	Big Pine Key, FL	4	4	W	HN	RR	Biologist (NMFS)	RI
Sand tiger shark	S Ocracoke, NC	Delaware Bay	15	261	N	LL	LL	Steve Branstetter	FL
Scalloped hammerhe	St. Simons Isl., GA	E Jekyll Isl., GA	<1	5	SE	RR	TN	Jonathan Currier	GA
Smooth hammerhead	SE Ocean City, MD	S Ocean City, MD	12	3	W	RR	RR	Mark Sampson	MD
Brown/Dusky shark	E Manasquan Inlet, NJ	E Jacksonville Bch., FL	90	671	SW	RR	RR	Art Schuessler	PA
" "	SE Moriches Inlet, NY	N Dry Tortugas, FL	83	1188	SW	RR	LL	Tom Boniberger	NY
" "	E Townsends Inlet, NJ	SE Wassaw Sound, GA	NR	534	SW	RR	RR	Pete Roscoe	PA
" "	SE Ocean City, MD	SE Little Egg Inlet, NJ	3	83	N	RR	LL	Mark Sampson	MD
Shark	NR	SE Little River, SC	NR	NR	NR	LL	LL	Eric Burcaw	NJ
" "	NR	S Flemish Cap	NR	NR	NR	RR	LL	Laird Summerlin	MA

Table 2. Tag recoveries: January-December 1998.

	GENERAL LOCATIONS		MONTHS AT LIBERTY	DIST. (MI.) AND DIR.		CAPTURE METHOD		TAGGED BY	
	TAGGED	RECAPTURED				TAG.	REC.	TAGGER	RESIDENCE
Shark	NR	S Flemish Cap	NR	NR	NR	NR	LL	Richard Brochu	RI
" "	E Flemish Cap	SE Flemish Cap	9	103	SE	LL	LL	Barry Marx	FL
Swordfish	E Rocha, Uruguay	N Florianopolis, Brazil	24	434	SE	LL	LL	Butch Winter	NJ
" "	SE Flemish Cap	SW Faial, Azores	7	650	S	LL	LL	Barry Marx	FL
Blackfin tuna	E Ocean City, MD	SW Cape Lookout, NC	55	257	SW	RR	RR	Richard Brown	PA
Bluefin tuna	NE Gloucester, MA	S Tenerife Isl., Canary Isl.	43	2687	E	RR	LL	Putnam Maclean	MA
White marlin	E Cape Canaveral, FL	NE Oregon Inlet, NC	14	498	N	LL	RR	Randall Smalling	FL

NOTE: FS=Free Swimming; GN=Gillnet; HL=Handline; LL=Longline; RR=Rod&Reel; TN=Trawl Net; TR=Trap; FD=Found Dead; HN=Hand landing net; DN=Drift Net; TO=Tag Only Found;Obs=Foreign Fisheries Observer; NR=Not Reported

Putting the Bite on Jaws: Copepods as Enemies of Sharks

by: George W. Benz and Susan M. Dippenaar

George Benz is Director of the Southeast Aquatic Research Institute and is employed by the Tennessee Aquarium. George has studied parasites of sharks for over 20 years and has often collaborated with biologists at the NMFS Narragansett Laboratory. Susan Dippenaar also studies parasites of sharks, and is a Lecturer and Ph.D. student at the University of the North in South Africa. George and Susan have provided the following overview of the general biology of copepods, the common parasites of sharks.

Most sharks are apex predators in marine ecosystems. However, this top-dog designation does not stop many hundreds of smaller organisms from relentlessly pursuing them as their home and source of food. Known as *parasites,* the number of these species probably far exceeds the number of sharks themselves – and this shouldn't surprise us when we consider the unsettling thought that there are probably far more parasite species on Earth than non-parasite species.

Derived from a Greek word meaning *one who eats at another's table* or *one who lives at another's expense,* a parasite is usually a smaller organism that harms a larger organism known as a *host.* Individual parasites usually do not kill their hosts, rather they live in close association with them and feed on or rob nutrients from them. In this way they impose an energy tax on the host that affects its ability to survive. Good parasites do not typically overtax their hosts. And, by not doing so, they ensure their own continued survival.

Many types of parasites pester sharks, including various viruses, bacteria, protozoans, worms, crustaceans, and even fishes. Among the crab-like critters, a.k.a. the crustaceans, a group known as the *copepods* has been exceptionally successful.

Copepods account for about 32% of all crustaceans (some 10,000 of 31,000 described species). While most of them (about 75%) are free-living, approximately 15% (1,500 known species) are parasites of fishes. A group of copepods called the siphonostomes has been most successful at parasitizing fishes, including sharks. These copepods possess a relatively long mouth tube that typically contains two sinister-looking saw-toothed mandibles that are used while feeding.

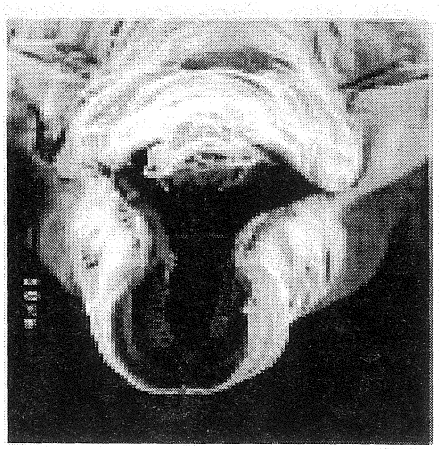
Virtually all sharks common to the western North Atlantic are tormented by copepods. The blue shark possibly holds the record for hosting the greatest variety and total number of copepods. In fact, close examination of a single blue shark from this region will probably reveal it to be infected by at least five species of copepods – including the Darth Vader look-a-like *Pandarus satyrus* that attaches in dense clusters on the pectoral fins, the nose inhabiting *Kroeyerina elongata*, the gill inhabiting species *Kroyeria carchariaeglauci* and *Phyllothyreus cornutus*, and the body pestering *Echthrogaleus coleoptratus.* All totaled, these copepods may number 3,000 or more per blue shark, with several hundred living on the fins and body, several hundred living in the nose, and several thousand more living on the gills.

Although the tax imposed on a shark by any individual copepod may be negligible, the overall burden inflicted by all of its parasites may be very significant. For example, research has shown that *Nemesis lamna*, a copepod that commonly infects the gills of the shortfin mako, causes modifications to the gill filaments that disrupt water flow. This suggests that if a mako became infected by a large number of these gill-clogging copepods, its ability to oxygenate its blood would be severely impaired and its ability to grow or even survive would be greatly compromised.

Sometimes, single copepods can radically affect the sharks they infect. For example, studies have shown that the eyes of virtually all Greenland sharks are infected by the large copepod *Ommatokoita elongata.* Typically, a single adult female infects the cornea of each eye. As she matures, the copepod embeds an anchoring device into the cornea and permanently tethers herself to it. There she remains throughout her life, feeding on and rubbing against the eye. Ultimately she causes such damage that the shark becomes partially blind – its eyes functioning more like photographic light meters than image-forming cameras.

How do these partially blind sharks survive? It has been reported that some Norwegian fishermen thought that the large, brightly colored copepods attached to the eyes of Greenland sharks might actually serve as lures that attract curious prey to this

Continued Pg. 18

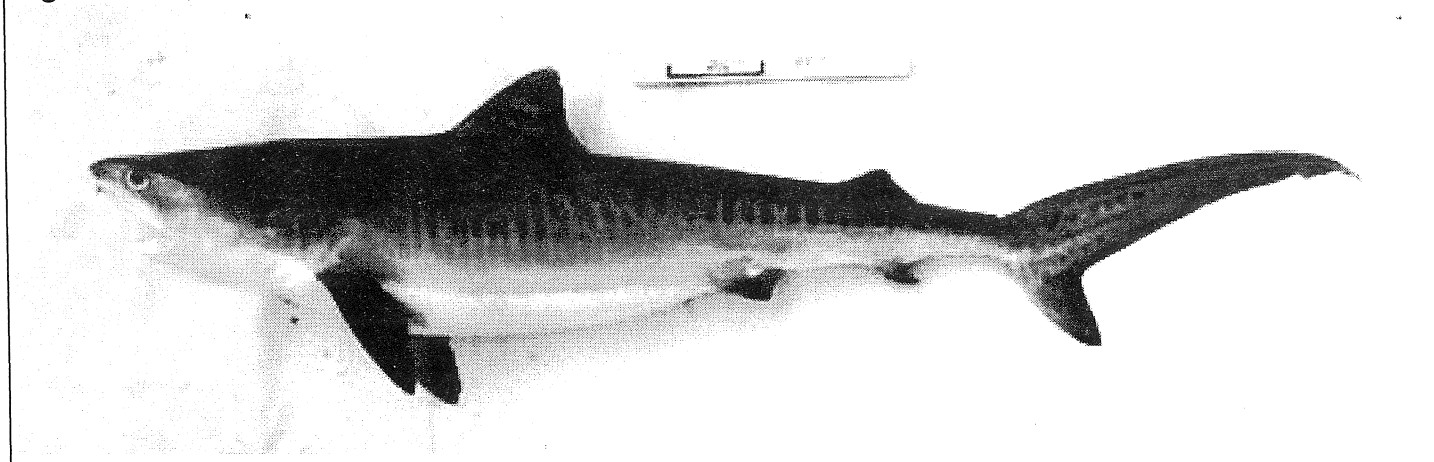


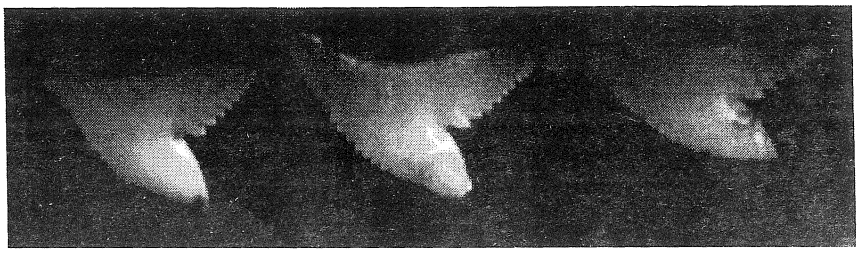
Open mouth tube of the parasitic copepod *Alebion lobatus*, a parasite of the smooth dogfish.

Feature Shark – Tiger (*Galeocerdo cuvier*)

The tiger shark is the easiest of the large coastal sharks to identify. The large head, with its short, blunt snout and wide mouth, makes this species stand out from most other requiem sharks. The curved teeth which are heavily serrated on both sides and have a distinct notch on their outer edge are one of their most diagnostic features. Small tigers are easily distinguished by their coloration, which varies from bluish to greenish gray to black above and from light gray to dirty yellow or white below. Sharks up to 4-5' FL also have a mottled appearance with their dorsal surface covered with dark spots. As tiger sharks grow, the spots fuse together to create vertical bars, hence their tiger-like appearance. In large tiger sharks, the bars tend to fade, but are usually visible upon close inspection. Approximately 2' FL at birth, tiger sharks are believed to reach a length exceeding 15' FL. In the western north Atlantic, the largest individual we have measured was 11' FL.

Tiger Shark, *Galeocerdo cuvier*





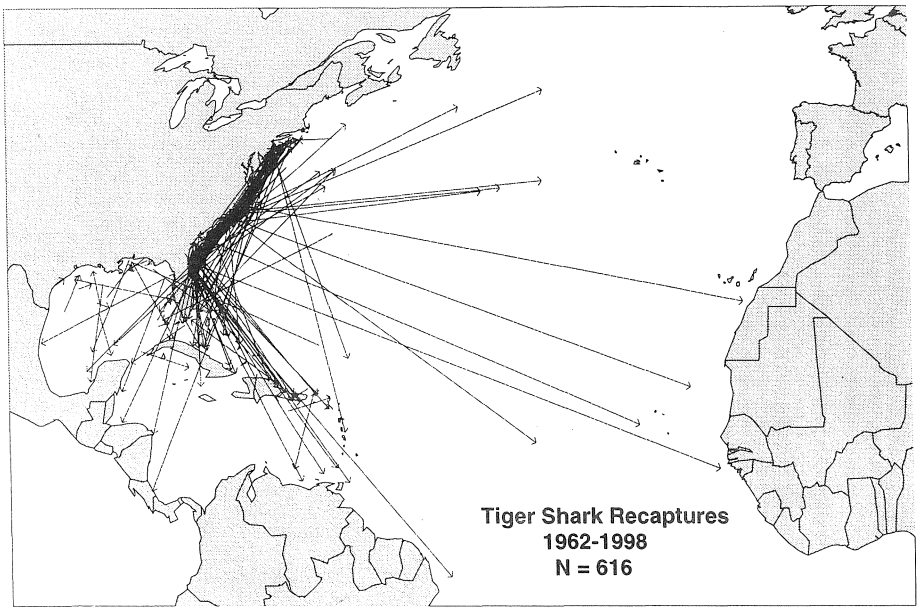
- **Maximum size (in North Atlantic): 15 feet FL**
- **Range (in North Atlantic): Brazil North to Nova Scotia**
- **Distinguishing Characteristics**
  Coloration-vertical bars
  Teeth-heavily serrated with strong lateral cusps

Distribution and Migration

Adult tiger sharks occur worldwide in temperate and tropical coastal waters. In the North Atlantic, they reside year round off the coast of Florida and seasonally migrate as far as Nova Scotia, Canada. Additionally, tiger sharks are known to make extensive movements throughout the North Atlantic, on occasion traveling to South America or Africa (see map). While considered to primarily inhabit coastal environments, it is clear from our recapture data that tiger sharks spend considerable time in the pelagic environment during part of their lives. Small tiger sharks appear to inhabit a different area than larger individuals, probably to avoid predation. Tagging and fishery data indicate that there is a nursery ground for tiger sharks on the continental shelf off the southeast coast of the U.S. This area extends from about Augusta, GA to Daytona, FL from shore, seaward to depths of 55 fathoms (fm). A similar area exists off the coast of North Carolina. In these nursery areas, tiger sharks ranging in size from birth to 4' FL are commonly caught. Larger individuals leave to occupy different habitats.

Food and Feeding Habits

More has been written over the years about the food and feeding habits of the tiger shark than most other shark species, perhaps because their stomachs have reportedly contained an assortment of bizarre items. A partial list from popular and scientific accounts includes: a rubber tire, roll of tar paper, roll of chicken wire, bag of potatoes, sack of coal, rags, bottles, shoes, dogs, ladies pajamas, a can of Spam, and parts of sheep, cattle and horses. The latter three items occurred in areas where offal from slaughterhouses was once dumped into the coastal rivers or at sea. The head and forequarters of a crocodile were found in a 14' total length tiger shark captured off Durban, South Africa. Parts of dolphins, porpoises, and whales have been found by several investigators. The list goes on and is proof that the tiger shark is sometimes a scavenger. Despite this reputation, our studies show that their usual prey is more mundane, being comprised of various fishes, cephalopods (squid and octopus), crustaceans (crabs, lobsters, and shrimp), and sea turtles. The frequency with which certain items occur depends on how



abundant they are and how much effort must be exerted to capture them. The tiger shark is most often associated with shallow depths (shore to 50 fm) around land masses and is usually considered a sluggish shark. Hence, its diet consists primarily of species found on the bottom, around reefs and outcroppings, or in the water column a fathom or so off the bottom.

Our studies of 51 tiger shark stomachs collected between Cape Hatteras and Georges Bank show that goosefish, searobins, sea ravens, lizard fish, and flounders occurred with the greatest regularity. Goosefish was the predominant species and occurred most often in stomachs examined at tournaments held along the New York and New Jersey coasts. The occurrence of these bottom dwelling species shows that the tiger shark regularly feeds on the bottom in this area. We also found remains of bluefish, mackerel and butterfish, but with less frequency, so it is evident that the tiger shark will feed on schooling prey when conditions are right. Sharks, skates and rays occurred in 23% of the stomachs we examined over the geographical range of our study, indicating that elasmobranchs are common prey.

Muscle and blubber from marine mammals were found in 24% of the stomachs we examined. Several species of sharks have been found with mammal remains in their stomachs, but the tiger shark with its cavernous mouth and large stomach capacity is particularly well adapted for devouring large prey. Because there is no evidence in the literature that tiger sharks successfully prey on healthy dolphins, porpoises, and whales, it is possible that these food items came from dead or moribund animals. Their large, blade-like teeth enable them to easily bite through bone and shells of large sea turtles. Although our data suggest that predation on sea turtles is relatively low north of Cape Hatteras, NC other studies have shown that in areas of higher turtle abundance (tropics and subtropics), turtle remains occur in tiger shark stomachs with much greater frequency (10-36%). The primary evidence of attacks on turtles is from the remains of shells and flippers found in shark stomachs. Some maimed turtles heal and survive, but an unknown percentage must surely die. Trash items we found in stomachs included small stones, sand, plastic bags, and assorted garbage such as pork chops, hot dogs, hamburgers, and beef bones. The small stones and sand were likely ingested along with bottom-dwelling prey. Overall, 46 stomachs (81%) contained some kind of food item.

Researchers in Hawaii have shown that there is a dietary shift throughout the lifetime of the tiger shark. Small sharks are nocturnal, bottom feeders with five major prey types: bony fish, birds, cephalopods, land mammals and crustaceans. Medium and large tiger sharks consume eight major prey types, the five listed above plus elasmobranchs, sea turtles and marine mammals. A dietary shift with increasing size is not uncommon in sharks and may be coupled with larger sharks being able to consume larger prey, an increase in hunting efficiency, or a change in geographic region inhabited.

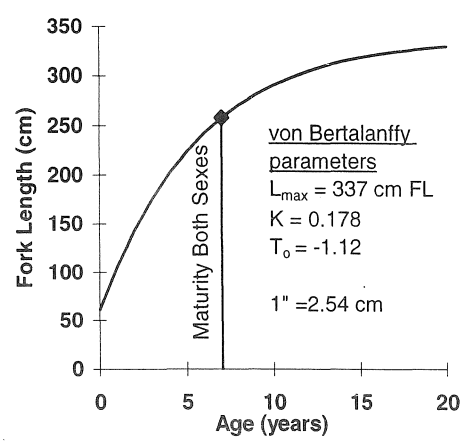
Age and Growth

Tiger sharks have been aged using two methods: bands on vertebral centra and tag/recapture data. Overall, the tiger shark is similar to other large carcharhinids in that it grows slowly and is relatively long-lived. Tag data indicate that tigers grow fast in their first few years, increasing by 74% from their size at birth during their first year of life (see figure). Since tiger sharks are rather awkward at birth, having a very large head and slender eel-shaped body, it is to their advantage to grow quickly through this stage to enhance their swimming capabilities for survival as both predator and potential prey.

The longevity of the tiger shark is difficult to estimate. The CSTP has received data on five tiger sharks at liberty between 6 and 11 years. The oldest of these fish would have been 3+ years at tagging and, therefore, 14+ years at recapture. Other authors have estimated maximum age at anywhere from 20 to 37 years.

Reproduction

The tiger shark is the only member of the family Carcharhinidae that is ovoviviparous. This means that the embryos develop inside the uterus but receive no placenta-like nutrition from the mother. It is also unusual for the relatively large number of young it produces, commonly from 35 to 55 with reports of as many as 82. Pups are born in the late spring and early summer. Gestation period is thought to be slightly over one year. In the Northwest Atlantic, both male and female tiger sharks mature at about 8.5' FL which corresponds to approximately 7 years of age. This suggests that females mature at 20 - 25% of their maximum age and may reproduce 10 times or more based on a two year reproductive cycle.



FIELD STUDIES

The 1998 field season was very successful, starting out strongly in early spring with our biannual research survey and continuing straight through October to end with a porbeagle tagging trip. During the season, we were able to continue and expand our research of coastal nursery areas and attend many of the summer's shark fishing tournaments.

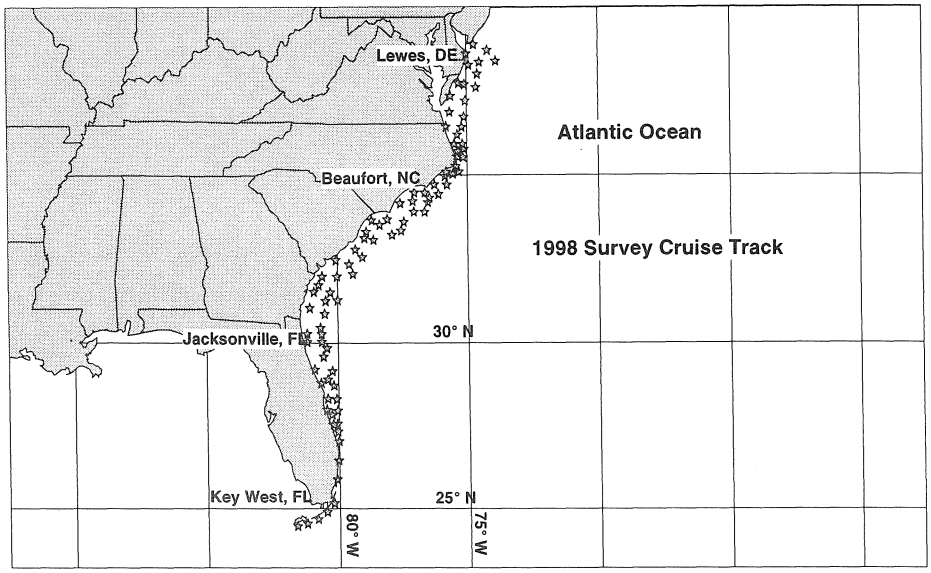
Research Cruises

Spring Shark Survey – NOAA Ship *Delaware II*

Members of the Apex Predators Program conducted three spring longline surveys on board the NOAA Ship *Delaware II* and R/V *Pelican* (1996) along the Atlantic coast during 1989, 1991, and 1996. The 1989 survey was conducted between Tampa Bay, FL and southern New England (Cruise DE II 89-03). The 1991 survey (Cruise DE II 91-06) was conducted between Miami, FL and southern New England using the same fishing methods. The third survey, conducted in 1996 (Cruise Pelican 96-01), repeated stations from the first two surveys in the region from Key West, FL to Delaware Bay, DE, between 5 and 40 fm. The cruises were essentially the same with respect to biological studies of sharks. However, the gear and soak times were altered in 1996 to more accurately represent that of the commercial large coastal shark fishery. The 1998 survey was basically a repetition of the 1996 survey

The objectives of the 1998 survey, like 1996, were to: 1) investigate the distribution, abundance and species composition of sharks; 2) collect baseline catch per effort data; 3) tag sharks for movement and distribution studies; 4) inject tagged sharks with tetracycline for age validation studies; 5) collect biological samples for age and growth, food habits and reproductive studies; and 6) collect morphometric data. This information will continue to be used in conjunction with data from previous surveys to assess the populations of coastal sharks in the Atlantic Ocean.

The survey was conducted from 13 April to 29 May 1998 on board the NOAA Ship *Delaware II*. Ninety-one sets were completed between Key West, FL, and the Maryland/Delaware border (see map). Of 917 sharks caught, 857 were tagged and released, 37 were brought on board and dissected for biological research and 23 were lost. The majority of sharks caught were sandbar (71%) and tiger sharks (15%). No other single species represented more than 4% of the catch.



Porbeagle Shark Tagging and Biology Cruise - NOAA Ship *Delaware II*

Apex Predators Program personnel, in conjunction with the Canadian Department of Fisheries and Oceans, are continuing their studies on the age and growth of the porbeagle shark and expanding research to include movements, reproduction, and food habits. To date, we have vertebrae from 140 porbeagle sharks, ranging in size from 2.5' (birth) to 7.9' FL. Preliminary analyses of these vertebrae show that they have distinct rings. Several hundred porbeagle sharks have also been tagged, primarily by Canadian commercial fishermen and observers. The 1998 cruise was designed to target porbeagles off the coast of Maine and possibly Canada for the primary purposes of tagging as many porbeagles as possible and injecting them with tetracycline. The validation of vertebral band periodicity using the backbones of tetracycline injected sharks is vital to our age and growth study.

The cruise was conducted from 19 to 30 October, 1998 offshore of Massachusetts and Maine on the U.S. Atlantic coast. The objectives of the cruise were to: 1) tag and inject porbeagle sharks with tetracycline; 2) place archival tags on porbeagles; 3) collect biological samples for age and growth, food habits and reproductive studies and 4) collect morphometric data.

A total of 130 sharks, representing 4 species, were caught on 12 longline sets. Of these, 121 were tagged and released (43 injected), and 9 were released untagged or lost. Sharks represented 96% of the total catch of which blue sharks (58%) were the most common, followed by porbeagle (43%), common thresher, spiny dogfish and unknown sharks (2% each); additionally two skates and three bluefish were caught. Archival tags were attached to the first dorsal fins of five porbeagles (see related article on pg. 20). The data collected on this cruise will be combined with data from previous cruises and used to study the life history of this species.

Coastal Shark Assessment Bottom and Surface Longlining Cruise

Contributed by: Mark Grace
NMFS, Pascagoula, MS

The NMFS Southeast Fisheries Science Center (Mississippi Laboratory) conducted longline survey operations aboard the NOAA Ship *Oregon II* from 7 July to 22 September, 1998 in the Gulf of Mexico and Caribbean Sea along the coasts of Mexico, Cuba and Navassa Island. Commercial style monofilament bottom longline was the primary fishing gear (see 1995 Shark Tagger for details). During Leg III, pelagic gear was used in addition to the bottom gear. Gear configuration for the pelagic sets consisted of a high flyer followed by five evenly spaced hooks, a bullet float alternating every five hooks until 50 hooks were out, after which a second high flyer was attached. Drop lines of 164, 328, or 492 feet were attached at the high flyers and float lines. To settle the mainline to the desired fishing depth, a weight was attached to the mainline at a depth corresponding to the drop line depth beneath the first high flyer. Additional gear modifications during pelagic work included the addition of an

TAGGING REMINDERS

Every year we strive to improve the quality of our data. The following reminders will help us complete the processing of Tag/Release cards:

- Tag only species you can identify. Request species identification material in the "remarks" section of the tag card and we will do whatever we can to assist you.
- Fish condition section of the tag card is for recording a measure of the health of the fish (for example, good, fair, or poor) when released, not weather conditions.
- The "remarks" section can be used for requesting tags, comments on condition of the fish, depth, surface temperature, suggestions, weather, etc.
- Please record locations, as either Lat/Longs or complete lorans.
- Please remember to indicate whether length and weight are estimated or measured.
- Record tagging information promptly and completely, please fill in the tag card as soon after a fish is tagged as possible.
- Please mail tags promptly. Tagging serves little use without timely full release and recapture information.

Thank you for your assistance.

Field Studies Cont.

8-10" steel leader (200 lb. test) to the monofilament gangions.

The primary objectives of the survey were to: 1) assess the distribution and abundance of coastal and pelagic sharks; 2) collect biological and environmental data; 3) tag and release sharks; 4) utilize underwater video cameras to assess reef fish species composition and reef habitats at Navassa Island; and 5) utilize a fisheries acoustic system (FAS) to collect acoustic data and bathymetry at Navassa Island.

During the survey, 216 sites were sampled, 134 by bottom longline, 76 by pelagic longline, three by underwater video with FAS, and three by FAS gear only. A total of 147 fish were caught by longlining. Sharks comprised 45% of the total while 55% was incidental catch. Eighty-five percent of the sharks caught were tagged and released; the rest were brought on board for examination.

Legs I and II were conducted in Mexican waters between the US/Mexican border along coastal Mexico to the Bay of Campeche and coastal Yucatan. A total of 110 bottom longline sets caught 21 sharks (0.19 sharks/100 hook hours (hkhrs)) consisting of 11 large coastal and 9 small coastal sharks and 50 incidental fish (0.45 incidentals/100 hkhrs). Most of the shark captures (76%) occurred along the Campeche Bank between 93° W to 90° W. The blacktip shark was the most common large coastal shark (4), the Atlantic sharpnose was the most common small coastal shark (7) and the southern stingray was the most common incidental fish (20).

Leg III was conducted in Cuban waters and around Navassa Island. Nineteen bottom longline sets produced 35 sharks (1.32 sharks/100 hkhrs) consisting of 16 large coastals and 9 small coastals and 18 incidental fish (0.95 incidentals/100 hkhrs). There were no dominant large coastal species caught but three each of scalloped hammerhead, tiger, Caribbean reef, and nurse sharks were caught. The dominant small coastal shark was the smooth dogfish (8) and the dominant incidental fish was the amberjack (6).

Seventy-six pelagic longline sets yielded 9 sharks (0.12 sharks/100 hkhrs) of 3 species, all of which were large coastals and 12 incidental fish (0.15 incidentals/100 hkhrs). The three shark species caught were silky (7), dusky (1), and scalloped hammerhead (1). The dominant incidental fish was the great barracuda (9).

The initial survey design for Cuban waters consisted primarily of bottom longline; however, due to the steep narrow continental shelf in most areas, pelagic longlining was thought to be the better sampling method. Areas conducive to bottom longlining were restricted to isolated locations along the southeast coasts (Caribbean and Atlantic) and an area along the north coast from 78° W to 82° W. Strong oceanic currents were prevalent throughout most of the survey area.

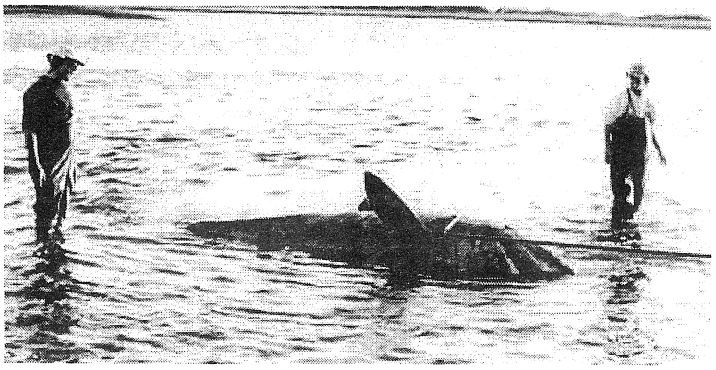
Five additional bottom longline survey sites were selected around the Navassa Island's perimeter and, when possible, parallel to depth contours. Ten sharks of 3 species were caught including scalloped hammerhead (7) smooth dogfish (2), and bull shark (1). The largest shark catch (6), occurred at the west-southwest station. Incidental catch from all longline stations included one misty grouper, one silk snapper, and one great barracuda.

Basking Shark Dissections

This year, project personnel had the unique opportunity to dissect two basking sharks. The basking shark can attain sizes up to 32' total length (TL) and even a small individual is large by common standards. Since these sharks are not economically or recreationally valuable in the US, they are normally not brought to the dock. Additionally, the basking shark is one of 19 shark species prohibited from directed fishing by the Atlantic Shark Fishery Management Plan (see management update page 19). Possession of any of these species is illegal and can lead to severe fines.

The first of the basking sharks we examined was a 24' TL (20' FL) immature female caught incidentally in a trawl net and brought to New Bedford, MA in mid-September with USCG and NMFS approval. The second shark, a 15' TL (14' FL) immature male was stranded in a salt pond in Wellfleet, MA. This shark was observed feeding for several hours. When the tide went out, it was unable to cross the sand bar at the entrance and died in the mouth of the bay. Project personnel and staff of the Tennessee Aquarium were able to find the shark and float it to a boat ramp where it could be dissected (see photo).

Both of these sharks were examined in detail for reproductive condition, stomach contents, liver weights and morphometric



data. Due to their large size and location, it was not possible to obtain whole weights. Both of the shark's stomachs were filled with planktonic prey. The plankton was so concentrated that it looked and felt quite similar to potters clay and consisted primarily of a copepod. In addition to the APP work-up, the skeleton of the first shark was forwarded to the University of Massachusetts, Amherst for further examination. The gills and nose of the second shark were also examined in great detail for parasite studies (see article page 12).

It is not uncommon for fishermen to report basking shark sightings in the summer and fall months. This past year, however, many fishermen felt that there were far more basking sharks here in the Northeast area particularly in the Gulf of Maine than they were used to seeing. This increase in sightings could be due to many factors including environmental conditions or plankton abundance. Regardless of the reason, while out fishing, keep an eye open for the possibility of viewing some of these remarkable creatures.

ONGOING RESEARCH

These articles update studies that we have reported on in previous Shark Tagger Newsletters.

COASTSPAN

The APP has initiated the Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) survey to investigate shark nursery grounds along the U. S. east coast. Cooperative state and university researchers from Georgia to Delaware participated in sampling a total of 1,156 sharks in coastal waters from May to November in 1998. Florida Department of Environmental Management (DEM) personnel also contributed data from the Indian River Lagoon which was sampled from April 1991 to March 1997.

Sampling was conducted in Delaware Bay from May through September by APP staff and graduate students from the University of Rhode Island. A total of 539 sharks were caught, including 534 sandbars and 5 sand tigers (no sharks were caught in May). Eighty-four percent of the sandbars caught were neonates (newborn) as defined by umbilical scars and the remaining 16% were juveniles. Neonate sandbar sharks remain in the Delaware Bay nursery for at least three months. Recaptures of tagged sharks show that some age 1+ juveniles return to the Bay the next year and probably up to six years later. One of the sand tigers caught in June could be considered a young of the year based on size (3' FL). The remaining sand tigers consisted of three juveniles and one adult. The presence of young juvenile sand tigers suggests that Delaware Bay may be a secondary nursery ground for that species.

A total of 236 sharks were sampled in North Carolina's coastal waters by personnel from the Department of Marine Fisheries in May and August through November. The species composition of the sampled sharks was 52% Atlantic sharpnose, 30% sandbar, 7% finetooth, 7% spinner, 1% Atlantic angel, 1% blacknose, and less than 1% scalloped hammerhead and smooth hammerhead. Preliminary results show that North Carolina's coastal waters support pupping and nursery grounds for spinner, dusky, and Atlantic sharpnose sharks. COASTSPAN data give supporting evidence that sandbars utilize North Carolina waters as overwintering and secondary nursery grounds. Blacknose, blacktip sharks, smooth hammerheads, and scalloped hammerheads also utilize these areas as secondary nursery grounds.

South Carolina cooperators from the Department of Natural Resources sampled from June to September. A total of 273 sharks were caught: 63% were Atlantic sharpnose, 15% bonnethead, 14% finetooth, 6% sandbar, 2% scalloped hammerhead, and less than 1% blacktip, lemon, and spinner sharks. COASTSPAN findings show that spinner, finetooth, sandbars, and Atlantic sharpnose utilize these waters to some degree as pupping and nursery grounds. Our data also suggest that blacktip, scalloped hammerhead, and bonnethead sharks utilize South Carolina waters as secondary nursery grounds.

Georgia cooperators from the Department of Natural Resources and Savannah State University sampled a total of 108 sharks from May to September. The species composition was 84% Atlantic sharpnose, 14% bonnethead, 1% scalloped hammerhead and 1% finetooth. COASTSPAN data lend supporting evidence that Atlantic sharpnose and bonnetheads utilize Georgia's coastal waters as pupping and nursery grounds. These waters may also support secondary nursery ground habitat for scalloped hammerhead and finetooth sharks.

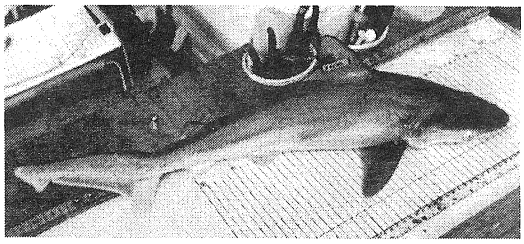
Florida DEM personnel contributed sampling data for 38 juvenile bull sharks from Indian River Lagoon from April 1991 to March 1997. All were young juveniles. No neonate bull sharks were sampled.

All sampled sharks in this program were marked with small blue tags in the first dorsal fin (see photo). If you catch one of these sharks, report measured fork length, sex of the shark, date and the latitude and longitude of capture. If the shark is not released, please freeze a six inch long piece of the backbone from over the gill area and call the Narragansett Lab at (401) 782-3320.

Tracking Juvenile Sandbar Sharks in Delaware Bay

Brad Wetherbee joined the APP as a National Research Council post-doctoral associate in the spring of 1998. He is currently heading up the tracking component of the nursery ground studies. Brad received his Ph.D. from the University of Hawaii, where he studied biochemical and physiological buoyancy adaptations in sharks. This study integrated the disciplines of biochemistry and physiology to investigate aspects of the ecology of sharks, particularly those that inhabit deep water. He found that there is a tremendous difference in the mechanisms involved in buoyancy control between shallow water and deep-sea sharks, and regulation of buoyancy is an extremely dynamic process throughout the life of a shark, resulting in striking differences in buoyancy characteristics even within species. While in Hawaii, Brad also became involved in studies of the movement patterns of fish through the use of telemetry and worked on tracking projects ranging from activity patterns of small reef fish in a conservation zone to long distance movements of large tiger sharks in coastal and pelagic waters. Prior to his work in Hawaii, Brad received his Masters degree at the University of Miami's Rosenstiel School of Marine and Atmospheric Science where he studied the digestive physiology of sharks. Brad is at the APP studying the movement patterns of juvenile sandbar sharks in the Delaware Bay nursery area.

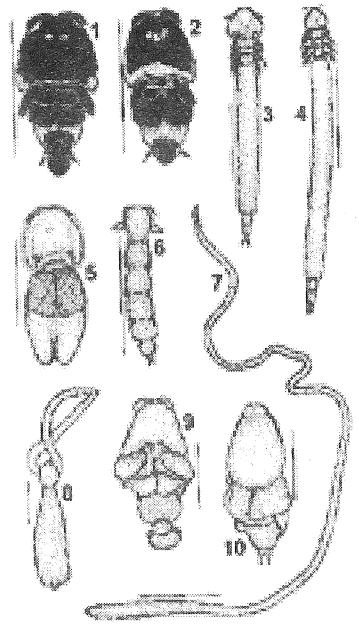
Members of the APP have recently undertaken studies to examine the use of nurseries by sandbar sharks, including quantification of their activity patterns in Delaware Bay through ultrasonic telemetry. Telemetry essentially involves attaching a



transmitter to a shark and following the movements of the shark for several days. Sharks can be followed by researchers in a small boat equipped with a hydrophone and receiver as long as the boat stays within range of the signal emitted by the transmitter. During the summer of 1998, 12 juvenile sandbar sharks were tracked in Delaware Bay for periods of up to 70 hours. The majority of sharks tracked showed a high degree of site specificity, remaining in the same area during the entire track with several sharks detected in the same area for up to five days following their release. These juvenile sharks essentially patrolled the coastline near Lewes, DE, primarily restricting their movements to water less than 3 fm deep, remaining within 1.6 nm of shore and moving with the tides. There was also a high degree of overlap in activity space utilized by different individuals. Nine of the 12 sharks tracked shared at least some common area and several sharks exhibited extremely similar movement patterns.

Two sharks that were tracked late in the summer moved long distances within the bay. Both individuals were captured and released nearshore, but one moved to the central and deepest part of the bay (>16 fm deep, 11 nm from shore), where it spent several days. During a subsequent track the next week, this shark was detected back near its release site in water <3 fm deep and within 1 nm of shore. The second far-ranging shark traveled from nearshore Delaware across the entire bay to New Jersey (>16 nm) in a matter of 18 hours. Both sharks were tracked in late September, which is just prior to the departure of most sharks from the Bay as they move to their wintering areas. It is possible that differences between the long distance movements of these sharks and the home ranging behavior of the other ten tracked sharks is related to an increased range of movement exhibited as the sharks prepare to leave the Bay at the end of their summer residence.

The results of this study indicate that relatively large numbers of sharks share common areas within a restricted portion of Delaware Bay and that this behavior may provide an opportunity to protect large numbers of juveniles through the setting aside of limited areas within the Bay.



Parasitic copepods of sharks mentioned in this article:

1. *Pandarus satyrus*
2. *Pandarus smithii*
3. *Kroyeria carchariaeglauci*
4. *Kroeyerina elongata*
5. *Echthrogaleus coleoptratus*
6. *Nemesis lamna*
7. *Kroyeria caseyi*
8. *Ommatokoita elongata*
9. *Phyllothyreus cornutus*
10. *Anthosoma crassum.*

Scale bars beside each copepod = 0.25".

Figures modified from several sources.

Parasites Cont. from Page 11

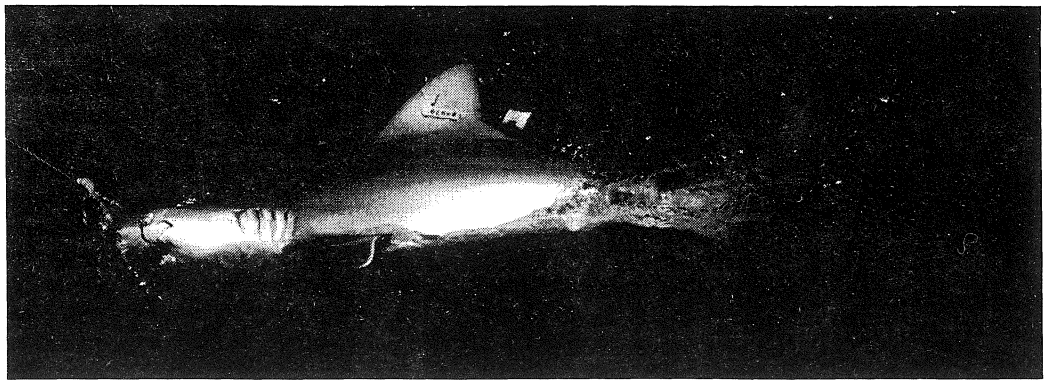
sluggish shark. However, as alluring as these copepods appear, no firsthand evidence supporting this notion has ever been documented.

Interestingly, a more reasonable and scientific explanation for the aforementioned Greenland shark riddle exists. If size is any indication, the Greenland shark appears to have a powerful nose. Therefore, it's possible that this shark uses smell as its primary means of detecting prey as it swims above the ocean floor sucking up small fishes and invertebrates. Recent studies suggest that the ancestors of the Greenland shark were most likely deep-water species that may not have relied heavily on eyesight. Like the deep ocean, Arctic waters are cold and dark for much of the year. Hence, the Greenland shark may have been pre-adapted to its partially blinded task of capturing prey beneath the ice in cold, dark, food-rich Arctic waters.

It's interesting to consider how successful copepods have been at colonizing specific locations on sharks. For example, *Pandarus smithii* typically attaches on the roof of the mouth and on the tongue of the shortfin mako. Gathering in tight clusters, these copepods are certainly well protected by the rows of dagger-like teeth only inches away. However, *Anthosoma crassum* really takes the top prize when one considers the routine attachment locations of copepods. Vaguely looking like a dark acorn, this large copepod excavates deep lesions between the teeth of the white shark where it routinely lives and feeds. Hence this truly is a copepod that literally puts the bite on Jaws!

Of course, where a copepod lives often determines what it will eat. While we are only beginning to learn about the diets of copepods that infect sharks, we can consider that copepods that actively move about the body surface probably feed on fish mucus and the uppermost layers of skin. More stationary copepods often form tighter associations with their shark hosts such that they excavate deeper feeding wounds while consuming deeper layers of the skin and/or blood.

Some parasitic copepods literally go to great lengths to acquire their food. For example the extremely long copepod *Kroyeri caseyi*, a species named in honor of retired



NMFS shark specialist Jack Casey, burrows so deeply into the soft gill tissue of night sharks that only a small percentage of its body remains exposed.

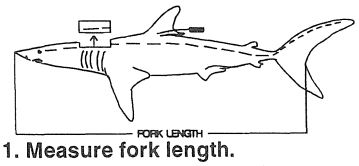
Like other crustaceans, parasitic copepods produce a larva known as a *nauplius*. The nauplius is a free-living stage in the copepod lifecycle that swims in the water. As such, it provides a vital service to parasitic species by allowing new generations of parasites to spread from shark to shark. Therefore, the lifestyles of egg-bearing female copepods must provide the hatching nauplii an opportunity to assume a free-living existence if their species are to survive. Because of this, parasitic copepods are usually *ectoparasites* on their shark hosts (i.e., they remain on the surface of the shark).

Throughout 20 or so years of studying parasitic copepods of sharks one of us (GWB) has often held, poked and prodded various species in hopes of determining whether or not they can bite humans. To date these attempts have been unsuccessful, and thus these remarkable parasites are either not equipped to do so or they merely prefer to turn the other cheek. In either case, this should provide some confidence for those curious readers that may wish to more closely examine the copepods that infect the sharks that they catch and, be assured, that these do not make the shark unfit for human consumption.

REQUEST FOR BACKBONES OF RECAPTURED SHARKS

The large number of sharks currently being recaptured offers a unique opportunity for fishermen to assist biologists in age and growth studies.

IF YOU CATCH A TAGGED SHARK



1. **Measure fork length.**
2. **Record tag number and recapture details (date, location, latitude and longitude or loran, sex, method of capture, etc.)**
3. **Remove a 6 to 10 inch piece of backbone from over the gills.**
4. **Freeze backbone.**
5. **Telephone collect for postage-paid mailers (401-782-3320).**

What the Final HMS FMP means to Atlantic recreational shark fishermen

Effective date July 1, 1999

PROHIBITED SPECIES

The following sharks **can not** be kept recreationally: whale, basking, sand tiger, bigeye sand tiger, white, dusky, night, bignose, Galapagos, Caribbean reef, narrowtooth, longfin mako, bigeye thresher, sevengill, sixgill, bigeye sixgill, Caribbean sharpnose, smalltail, and Atlantic angel sharks.

RECREATIONAL REGULATIONS

Management Unit	Species that can be kept	Retention Limit	Authorized Gear
Large Coastal, Pelagic, and Small Coastal Sharks	LCS: Sandbar, silky, tiger, blacktip, bull, spinner, lemon, nurse, smooth hammerhead, scalloped hammerhead, great hammerhead Pelagic: shortfin mako, thresher, oceanic whitetip, porbeagle, blue SCS: Atlantic sharpnose, blacknose, finetooth, bonnethead	1 shark per vessel per trip (all species) with a 4.5 feet fork length minimum size ; allowance for 1 Atlantic sharpnose per person per trip (no minimum size)	Rod and reel; handline; bandit gear

Additional remarks:

Harvested sharks must have fins, head, and tail attached (can be bled and gutted if tail is still attached)
No recreational limits on deepwater and other sharks.

For further information consult the web page: http://www.nmfs.gov/sfa/hmspg.html

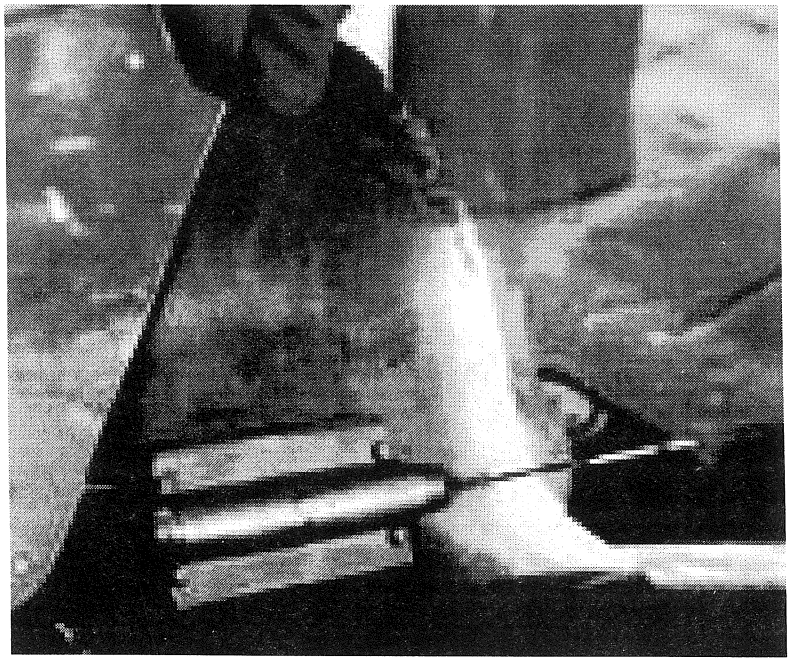
THE SHARK TAGGER NEWSLETTER

Published by:

Apex Predators Cooperative Shark Tagging Program

Nancy E. Kohler, Lisa J. Natanson, Harold Wes Pratt, Jr., Patricia A. Turner, and Ruth Briggs.
www.nefscsharks.nmfs.gov

REWARD



Archival Tag Update

During the Porbeagle Tagging and Biology Cruise (see Field Studies), 5 porbeagle sharks were tagged with archival tags. These tags are designed to determine and record the shark's position and key environmental variables every day for several years. The tag itself is housed in a stainless steel cylinder 0.6" in diameter and 4" long. A thin flexible measurement stalk 0.08" in diameter and 2" long is attached to one end. For our purposes, the tag was welded to a stainless steel bracket which was used to attach the tag to the first dorsal fin of the porbeagle sharks. A legend is etched into the bracket backing plate with return information in several languages. Unlike satellite tags which transmit data periodically, archival tags **MUST** be returned in order for us to retrieve the data. When recovered and interrogated, the tag will yield position information along with statistical summaries of all measured data and a detailed record of the shark's time at liberty with the tag.

If you encounter a fish with one of these tags, please bring it in and contact us immediately at (401) 782-3320. Recovery of these tags is extremely valuable to our studies.