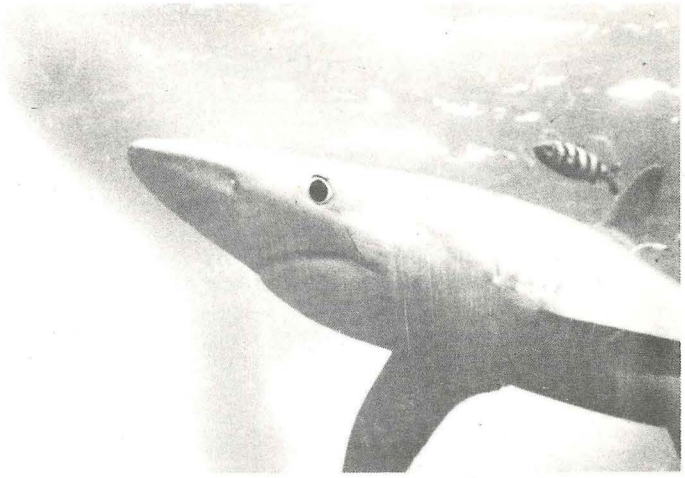
THE SHARK TAGGER
1982 SUMMARY



JOHN CASEY, HAROLD WES PRATT, CHARLES STILLWELL

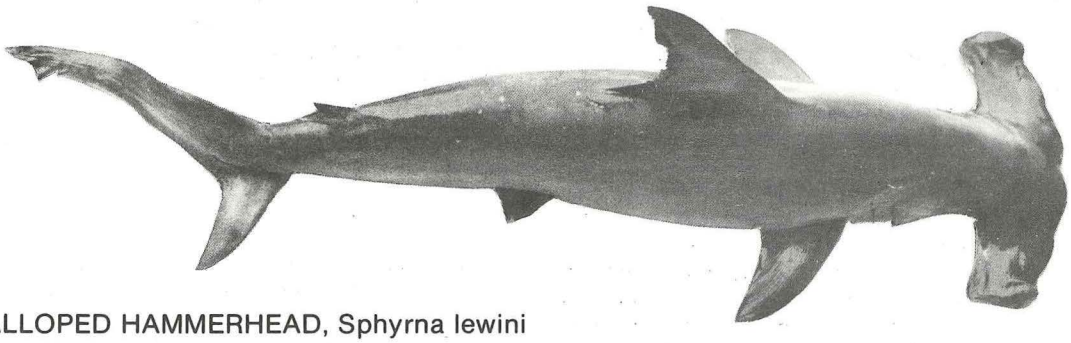
PHOTO BY H. W. PRATT

1982 OVERVIEW

- OVER 4500 FISH TAGGED AND 139 RECAPTURED IN 1982
- TEN TAGGED BLUE SHARKS TRAVEL OVER 2000 MI (U.S. TO EUROPE, AFRICA, AND SOUTH AMERICA)
- FIRST TAGGED BLUE SHARK CROSSES EQUATOR (NORTHERN TO SOUTHERN HEMISPHERE)
- TAGGED SANDBAR SHARK SETS NEW RECORD OF 17 YEARS AT LIBERTY (ANOTHER RECAPTURED AFTER 16 YEARS)
- SIX SANDBAR SHARKS TRAVEL IN EXCESS OF 1000 MI FROM NORTHEAST COAST OF U.S. INTO GULF OF MEXICO
- TAGGED TIGER AND BIGEYE THRESHER SHARKS SET DISTANCE RECORDS FOR SPECIES

In 1982 a total of 4,553 sharks and teleosts (bony fishes) were tagged under the NMFS Cooperative Shark Tagging Program. These represented 36 species of sharks and 7 species of teleosts (Table 1). Of the total number of fish tagged, rod and reel fishermen accounted for 44%; U.S. longline fishermen, 11%; U.S. Fishery Observers on foreign vessels, 17%; U.S. Research Vessel *Geronimo,* 15%; Polish Research Vessel *Wieczno,* 10%; and the remaining 3% were released by NMFS biologists.

A total of 139 tags from 18 species were returned in 1982. These came from blue (66), mako (15), sandbar (10), tiger (9), lemon (8), dusky (6), other sharks (20), and teleosts (5) (Table 2). The categories of fishermen who returned tags in 1982 were: U.S. sportsmen (41%), U.S. longliners (24%), other U.S. fishermen (5%), foreign longliners (21%), and other foreign fishermen (9%). In the latter categories, tags were returned by fishermen from 15 countries including Japan (11), Mexico (5), Korea (5), Cuba (5), Spain (3), Taiwan (2), Canary Is. (2), Canada (1), West Indies, Bermuda and Bahama Is. (5), and others (3).



SCALLOPED HAMMERHEAD, Sphyrna lewini

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

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

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Table 1. SUMMARY OF SHARKS AND TELEOSTS TAGGED, January--December 1982

SPECIES	TAGGED BY COOPERATIVE TAGGERS	NARRAGANSETT BIOLOGISTS	TOTALS
Sharks			
Blue shark	2,268	135	2,403
Sandbar shark	464	0	464
Dusky shark	440	0	440
Bull shark	24	0	24
Blacktip shark	68	0	68
Spinner shark	5	0	5
Oceanic whitetip shark	45	0	45
Silky shark	52	0	52
White shark	6	0	6
Shortfin mako shark	236	0	236
Longfin mako shark	3	0	3
Porbeagle shark	10	0	10
Sand tiger shark	9	0	9
Smooth dogfish shark	11	0	11
Bonnethead shark	17	0	17
Great hammerhead shark	16	0	16
Scalloped hammerhead shark	65	0	65
Smooth hammerhead shark	6	0	6
Atlantic sharpnose shark	145	0	145
Blacknose shark	7	0	7
Tiger shark	122	0	122
Finetooth shark	2	0	2
Lemon shark	109	0	109
Nurse shark	47	0	47
Bigeye thresher shark	17	0	17
Common thresher shark	1	0	1
Night shark	36	0	36
Bignose shark	1	0	1
Angel shark	6	0	6
Basking shark	4	0	4
Reef shark	32	0	32
Leopard shark	2	0	2
Florida smoothhound shark	2	0	2
Greenland shark	1	0	1
Centrophorus granulosus	3	0	3
Hexanchus vitulus	5	0	5
Hammerhead unspecified	29	0	29
Thresher unspecified	3	0	3
Sand unspecified	5	0	5
Blacktip unspecified	3	0	3
Brown/Dusky unspecified	2	0	2
Unknown*	3	0	3
Total sharks	4,332	135	4,467
Teleosts			
Swordfish	59	0	59
White marlin	9	0	9
Blue marlin	3	0	3
Bluefin tuna	7	0	7
Miscellaneous teleosts	8	0	8
Total teleosts	86	0	86
Grand Total	4,418	135	4,553

*Includes species reported as "shark".

OVERVIEW *(Continued from page 1)*

The 139 fish that were recaptured in 1982 were originally tagged by: U.S. sportsmen (52%), U.S. longliners (9%), U.S. fishery observers aboard foreign longliners (11%), R/V *Geronimo* (17%), R/V *Wieczno* (9%), NMFS biologists and others (2%).

Long lists of statistical information can be a bit indigestible for even the strongest of stomachs. Nevertheless the above figures reflect the diversity of people who participate in the tagging program. They also show the types of fisheries that are (or can be) directed toward sharks. Any attempt to manage sharks as a resource will, depending on the species, have to consider several different international and U.S. interests. (See article on Recreational Catches in this issue).

In 1982, both the number of fish tagged and recaptured was slightly lower than in 1981 (826 fewer tagged, 14 fewer recaptures). The difference is largely explained by fewer blue sharks being tagged and recaptured in June of 1982. Poor weather conditions last spring resulted in reduced fishing effort when blue sharks are normally most abundant off New York and New Jersey. Our data from tournaments and results of tagging efforts later in the summer did not indicate any decline in the shark population.

Blue sharks were recaptured after a maximum of 4 years at liberty and over distances of nearly 3,000 miles. Several blue sharks made transatlantic migrations from North America to the offings of the Azores, Canary, Madeira, and Cape Verde Islands. Others tagged off the northeastern U.S. were recaptured off Cuba, Barbados, Trinidad, French Guiana, and Colombia, South America. Recapture distances for blues included 10 over 2,000 miles, 5 over 1,000 miles, 4 over 500 miles, 10 over 200 miles, 10 over 100 miles and 27 "local" returns (less than 100 miles).

The blue shark is a wide-ranging species in which some mixing occurs between populations in the eastern and western Atlantic. Until this year, however, we have not seen evidence that blue sharks cross the equator. In April and May of 1982, cooperating Polish scientists aboard the R/V *Wieczno* tagged 450 blue sharks off the north coast of Africa. This is an area where we have had several recaptures from blues tagged off North America. Two months later one of the *Wieczno's* blue sharks was recaptured in the southern hemisphere, having travelled from approximately 600 miles north to 600 miles south of the equator. This recapture may be an example of an individual straying away from its normal range. However, the movement appears quite direct since the shark averaged 19.0 miles per day. This rate is near the maximum daily rate we have observed in blue sharks from tracking experiments and other tagging data.

Additional tagging off the European, African, and South American coasts would certainly add to a clearer understanding of the relationships between populations of blue sharks in different parts of the Atlantic.

Shortfin makos were recaptured after 4.6 years at liberty and over distances of 1,500 miles. The longest distance recorded came from a mako tagged off Oregon Inlet, N.C., that was recaptured off Barbados, British West Indies (1,534 miles, 56 months). Another return came from a mako tagged off Texas that was recaptured off the east coast of Florida. This is the third mako to demonstrate movement from the Gulf of Mexico into the Atlantic. The remaining mako recaptures in 1982 generally showed movements of less than 300 miles along the east coast, although some individuals were at liberty for two or three years.

In 1981 the mako that covered the longest distance was also tagged off Oregon Inlet, N.C., and recaptured off the British West Indies (1,592 miles, 46 months). Although mako sharks tagged off the northeastern U.S. have in the past been recaptured in the Sargasso Sea, the West Indies, and in the Caribbean, their overall migration patterns are difficult to describe. So little is known about the makos' life history, particularly with respect to the distribution of large females and their breeding grounds, that it is only from observations covering a wide geographic range that knowledge of this species will advance. For example, makos occur in the Gulf Stream off Cape Hatteras, N.C., in all months of the year. Yet, some members of the population undertake the long distance movements we mentioned. Unfortunately, it is almost completely by chance that extremely large specimens have ever been taken. *We would appreciate a telephone call (401-789-9326) from anyone who learns about the capture of a pregnant mako or any mako in excess of 1,000 lb.*

Sandbar sharks were recaptured after up to 17 years at liberty and over distances of 1,948 miles. With respect to the tagging program, 1982 was indeed the "year of the sandbar shark." Six of the ten recaptures showed movement from northeastern U.S. into the Gulf of Mexico, and of these, three were taken off Mexico. Two of the three returns from Mexico were tagged off Long Island, N.Y., by the same fisherman and were recaptured 37 miles apart on consecutive days. Herman Kornaherns tagged a young sandbar shark on June 27, 1976, off Long Island, that was recaptured off Tampico, Mexico, on September 24, 1982 (6 years at liberty). The following year, on July 8, 1977, he tagged another sandbar shark near

the same Long Island location that was subsequently recaptured off Tampico on September 23, 1982 (5 years at liberty). Size data from these and several other recaptures that were at liberty from 3 to 17 years provided valuable supporting evidence for our age analysis from rings in vertebrae (related article in the Newsletter).

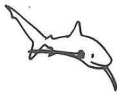
The higher percentage of recaptures from the Gulf of Mexico in recent years is interesting because it indicates that sandbar sharks from the Atlantic and Gulf are very likely members of the same population. This is not a new idea, although previous information suggested that sandbar sharks taken in the western Gulf were probably strays from the Atlantic population. That could still be the case, but recent tag returns indicate a higher degree of mixing between the stocks in the Atlantic and Gulf than had been proposed.

An important aspect of some of the long-term recaptures was that the addresses on the fin tags were completely worn away. We are fortunate that the tags found their way back to us and that the numbers were still legible. *If you hear of anyone who has a tag from a shark, please have him send it to our laboratory.*

Tiger sharks were recaptured after up to 2 years at liberty and over distances of 1,500 miles. The longest return came from a 9′6″ (fork length) individual measured and released by a U.S. foreign fisheries observer after it was caught by fishermen on an Italian squid trawler off North Carolina. The shark was tagged in October 1980 and recaptured in January 1982 off Martinique, West Indies. This is a new long distance record for a tagged tiger shark. Another tiger shark tagged off the west coast of Florida was recaptured 8 months later on the north coast of Cuba.

Although tagged tiger sharks have travelled several hundred miles from Bermuda into the Gulf of Mexico, and from Florida to the Bahamas and West Indies, the details of their migrations are largely incomplete. Since the tiger shark is one of the largest sharks, and quite easy to identify, a more intensive tagging effort in southern areas where it is most abundant (i.e., Florida, the Bahamas, the Gulf of Mexico, and the Caribbean) would be particularly useful to understanding their movements.

Other species. Returns from other species showed movements of **night sharks** from the east coast of Florida southward into the Gulf of Mexico and northward to Georgia. This species appears to be quite abundant along the outer edges of the continential shelf from the Middle Atlantic Bight to the north coast of Cuba and into the Gulf of Mexico. Until recently it was considered rare north of Florida and its distribution and abundance in the Gulf of Mexico is still not well known. The **longfin mako** was also considered a strictly tropical offshore species until recently. It has been reliably (but uncommonly) reported from the outer edge of the continental shelf as far north as Georges Bank. The recapture of an individual that travelled 859 miles from the Gulf of Mexico into the Florida Straits in 1982 is the longest distance recorded for a tagged longfin mako. The 1982 recapture of a **bigeye thresher** that travelled 1,048 miles is also a new long-distance record for that species. The bigeye thresher was tagged by a U.S. fishery observer aboard a Japanese longliner 150 miles southeast of Cape Cod. It was recaptured by a longliner from Taiwan in the mid-Atlantic 855 miles east of Bermuda. Recaptures were made from four **swordfish** at liberty for up to 2 years. The longest distance covered by a swordfish was 561 miles from North Carolina into the Florida Straits off West Palm Beach. Information on the recaptures from other sharks are included in Table 2. Although we have not mentioned them in this brief overview we acknowledge the importance of these returns in providing information on local movements, growth, and other aspects of our studies. Moreover, your release records include unique observations and provide valuable information on distributions, sizes, sex ratios, and species composition for a variety of sharks. Thanks to all of you for making 1982 a successful year.



AGE AND GROWTH OF THE SANDBAR SHARK

Biological information on the age, size at maturity, and rates of growth is essential for the successful management of any fishery resource. Our age studies are directed toward providing this information on some of the important species of large Atlantic sharks.

Traditional techniques for determining age and growth in fishes utilize marks ("rings") on scales, otoliths (ear stones), vertebrae, gill covers and fin spines. Other methods, such as analysis of size-frequency information, tag-recapture data and studies of captive fish are often used to validate ring studies.

As cartilaginous fishes, the elasmobranchs (sharks, skates, rays) present special problems in ageing because they either lack the hard parts used in ageing bony fishes, or, if the structures are present, rings are often confused or lacking. However, rings do appear on the densely calcified vertebrae of some sharks which, when compared with size frequency data and tag-recapture information, can provide estimates of age.

In the past two years we have been successful in determining the age and growth of the shortfin mako and the sandbar shark. A summary report of work on the mako was presented in our 1981 Newsletter. We present here a summary of our findings for the sandbar shark.

Age and growth of the sandbar shark was estimated from rings in the vertebrae, tagging data, and size-frequency distributions. Vertebrae were prepared for age analysis by cutting thin sections (*z-z′* in Fig. 1 on page 8) from the center of each vertebrae after which they were stained and mounted on glass slides. The "rings" (0-4, Fig. 1) were then measured with the aid of a microscope. Growth zones on vertebrae from 475 sandbars, including samples from full term embryos and adults were "read" and the measurements used to back calculate the size of each shark at previous ages. From average back-calculated lengths at each ring we constructed the growth curves shown in Figure 2. The open circles in this figure are mathematical predictions based on the measured data. The oldest male aged from the vertebrae was 15 years (154 cm fork length) and the oldest female was 21 years (204 cm fork length). The estimated age to maturity was 13 years for males and 12 years for females. Annual growth averaged 7.5 cm in males and 7.1 cm a year in females.

Evidence from 220 tag-recaptured sharks at liberty for up to 17 years also showed the slow growth rate seen in the vertebral data. Although many of these returns came from sharks that had estimated lengths, 22 sharks that were measured at tagging and recap-

Continued on Page 8.

Table 2. Tag recoveries: January-December 1982

SPECIES	GENERAL LOCATIONS TAGGED	GENERAL LOCATIONS RECAPTURED	MONTHS/ LIBERTY	DIST. & DIR. TRAVELLED N. MI.		CAPTURE METHOD TAGGING	CAPTURE METHOD RECAPT.	TAGGED BY TAGGER	TAGGED BY RESIDENCE
Blue shark	NE Oregon Inlet, NC	E Jekyll Is., GA	4	364	S	LL	LL	John Bazuin NMFS Obs.	MS
" "	S Block Is., RI	E Jacksonville, FL	5	443	S	LL	LL	RV WIECZNO	Poland
" "	ESE Block Is., RI	ESE Trinidad	7	2310	SE	FS	LL	Al Anderson	RI
" "	SE Montauk, NY	SE Ocean City, MD	1	202	SW	RR	LL	Jim Humphrey	CT
" "	S Block Is., RI	SE Block Is., RI	2	30	NE	RR	RR	Lou Rosado	NY
" "	SW Nantucket, MA	E Barbados, W Indies	7	2362	SE	LL	LL	Stephen Connett	RI
" "	S Moriches, NY	SE Nantucket, MA	22	387	NW	LL	LL	Biologist	RI
" "	S Montauk, NY	E French Guiana, S. America	19	2178	SE	LL	LL	Stephen Connett	RI
" "	S Block Is., RI	E Sao Miguel, Azores	31	2357	E	RR	LL	Walter Kaprielian	NY
" "	SE Block Is., RI	ESE Trinidad	30	2697	SE	LL	LL	Stephen Connett	RI
" "	S Moriches, NY	SSE Block Is., RI	1	73	NE	RR	RR	Frank Signorello	NY
" "	SE Fire Is., NY	E Block Is., RI	1	310	E	RR	LL	Ray Wittman	NY
" "	S Montauk, NY	SSE Cape Hatteras, NC	21	390	S	RR	LL	Zac Grossman	NY
" "	SE Block Is., RI	SE Oregon Inl., NC	6	325	SW	LL	LL	Alan Criss NMFS Obs.	MS
" "	S Shinnecock, NY	NE Oregon Inl., NC	7	271	SW	RR	LL	William Williams	NY
" "	SE Montauk, NY	E of Cape Cod, MA	10	485	E	LL	LL	Stephen Connett	RI
" "	S Montauk, NY	SE Nantucket, MA	22	187	E	RR	LL	Frank Mundus	NY
" "	S Montauk, NY	S Manasquan, NJ	9	93	SW	RR	RR	Frank Mundus	NY
" "	SSE Block Is., RI	S Canary Islands	34	2881	E	LL	LL	Stephen Connett	RI
" "	SE Shinnecock, NY	SE Shinnecock, NY	<1	3	SE	RR	LL	Steve Radacinski	NY
" "	SE Block Is., RI	Northeast Coast-Cuba	9	1188	S	RR	LL	Mario Pagano	RI
" "	SE Block Is., RI	N Columbia, S. America	18	1624	S	LL	LL	Mark Houck NMFS Obs.	MS
" "	S Montauk, NY	S Barbados	10	1791	SE	RR	HL	Stret Whitting	NY
" "	S Montauk, NY	ESE Cape Cod, MA	11	511	E	RR	LL	Ed Stierniak, Jr.	NY
" "	ESE Block Is., RI	SSE Montauk, NY	12	39	W	LL	RR	Stephen Connett	RI
" "	SSE Montauk, NY	SE Montauk, NY	10	20	NW	RR	RR	James T. Frost	NY
" "	S Moriches, NY	S Moriches, NY	<1	12	SW	RR	RR	Peter Jakits	NY
" "	SE Cape Verde Islands	S Cape Verde Islands	<1	94	N	LL	LL	RV WIECZNO	Poland
" "	ESE Block Is., RI	SSE Moriches, NY	1	87	SW	FS	RR	Ernest Dunphy, Jr.	RI
" "	S Montauk, NY	S Moriches, NY	10	53	NW	LL	RR	Harold West NMFS Obs.	MS
" "	ESE Montauk, NY	W Maderia Is.	23	2332	E	RR	LL	Greg Shepis	NY
" "	SE Montauk, NY	ESE Block Is., RI	12	44	NE	RR	RR	Joe Nesto	NY
" "	S Block Is., RI	SE Montauk, NY	<1	56	E	RR	LL	Warren Hader	NY
" "	S Block Is., RI	E Manasquan Inl., NJ	11	140	W	LL	RR	Stephen Connett	RI
" "	S Montauk, NY	S Montauk, NY	<1	0		RR	RR	Murray Roth	NY
" "	E Beach Haven, NJ	SSE Moriches, NY	1	107	E	RR	RR	Ralph Leyrer	NJ
" "	SE Montauk, NY	SE Montauk, NY	NR	NR		RR	RR	Joe McBride	NY
" "	SSE Montauk, NY	SE Montauk, NY	10	10	SW	RR	RR	Terry McConnell	NY
" "	SSW Block Is., RI	SE Block Is., RI	<1	102	SE	RR	RR	Bob Rowan	RI
" "	S Montauk, NY	SSW Hyannis, MA	14	46	NE	FS	RR	R. C. Flanagan	CT
" "	S Moriches, NY	E Barnegat, NJ	<1	52	S	RR	RR	Joseph Mistina	NJ
" "	SE Montauk, NY	SW Cape Verde Islands	25	2980	SE	LL	LL	Stephen Connett	RI
" "	S Fire Is., NY	SE Shinnecock, NY	<1	60	NE	RR	RR	Robert Gross	NY
" "	SE Shinnecock, NY	ESE Barnegat, NJ	1	60	S	RR	LL	Ed Anker	NY
" "	ENE Oregon Inl., NC	E Oregon Inl., NC	35	31	SW	HL	LL	R. Driscoll	MA
" "	S Block Is., RI	E Fr. Guiana, S. America	5	2509	SE	LL	LL	Biologist	RI
" "	SE Block Is., RI	SSW Montauk, NY	<1	103	SW	FS	LL	Biologist	RI
" "	SE Block Is., RI	S Block Is., RI	1	47	W	LL	RR	Stephen Connett	RI
" "	SE Block Is., RI	N Gibara, Cuba	8	1208	S	LL	LL	Stephen Connett	RI
" "	SE Block Is., RI	SE Montauk, NY	23	72	W	LL	RR	Stephen Connett	RI
" "	S Montauk, NY	SE Shinnecock, NY	<1	64	N	LL	RR	Kevin Flanagan NMFS Obs.	MA
" "	SSW Shinnecock, NY	SE Marthas Vineyard, MA	2	214	E	RR	LL	Ray Hendrickson	NY
" "	SE Shinnecock, NY	SW Sable Is., Canada	12	593	E	RR	LL	James Gubista	NY
" "	SW Cape Verde Islands	S Cape Verde Islands	11	645	SE	LL	LL	RV WIECZNO	Poland
" "	S Cape Verde Islands	WSW Ascension Islands	2	1241	S	LL	LL	RV WIECZNO	Poland
" "	NE Cape Hatteras, NC	S Marthas Vineyard, MA	29	372	NE	LL	RR	Biologist	RI
" "	SSW Montauk, NY	SSE Fire Is., NY	2	91	S	RR	LL	Gloria Hayn	NY
" "	W Provincetown, MA	S Montauk, NY	47	165	SW	LL	RR	Marty Bartlett	GA
" "	E Barnegat Inl., NJ	E Virginia Beach, VA	2	233	SW	RR	LL	Ray Schmidt	NY
" "	S Block Is., RI	S Montauk, NY	3	63	SW	RR	LL	Al Anderson	RI
" "	SSE Montauk, NY	SSE Montauk, NY	3	20	S	LL	LL	Stephen Connett	RI
" "	E Montauk, NY	S Montauk, NY	25	55	S	LL	LL	Stephen Connett	RI
" "	S Cape Verde Islands	S Cape Verde Islands	2	159	N	LL	LL	RV WIECZNO	Poland
" "	S Cape Verde Islands	SW Cape Verde Islands	1	571	SW	LL	LL	RV WIECZNO	Poland
" "	S Nantucket, MA	E Ocean City, MD	3	210	SW	LL	TN	Stephen Connett	RI
" "	ESE Atlantic City, NJ	NNW Cape Verde Is.	10	2484	E	TN	LL	Brad Haskell NMFS Obs.	MA
Mako shark	SE Block Is., RI	ESE Cape Fear, NC	6	523	S	LL	LL	Stephen Connett	RI
" "	SE Manasquan Inl., NJ	E Ocean City, MD	8	57	SE	RR	TN	William Render	NJ
" "	E Oregon Inl., NC	NE Barbados	56	1534	ESE	LL	LL	Biologist	RI
" "	S Ocean City, NJ	W Virginia Beach, VA	10	225	SW	RR	RR	David Moss	PA
" "	ESE Block Is., RI	SE Nantucket, MA	12	104	E	LL	LL	Stephen Connett	RI
" "	SE Nantucket, MA	S Shinnecock, NY	10	189	W	LL	RR	NMFS Obs.	MS
" "	SE Aransas Pass, TX	E Palm Beach, FL	48	938	E	LL	LL	NMFS Obs.	MS
" "	SSE Block Is., RI	SE Manasquan, NJ	36	131	SW	LL	RR	Stephen Connett	RI
" "	SE Nantucket, MA	SE Shinnecock, NY	9	181	W	LL	RR	Jeff Campbell NMFS Obs.	MS
" "	ESE Barnegat Inl., NJ	S Montauk, NY	21	81	N	LL	RR	Tom Furtado	FL
" "	SSE Shinnecock, NY	E Cape Henlopen, DE	23	148	SW	RR	RR	Ray Hendrickson	NY
" "	ESE Barnegat, NJ	SE Manasquan, NJ	<1	10	N	RR	RR	Roy Rapp	NJ
" "	SE Brielle, NJ	SSE Shinnecock, NY	0	71	NE	RR	RR	David Soleau	NJ
" "	SE Oregon Inl., NC	ESE Ocean City, MD	28	157	N	LL	LL	Phil Ruhle, Sr.	RI
" "	S Nantucket, MA	S Nantucket, MA	1	13	W	LL	LL	Kevin Flanagan NMFS Obs.	MA
Sandbar shark	S Shinnecock, NY	ESE Hatteras, NC	6	349	SSW	RR	TN	Floyd Carrington	NY
" "	S Virginia Beach, VA	N Oregon Inlet, NC	1	62	S	LL	RR	VIMS	VA
" "	S Shinnecock, NY	S Panama City, FL	95	1545	SW	RR	LL	Charles Roswell	NY
" "	Chesapeake Light, VA	E St. Helena, SC	9	358	SW	RR	TN	Michael Halperin	VA
" "	SE Jones Inl., NY	Panama City Pier, FL	35	1593	SW	RR	RR	Greg Scala	NY
" "	Little Egg Inl., NJ	Little Egg Inl., NJ	12	2	SW	RR	RR	Bill Figley	NJ
" "	Gr. Machipango, VA	W Campeche, Mexico	205	1512	SW	GN	LL	Biologist	RI
" "	S Fire Is., NY	E Tampico, Mexico	75	1929	SW	RR	NR	Herman Kornaherns	NY
" "	S Fire Is., NY	NE Tampico, Mexico	62	1948	SW	RR	NR	Herman Kornaherns	NY
" "	Great Machipongo Inl., Va.	W Tampa Bay, FL	198	1193	SW	GN	LL	Biologist	RI

Table 2 continued.

SPECIES	GENERAL LOCATIONS TAGGED	RECAPTURED	MONTHS/ LIBERTY	DIST. & DIR. TRAVELLED N. MI.		CAPTURE METHOD TAGGING	RECAPT.	TAGGED BY TAGGER	RESIDENCE
Tiger shark	W Charlotte Hbr., FL	N Cayo Coco, Cuba	8	428	SSE	FS	LL	Clark Balsinger	FL
" "	E Oregon Inl., NC	N Martinique	15	1556	SSE	TN	LL	Brad Haskell NMFS Obs.	MA
" "	E Mayport, FL	Ponte Verde Beach, FL	25	21	S	RR	RR	Cathi Frascello	FL
" "	S Shinnecock, NY	SE Ocean City, NJ	12	123	SW	RR	RR	Floyd Carrington	NY
" "	SE Moriches, NY	E Barnegat Inl., NJ	1	83	SW	RR	RR	Vin Pascale	NY
" "	S Shinnecock, NY	SSE Atlantic City, NJ	<1	100	SW	RR	RR	Vin Pascale	NY
" "	E Eleuthera, Bahamas	W Rum Cay, Bahamas	24	61	S	LL	LL	Stephen Connett	RI
" "	E Cape May, NJ	E Ocean City, MD	1	36	S	RR	RR	Rich Hineline	NJ
" "	Bimini, Bahamas	ENE Ft. Pierce, FL	7	122	NW	LL	LL	Ron Schatman	FL
Lemon shark	Islamorada Keys, FL	Islamorada Keys, FL	1	2	E	RR	RR	Ted Avellone	FL
" "	Islamorada Keys, FL	Islamorada Keys, FL	<1	1	E	RR	RR	Ted Avellone	FL
" "	Islamorada Keys, FL	Islamorada Keys, FL	1	0		RR	RR	Ted Avellone	FL
" "	Islamorada Keys, FL	Islamorada Keys, FL	1	0		RR	RR	Ted Avellone	FL
" "	Islamorada Keys, FL	Islamorada Keys, FL	<1	0		RR	RR	Ted Avellone	FL
" "	Islamorada Keys, FL	Islamorada Keys, FL	<1	0		RR	RR	Ted Avellone	FL
" "	Chesapeake Tower, VA	Magothy Bay, VA	10	11	W	RR	LL	Michael Halperin	VA
" "	Islamorada Keys, FL	Islamorada Keys, FL	2	0		RR	RR	Ted Avellone	FL
Dusky shark	SW Miss. R., MS	S of S Pass, MS	<1	78	NE	EMB	HL	Floyd Condit	TX
" "	Wassau Sound, GA	Atlantic Beach, FL	51	93	S	RR	RR	Hank Page	GA
" "	W Bermuda	SW Bermuda	25	18	NE	LL	LL	Stephen Connett	RI
" "	Cape Hatteras Fish. Pier, NC	SE Cape Hatteras, NC	4	19	E	RR	GN	Sharon Buhls	VA
" "	S Jones Inl, NY	NE Oregon Inl, NC	26	270	S	RR	TN	John Pope	NY
" "	SE Fire Is., NY	SE Cape Hatteras, NC	4	319	S	RR	TN	Bill Russo	NY
Silky shark	E Delray Beach, FL	S Bay Cabonas, Cuba	9	310	SW	LL	HP	Ron Schatman	FL
" "	SE Palm Beach, FL	N Palm Beach,FL	3	31	NW	LL	RR	Ron Schatman	FL
" "	E Eleuthera, Bahamas	S Cape Eleuthera, Bahamas	28	11	W	LL	RR	Stephen Connett	RI
" "	SSE Miami, FL	NE Ft. Pierce, FL	<1	150	NE	LL	LL	Stephen Connett	RI
Blacktip shark	NE Key West, FL	NE Key West, FL	1	1	E	RR	HL	Raymond Lovell	FL
" "	E St. Augustine, FL	E Mayport, FL	<1	34	N	RR	RR	Buddy Robey	FL
" "	SSE Grand Isle, LA	SSE Grand Isle, LA	<1	6	SE	RR	RR	Rich Pitre	LA
Nurse shark	E Vaca Key, FL	Key Colony, FL	21	4	W	HL	RR	William Botten	FL
" "	Coral World, St. Thomas,W.I.	SE St. Thomas, W.I.	7	9	E	FS	SG	Joe Bycz	Vir.Is
" "	Satellite Beach, FL	Satellite Beach, FL	2	0		RR	RR	Joe Wasneski	FL
Night shark	E Ft. Lauderdale, FL	W Key West, FL	5	245	SW	LL	LL	Ron Schatman	FL
" "	E Ft. Lauderdale, FL	E Brunswick, GA	17	300	N	LL	LL	Ron Schatman	FL
" "	NE Miami, FL	SW St. Petersburg, FL	9	452	W	LL	LL	Ron Schatman	FL
Longfin mako	E Ocean City, MD	E Ocean City, MD	10	434	E	LL	LL	Brad Walters NMFS Obs.	MS
" "	WNW Dry Tortugas, FL	SE Cape Canaveral, FL	14	859	NE	LL	LL	Gary Spake NMFS Obs.	MS
Scalloped hammerhead	NE Charleston, SC	SE Charleston, SC	49	32	E	LL	LL	Biologist	RI
Bigeye thresher	SE Cape Cod, MA	E Bermuda	3	1048	E	LL	LL	Charles Harp NMFS Obs.	MS
Sharpnose shark	Ponte Vedra Beach, FL	NNE Fernandina Beach, FL	5	57	N	BS	TN	Rose Sarkees	FL
Bignose shark	NE Mayport, FL	E St. Simons Is., GA	13	41	N	RR	RR	Tom Hurst	FL
Springeri (reef)	W Freeport, Bahamas	S Freeport, Bahamas	13	16	W	LL	RR	Stephen Connett	RI
Amberjack	E Jacksonville, FL	E Miami, FL	25	282	S	LL	RR	Biologist	RI
Swordfish	SE Marthas Vineyard, MA	ESE Barnegat Inl., NJ	11	197	W	LL	LL	NMFS Obs.	MS
"	NW Dry Tortugas, FL	SW Try Tortugas, FL	21	104	E	LL	LL	Ted Malley	FL
"	SE Cape Hatteras, NC	E West Palm Beach, FL	3	561	SW	LL	LL	Phil Ruhle, Sr.	RI
"	SSE Montauk, NY	ESE Nantucket, MA	24	177	E	LL	HP	Phil Ruhle, Jr.	RI

NOTE: BS = Beach Seine; EMB=Embryo; FS=Free Swimming; GN=Gill Net; HL=Hand Line; HP=Harpoon; LL=Longline; NR=Not Reported; Obs.=Foreign Fisheries Observer; RR=Rod & Reel; SG=Speargun; and TN=Trawl Net.

ESTIMATES OF THE U.S. RECREATIONAL CATCH OF SHARKS IN THE ATLANTIC

The primary consideration of the Fishery Conservation and Management Act (FCMA) is to provide for the needs of U.S. interests through the development of fishery management plans (FMP's). These FMP's provide estimates of the optimum sustainable yield for each species (or species group), how much is needed by U.S. fishermen, and whether or not any surplus is available for foreign nations. Although tuna are excluded from the FCMA, the by-catch of sharks and billfish is within the jurisdiction of the law. In the Western North Atlantic, several nations including Canada, Cuba, Denmark, Japan, Korea, Norway, and the United States participate in pelagic longline fisheries primarily directed at tuna and swordfish. During the preparation of the preliminary management plan (PMP) for sharks we were asked to provide estimates of the recreational catch of sharks along the east coast of the U.S., including the Gulf of Mexico.

We examined several past national surveys and decided that the most recent survey, directed specifically at sport fishing for billfish and sharks, provided the "best available data" on the numbers of sharks caught (dogfish were excluded). We compared our tagging data for 1963 through 1982 to the number and species composition data in that survey, (Hamm and Slater, 1979, NOAA Tech. Memo SEFC-5, 169 pp). Average weights for each species, from measurements obtained aboard research vessels and from your catches at tournaments, were then applied to the numerical estimates from the survey. Results of our analysis showed recreational fishermen caught 230,000 sharks weighing 22.7 million pounds (overall average 98.1 lb per shark, although average size differed slightly in different regions). Most of the shark catch was in the northeast between Maine and Cape Hatteras, N.C. (54%), followed by the southeast from Cape Hatteras to the Florida Keys (26%) and the Gulf of Mexico (20%). Blue sharks dominated the overall catch (98,000 sharks, 8.4 million pounds), followed by hammerheads (23,503 sharks, 2.6 million pounds), and mako sharks (17, 973 sharks, 2.7 million pounds). As a species complex, blacktip, dusky, bull, sandbar, and other carcharhinid sharks were important (76,000 sharks, 7.0 million pounds), particularly in the southeast and Gulf of Mexico. Additional species, including tiger, thresher, and nurse sharks, represented 6% of the total catch (approximately 14,600 sharks, 2.0 million pounds). These results generally agree with our tagging records that show the recreational shark fishery has been most intensive in the Middle Atlantic Bight (Cape Cod, Mass. to Cape Hatte-

ESTIMATES *(Continued from page 5)*

ras, N.C.). Since the completion of the survey in 1978, however, we have noticed a marked increase in the recreational shark fishery in the Gulf of Mexico and along the east coast south of Virginia. The number of taggers and shark tournaments has also increased in other areas. This continued expansion of the recreational fishery generally indicates that our 22.7 million pound estimate may be conservative, and in fact, well below the current actual catch. Although some large sharks are released, catches of young sharks from inshore waters are not included in any survey. These catches may be considerable in some areas.

In any event, the importance of sharks to U.S. fisheries has been clearly recognized in the fishery management plan for sharks. Our calculations and estimates were described in a laboratory report that was submitted to the Management Councils together with information from other sources on commercial shark catches in the Fishery Conservation and Management zone. Partially due to the size and economic value of the recreational fishery, the current management plan allows for a total foreign allocation of only 1,150 metric tons (2.5 million pounds) of sharks. In terms of commercial fisheries this is an insignificant amount which seems to have discouraged foreign nations from requesting an allocation of sharks. Only the Faroe Islanders have requested and received an allocation of 500 metric tons (1.1 million pounds) of porbeagles and to date that allocation has not been reached in any year since 1978. All other sharks taken by foreign fishermen must be returned to the sea.

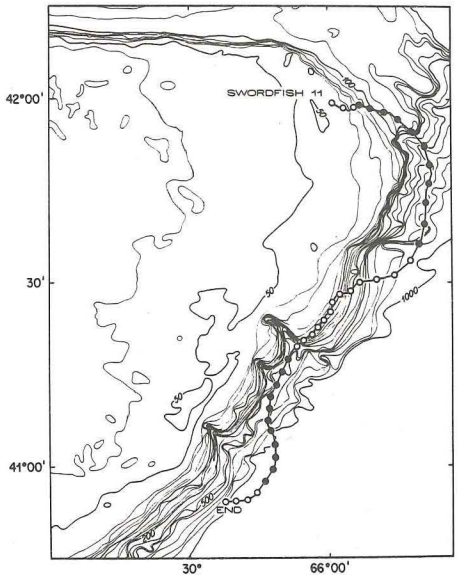
We provided this update in answer to questions about catches and regulations relating to sharks. There are no regulations on sharks that apply to U.S. fishermen. Whether there ever will be, will depend on the future demands for sharks in our domestic fisheries.

AN ACOUSTIC TELEMETRY EXPERIMENT WITH SWORDFISH

Partial support for research on large apex predators by Dr. Frank Carey (WHOI) has been provided by NMFS. The following is his report of a recent experiment.

As part of our research on large pelagic fishes we have conducted a number of experiments in which transmitters are attached to billfish, sharks or tunas, allowing us to follow them in course and depth as they swim free in the open ocean. From such experiments we learned that swordfish make a regular daily migration between the surface at night and depths as great as 600 m during the day. In the open ocean these vertical movements are related to light. The swordfish leaves the surface at first light just before dawn and comes back up just after sunset. In a number of places in the world, however, swordfish may be found basking or finning on the surface during the day. These fish may be approached by a boat and harpooned. This behavior is quite different from the daily vertical migration and we wondered how the two activities were related.

Last summer we had an opportunity to work with swordfish in the harpoon fishery on Georges Bank. NOAA-NMFS provided us with a research vessel, the *Gloria Michelle*, which we equipped for following swordfish. We were using transmitters which told the depth of the fish and its muscle temperature from a thermistor in the harpoon dart. During such an experiment we measure daily changes in environmental features such as light intensity and water temperature structure with depth, using instruments lowered from the research vessel. On this cruise we also had a powerful echo sounder which allowed us to visualize the presence of some of the other organisms in the water with our experimental fish.



On 29 August we were working with the fishing vessel *Gale* out of New Bedford. At 2 PM the pilot of the *Gale's* spotting plane found a 250 lb swordfish on the surface on the northeast peak of Georges Bank. Captain William Gell harpooned our depth and temperature transmitters into the fish and we returned to the *Gloria Michelle* to follow it for two days.

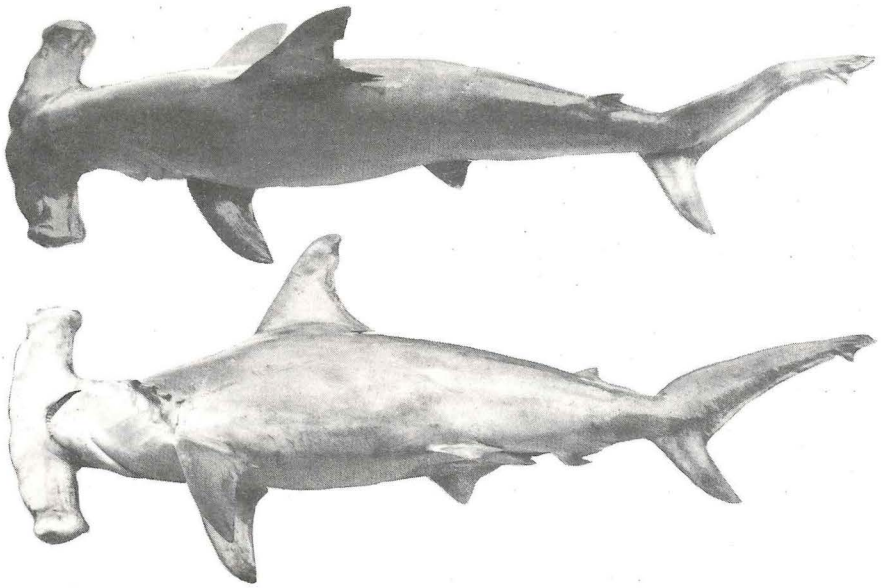
The swordfish swam near the surface in the upper 20 meters and left Georges Bank by the Northeast Channel (Figure 1). It spent the night on the surface and moved at a steady speed of 3 knots to the southwest. At dawn the next morning, it turned toward the bank and when over the 300 fathom curve, dove and swam along the bottom on the edge of the bank for the rest of the day. The echo sounder showed an aggregation of small fish or squid within 10 meters of the bottom. The swordfish stayed in the vicinity of these echo returns and ignored the abundance of organisms that the echo sounder detected in overlying waters.

In the late afternoon the swordfish reached the edge of Corsair Canyon at 300 m. It rose up from the bottom and in less than 3 minutes lept out of the water right in front of our bow. We burned our supper as we all crowded forward to watch it breech about 8 times in 10 minutes.

The swordfish again spent the night near the surface over deep water. As the sky began to lighten, it turned toward the bank again and before dawn, it was swimming down with the animals of the main sound scattering layer which we could follow with the echo sounder. The swordfish and the sound scattering layer had reached a depth of 350 meters by 9 AM when we abandoned it to head home to Narragansett. We had followed the fish for 42 hours over a distance of 105 miles.

The muscle temperature record during the experiment showed that the swordfish cooled slowly when it swam through the thermocline into cold water, but warmed rapidly when it returned to warm surface water. The "basking" behavior of swordfish may be related to such changes in body temperature. We hope to continue these experiments next year and would welcome assistance from interested fishermen.

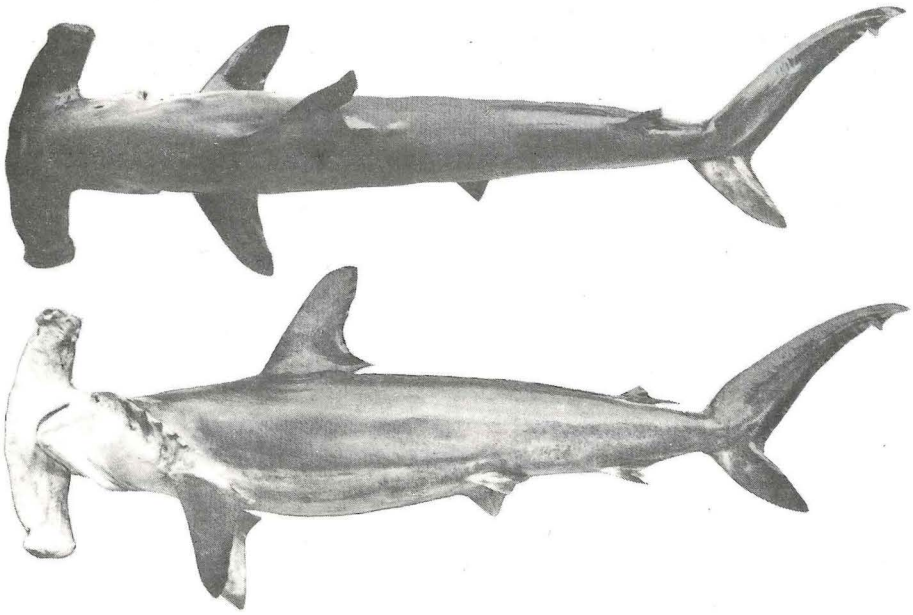
THE TEMPERATE HAMMERHEADS
FAMILY SPHYRNIDAE



SCALLOPED HAMMERHEAD

Sphyrna Lewini

* Head indented at midline
* Corners of mouth behind head
* Teeth smooth
* Maximum size 13 ft.



SMOOTH HAMMERHEAD

Sphyrna Zygaena

* Margin of head smooth
* Corners of mouth even with head
* Teeth of adults saw-edged
* Rear tip of second dorsal closer to tail than scalloped
* Maximum size 14 ft.

THE TEMPERATE HAMMERHEADS

The scalloped hammerhead (*Sphyrna lewini*) and the smooth hammerhead (*Sphyrna zygaena*) are the two species of hammerhead sharks that commonly migrate north of Cape Hatteras, N.C. They are separated by the presence or absence of a distinct indentation in the midline of the head of the scalloped hammerhead; the smooth hammerhead has only a slight indentation. The teeth of the scalloped hammerhead are smooth-edged and the corners of the mouth are behind the rear margin of the head. The great hammerhead (*Sphyrna mokarran*) also has an indented head but adults are distinctive in having a "hammer" at right angles to the midline instead of swept back as in the scalloped and smooth hammerheads. Both the upper and lower teeth of the great hammerhead are serrated (saw-edged). The great hammerhead is tropical in distribution and has not been reported north of Cape Hatteras. There are three additional species of hammerheads that occur in the western Atlantic: the bonnethead (*Sphyrna tiburo*), a small (less than 6 ft) inshore species with a "shovel" head; and two South American species *Sphyrna media* and *S. tudes* which venture into the Southern Caribbean but do not overlap the ranges of the scalloped and smooth hammerheads and are not likely to be taken by U.S. anglers. Casey's "Angler's Guide to Sharks..." provides details of the first four species. Our supplies of this guide are depleted. Copies are available for $1.50, from: The American Littoral Society, Highlands, NJ 07732.

Continued from Page 3.

ture grew an average of 5.2 cm a year (1 to 10 years at liberty). Six of these sharks measured at tagging and recapture by the authors (after 1 to 5 years) grew an average of 4.1 cm a year. The following recaptures are examples that illustrate growth rates for different sizes and time at liberty. A 47 cm sandbar which we carefully measured at tag and recovery showed less than 3 cm growth between mid-July and mid-September. Another shark, a 99 cm male we tagged in Virginia was recaptured 15 years later by a gillnet fisherman off Rhode Island. Although the fisherman did not measure the length of the shark, it was one of 26 juvenile sandbar sharks he caught and sold on the same day. The weights of the sharks and discussions with the fisherman established the best fork length estimate for the tagged shark was between 130 and 148 cm. Since the minimum fork length at maturity in male sandbar sharks is about 150 cm, and mature male sandbar sharks are usually found segregated from juveniles, this individual could have been immature at an estimated age of 23 years. A recent return came from a 92 cm female we measured in Virginia in 1965 that was recaptured 17 years later near Campeche, Mexico. The reported length of 125 cm at recapture appears underestimated (1.9 cm/yr) but assuming the shark had reached an average adult size of 175 cm it would still show a relatively slow growth rate of 4.8 cm/yr. Individual recaptures from large sandbar sharks also show extremely slow growth. In September 1966 an adult male was caught from shore at Edisto Beach, S.C. The shark was hauled to the beach, measured, tagged, photographed and released. Ten years later when it was recaptured and measured at Jacksonville, Fla., it showed little, if any, growth. The photograph confirmed it was a large male at tagging and its total length at recapture (223 cm) was only 2.5 cm less than the maximum reported size for males. Assuming males mature at about 15 years this individual was at least 25 years old. This recapture and others suggest that this species may live for 30 years or more.

Manuscripts for the mako and sandbar sharks were presented at an International Age and Growth Workshop held in Miami, Fla., during February 1982. Much of the material for these studies was collected during the past several years on research and commercial vessels and at shark fishing tournaments from Massachusetts to New Jersey. We are grateful to those of you who allowed us to collect samples from your shark catches and particularly to you taggers who have contributed so much to our research.

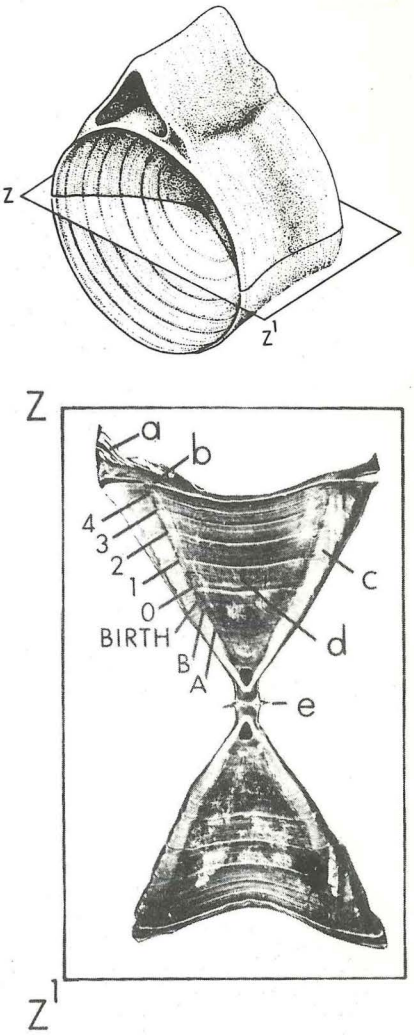


FIGURE 1

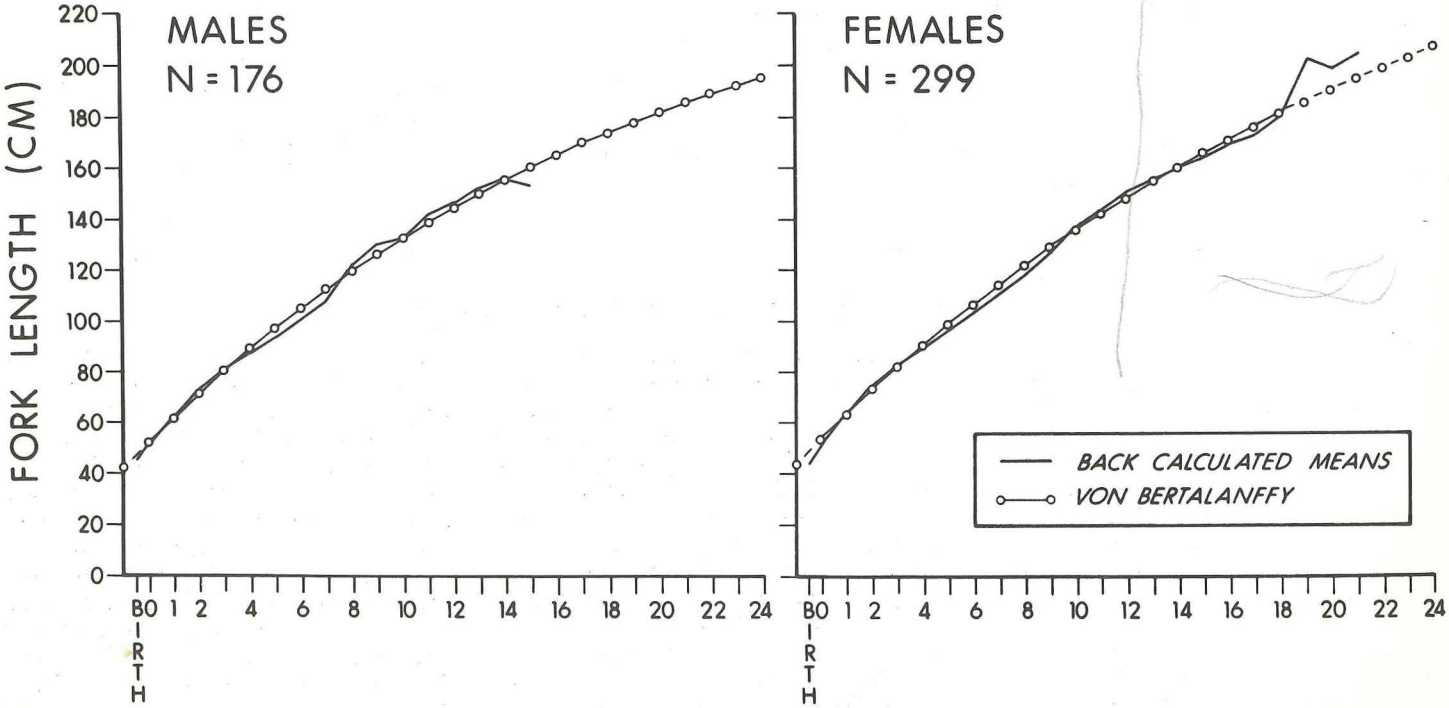


FIGURE 2