



NORTHEAST FISHERIES CENTER

NEWSLETTER

MAY-JUNE 1983

SPOTLIGHT:

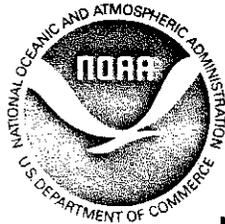
*APEX PREDATORS: A GROWING FISHERY AND A GROWING NEED FOR BIOLOGICAL INFORMATION FOR THE WISE MANAGEMENT OF THE NORTH ATLANTIC'S LARGE SHARKS, TUNAS, BILLFISHES, AND SWORDFISH.....1

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US DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
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"NORTHEAST FISHERIES CENTER NEWSLETTER"

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**APEX PREDATORS: A GROWING FISHERY AND A GROWING NEED
FOR BIOLOGICAL INFORMATION FOR THE WISE MANAGEMENT OF THE
NORTHWEST ATLANTIC'S LARGE SHARKS, TUNAS, BILLFISHES, AND SWORDFISH**

by

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Apex Predators Investigation, Marine Ecosystems Division

INTRODUCTION

Fishery

The growth of big-game recreational fishing and of high-seas commercial fishing has focused attention on the need for wise management of the world's stocks of large sharks, tunas, billfishes, and swordfish--the apex predators of the marine environment. In fact, present evidence suggests that the decreased stock abundance of giant bluefin tuna and swordfish is the result of increased fishing pressure.

In the Northwest Atlantic, the most abundant stocks of apex predators regarded as "big game" are the large sharks. These stocks are currently virgin populations with respect to commercial fishing, but since the world's annual landings of sharks, skates, and rays are nearly 1.3 billion pounds, the future development of commercial fisheries for the Northwest Atlantic's sharks seems assured. Moreover, in the demand for big-game species, sharks are of considerable and growing importance to U.S. recreational interests. The most recent survey of recreational fishing shows that an estimated 230,432 large sharks (22.6 million pounds) were landed in 1979. All indications are that large sharks will continue to be increasingly important in meeting the needs of our domestic fisheries--both recreational and commercial.

Management

Any management initiatives directed toward optimum utilization and allocation of large sharks, swordfish, and other apex predators require baseline biological information on their migration, feeding, growth, maturity, reproduction, mortality, and other elements of population dynamics and life history. However, for many species this information is incomplete or lacking. With respect to large sharks, the best available data have been used to develop preliminary fishery management plans that currently provide only a small (1,150 tons) allocation of large sharks to foreign fishermen who are allowed to fish within the U.S. Fishery Conservation Zone. The successful management of these and other apex predators (tunas, swordfish, etc.) demands solid statistical information on population sizes, amounts caught, and replenishment rates.

Research

Accordingly, the Apex Predators Investigation conducts biological studies of stocks of large oceanic gamefish to provide needed information for their management. These studies have six objectives: (1) delineate population structure and migration patterns of large sharks through tagging

Table 1. Apex predators tagged by cooperating taggers and National Marine Fisheries Service biologists during 1963-82.

Species	Sex			Total	Species	Sex			Total
	Male	Female	Unknown			Male	Female	Unknown	
Shark (a)	29	39	68	136	Media hammerhead shark	0	1	0	1
Sandbar shark	1914	2740	562	5237	Florida smoothhound shark	4	3	0	7
Blue shark	10823	7440	6345	24742	Carcharhinus (a)	25	26	26	77
Dusky shark	637	1434	1164	3239	Wahoo	0	0	3	3
Bull shark	65	107	44	217	Bluefin tuna	1	1	81	83
Blacktip shark	193	381	135	710	Skipjack tuna	0	0	1	1
Spinner shark	50	63	39	153	Bigeye tuna	0	0	3	3
Oceanic whitetip shark	69	87	16	319	Yellowfin tuna	1	1	16	18
Silky shark	148	193	256	599	Albacore	1	0	2	3
White shark	12	15	23	50	Blackfin tuna	0	0	1	1
Shortfin mako shark	283	387	519	1192	Atlantic bonito	1	0	10	11
Porbeagle shark	11	16	28	55	Squid	0	0	24	24
Sand tiger shark	107	133	37	279	Dolphin	2	2	8	12
Spiny dogfish shark	52	97	19	171	Bluefish	0	1	18	19
Smooth dogfish shark	94	144	44	287	Amberjack	1	0	14	15
Bonnethead shark	109	121	70	301	Tuna (a)	0	0	25	25
Great hammerhead shark	24	25	24	73	Summer flounder	0	0	1	1
Scalloped hammerhead shark	293	456	184	934	Permit	0	0	4	4
Smooth hammerhead shark	24	28	10	62	Bonefish	0	0	2	2
Atlantic sharpnose shark	310	361	76	755	Barracuda	0	2	4	6
Blacknose shark	60	146	4	210	Marine mammals	0	1	6	7
Tiger shark	160	347	198	707	Swordfish	3	4	563	574
Finetooth shark	37	30	5	72	Sailfish	1	4	69	74
Lemon shark	112	194	59	366	White marlin	2	1	162	165
Nurse shark	96	99	47	242	Black marlin	0	0	7	7
Bigeye thresher shark	38	21	60	119	Blue marlin	0	0	17	17
Common thresher shark	11	10	11	32	Longbill spearfish	0	0	1	1
Night shark	17	31	59	107	Striped marlin	0	1	9	10
Bignose shark	23	36	10	69	Crevalle jack	0	0	3	3
Angel shark	4	12	4	20	Oiler shark (a)	0	0	2	2
Small tail shark	3	14	4	21	Reef shark	56	96	29	181
Hammerhead shark (a)	99	123	137	360	Pacific angel shark	0	0	1	1
Dogfish shark (a)	5	10	1	16	King mackerel	0	0	1	1
Thresher shark (a)	12	8	14	34	Shortnose lancetfish	0	0	1	1
Sand shark (a)	16	35	34	85	Longfin mako shark	13	4	8	25
Brown shark (a)	526	1536	751	2816	Escolar (Snake mackerel)	0	0	3	3
Grey shark (a)	4	3	8	15	Greenland shark	0	5	0	5
Sting ray (a)	0	2	5	7	Black turtle (a)	0	0	5	5
Blacktip shark (a)	116	158	82	357	Green turtle	0	0	1	1
Brown/Dusky shark (a)	11	53	36	100	Leatherback turtle	0	0	2	2
Basking shark	9	5	29	43	Galapagos shark	3	4	3	10
Leopard shark	0	3	0	3	Loggerhead turtle	0	0	5	5
Eagle ray	1	0	2	3	Tarpon	0	0	1	1
Cownose ray	0	1	1	2	Centrophorus granulosus	0	3	0	3
Clearnose skate	3	7	0	10	Hexanchus vitulus	2	3	0	5
Ray (a)	2	1	3	6	Total	16728	17315	12515	46748

(a) Species not specified.

studies that utilize assistance from volunteer recreational and commercial fishermen; (2) collect biological samples required for life history studies by monitoring selected sport fishing tournaments along the Northeast Coast; (3) obtain catch-and-effort data necessary to establish annual abundance indices in areas of intensive sport fishing; (4) measure the impact of shark predation on populations of important marine species inhabiting the Northeast's continental shelf, including bluefish, squids, Atlantic mackerel, butterfish, Atlantic cod, and haddock; (5) correlate ecological conditions (water temperature, prey abundance, etc.) with biological indices (migratory behavior, food habits, etc.) of large sharks; and (6) publish results in scientific media and provide timely and practical information to technical and popular constituencies (other elements of our own agency, other federal agencies, regional fishery management councils, states, fishing public, academic institutions, etc.).

Ongoing research emphasizes the population structure, migratory behavior, age & growth, food habits, and reproductive habits of several species of large sharks. Future research will emphasize population dynamics information necessary for making stock assessments and determining potential yields of the more abundant species of large sharks.

DATA SOURCES

We gather our data primarily from four sources--a tagging program, fishing tournaments, research cruises, and contract research. The NMFS Cooperative Shark Tagging Program relies on 2,500 volunteer recreational fishermen, commercial fishermen, and fishery biologists to tag and release large oceanic gamefish, principally sharks, and to return tags from recaptured individuals (Figure 1). Tagging occurs along the U.S. East and Gulf Coasts, and the coasts of Europe and Africa. We maintain contact with the 2,500 cooperators through issuance of the "Shark Tagger," a semiannual newsletter that summarizes the Investigation's accomplishments during the preceeding year. Since the Program began nearly two decades ago, 47,000 sharks and other apex predators have been tagged (Table 1). Tags recovered from 1,500 fish (Table 2) have provided new information on several species of sharks with respect to seasonal occurrence and distribution, rates of travel, migratory behavior, and growth rates.

To collect biological samples and data on food habits, reproduction, and age & growth we attend shark fishing tournaments during the summer months and participate on research and commercial vessel cruises as opportunities permit. Sport tournaments alone permit us to examine several hundred sharks each season.

The National Marine Fisheries Service has helped fund, and the Apex Predators Investigation has cooperated in, studies by Dr. Frank Carey of the Woods Hole Oceanographic Institution in sonic-tracking experiments on blue, mako, and white sharks, as well as swordfish. These experiments deal with: diurnal behavior in response to light, temperature, and depth; physiological parameters such as body (muscle) temperature; and food digestion as indicated by increased stomach temperature due to increased gastric activity.

Table 2. Sharks and teleosts recaptured by cooperating taggers and National Marine Fisheries Service biologists during 1963-82.

Species	Sex			Total
	Male	Female	Unknown	
Shark (a)	0	0	1	1
Sandbar shark	82	120	26	230
Blue shark	260	403	191	858
Dusky shark	14	13	14	41
Bull shark	0	1	1	2
Blacktip shark	7	15	8	30
Spinner shark	3	1	3	7
Oceanic whitetip shark	0	1	0	1
Silky shark	5	8	12	25
Shortfin mako shark	31	25	19	75
Sand tiger shark	3	5	6	14
Spiny dogfish shark	0	3	2	5
Smooth dogfish shark	0	8	3	11
Bonnethead shark	0	2	4	6
Scalloped hammerhead shark	2	9	0	11
Smooth hammerhead shark	0	2	1	3
Atlantic sharpnose shark	5	1	2	8
Blacknose shark	1	1	0	2
Tiger shark	6	22	5	33
Lemon shark	9	7	4	20
Nurse shark	7	6	3	16
Bigeye thresher shark	0	1	1	2
Night shark	1	4	1	7
Bignose shark	1	1	0	2
Hammerhead shark (a)	1	4	2	7
Brown shark (a)	1	2	3	6
Grey shark (a)	1	2	1	4
Sting ray (a)	0	1	0	1
Blacktip shark (a)	1	3	6	10
Brown/Dusky shark (a)	1	2	6	9
Bluefin tuna	0	0	20	20
Amberjack	0	0	2	2
Swordfish	0	0	16	16
White marlin	0	0	1	1
Crevalle jack	0	0	1	1
Reef shark	1	0	0	1
Longfish mako shark	3	0	1	4
Total	446	673	366	1492

(a) Species not specified.

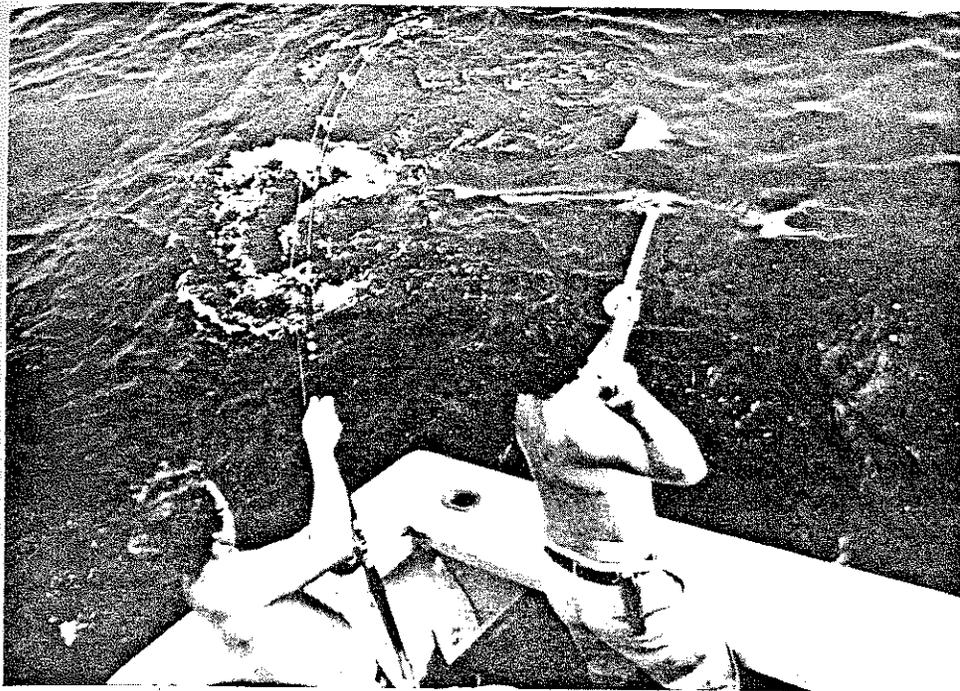


Figure 1. Sportsmen tagging a blue shark as part of the NMFS Cooperative Shark Tagging Program.

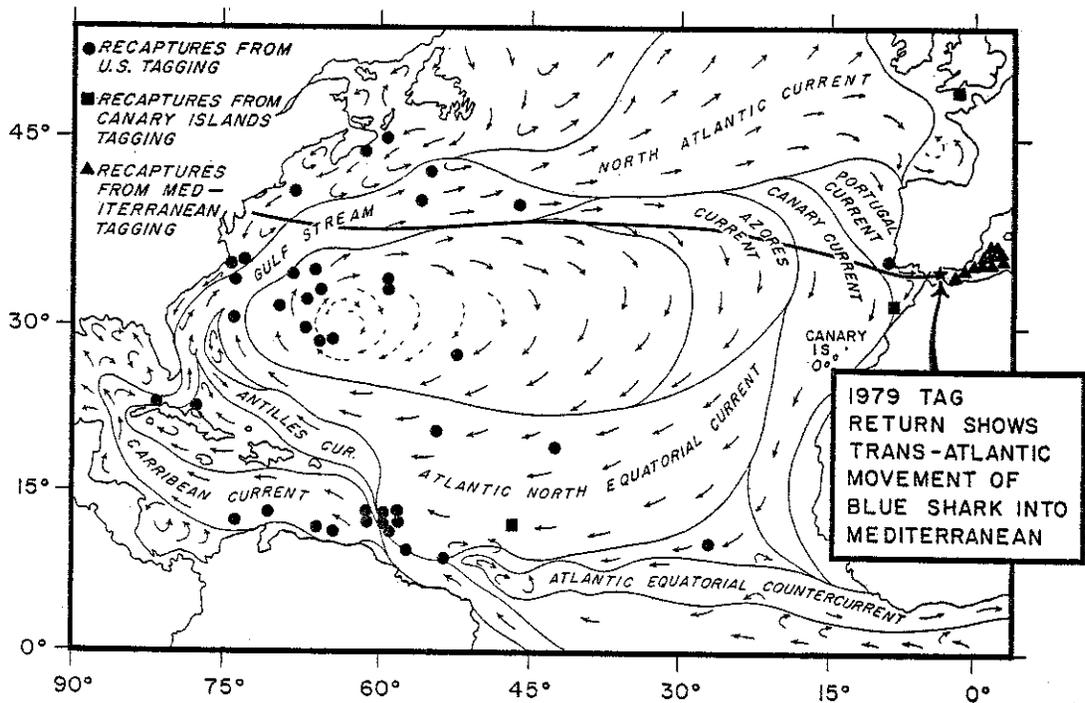


Figure 2. Distribution of tag-recaptured blue sharks in relation to current patterns occurring in the North Atlantic.

DATA PROCESSING

We have designed and implemented a data processing system to help analyze our tag-return and length/weight records from over 100,000 Atlantic sharks, tunas, and swordfish, and to summarize longline catch records for sharks and swordfish taken by research and commercial vessels over the last 20 years. This data base has contributed to the preparation of: (1) seasonal distribution charts for 10 major apex predator species; (2) length/weight relationships for several big-game sharks; and (3) the "Atlantic Billfishes and Sharks Preliminary Fishery Management Plan," under which the Northwest Atlantic's large sharks are currently managed.

RESEARCH FINDINGS

Below are findings on our recent research in four areas: migrations, predator-prey interactions, growth, and reproduction. Upcoming research will be targeted for improved assessment, particularly population estimates, of sharks inhabiting the Northwest Atlantic.

Migrations

Tagged sharks have been recaptured after 17 years at liberty and over 3,000 miles from the point of tagging. Recaptures have been made by U.S. recreational and commercial fishermen and by foreign fishermen representing 18 countries. Blue sharks have demonstrated the most dramatic movements (Figure 2). Individuals tagged in the New York Bight have migrated to the coast of Europe, the Cape Verde Islands, the Caribbean, and off the northeast coast of South America. Those tagged around the Canary Islands have in turn moved several hundred miles southeast to be recaptured a few hundred miles off the coast of French Guiana and Surinam, South America. Recently, a blue shark tagged 600 miles north of the equator, off the Cape Verde Islands, was recaptured 600 miles south of the equator. This is our first evidence of transequatorial movement for the species.

Future research will be targeted for improved forecasting of shark distribution and availability to fishing interests.

Predator-Prey Interactions

To evaluate the impact of apex predators on other fisheries resources, it is necessary to know the daily and annual food consumption rates for the apex predators, and the species composition of their prey. Our food studies show that the average mako shark will consume at least three percent of its body weight per day and 8-11 times its weight per year. Bluefish constitute 77.5 percent of the mako's diet by volume in this area. Estimates of the mako's depredation on the bluefish population between Cape Hatteras and Georges Bank run as high as 39 million pounds of bluefish, approximately 14.5 percent of the bluefish biomass. Because of their maneuverability and aggressive nature, makos obviously have no difficulty in pursuing and capturing bluefish from behind, often ingesting large (15-20 pounds) individuals in three or four consecutive bites (Figure 3).

Similar statistics for the blue shark and swordfish suggest that daily rations amount to 0.4 percent and 1.0-1.7 percent of the average body

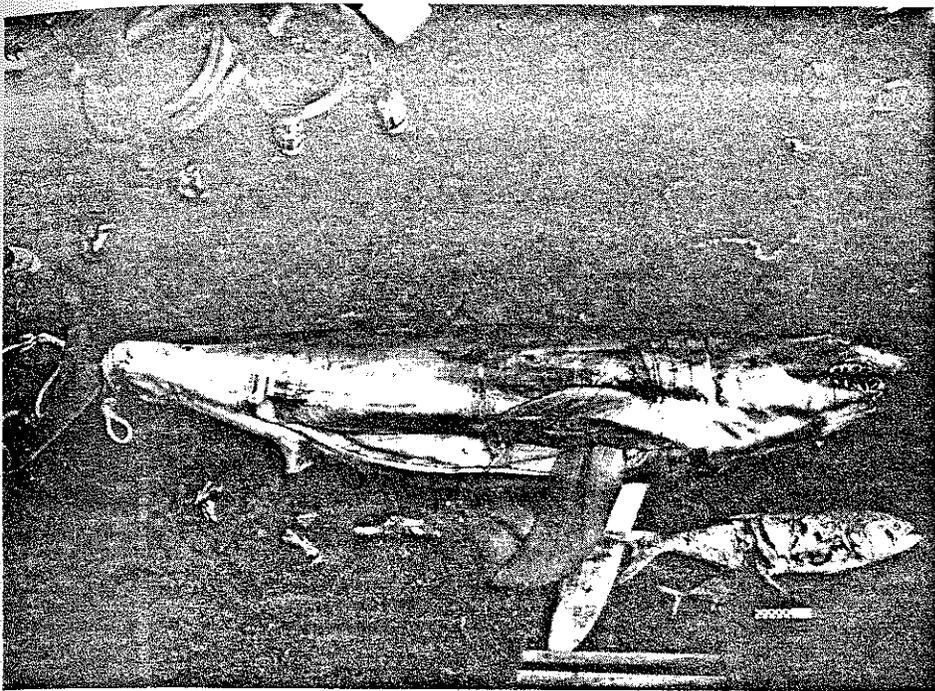


Figure 3. Mako shark (512 pounds) with bluefish prey (15 pounds).

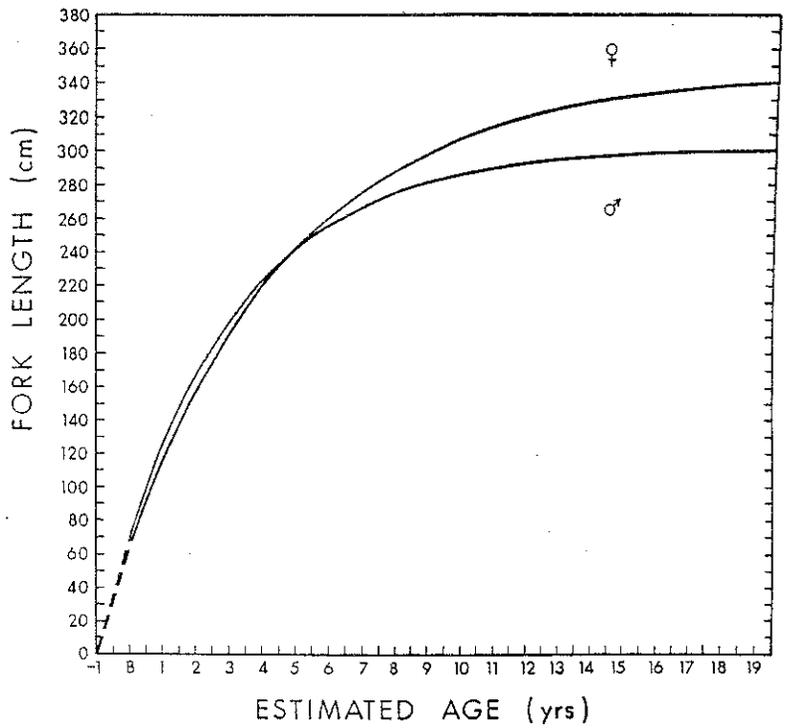


Figure 4. Calculated length-at-age curves for male and female mako sharks.

weight, and that yearly consumption rates amount to 1.4 and 3.6-6.2 times the average body weight, respectively.

Future research will be targeted for improved estimates of the short-term effects of apex predation on recreationally and commercially important species (bluefish, haddock, Atlantic cod, squids, etc.), as well as the long-term effects on overall fish production on the Northeast's continental shelf ecosystem.

Growth

We have developed histological techniques that reveal growth zones in vertebrae. Our measurements of these vertebral growth zones, in comparison with length-frequency and tag-recapture data, have permitted us to calculate length-at-age estimates for sandbar and mako sharks (Figure 4).

Age & growth studies of sharks will continue, particularly for species of value to the recreational and commercial fishing interests. Most recently, analysis of vertebral samples and length/weight data for the great white shark was initiated.

Reproduction

Understanding a species' reproductive biology is essential for successfully managing any fishery resource. To date, our studies of elasmobranch (sharks, skates, and rays) reproduction has focused on the blue shark, the most abundant pelagic shark occurring off the U.S. East Coast. Findings show that both sexes mature at about 183 centimeters (fork length). Males produce spermatozoa year-round, and although mating appears most prevalent during the summer, fertilization does not occur until the following spring. Females usually produce litters of 45-80 pups following gestation periods of 9-12 months (Figure 5).

Methods of reproduction in elasmobranchs include depositing encapsulated eggs and birthing well-developed young. These protective methods may well be the key to elasmobranch success in the marine environment.

ANCILLARY EFFORTS

Opportunities to examine large individuals of most shark species occur rarely. This is more so the case with the great white shark, since few are caught and even fewer are landed (Figure 6). For this reason, in the course of our regular work over the past 20 years, we have accumulated biological data on this enormous predator to better understand its life history. Our data base on white sharks, which includes a sightings file and the detailed examinations from 127 individuals, is one of the most extensive in the world. Although white sharks are among the most efficient predators in the sea, their relatively low reproductive rate serves to maintain their population at low levels.

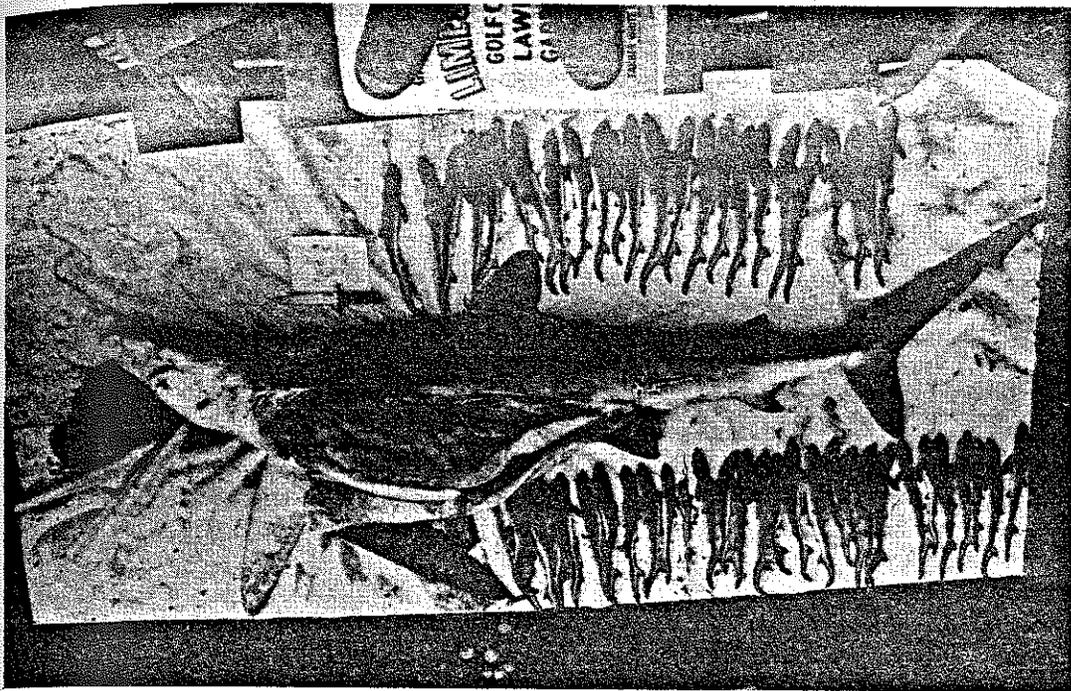


Figure 5. Pregnant female blue shark with 52 embryos close to full-term development. Captured in June off Bayshore, Long Island, New York.

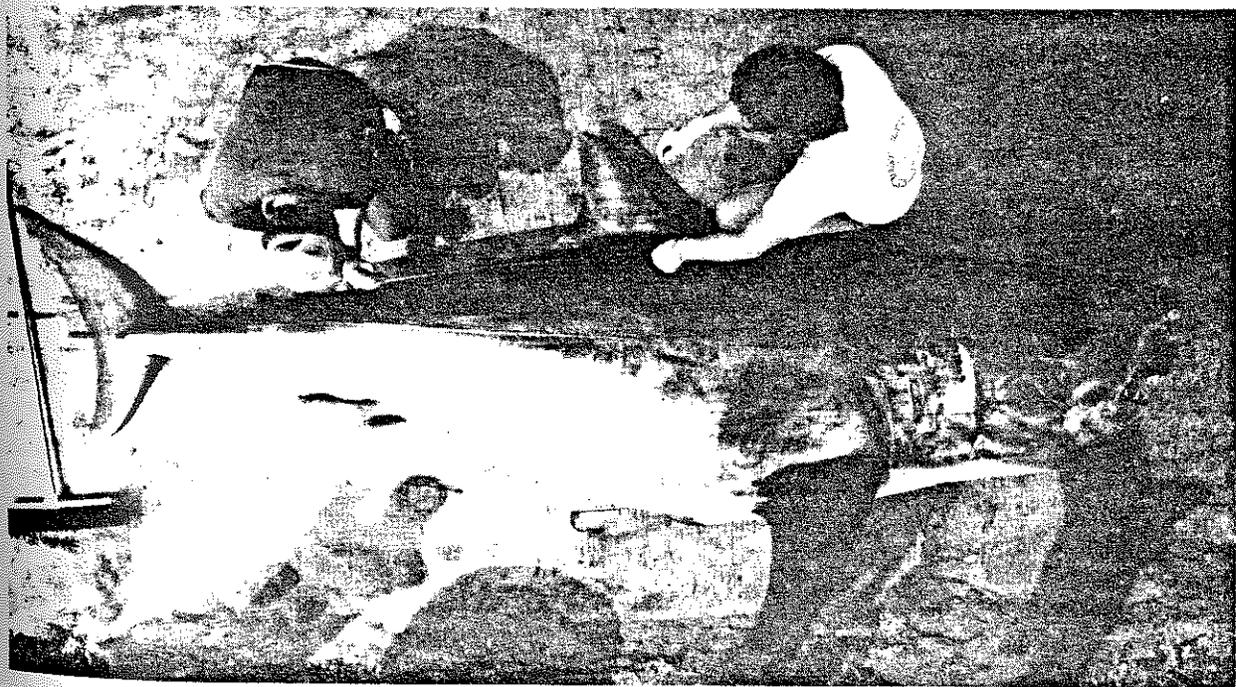


Figure 6. National Marine Fisheries Service biologists measuring and examining a 15-foot, 2,075-pound great white shark captured off Moriches Inlet, New York, on 29 June 1979.

COOPERATIVE ARRANGEMENTS

The physical problems of studying large, highly migratory marine animals explain, in part, why some of the most fundamental questions surrounding their biology remain unanswered. The geographic ranges of the most common species of large Atlantic sharks extend over thousands of miles and many species are seasonal migrants that are available to biologists for relatively short periods during the year. Large specimens require special gear and expensive vessels to collect. In addition, the absence of a commercial fishery (at least in the United States) makes it important to obtain information on sharks from fisheries directed toward more popular and valuable species such as swordfish, tunas, etc.

Consequently, several aspects of our research on sharks completely depend on the volunteer assistance of recreational and commercial fishing interests. On an annual basis, over 90 percent of all sharks are tagged by anglers and longline fishermen. Tournament officials, sport fishing organizations, and individual fishermen have developed procedures specifically for providing us with catch data and specimens for examination. Fishing clubs and marina owners have borne the cost of printing our "Shark Tagger" newsletters, and have donated research equipment and established scholarships at our request. Commercial longliners have maintained catch records and otherwise provided us with data and biological samples at little or no cost. The U.S. Foreign Fishery Observers who sail aboard foreign vessels also provide statistical information and tag hundreds of sharks every year. The importance of this assistance is clearly recognized by the Northeast Fisheries Center and the staff of the Apex Predators Investigation.

PERTINENT PUBLICATIONS AND REPORTS

- Carey, F.G., G. Gabrielson, J.W. Kanwisher, and O. Brazier. 1979. The white shark, *Carcharodon carcharias*, is warm bodied. Int. Council. Explor. Sea, Pelag. Fish. Comm. Mem. 1979/H:50.
- Carey, F.G., J. Kanwisher, O. Brazier, G. Gabrielson, J.G. Casey, and H.L. Pratt, Jr. 1982. Temperature and activities of a white shark (*Carcharodon carcharias*). Copeia 1982(2):254-260.
- Casey, J. 1982. Shark tagging. AIFRB [Am. Inst. Fish. Res. Biol.] Briefs 11(2).
- Casey, J.G. 1983. Blue shark, *Prionace glauca*. Pages 45-48 in M.D. Grosslein and T. Azarovitz, eds. Fish distribution. MESA [Mar. Ecosyst. Anal.] N.Y. Bight Atlas Monogr. 15.
- Casey, J., and J. Hoey. 1980. Estimated catches of large sharks by recreational fishermen in the Atlantic and Gulf of Mexico. Narragansett Lab. Ref. Doc. No. 80-7.
- Casey, J.G., F.J. Mather, III, J.M. Mason, Jr., and J. Hoenig. 1978. Offshore fisheries of the Middle Atlantic Bight. Pages 107-129 in Marine recreational fisheries 3. Sport Fishing Institute, Washington, D.C.
- Casey, J., and W. Pratt. 1979. Great white sharks studied. Coast. Oceanogr. Climatol. News 1(4):42.
- Casey, J., H. Pratt, and C. Stillwell. In press. Age determination of the sandbar shark (*Carcharhinus plumbeus*) with age estimates for some other carcharhinid species. International Workshop on Age Determination, February 1982. (Abstr.).
- Hoey, J., and J. Casey. 1981. Species composition and catch rates from selected longline fisheries in the western North Atlantic. Int. Council. Explor. Sea, Pelag. Fish. Comm. Mem. 1981/H:62.
- Kohler, N.E., and C.E. Stillwell. 1981. Food habits of the blue shark (*Prionace glauca*) in the Northwest Atlantic. Int. Council. Explor. Sea, Pelag. Fish. Comm. Mem. 1981/H:61.
- Pratt, H.L., Jr. 1979. Reproduction in the blue shark, *Prionace glauca*. Fish. Bull. 77(2):445-470.
- Pratt, H.W., and J. Casey. In press. Age and growth of the shortfin mako, *Isurus oxyrinchus*. International Workshop on Age Determination, February 1982. (Abstr.).
- Pratt, H.W., J. Casey, and R.B. Conklin. In press. Observations on large white sharks, *Carcharodon carcharias*, off Long Island, N.Y. Fish. Bull.
- Stillwell, C.E. 1981. Daily ration of the shortfin mako (*Isurus oxyrinchus*) in the Northwest Atlantic. Int. Council. Explor. Sea, Pelag. Fish. Comm. Mem. 1981/H:63.
- Stillwell, C.E., and J.G. Casey. 1976. Observations on the bigeye thresher shark, *Alopias superciliosus*, in the western North Atlantic. Fish. Bull. 74(1):221-225.
- Stillwell, C., and N. Kohler. 1982. Food, feeding habits and estimates of daily ration of the shortfin mako (*Isurus oxyrinchus*) in the Northwest Atlantic. Can. J. Fish. Aquat. Sci. 39:407-414.

MARINE ECOSYSTEMS DIVISION

submitted by

Dr. Kenneth Sherman, Chief

ICHTHYOPLANKTON INVESTIGATION

We completed the final leg of the spring Marine Resources Monitoring, Assessment, and Prediction Program (MARMAP) survey on 22 June, one day ahead of schedule. Excellent weather during the course of the 28-day cruise was a factor in the early finish, but most of the credit for this accomplishment must go to the scientific field party and the crew of *Albatross IV*. It was a total team effort and everyone who had a part in the cruise is to be congratulated. Gross observations of 685 bongo samples revealed that yellowtail flounder and Atlantic mackerel larvae were numerically dominant in the southern New England subarea. The small flounders were especially abundant off eastern Long Island. Concentrations of unidentified eggs were encountered at several stations on Georges Bank along with small gadid larvae presumed to be young cod and/or haddock. Although results of the cruise must be considered preliminary at this point in time, it appears that both cod and haddock on Georges Bank produced significantly more larvae during the spawning season than during the 1981-82 spawning season, which was the poorest of the seven-year MARMAP time series. Our next ichthyoplankton survey will begin in late July when we will join forces with Resource Assessment personnel on the annual scallop survey. We will also participate in the August clam survey to collect samples in nearshore waters not covered on the scallop cruise.

First drafts of International Council for the Exploration of the Sea contributions have been circulated within the investigation for review and are now back in the hands of the authors for revision. Myron Silverman noted a sharp increase in the abundance and production of yellowtail flounder larvae during the 1980 and 1981 spawning seasons as compared to the three previous years. The young flounders were consistently most abundant in the Georges Bank and Southern New England subareas, with only scattered occurrences in the Middle Atlantic and Gulf of Maine subareas. This is in contrast to results of the R/V *Dolphin* survey of the Middle Atlantic Bight in 1965-66, a year when yellowtail flounder occurred in dense concentrations off the Middle Atlantic states. Tom McKenney found offshore hake larvae most abundant along the outer edge of the shelf off Georges Bank and Southern New England during the late spring and summer months. This distribution pattern overlaps the area and time of major spawning for silver hake, but offshore hake larvae are significantly less abundant and more restricted in distribution on the shelf. Based on the distribution and abundance of silver hake eggs in 1979, Pete Berrien estimated the adult spawning biomass within the MARMAP survey area at 364,000 metric tons. Finally, the 5-yr analysis of larval haddock drift on Georges Bank shows that larvae originating on the Bank remain there during the course of their development. Smith and Morse note a westerly movement of larvae from the principal spawning grounds on eastern Georges but they see no indication in their preliminary analysis that larvae are advected off the Bank in any direction.

LARVAL FISH DYNAMICS INVESTIGATION

Experimental Studies

Atlantic mackerel held in the laboratory for over one year spawned intermittently during the latter part of May through June and into July at water temperatures between 12.1°C and 17°C. A few larvae were successfully reared to metamorphosis. Duration of the embryonic stage ranged from about 6 days at 12°C to 3.5 days at 18°C. The point of no feeding of mackerel larvae was between four and five days at 15°C. Two periods of heavy mortality occurred in all groups. The first occurred shortly after hatching prior to completion of yolk absorption before the eyes and mouth were fully developed. The second occurred seven to ten days after hatching, several days after the larvae had absorbed their yolk and established feeding. Careful control of environmental variables including temperature, salinity and prey density did not result in reduced mortality. The survival rate of larvae reared at low densities (one larva per liter) in 200-l containers at prey densities of 2,000 and 10 plankters per liter was about 1%. Attempts to culture mackerel larvae are continuing.

Haddock held in the laboratory for several months spawned intermittently but none of the eggs were viable. The rearing portion of a study of the temperature and salinity tolerance of sand lance embryos was completed. Data compilation and analysis is in progress.

Studies of proteolytic digestive enzyme activity in larval sand lance and mackerel are in progress. Studies of nucleotide levels in fish eggs and larvae were resumed. Analysis of RNA, DNA and protein content of larval and juvenile fish collected on the spring census is in progress.

Geoff Laurence and Larry Buckley contributed to the drafting of a proposal with Tony Calabrese and Dave Nelson of the Environmental Assessment Division for joint work on the influence of Hudson-Raritan Estuary water quality on early development of finfish, molluscs and crustaceans.

Geoff Laurence attended the Annual Meeting of the American Society of Limnology and Oceanography in St. John's Newfoundland where he chaired a special session on larval fish and zooplankton interactions and presented a paper on food limitation of larval cod and haddock on Georges Bank.

Population Processes

The Larval Fish Dynamics cruise *Albatross IV* 83-03, 9-20 May 1983, was carried out successfully with participants from the Plankton Ecology Investigation. Relatively high numbers of haddock, yellowtail and cod larvae were collected along the southern flank of Georges Bank. After a bongo grid of 52 stations was completed, a 30-hour time series of discrete vertical sampling was made on three stations on a transect from the shoal well-mixed waters south to the shelf/slope water front. Nine multiple opening-closing net and environmental sensing system (MOCNESS)-10 hauls were made the final two days of the cruise, mostly in the shoaler reaches of Little Georges and Cultivator Shoals. Catches of postlarval cod (10-40 mm SL) and sand lance (60-80 mm) were obtained from all hauls, up to several hundred individuals in each net. The largest and most abundant catches of cod were observed just south of Cultivator Shoals.

Ashore, sample processing and data analyses concentrated on the spring 1981 larval cod and haddock cruises to provide material for talks by Roz Cohen and Greg Lough. Roz Cohen presented a talk on larval fish feeding in stratified vs. well-mixed waters at the June American Society of Limnologists and Oceanographers Meeting, Memorial University, Newfoundland, and Greg Lough presented a paper on sampling strategy for larval fish studies at the Propagation of Cod Symposium, Arendal, Norway. Phil LeBlanc completed the sorting and identification of ichthyoplankton from the April 1981 MOCNESS hauls and Dave Potter entered the data on computer and produced standardized outputs. Peter Auditore completed processing of larval cod and haddock gut contents from five MOCNESS hauls made during spring 1981. George Bolz continued work on analyses of juvenile cod otoliths and mounted 50 specimens each of larval cod, haddock, and yellowtail from the May 1983 cruise for preparation of growth curves. Hal Merry prepared three MOCNESS systems for the May cruise. A new belt-drive release was installed on the MOCNESS-10 underwater unit which solved previous problems with the net-release mechanism. Post-cruise activities by Hal include the usual disassembly and repairs. Hal has been repairing and modifying surplus wire spools that will permit winding of MOCNESS towing cable under tension dockside.

PLANKTON ECOLOGY INVESTIGATION

Jack Green participated in the multidisciplinary studies cruise, *Albatross IV* 83-03. The complete plankton pumping system was employed successfully using 20 um nets to filter water pumped to the surface. The remainder of May was spent in preparation of 3 presentations for the American Society of Limnologists and Oceanographers meeting in St. Johns Newfoundland 12-17 June. By the end of the month the final draft of Deepwater Dumpsite 106 report on zooplankton was completed.

Joe Kane prepared a poster for American Society of Limnologists and Oceanographers and participated in *Albatross IV* Cruise No. 83-03 and served as chief scientist on the last leg of the MARMAP Cruise 83-04. Joe has initiated a study of dry weight change in copepods due to formalin preservation.

Donna Busch prepared a presentation on remote sensing for a visiting National Oceanic and Atmospheric Administration/National Marine Fisheries Service budget delegation, made arrangements for a visiting scientist from Gdynia, Poland to work at Narragansett and Woods Hole this autumn. She reviewed several manuscripts and a remote sensing proposal, worked on a draft chapter of the Georges Bank book, and responded to a request for assistance on the U.S./Canadian issue.

During May-June, Jerry Prezioso completed the computer analysis of data from Antarctic bongo samples collected by the Vulcan cruise of the R/V *Melville* in 1981. He also arranged and sent out the plankton samples from the spring MARMAP surveys to Poland via American-Polish lines.

Image Analysis

Mark Berman presented a paper on our image analysis system to the American Society of Limnologists and Oceanographers convention in St. Johns Newfoundland. It was part of a symposium on particle size distribution in the sea, and was well received.

The automated stage/optical assembly has been received from the subcontractor. The stage can be programmed to move a counting chamber under the video camera to scan an entire sample. This process will be controlled by the eclipse computer.

The optical assembly offers a choice of a Zeiss SR dissecting microscope or a set of Nikon lenses. Substage illumination is bright or dark field.

These components are being tested and calibrated before they are interfaced with the current prototype image analysis system. When they are incorporated into the system, the prototype will be complete and ready for testing and demonstrations.

Biostatistics

Pam Sherman and Joe Berlanga came on board 13 June. They will spend the summer quality controlling and moving data from the MARMAP Information System to the MARMAP Ecosystem Data Base and Information Management (MEDBIM) system.

Karen Marti came on board 13 June. She will spend the summer working on ecosystem statistical analysis--the real goal of BIOSTATISTICS.

On 5 May Julien Goulet visited Woods Hole for an automated data processing Factor IV committee meeting and for an A76 committee meeting.

The System Support Group (SSG) continued designing and testing software for moving data from the MARMAP Information System to the MEDBIM system. They also began designing software for direct entry of data into MEDBIM. The System Support Group implemented the Selanar Graphics routines. They are a collection of subroutines that can be built into mapping packages. As they are hardware specific, it would be better to use general graphics subroutines when building mapping packages in order to utilize different plotting devices.

The System Support Group provided training on the PDP71 operating system (PDS), editor (EDT) and data base system (DATMAN) for the summer employees.

Tom Plichta worked on volumes and dominant taxa from the Gulf of Maine 1963-1968 data sets. He loaded several cruises of egg data for processing by Sandy Hook. He moved station data from the MARMAP Information System to the PDP71 for processing by Pam Sherman and Joe Berlanga.

FISHERY OCEANOGRAPHY INVESTIGATION

The Fishery Oceanography Investigation is working cooperatively with a group of investigators from various institutions and laboratories in preparation for a cruise in the Antarctic this fall. The study is titled the Antarctic Marine Ecosystem Research at the Ice-Edge Zone (AMERIEZ) and is funded by the National Science Foundation (for the other investigators). The object of the study is to investigate the biological production during the retreat of the Weddell Sea ice cover and its relation to the physical oceanographic environment. Two ships will be involved, with Dave Mountain and Ron Schlitz making conductivity-temperature-depth measurements on the *Melville* and Steve Ramp doing the same on the icebreaker US Coast Guard Cutter *Westwind*. Preparations for getting material and instrumentation to the vessels has begun.

Dan Patanjo, Ben Marshall, Catherine Jewell and Dana Densmore made hydrographic measurements on MARMAP *Albatross IV* Cruise No. 83-04. Sam Nickerson and Karen Lennon are processing the salinity samples from the cruise. Dan and Karen are cleaning the MARMAP hydro data files to have all of the past cruise data in easily accessible form.

At the spring AGU meeting, two papers were presented by the Investigation: "Variations in the deep water of the Gulf of Maine, 1979-1980" by David Mountain and Paul Jessen; and "The mean advective and eddy heat transport through Nantucket Shoals Flux Experiment (NSFE79)" by Steven Ramp, Ron Schlitz and David Mountain.

Ronald Schlitz and Ben Marshall are continuing the processing of the Warm Core Ring study conductivity-temperature-depth data. The calculation of oxygen values has turned out to be a much more complicated process than indicated by the instrument manufacturer or as done by many other investigators. Investigation of this problem is continuing with a solution expected soon.

APEX PREDATORS INVESTIGATION

Eight sharks were recaptured during May while 19 sharks were recaptured in June. In total eight blue sharks, six sandbar sharks, five makos, two tigers, two swordfish, and one each of dusky, blacktip, Atlantic sharpnose and porbeagle were recaptured in this two-month period.

Two blue sharks were at liberty for almost two years traveling 208 mi (Massachusetts to Maryland) and 115 mi (Massachusetts to Fire Island, New York) respectively. Another blue shark traveled 428 mi in four mo from off Georges Bank to North Carolina. One sandbar shark was recaptured after almost three yrs. This shark traveled 156 mi SW from off Seaside Heights, New Jersey, to Chincoteague, Virginia. Another sandbar shark traveled 523 mi in 10 mo from SE Moriches to Murrells, South Carolina. One tiger shark traveled 378 mi in 29 mo from Marathon, Florida, to Isla Mujeres, Mexico. The dusky shark tagged off Bermuda was recaptured 10 mo later 21 mi west of the tagging site. Four of the five makos were recaptured off the coast of North Carolina. All were at liberty for less than one yr. A swordfish tagged off Nantucket, Massachusetts was recaptured off Pompano Beach, Florida (971 mi) after over one and one-half yrs at liberty.

We attended shark tournaments at Brielle, New Jersey; Shinnecock, Moriches, and Bay Shore, New York, during June. Over 400 boats caught nearly 200 sharks at these tournaments. All sharks landed were measured and biological samples for food, reproductive habits and age studies were obtained. The major species landed were blue, mako and sandbar sharks. A pregnant dusky shark containing 12 full term embryos was landed at Bay Shore. This is the first gravid female of this species we have had an opportunity to examine.

Chuck Stillwell presented a talk on life history studies of sharks at the 13th Annual "Our World Underwater" Conference held in Chicago on May 5-7. The conference attracted over 3,000 people interested in scuba diving and water sports. Stillwell delivered liver and flesh samples from 35 blue and mako sharks collected during the R/V *Wieczno* Cruise No. 83-02 to the Sandy Hook Laboratory for colorimetric analysis. He also discussed the preparation of a manuscript on the bioenergetics of shark tissue with Frank Steimle and Russ Terranova.

Chuck Stillwell and Robert Medved (University of Rhode Island graduate student) collected stomach content data from 99 sandbar pups and yearling juveniles from various estuarine fishing stations at Chincoteague, Virginia. Sampling was conducted by rod and reel gear over a seven-day period from 23-29 June. Average food volumes decreased from 47.5 ml to 17.5 ml between night and day with highest average volumes occurring in the night hours.

Jack Casey and Wes Pratt attended a symposium on "Biology of the White Shark" hosted by the Southern California Academy of Sciences in Fullerton, California. Jack presented a paper, "Distribution of the white shark in the western North Atlantic," which will be published in the proceedings of the symposium by SCAS.

Wes Pratt continued Greg Skomal's training in histology and photography. Together they worked up reproductive and age and growth samples from the early tournaments. Greg continued to verify the reproductive data base and Wes returned the manuscript, "Age and Growth of the Shortfin Mako" to the *Canadian Journal of Fisheries and Aquatic Sciences* after correcting referee amendments.

During May and June John Hoey continued working on several manuscripts. The latest revisions of the swordfish and recreational fishing manuscripts were circulated for in-house review. Comments were incorporated into the drafts and work continued on finalizing the tables, graphs and artwork. A first draft was completed on a manuscript tentatively titled "Distribution and Relative Abundance of Sharks in the Western North Atlantic." This paper documents seasonal distribution and relative abundance for nine species of sharks along with temperature and water mass information. On 9 June, John presented a talk on swordfish distribution and abundance in the western North Atlantic to the Southern New England Chapter of the American Fisheries Society at the annual June workshop. John also spoke with Gregg Waugh of the South Atlantic Management Council about our longline data base. The Council requested use of the data in our draft manuscript on swordfish.

PUBLICATIONS

- Berman, M. S., H. P. Jeffries, A. D. Poularikas, C. Katsinis, I. Melas, and K. Sherman. Automated sizing, counting, and identification of zooplankton by pattern recognition. ASLOI 46th Annual Meeting, 13-16 June 1983, Memorial University of Newfoundland, St. John's, Newfoundland. (Abstract)
- Buckley, L. J., S. I. Turner, T. A. Halavik, A. S. Smigielski, S. M. Drew and G. C. Laurence. Effects of temperature and food availability on growth, survival and RNA-DNA ratio of larval sand lance (*Ammodytes americanus*). Mar. Ecol. Progr. Ser. (S)
- Buckley, L. J. RNA-DNA ratio: an index of larval fish growth in the sea. Mar. Biol. (S)
- Cohen, R. E. Larval fish feeding in stratified versus well-mixed environments. ASLO 46th Annual Meeting, 13-16 June 1983, Memorial University of Newfoundland, St. John's, Newfoundland. (Abstract)
- Laurence, G. C. Food limitation of Georges Bank larval cod and haddock. ASLO 46th Annual Meeting, 13-16 June 1983, Memorial University of Newfoundland, St. John's, Newfoundland. (Abstract)

- Laurence, G. C., J. R. Green, P. W. Fofonoff and B. R. Burns. Small-scale variability of plankton on Georges Bank with particular reference to prey organisms of larval cod and haddock. (in prep.)
- Mountain, D., and P. Jessen. Variations in the deep water of the Gulf of Maine, 1979-1980. ASLO 46th Annual Meeting, 13-16 June 1983, Memorial University of Newfoundland, St. John's, Newfoundland. (Abstract)
- Lough, R. G. Sampling strategy for larval fish trophodynamic studies on Georges Bank. Symposium on the Propagation of Cod, *Gadus morhua* L., 14-17 June 1983, Arendal, Norway. (Abstract) (in press)
- Mountain, D. G. and P. F. Jessen. Variations in the deep water of the Gulf of Maine, 1979-1980. Spring Meeting, AGU, Pennsylvania. (Abstract)
- Ramp, S. R., R. J. Schlitz, and D. G. Mountain. The mean advective and eddy heat transport through the Nantucket Shoals Flux Experiment (NSFE79). Spring Meeting, AGU, Pennsylvania. (Abstract)
- Sherman, K., J. R. Green, J. R. Goulet, and L. Ejsymont. Zooplankton coherence in a large Northwest Atlantic ecosystem. ASLO 46th Annual Meeting, 13-16 June 1983, Memorial University of Newfoundland, St. John's, Newfoundland. (Abstract)
- Smigielski, A. S., T. A. Halavik, L. J. Buckley, S. M. Drew and G. C. Laurence. Spawning, embryo development and growth of the American sand lance (*Ammodytes americanus*) in the laboratory. Mar. Ecol. Progr. Ser. (In press)

REPORTS

- Smith, W. 1983. Temporal and spatial shifts in spawning times of selected fish and invertebrate species in the Georges Bank region. NMFS, NEFC, Sandy Hook Laboratory Report No. SHL 83-08. MARMAP Contribution MED/NEFC 83-28, 22 p.
- Sherman, K., R. Lasker, W. Richards, and A. Kendall. 1983. Ichthyoplankton and fish recruitment studies in large marine ecosystems. ICES C.M. 1983/L:24. MARMAP Contribution MED/NEFC 83-24.
- Sherman, K., W. Smith, W. Morse, and L. Ejsymont. 1983. Spawning strategies of fishes in relation to circulation, phytoplankton production, and pulses in zooplankton off the northeastern United States. ICES C.M.1983/L:25. MARMAP Contribution MED/NEFC 83-25.

MISCELLANEOUS

Travel, Meetings, and Presentations

- 3 May, Ken Sherman briefed Department of Commerce representatives at the Narragansett Laboratory.
- 5-7 May, Chuck Stillwell attended the 13th Annual "Our World Underwater" Conference, held in Chicago and presented a talk on the life history studies of sharks.
- 7 May, Jack Casey presented a paper, "Distribution of the white shark in the western North Atlantic" by J. Casey and H. L. Pratt, at the Symposium on Biology of the White Shark, hosted by the Southern California Academy of Sciences in Fullerton, California.
- 9-10 May, David Mountain attended a meeting in Fredericksburg, Virginia, to review a U.S./Canada boundary dispute manuscript.

12 May, David Mountain met with Arnold Gordon and Bruce Huber of the Lamont-Doherty Geological Observatory concerning the Antarctic cruise this fall.

23 May, Ken Sherman participated in a Congressional Briefing at Washington, D.C.

30 May-1 June, Paul Jessen, Ron Schlitz, Steve Ramp and David Mountain attended the spring American Geophysical Union meeting in Baltimore, Maryland, where they presented two papers entitled: "Variations in the deep water of the Gulf of Maine, 1979-1980" by David Mountain and Paul Jessen; and "The mean advective and eddy heat transport through the Nantucket Shoals Flux Experiment (NSFE79)" by Steven Ramp, Ron Schlitz, and David Mountain.

7 June, Hal Merry attended RCA Integrated Circuit Seminar in Boston, Massachusetts.

9-10 June, Ken Sherman attended a FOCI PDP meeting at OAR, Rockville, Maryland.

13-16 June, Roz Cohen, Geoff Laurence, Jack Green, and Mark Berman attended the 46th Annual American Society of Limnologists and Oceanographers Meeting at Memorial University, Newfoundland and presented papers (see Abstracts).

16 June, Ken Sherman and Wally Smith met with the Polish Delegation (Drs. Ropelewski, Janson, and Ejsymont), and the Polish Consul Mr. Pintowski, at Newark, New Jersey.

14-17 June, Greg Lough participated in the Propagation of Cod Symposium in Arendal, Norway and presented a seminar to the Cod Larvae Group on the results of our cod-haddock larval studies on Georges Bank.

18-25 June, Mike Fahay attended the Annual Meeting of the American Society of Ichthyologists and Herpetologists, held at Florida State University, Tallahassee, Florida.

Seminars

4-5 May, Ken Sherman convened a Marine Ecosystems Division meeting at Narragansett.

26 May, Greg Lough presented a noon hour seminar at Woods Hole Oceanographic Institution entitled, "Survival of haddock and cod larvae on Georges Bank."

16-27 May, Ken Sherman, Wally Smith, and others attended a Risk Analysis meeting at Sandy Hook.

1-2 June, Ken Sherman attended the Board of Directors meeting at Woods Hole.

24 June, Steve Ramp and Ron Schlitz met with other investigators in the Nantucket Shoals Flux Line Experiment to review preparation of a manuscript on those measurements.

27 June, Ken Sherman chaired a meeting in Narragansett on Secondary productivity research. Dave Mountain, Greg Lough, Roz Cohen and other Division scientists attended.

Visitors

24-26 May, Paul Olson, Rockwell International visited the lab to inspect the solar modifications at the Narragansett Laboratory.

6-8 June, Ken Sherman, Wally Smith, Thomas Potthoff (NMFS, Sandy Hook), Ann Matarese (NMFS, Seattle), Robert Marak (Narragansett), and Martin Newman (NMFS, Oxford) attended the Annual Advisory Board meeting of the Polish Sorting Center (Szczecin, Poland) at the Narragansett Laboratory. The representatives from Poland were: Andrzej Ropelewski (MIR, Gdynia), Jerzy Janson (MIR, Gdynia), and Leonard Ejsymont (ZSOP, Szczecin).

9-14 June, the Polish contingent visited the Narragansett Laboratory and the Sandy Hook Laboratory.

University Affairs

19 May, Ken Sherman (on Ph.D. committee) participated in Mark Tercero's Oral Examination at the Bay Campus, University of Rhode Island.

24 June, Dave Potter met with Louis Defeloece, Marine Biological Laboratory, to assist him with research problems on sea urchins.

Donna Busch met with Peter Cornillon (University of Rhode Island) to discuss progress on activities at the Remote Sensing Institute and outline contents of a BIOMASS handbook on remote sensing for use with Antarctic investigations.

Miscellaneous Travel and Meetings

27 June, Dave Potter attended the Woods Hole Laboratory scientific council meeting to review on-going construction project.

Public Affairs

The Narragansett Laboratory held an Open House for scientists of the Environmental Protection Agency and the Bay Campus.

Personnel

Ben Marshall has begun a FORTRAN programming course.

Jack Thiel completed two days of training on the maintenance of the Investigation's Guildline Autosol salinometers.

David Mountain completed 40 hours of Introduction to Supervision training.

Phil LeBlanc completed three graduate level courses at Southern Massachusetts University, Dartmouth: Advanced Biology of Invertebrates, Animal Behavior and Directed Study.

EEO Activities

7 June, Greg Lough and Roz Cohen participated in a Federal Womens Program "Communications Workshop" at Woods Hole.

30 June, Roz Cohen attended a Federal Womens Program meeting in Woods Hole.

RESOURCE UTILIZATION DIVISION

submitted by

Robert J. Learson, Acting Chief

FISHERIES CHEMISTRY INVESTIGATION

Product Quality Chemistry

A study to investigate further the iced shelf-life extending effects of gamma irradiation (cobalt-60) and a potassium sorbate dip was carried out on market size cod. Packaged fillets treated with a 45 second dip in 5 percent potassium sorbate solution and/or a 200 Krad dose of irradiation were monitored for quality deterioration over a 43 day period in ice. Certain chemical tests remain to be completed before collation and analysis of the data can be made.

Examination of water samples for the University of Massachusetts-sponsored Acid Rain Monitoring Project continues. The Commonwealth of Massachusetts received an extraordinary amount of rain this spring, and it was found to be quite acidic. The lowest pH of precipitation measured at University of Massachusetts this year to date was 3.36 on April 25. All but three storms analyzed in 1983 have had pH's less than 5.0 and many have been below 4.0.

A new study was initiated to test the effects of some oxidizing agents on stabilizing the texture of frozen red hake. We previously determined that gaseous oxygen, hydrogen peroxide, and sodium hypochlorite were all effective in inhibiting the enzymatic degradation of trimethylamine oxide to dimethylamine and formaldehyde. In this latest experiment, either hydrogen peroxide, sodium hypochlorite, or potassium bromate were added to minced red hake muscle at four different concentrations ranging from 0.01 to 0.25 percent by weight. After four weekly sampling periods at 10°F storage, a clear trend is developing. All oxidizing agents are inhibiting the production of dimethylamine and formaldehyde, but samples treated with either hypochlorite or bromate seem to be tougher (higher shear force) than the control sample as measured with the Instron Universal Testing Machine. Samples treated with peroxide are not significantly tougher than the control, but they do have lower contents of dimethylamine and formaldehyde. An additional study has been initiated to examine the efficacy of hydrogen peroxide in greater detail.

An investigation to study the effects of freezing and frozen storage on the microbial flora of cod has been initiated. The objective of this study is to determine whether or not frozen and thawed fish spoil (microbiologically) at a different rate compared with fresh nonfrozen fish.

The study to determine the effect of iced storage on edibility characteristics is continuing. Edibility characteristics are being determined on one day post-mortem fish and fish held several days in ice.

Cooked samples being submitted for species identification are becoming more exotic and difficult to identify. Canned fish samples packed in oil or tomato sauce were submitted for speciation, and these are also not

conforming to the parameters necessary for the procedure. The samples packed in oil show no clear-cut discernable bands after staining when using either water or urea for the protein extraction. An alternate procedure and/or workup of these samples is forthcoming.

In the past several months, we have been unsuccessful in adapting a published gas-liquid chromatography procedure for the analysis of malonaldehyed. It has been recently learned that some other labs are also experiencing the same problem. Our sample was submitted to the reporting researchers, and they could not get results with their method. We are now attempting to modify the procedure.

Product Safety

Evaluation of the Grimmer Method

Eight experiments were conducted to improve polynuclear aromatic hydrocarbon yields and to evaluate the usefulness of the method for hydrocarbon analysis. Six of these experiments were "breakdown" analyses in which aliquots of the extract were taken after each step to pinpoint specific sources of polynuclear aromatic hydrocarbon loss. Proposed modifications were:

1. doubling the number of extractions for the liquid-liquid partition steps. This modification fails to improve yields and was withdrawn.
2. discarding the Sephadex LH-20 step. This step is used to fractionate the lower from the higher molecular weight polynuclear aromatic hydrocarbons. This step caused losses of some high molecular weight polynuclear aromatic hydrocarbons.
3. extracting the polynuclear aromatic hydrocarbons from cyclohexane with pure N,N-dimethyl formamide rather than 90%. The 10% water added in this step is believed to be an unnecessary precaution against emulsions. This improved the yields of low molecular weight polynuclear aromatic hydrocarbons significantly.

Recoveries for the high molecular weight polynuclear aromatic hydrocarbons have been satisfactory (80-100%), but yields of naphthalene, acenaphthylene, acenaphthene, and fluorene remain low (25-60%). Present experimentation is aimed at determining if these compounds are being chemically altered by the isolation process.

Gas Chromatography/Mass Spectrometry

The lobster polynuclear aromatic hydrocarbons extracts from the *Kelez-8008* cruise were combined and displaced into hexane using a C18 solid phase extraction column. This extract was run on a gas chromatograph-mass spectrometer (GC-MS). The presence of polynuclear aromatic hydrocarbons was confirmed.

These extracts were previously analyzed and quantified by high pressure liquid chromatography with in-series ultraviolet and fluorescence detectors. This method is more sensitive than GC/MS but does not give positive identification of individual components.

Compound Separation by Class

Two experiments utilizing cyano and silica columns in series for the separation of hydrocarbons, polynuclear aromatic hydrocarbons, nitrogen,

oxygen, and sulfur containing polynuclear organic materials were attempted. Clean separation was not obtained on a mixed standard. The columns were overloaded by a National Bureau of Standards shale oil sample. The experiment will be repeated on an in-house standard.

Standard Reference Material

An experiment to calculate the reproducibility of the in-house Standard Reference Material was completed. Ten of the samples contained 8.8-10.3 ppb each of phenanthrene, pyrene, 1,2-benzofluorene, chrysene, benzo(e)pyrene, benzo(a)pyrene, and dibenzo(a,h)anthracene. The eleventh was blank control. Four percent deviation was found.

Internal Standards

Six solutions of chrysene and 1,2-benzofluorene (internal standard) in varying concentration ratios were prepared to determine the linearity of the internal standard method. Excellent linearity was found throughout the investigated range of 1-50 ng chrysene per 2 ng 1,2-benzofluorene.

Analysis of Polychlorinated Biphenyls in Mackerel Samples

Forty-seven mackerel samples were collected at Pleasant Point, NY, by Dr. Longwell's group of the Milford Laboratory. At the Gloucester Laboratory each fish was dissected. The fillets, livers, kidneys, and gonads were separated and individually stored in aluminum foil at -20°F for future analysis. The gender, length, and weight of each fish were noted and recorded. The heads were removed, tagged, and prepared for shipment to Woods Hole for age determination. The ovaries and testes of all the fish were worked up by the new Association of Official Analytical Chemists procedure and analyzed by gas liquid chromatography utilizing a Ni⁶³ electron capture detector. The chromatograms from this study are presently being interpreted for the identification and quantification of polychlorinated biphenyls. A final report will be sent Dr. Longwell on this study.

FISHERIES TECHNOLOGY AND ENGINEERING INVESTIGATION

Products Standards and Specifications

Following a meeting of the relevant Technical Working Group, a proposed draft U.S. Standards for Grades of Fresh or Frozen Fish Steaks was revised and sent to interested persons.

Following a meeting of the fish block Technical Working Group, three proposed draft U.S. Standards for Grades were revised and sent to interested people. They are for Frozen Fish Fillet Blocks, Mixed Fillet-Minced Fish Blocks, and Minced Fish Blocks.

A proposed draft U.S. Standards for Grades of Frozen Fish Portions and Fish Sticks is being revised.

An initial proposed draft U.S. Standards for Grades of Fresh or Frozen Raw Clams is being prepared.

Instructions to accompany relevant U.S. Standards for Grades are being revised. They are for fish blocks and for fish steaks.

The Washington Office is supporting a petition to the U.S. Department of Agriculture to allow the use of minced fish meat in their regulations

governing the composition of meat products such as frankfurters and sausages. In support of this petition, we have reviewed relevant documents and revised a draft U.S. Standard for Minced Fish Meat.

Over three hundred samples of shrimp covered by the Proposed General Standards for Grades of Shrimp have been graded by the U.S. Department of Commerce Inspection Service to test the new score point deductions. Results from the grading survey will be used to revise the proposed standard.

An evaluation of the Bergen procedure for determining the amount of minced fish in a mixed fillet-minced fish block was conducted on 10 fish blocks. The data were analyzed and a report written on the results. The general conclusion was that it was too time consuming

Changes were made to the Norwegian procedure for determining the amount of minced fish in mixed fillet-minced fish blocks. A special sieve was manufactured for use with this procedure. The revised procedure was tested on 18 blocks of unknown minced fish content. To test the proposed method, 90 fish blocks were produced consisting of thirty each with 15%, 20%, and 25% minced fish content. These blocks were examined by a staff member and two industry members of the methods committee. The data were evaluated using statistical methods, and a report written. The general conclusion was that the method looked practical and realistic.

Processing and Preservation

Sorbate Preservation

An experiment to determine the shelf life of freshly caught, drawn cod dipped in potassium sorbate was completed.

For this work, two hundred pounds of market cod, all caught in the same tow of a Gloucester fishing boat, were eviscerated and washed - half of the lot was dipped in five percent potassium sorbate in seawater and the other half designated the nondipped control. Both lots were then iced down in boxes and transported to the laboratory at the end of the trip. Organoleptic tests were conducted on both lots of iced fish, both whole and cooked fillets, in order to determine their acceptable shelf life. Acceptable shelf life ended when any quality attribute average fell below 5.0 (borderline) on a raw or cooked evaluation 9-point scale.

The acceptable shelf life of whole iced, nondipped cod was 8-9 days while that of the dipped-at-sea (KS) cod was 16-17 days. The acceptable shelf life of the fillets cut from the nondipped cod was 13-15 days while the fillets from the dipped fish lasted 17-18 days. Our panelists commented that the odor of the gill cavity of the sorbate dipped fish was unfamiliar to them it was not like the usual fish spoilage odor.

This preliminary experiment showed that dipping whole fish in potassium sorbate immediately after being caught and eviscerated did have a beneficial effect on extending shelf life. The experiment will be repeated at least twice.

Blue Crab

Bluing in sterilized canned blue crabmeat has been a consistent problem. A pack of sterilized blue crabmeat was produced using a new NaCl-Citric Acid-ethylenediaminetetracetate formulation which eliminates this problem. This experiment will be repeated for reproducibility using different lots of crabmeat.

Frozen Fish

A frozen storage stability experiment of scrod cod stored at -10° , 0° , and $+10^{\circ}$ F was begun. Prior to freezing, the fish were held in ice for 1, 6, and 9 days. After iced storage, the fish were filleted and frozen immediately. Aliquots of the frozen fish fillets were placed into the -10° , 0° , and $+10^{\circ}$ F storage rooms. Periodically, the frozen fish fillets will be taste tested and checked for changes in edibility characteristics. The color and texture of the fish fillet will also be measured.

The initial taste test results show that the 9 day iced cod is barely acceptable, having scored slightly above borderline on the 9 point scale.

Colorimetric Analysis

The protocol used by the Seattle Laboratory for determining the color of fish in the edibility study was found to be satisfactory. This procedure will be used in all further color measurements.

Engineering

A design drawing is being prepared of a modified version of the prototype squid ring cutter built and tested at the laboratory. The new design will incorporate an adjustable set of cutting knives so that rings of different widths can be made.

A heat pump/air conditioner that utilizes waste heat from the freezers in the heating mode is being installed in one of the laboratories.

An invitation for bid #83-FA-0002 has been issued on the Solar Project. A pre-bid conference will be held on June 29 at the Gloucester Laboratory.

Partitions to allow for several different temperatures within the same room are being installed in freezer room #6.

A deck plan is being made of the M/V *Two Friends* for Capt. Joe Parco. A layout will be done to locate automation equipment for heading and conveying of fish on deck and into the fish hold.

Another attempt is being made for a joint project with the University of Massachusetts to recover waste engine stack heat and use it to produce refrigeration.

The heat exchanger for the R/V *Gloria Michelle* has been purchased, and the control valve has been exchanged for one with the proper size ports. Arrangements will be made to install this equipment which will complete the vessel's heating system.

NMFS/URI Cooperative Fisheries Engineering Unit

Bugs are being worked out of the Microlog data acquisition system, and the Indikor thrust meter has undergone modification after initial trials.

The Lowrance X-15 sounder is now being tested in the University of Rhode Island tow tank for model net measurements.

The R/V *Gloria Michelle* is being rigged for offshore lobstering in preparation for a lobster tagging cruise in July, and plans are being made for a ghost gill net survey in August. In addition, the deck and rails are being sandblasted, and bridge blocking is being installed on deck.

The Fisheries Engineering Group is cooperative with the Resource Assessment Division in the selection of candidate doors and planning the tests to find a new type of door to be used with the bottom survey trawl.

R/V *Gloria Michelle* cruises during the period were:

Cruise NO.	Title	Area
GM 83-09	Fish Feeding Study and Trawl Mensuration	S. of Nantucket Shoals
GM 83-10	Inshore Bottom Trawl Survey	Mass. State Waters
GM 83-11	Diurnal Plankton & Benthic Sampling	Narragansett Bay
GM 83-12	Ocean Pulse Diving Survey	Jeffreys Ledge to Block Island
GM 83-13	Diurnal Plankton & Benthic Sampling	Narragansett Bay

PUBLICATIONS

- King, F.J. 1983. Procedure for cooking seafood products. *J. Assoc. Off Anal. Chem.* 66(3):813-815.
- Krzynowek, J. Effect of agricultural practices, handling, processing and storage on foods of animal origin - fish and shellfish. Manuscript submitted to publisher for inclusion in *Nutritional Evaluation of Food Processing*, third edition.
- Licciardello, J.J., E.M. Ravesi, B.E. Tuhkunen, and R.C. Lundstrom. The effect of handling or processing treatments on storage characteristics of fresh or frozen dogfish (*Squalus acanthias*). Woods Hole Laboratory Reference Document No. 83-15.

MISCELLANEOUS

Travel, Meetings, and Presentations

Dan Baker traveled to Santa Cruz, California, to preview a demonstration of a new squid cleaning and skinning machine. The machine performed extremely well and modified versions under construction look very promising for east coast squid varieties.

Fred King participated in a meeting of the New England Fisheries Institute in Danvers, Massachusetts, June 23. The speaker was John Sackton who discussed the activities of the New England Fisheries Development Foundation.

Perry Lane participated in the meeting of the New England Quality Project Advisory Committee.

Judith Krzynowek attended the 74th Annual Meeting of the American Oil Chemists Society held in Chicago, Illinois. Judith also attended the 95th Annual Meeting of the Shellfish Institute of North American/National Shellfisheries Association and represented Bob Learson (board member) at the Board of Director's meeting of the National Blue Crab Industry Association.

Joe Licciardello, Judith Krzynowek, Ron Lundstrom, and Betty Tuhkunen participated in a New York Sea Grant-Seafood Seminar at Cornell University and each presented a program review of their research activities.

Joe Licciardello, presented a lecture on quality factors of seafoods at Boston, Massachusetts.

Al Blott attended the International Council for the Exploration of the Sea working group meetings on Engineering and Fish Reaction in IJmuiden, Holland, May 2 - May 6.

Al Blott, Vern Nulk, and Monica Hallisey visited the New Bedford International Commercial Fisheries Show.

Al Blott attended a planning session for the upcoming ghost gill net assessment cruise.

Al Blott participated in a planning meeting for a Marine Advisory Service Training Workshop which will be held in October.

Bob Learson took part in the following activities:

Gave a seminar on fish quality to a group of retailers in Boston, Massachusetts May 17.

Attended the NEFC Board of Directors meeting June 1 and 2 in Woods Hole, Massachusetts.

Met on June 16 with Dr. John Rosignal of the Department of Agricultural Engineering and Tony Verga, the Executive Director of the Gloucester Fisheries Commission, to discuss a potential joint project on fish processing effluents.

Attended a meeting on gillnet problems in Peabody, Massachusetts on June 21.

Traveled to Long Island and New York City June 27-29 to meet with members of the New York fishing industry. This included visits to several fish processors, the Fulton Fish Market, and a meeting with the New York-New Jersey Port Authority for a briefing on the proposed Erie Basin fish processing complex.

Visitors

Professor Chen Wenxiu from the Department of Chemistry, Peking Normal University, Peking, China, was given a tour of the Marine Products Development Irradiator (MPDI).

Boris Wilfrido Ramirez L. from Republic of Panama visited the laboratory to talk on quality in fishery products.

Public Affairs

Twenty-one frozen fish fillets were submitted for species identification by Mr. Jay Gosley of Cable Network News (CNN), Atlanta, Georgia. Isoelectric focusing analysis revealed that six samples were the species indicated on the label of the retail package. Nine samples were found not to be the species indicated on the package, and we were able to identify the correct species in six of the nine cases. The remaining six samples could not be identified because of our lack of proper authentic samples for reference purposes. Ron Lundstrom and Bob Learson appeared in a taped camera interview with Mr. Gosley and discussed scientific identification of fish samples and possible solutions to mislabeling of fish.

Two dozen scallop samples were identified as to species at the request of the NMFS Enforcement Division.

Information and several reprints on fish species identification were provided to Ray Grimsbo of the Oregon State Police Crime Lab., Portland, Oregon. They are interested in applying isoelectric focusing as a method of identifying game fish.

Technical assistance was provided to the following:

Information on shelf life of fresh and frozen seafood to Congressman Ridge, Sharon, Pennsylvania.

Information on thiobarbituric acid and trimethylamine methodology to Rip Rice, Food Marketing Institute.

Microbial standards for minced catfish to Jeanine Burgin, Mississippi Extension Service.

Retort Pouch to Bob Hawes, New Bedford, Massachusetts.

Use of Torrymeter to Seth Barker, Maine Dept. Marine Resources.

Fat measurement in herring to Richard Bruno, American Travelers, Inc.

Processing and handling shark to Ray Roman, Brandon, Florida.

Quality of gill netted fish to Bob Slabyj, University of Maine.

Information on agarose gel isoelectric focusing to Beverly Smith of the Pascagoula Lab.

Multiple questions on seafood nutrition and safety were answered.

Several of the questions were from newspapers and magazines.

Ron Lundstrom reviewed a manuscript being considered for publication in the *Journal of Food Science*.

Joe Licciardello reviewed a research proposal for Maine-New Hampshire Sea Grant.

Federal programs in fisheries technology to Dr. Soliman Shenouda, General Foods Corporation, Tarrytown, New York.

Fat content of several species of eels to David Wallerstein, Maritime Seafood Corporation, Washington, D.C.

Minced fish technology to M. Iskia, Quipid Corporation, Greenwood, Mississippi.

Polyphosphates in fishery products to Colin Wiley, B.K. Ladenburg Inc., New York, New York.

Parasites to Dr. Donald Cann, Torry Research Station, MAFF, Aberdeen, Scotland.

Frozen storage stability of prepackaged frozen flounder to David Jermain, Fishery Products Inc., Danvers, Massachusetts.

FDA policies for Indian shrimp to Manor Hill Foods Co., Baltimore, Maryland.

A commercial source of cod liver oil to Gerde Macekonis, Consultant, White Plains, New York.

Firms interested in exporting skate wings or sea urchins to Europe to Daniel Casper, Consultant, Malden, Massachusetts.

Retail promotion material on seafoods to Allan & Priscilla Toth, Ipsilanti, Michigan.

Total volatile basic nitrogen as a measure of fish quality to Robert Lambert, Export-Import Corporation, Washington, D.C.

Myxosporidia in whiting (hake) to Food Service Board, Fort Lee, Virginia.

Baader machines to John Martin, Cozy Harbor Seafoods Inc., Portland, Maine.

Solubilized fish muscle as a binding material to Dr. Bonnie Sun Pan, National Taiwan College of Marine Science and Technology, Keelung, Taiwan, Republic of China.

Bulk density of flounder to Paul Land, Pepperidge Farms Inc., Norwalk, Connecticut.

Statistics on U.S. supply of cod fillets to Paul Weismann, Jones-Weismann & Company, Chestnut Hill, Massachusetts.

Promotional material on silver hake and red hake to James Thirkell, Fishline Seafoods, Norwood, Massachusetts.

Provided information on foreign markets for chub caviar to "Jay" Haegele, Florida.

Furnished information on lobster tanks to Tom Morse, Gloucester, Massachusetts.

Gave sources of information on heavy metals research to Tim Sullivan, Salem Daily News.

Provided information on cholesterol content of cod to National Fisheries Institute.

Information was also supplied on preparing salt fish and determining their salt and moisture contents; holding ocean quahogs alive; and harvesting and using ocean quahogs.

Personnel

Dan Baker and Louis Ronsivalli received certificates of recognition for having a publication chosen for the publication of the year award.

We welcome aboard two summer students, Susan Gerow who will be working in Elinor Ravesi's lab and Rebecca Marsden who will be working in Ron Lundstrom's lab.

LtJG Jon Bailey has joined Fisheries Engineering to help operate R/V *Gloria Michelle*.

Training

Denise Peton attended a workshop at Water Associates in Milford, Massachusetts on the use of high pressure liquid chromatography for the analysis of vitamins. Denise also attended a seminar on Advances in Chromatography held at the Hewlett-Packard Corporation in Lexington, Massachusetts.

Ken Rowe, a fishery products inspector with the U.S. Department of Commerce Northeast Inspection Office at Gloucester, is currently working three days per week in Ron Lundstrom's Lab being trained in the technique of species identification by isoelectric focusing. The training will cover all aspects of isoelectric focusing methods, and interpretation of results.

John Kenney attended a training course for Coast Guard licensing and, as a result, has been licensed for both inland and offshore waters.

Vernon Nulk is attending a University of Rhode Island summer computer course on "Machine and Assembly Language Programming."

EEO Activities

On 4 May, the Gloucester Laboratory EEO Committee elected officers and proposed revisions to the Charter and Bylaws. A rough draft was prepared.

On 9 May and 14 June, Barbara Jobe attended meetings of the Regional Office EEO Committee.

On 15 June, the Gloucester Laboratory EEO Committee made revision to the rough draft of the Charter and Bylaws. The Committee also drafted proposed EEO Elements and Standards for Merit Pay and GWPAS Performance Plans.

ENVIRONMENTAL ASSESSMENT DIVISION

submitted by

Dr. John B. Pearce, Chief

BEHAVIOR OF MARINE FISHES AND INVERTEBRATES INVESTIGATION

As an extension of previous departmental research efforts, a field investigation of the feeding ecology and growth of age -0 blue fish in estuarine and coastal nursery areas has been initiated. The diet of bluefish from several Raritan Bay locations will be described and compared to potential prey assemblages. By statistically evaluating a range of prey and predator characteristics, an attempt will be made to determine the mechanisms of behavioral prey selection by juvenile bluefish. This information should enhance understanding of the factors which control bioaccumulation of organic contaminants by predatory fishes. Ontogenetic changes in growth rates and diet of juvenile bluefish in Raritan Bay will also be investigated. Field research will be conducted in conjunction with laboratory studies of bluefish growth and feeding behavior.

During June bluefish approximately 70 to 80 mm in length were caught and experiments begun in the laboratory on growth, daily ration, feeding behavior and prey selection. These results will supplement an existing data base compiled for adult bluefish under laboratory conditions, as well as allow comparison with field studies. Results of these studies will provide insight on important aspects of several life history stages and enhance understanding of the factors which may be involved in bioaccumulation.

BIOLOGICAL OCEANOGRAPHY OF STRESSED ECOSYSTEMS INVESTIGATION

Twenty-three shelf water samples were assayed during March and April to determine nutrient limitation. Nitrogen was the sole limiting nutrient in 10 samples and was most critical in another 9 samples in which phosphorus was secondarily limiting. These two nutrients were proportionally abundant in two samples. Growth of the assay diatom was completely inhibited in two samples.

During the May-June period, 49 samples of shelf waters were assayed in two batches. The two runs completed the algal bioassay of the Nempal 80-07 cruise collection. To date, collections from two September cruises, one March cruise and the July cruise have been assayed. Two December sample collections remain and preparations were begun to assay one of them, at least, before publishing the study results.

An assay run of 12 samples collected last summer from Lower New York Bay was set in June. This is the third of a planned series of seven assays to determine how well the red tide dinoflagellate, *Gonyaulax excavata*, can grow in New York Harbor waters. This is a resumption of the study which was suspended when Denise Holloman left the Laboratory in February. A student assistant, Donna Johnson, is now helping with the work.

Results of a second *Gonyaulax excavata* assay of surface and bottom samples from seven stations in Lower New York Bay further suggest that

chemical water quality of the bay water can be suitable for this species, particularly with increased chelation. This red tide dinoflagellate has not yet been detected in Lower Bay, but has been found recently in Nassau County, New York waters.

In response to a request to the laboratory for assistance (reviewed by A. Pacheco), Donna Johnson examined material which was clogging the intake screens of the Middlesex Water Company. As suspected by Mr. Pacheco, the specimen was determined by Ms. Johnson to be a bryozoan. She identified it as *Pectinella magnifica*. The water company hadn't seen this phenomenon in 15 years of operation of the Delaware-Raritan Canal.

Water samples for determining phytoplankton population assemblages were obtained by Clyde MacKenzie at nine stations in Raritan Bay and the New York Bight apex on April 15, 12 May and 17 June. The samples are being processed concurrently by Dr. Harold G. Marshall, Old Dominion University, Norfolk, Virginia, and Mrs. Myra S. Cohn, NMFS, Sandy Hook Laboratory. The stations included locations in Ambrose and Sandy Hook Channels off the Sandy Hook Coast Guard dock, and at six locations along a transect in the New York Bight apex.

Surface water samples for determining phytoplankton assemblages were also obtained on the June Ocean Pulse/Northeast Monitoring Program cruise along the northeastern seaboard of the U.S.

A paper on phytoplankton communities off the NE United States by Harold G. Marshall and Myra S. Cohn has been accepted and will be published in the forthcoming issue of *Estuaries*.

Data processing and microscopic examination of samples is proceeding to define three shelf regions based on recurrent patterns of phytoplankton biomass. Results will be important to water management unit descriptions.

John Mahoney and Myra Cohn are continuing a joint effort with Paul Olsen and Eric Feerst of the New Jersey Department of Environmental Protection to provide surveillance for cysts of *Gonyaulax excavata* in New Jersey waters. Samples obtained during March-April, were sonicated and examined by three separate investigators for cysts. No cysts of *G. excavata* (or *Gonyaulax tamarensis*) were found.

Mrs. Myra A. Cohn and Dr. John Mahoney of Sandy Hook Laboratory attended a meeting of the Interagency Committee on Red Tide Blooms on 1 June. Present were representatives from Suffolk and Nassau counties, State University of New York (Stony Brook) personnel, Interstate Sanitation Commission and New Jersey State Department of Water Quality Resources. The committee's purpose is to coordinate surveillance and reporting of red tide blooms in the New York Metropolitan area.

Seabed metabolism personnel continued to analyze data regarding the effects of cadmium on seabed oxygen consumption rates in preparation for the first draft of a manuscript. The extensive equipment overboard programs, started in March, is almost completed and preparations for the July New York Bight Apex cruise have begun.

Plots of seabed oxygen consumption measurements for the northeast continental shelf and associated estuaries for the period 1974-1983 are almost completed. These plots will be utilized in a forthcoming technical report.

Bill Phoel and Pete Kube assisted National Ocean Survey personnel in the installation of a current meter at Ambrose Tower, New York by removing, underwater, the end of a pipe to be used for a cable conduct. The removal required the use of an underwater cutting torch.

Peter Kube and Dave Radosh, using equipment for contaminated water diving, retrieved a trawl net lost by the R/V *Kyma* from the heavily polluted Gravesend Bay, Brooklyn.

Jim Thomas and Craig Robertson visited NASA/Goddard Space Flight Center on 28-30 March 1983. They met with Cathy Warsh of NOAA/NOS, Rockville, Maryland to plan satellite thermal data acquisition during her April 1983 Water Column Monitoring Survey. Three National Ocean Survey employees, Gary Dingle, Patti Eichelberger and Tracy Gill, were given training on the enhancement procedure for producing satellite images. They will collect imagery during the April, June, July and September 1983 cruises. These thermal images will be transmitted to the vessel and will be used in guiding the oceanographic survey activities. Additionally, exceptionally clear images for post cruise comparison and analyses.

Final installation of the conditioned telephone line to Narragansett and of the Unifax Facsimile machine were completed in the latter part of May. We are now receiving facsimile copies of the NOAA series and Geostationary Orbiting Environmental Satellite east satellite imagery on a continuous schedule. The imagery will be used in monitoring sea surface thermal patterns, frontal systems, warm core eddies and cloud cover for the northeastern U.S. coast.

Final correcting and compositing of figures for the Superflux Data Report is near completion.

Data from three cruises, two from 1977 and one from 1979, were submitted to data management for transcription and entry into the Northeast Monitoring Program/Ocean Pulse data base. The cruise data consisted of the standard hydrographic measurements, dissolved oxygen, percent oxygen saturation, bacterial counts and total plankton respiration. Data from cruises in 1975 and 1976 are preparation for submission. This will complete entry of all our data into the Northeast Monitoring Program/Ocean Pulse data base.

COASTAL ECOSYSTEMS INVESTIGATION

Community Structure

Clyde MacKenzie and Dave Radosh prepared for this summer's extensive suite of field experiments on effects of sediment type and contaminant loads on settlement of larval surf clams and other invertebrates. The experimental design has been expanded to eight replicate sediment trays for each of nine different treatments for each deployment, with four deployments planned for the summer. The first set of trays was deployed on June 23, with retrieval planned for July 6. Treatments include several concentrations of five trace metal, singly and in combination, as well as sludges from different sewage treatment plants, and sulfide. This work is being coordinated with that of Dr. Norm Rubinstein (Environmental Protection Agency, Gulf Breeze, Florida), who will deploy trays with various sediment types in a Corps of Engineers-sponsored study to determine suitability of different sediments as materials for capping contaminated dredged material. We have also helped Norm set up a laboratory system at Sandy Hook to examine the similar problems. Clyde also developed a manuscript on effects of silt on estuarine fauna, and Dave prepared for the July Ocean Pulse cruise.

Ann Frame and Steve Fromm worked on identifying macrofauna specimens and computerizing the resultant data for our Northeast Monitoring Program

regional survey as well as for samples from 1) the sediment tray experiments discussed above; 2) an earlier study of the macrobenthos at Deepwater Dumpsite 106; 3) a survey of benthos in the New York Bight acid waste disposal area compared to a control area in the Bight; and 4) a survey of Lydonia Canyon which included *intercalibration* of our Smith-McIntyre grab samples with samples taken on the *Alvin* (this is a cooperative project with Alan Hulbert of the Woods Hole Laboratory). Bob Reid coordinated the drafting of the Sediment Quality and Benthos section of the overall Northeast Monitoring Program Annual Report. He also helped revise an NMFS position paper recommending that sewage sludge be dumped at Deepwater Dumpsite 106 rather than the present 12-Mile Site. Bob provided data on hydrocarbon contamination in Penobscot Bay, Maine, to the New Jersey Department of Environmental Protection, and on metals in Hudson Canyon sediments to JRB Associates, who are working on an environmental impact statement for the 106-Mile Site. Tapes of our 1980-81 New York Bight benthic data were provided to Dr. Dan Dauer (Old Dominion) as part of a comprehensive analysis of Bight pollution impacts. Sediment information from the same data set were given to Gary Bingham (Tetra Tech, Seattle) who is interested in interreplicate variability. We advised the Corps of Engineers on living resources in coastal New Jersey water where they plan to dredge sand for beach fill.

Benthic Energetics

Frank Steimle continued working on several manuscripts and reports. Jan Ward continued working on the 60-mile alternate dumpsite assessment, her benthic invertebrate life history file, and a preliminary outline of data types available to understand the impact of pollutants on benthic species. Dot Jeffress worked on developing biomass values for benthic material collected at the 106-mile and 60-mile proposed dumpsites. Russ Terranova developed an analysis of what proportion of the wet weight biomass of molluscs is composed of the shell and he continued to collect fish and lobster feeding habits data from the New York Bight apex.

Frank Steimle completed the benthic section of the 106 mile disposal site characterization update.

On 16 May, Frank Steimle, Bob Reid, and Jack Pearce made presentations to the Center risk assessment meeting held at Sandy Hook. The presentations included information on the impacts of ocean dumping in the New York Bight apex, changes in benthic biomass and community structure, and possible effects on secondary productions schemes of relevance to fishery resources. Information from the past year, developed by the Ocean Pulse and Northeast Monitoring Programs, was also discussed in the context of how contaminant data and biological effects would be used in risk assessment analyses.

On 2 and 3 June, Frank Steimle met with Roger Theroux and Marvin Grosslein, Woods Hole Laboratory, to discuss the developemnt of Center benthic data bases and the status of the Center ecosystem model.

On 8 and 21 June, Division personnel including Cdr. Carl Berman, Mr. Robert Reid, Mr. Frank Steimle, Dr. James Thomas, and Dr. Jack Pearce met with Environmental Protection Agency, Region II personnel to discuss an upcoming cooperative cruise aboard the R/V *Antelope*. This cruise will operate in New York Bight apex waters and to a more limited extent in other coastal areas.

The purpose of this cruise is to assess living marine resources in areas which are being affected by ocean dumping. Mr. Stu Wilk is also working with the environmental protection agency in order to plan an intensive survey of commercial and recreational finfish in and around the dumpsite area.

During the reporting period, Mr. Frank Steimle and Mr. Robert Reid worked extensively in planning and preparing for the July Ocean Pulse and Northeast Monitoring Program cruise. This cruise will operate from the Gulf of Maine to off of Cape Hatteras and is designed to assess benchmark data developed during the past three years.

On 16 May, Mr. Russel Terranova met with C. Stillwell, Narragansett Laboratory, to discuss the completion of calorimetric measurements from shark tissues and the development of a manuscript on the results of these important measurements. Russ Terranova, Dot Jeffress and other Division personnel have been working on the R/V *Kyima* to collect fish stomachs from the bight apex for future contaminant analyses.

During the reporting period, Jan Ward added life histories for 38 additional benthic invertebrates to the Division benthic life history computer file. She also began developing the life histories for dominant benthic invertebrates from the Gulf of Maine and also started searching the literature for information on the effects of oil dispersants on marine organisms. The latter is being done as a contribution to NOAA Superfund activities.

Dot Jeffress and Jan Ward also worked on the historical samples from alternative dumpsites in the New York Bight; these materials are being examined to determine biomass and will be used in an upcoming report.

Knee McNulty developed and presented a seminar on "How to Compare Samples Statistically".

ENVIRONMENTAL CHEMISTRY INVESTIGATION

In early May, Andrew Draxler began weekly monitoring of bottom dissolved oxygen, sediment trace metals and chemical potential at the New York Bight sewage sludge setting area (Station 6). Very rapid changes in dissolved oxygen and chemical potential have been observed. Dissolved oxygen near the seabed decreased from 8mg/l to 4.5 mg/l from early May to the end of June. The chemical potential in the upper 1 cm of sediment declined from slightly oxidizing to highly reducing. We plan to continue monitoring this site at weekly intervals until mid-October, following the breakup of vertical stratification.

Weekly monitoring of the thermocline and vertical distribution of nutrients along a transect perpendicular to the New Jersey coast of Long Branch was also initiated in early May. Primary production in the inshore coastal band (0-20m depth) from New Jersey to Cape Hatteras is exceptionally high and is comparable to that in the shallow, well-mixed region over Georges Bank. The goal of this study is to assess the relative importance of the outflow of the Hudson estuary versus upwelling as a source of nutrients which would stimulate nearshore production. Part of this study involves measurements of nutrients, chlorophyll, temperature, salinity, and wind speed and direction taken daily at the Long Branch pier.

Ruth Walkhauer completed analyses and computer archival of nutrient data collected during the warm core ring surveys AL-8209 and DL-9206. Computer listings and data files were transferred to R. Schlitz, Woods Hole, who will merge the nutrient data with hydrographic information from

the ring surveys. Inorganic nutrient analyses made during the late January-February (NMFS) Marine Resources Monitoring, Assessment, and Prediction Program survey (AL-8301) were also computer archived. These data are unique in that they contain the maximum nitrate concentrations observed in our four years of monitoring. Surveys in previous years began in late February - early March and missed the annual nutrient maxima.

Several members of this investigation participated in the May-June Marine Resources Monitoring, Assessment, and Prediction Program survey: Cynthia Muchant, Kathy Ingham and Paul Lyons measured chlorophyll throughout the water column at 176 stations. Tom Finneran and Don McMillan measured ^{14}C - primary productivity.

Incorporating reviewers comments, Al Matte revised the manuscript "Nutrient baseline studies in relation to site characterization of the 106-mile disposal site." Chris Evans-Zetlin revised a manuscript which characterizes phytoplankton biomass at the 106 mile disposal site.

Jay O'Reilly and Chris Zetlin completed an initial draft of a chapter on primary production which will be part of a book on Georges Bank edited by Backus et al., Woods Hole Oceanographic Institution.

PHYSIOLOGICAL EFFECTS OF POLLUTANT STRESS INVESTIGATION

Physioecology

Two experiments challenging oyster embryos with water collected at specific sites from the Central Long Island Sound Dumpsite were conducted this reporting period. These experiments are being done to ascertain the normal variation in water quality at the dumpsite prior to the dumping of spoils from Black Rock Harbor, Bridgeport, Connecticut. Dumping was to begin in mid-April but was rescheduled for late April.

Two diluters were calibrated for Biochemistry. Both diluters are being used to expose sea scallops to either cadmium ($\text{CdCl}_2 \cdot 2-1/2\text{H}_2\text{O}$) or copper ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) at 0 and 20 $\mu\text{g}/\text{l}$.

One diluter was calibrated for Physiology. Windowpane flounder are being exposed to cadmium ($\text{CdCl}_2 \cdot 2-1/2\text{H}_2\text{O}$) at 0, 5, and 10 $\mu\text{g}/\text{l}$.

Five experiments challenging oyster embryos with water collected at specific sites from the Central Long Island Sound Dumpsite were completed this reporting period, and results are being analyzed. The purpose of the study was to monitor the water quality at the Central Long Island Sound Dumpsite before, during, and after dumping, using oyster embryos as test organisms. Seventy-five thousand yds³ of spoils from Black Rock harbor and Ash Creek in Bridgeport, Connecticut, were dropped at the northeast corner of the dumpsite (latitude $41^\circ 09.389'\text{N}$, longitude $72^\circ 51.68'\text{W}$), designated Ground Zero (GZ). Another site, three miles south of the dumpsite (latitude $41^\circ 07.95'\text{N}$, longitude $72^\circ 52.7'\text{W}$) served as control. An additional 12 stations were sited along transects at .25 and .75 miles from GZ, spaced at 60° (magnetic) from one another. Surface and bottom water samples were collected at these 14 sites for monthly monitoring prior to dumping, weekly during dumping activity, and monthly after dumping. Water samples were collected using five-liter Niskin bottles. The water was emptied from the Niskin bottle into a plastic 2-1/2 gallon container and transported to the lab where it was stored overnight at 26°C . Just prior to the experiment, the water was filtered grossly through 100% polyester filter fiber. Throughout the study, the American Society for Testing and Materials Standardized Bioassay Practice for Bivalve Molluscs was used.

Other activities included calibrating and starting a diluter for the Physiology subtask to expose lobsters to cadmium ($\text{CdCl}_2 \cdot 2\frac{1}{2} \text{H}_2\text{O}$) at 0 and 10 ug/l. Slipper limpets, *Crepidula fornicata*, are being exposed to mercury (HgCl_2) at 0, 1, 5, and 10 ug/l and will be exposed for at least one year to examine effects of the metal on reproduction and larval abilities.

Physiology

We have been studying the effects of various pollutants on lobster physiology this reporting period. By means of electrodes and pressure transducers, we now understand better the mechanics of water flow and gill-flushing in the branchial chambers of lobsters. We have also observed increased "coughing" in lobsters in response to challenge with various pollutants. We have set caged lobsters at the Central Long Island Dumpsite and will be monitoring the above respiratory responses as contaminated dredge materials from Black Rock Harbor, Bridgeport, Connecticut, are dumped in this area. As reported last period, our studies will also include measurements of flounder hematology and metabolism in blue mussels at this site. We have made all the initial preparations for the study and pre-dump baseline measurements have been taken. We expect that heavily-contaminated spoils from Black Rock Harbor will be disposed of at the site in late April.

Pre-dump sampling of winter and windowpane flounder at the Central Long Island Sound dumpsite and at two other Long Island Sound stations has been completed. Blood samples have been obtained from both species monthly since December 1982 for a variety of hematological measurements. The two species will be monitored monthly following the experimental dump to determine possible hematological changes.

We completed a 60-day exposure of striped bass to 5 and 10 ug/l mercury. We took blood samples from half the fish for hematological measurements and are holding the remaining half for a 60-day recovery period.

We are also in the process of completing a series of windowpane flounder exposures to heavy metals for hematological measurements. A 60-day exposure to 10 and 20 ug/l copper was completed in early March. A 60-day exposure of the same species to cadmium is in progress and will be completed in June.

We participated in the first two legs of the Spring Bottom Trawl Survey (southern and Georges Bank legs) and added a considerable amount of blood samples to our bank of Ocean Pulse/Northeast Monitoring Program flounder hematology data. These samples will be analyzed in the laboratory during the next reporting period.

The Environmental Protection Agency Laboratory in Narragansett, Rhode Island has set cages of blue mussels at sites 400 and 100 meters east of the dumpsite and at a control site some distance south of the dump location. We are measuring gill-tissue respiration rates from these animals to compare with other metabolic measurements made by Environmental Protection Agency and University of Connecticut researchers. Zero-time measurements were made before the animals were deployed. One month after initiation of dumping we found no respiratory differences between animals held 1000 meters east of the site and those held at the control site. After six weeks, animals held 400 meters from the site were tested and, again, no difference was found between those animals and the controls.

Environmental Protection Agency will retrieve animals after eight to ten weeks from all three sites and we will examine them as well, and compare results with personnel from cooperating laboratories.

We set cages with 24 lobsters at the 400 meter east study site, and at the control site, for examination after one month exposure to the dump plume. On the twenty-ninth day the lobsters were stolen at the 400 meter site despite the fact that we used radio pingers rather than surface markers. We reset a new collection of lobsters and successfully retrieved these, and controls, three weeks later. This is not an ideal design because dumping ceased about the time the new set was deployed. We measured heart and gill-bailer rates and gill-tissue respiration on these animals; analyses of the data are not complete at this time. We also preserved gill tissue for scanning electron microscope examination. In addition to the caged lobsters, we captured lobsters living in the vicinity of the dump and control sites during the dumping activity and conducted similar tests on them. Lobsters were also provided to Environmental Protection Agency for pollutant analysis of various tissues, and to the Microbiology subtask (*Graikoski*) for bacterial evaluation.

Winter flounder and windowpane flounder were captured by trawl before, during and after the dumping episode at the dumpsite and at our Long Island Sound control site. The fish were examined for changes in blood chemistry. Our three-year study of hematology of flounder captured at various stations in the Sound will provide a baseline of information on fish from clean and polluted areas, and will aid in interpreting data collected from the dumpsite.

Biochemistry

Research Laboratory

Biochemical analyses were completed for sea scallop adductor muscle samples from last summer's scallop survey, AL 82-08, and from last winter's Ocean Pulse/Northeast Monitoring Program cruise, AL 82-12. We also completed analyses of gonad preparations from last winter's experimental exposure of scallops to either cadmium or copper (7 weeks, 20 ug/l metal), with subsequent periods of clearing. Kidney analysis from this experimental series is currently in progress. Fixed kidney sections from the same study were shipped to Dr. Bruce A. Fowler (National Institute of Environmental Health Science Research, Triangle Park, North Carolina) for EDAX analysis. An analogous set of experimental exposures is presently underway to compare scallop responses to metal intoxication at an active stage of the reproductive cycle (energy stores are transferred from muscle to gonad during May and early June) with similar responses during last winter's relatively inactive metabolism.

Analyses of tissues from the monthly sampling of the New Jersey sea scallop population continues. We are planning intensive sampling of these scallops during May and early June, to follow more precisely the transfer of muscle glycogen to gonad for gamete maturation.

Analyses were completed for all adductor muscle and kidney samples from this past winter's paired experimental exposures of sea scallops, either to copper or the cadmium (20ug/l metal, 7 weeks \pm 1, 2, or 4 weeks' clearing). Gonad analyses were also finished, and data tabulation and interpretation are underway.

An analogous set of paired exposures (timed for takedown during the active metabolic period when glycogen reserves are transformed from muscle to gonad) was completed, and analysis has begun of tissues taken from those animals. Observations of the data strongly reinforce last winter's picture of copper's inhibitory effect on gametogenesis (apparent gamete resorption) and of cadmium's hormetic effect (many of the cadmium-exposed scallops spawned). The scallops used for this experimental series, however, are from a different population ESE of Montauk Point, near Ocean Pulse Station 34, as the *Gloria Michelle* was unsuccessful in collecting scallops from our usual site SE of Block Island. Dr. M.P. Morse (Northeastern University's Marine Science Institute, Nahant, Massachusetts see below), who is examining the pericardial gland from scallops in this exposure series, found the cellular morphology of that organ to be abnormal, even in control animals. Because we also lost (mortality) several of the copper-exposed animals, (in contrast to last spring's copper exposure using the Block Island scallops), it is not unlikely that the Montauk population has some pre-existing stress.

Field Research

Biochemistry participated in the final northern leg of Resource Assessment's spring bottom-trawl survey, AL 83-02. We generally get deepwater scallops on these cruises, and it is in later April - early May that adductor muscle glycogen stores are normally at their highest. In deepwater animals, we have observed that the highest glycogen (but always low, compared to other scallop populations) is found in late October, a phenomenon suggesting gamete resorption.

An intensive series of weekly samplings of the New Jersey scallop population was performed with the help of Sandy Hook's Environmental Chemistry unit during May and through early June. This is the period when that population, at least, transfers glycogen from muscle to gonad; our intention is to determine how rapidly the transfer is made, and how this affects the metabolism of the gonad itself as well as the muscle.

The last leg of the spring bottom trawl survey cruise (AL 83-02), in which Biochemistry participated, was completed in early May, providing us with adductor muscle, kidney, and gonad samples from 70 sea scallops collected at a total of eight stations, seven of them deepwater sites. One of these (#399, 190m) provided 18 animals of similar size (9.2 - 11.1 cm) but with a wide range of gonad development, shell thickness, and muscle size - all fairly good circumstantial evidence for recent recruitment of adults from nearby ledge populations; biochemical data (glycogen levels) should tell us, one way or the other. Because it was possible that the trawl may have drawn from more than a single population and from different depths (30-min trawls during bottom-trawl cruises), we asked the Woods Hole Resource Survey unit for assistance. Don Clescher sent bottom tracings for the 5 deepest stations, pointing out that the entire trawl at station #399 did not vary in depth more than 10 m. This suggests that the scallops with more developed gonads, thicker shells, and larger muscle were, indeed, recent and adventitious settlers.

Collaborative Work with Non-Center Personnel

With Physiology, Biochemistry sampled kidneys and antennal glands, respectively, from pre-dump collections of flounder (winter and windowpane) and lobsters taken from the proposed Central Long Island Sound dumpsite. After dumping begins, we will sample and analyze flounder taken from the

uncapped dumpsite as well as and lobsters that have already been placed in cages at the site. This field exercise is being performed in collaboration with the Environmental Protection Agency, Narragansett, Rhode Island.

Chemically fixed gonad sections from scallops taken during Resource Assessment and Ocean Pulse/Northeast Monitoring Program cruises, and from monthly collections from the New Jersey locations (July 29, 1982 - April 5, 1983) were shipped to Dr. R.J. Thompson (Memorial University, St. John's, Newfoundland) for microscopic examination. He will assess the reproductive stage and relative gamete maturation of the specimens, and attempt to establish a fecundity index for the NJ population. We also shipped him frozen whole scallops of wide size range, 25-30 animals/collection, taken in September, October, February, and April; from these, Dr. Thompson hopes to construct a growth curve for this population.

From the experimental exposure series completed in May, tissues were supplied to the following scientists: 1.) Dr. Bruce A. Fowler (NIEHS, Research Triangle Park, North Carolina), fixed kidney sections and frozen fresh kidney pools for EDAX and column study of Ca-P concretions and metallothioneins, respectively; 2.) Dr. M.P. Morse (Northeast University Marine Science Institute, Nahant, Massachusetts), pericardial gland, see above; and 3.) Dr. Ray J. Thompson (Memorial University, St. John's), fixed gonad sections for establishing gamete maturation stage. Dr. Thompson was also supplied with fixed gonad sections from the New Jersey scallop collections, as well as from deepwater scallops collected from five stations in the Gulf of Maine during the northern leg of this spring's bottom-trawl survey cruise.

Miscellaneous

Considerable time was spent in writing the Biological Effects section for the draft 1982 Northeast Monitoring Program Annual Report.

Anaerobic Bacteriology

Field and related laboratory studies have concentrated on collecting the background necessary for several bacteriological indices, i.e., *Clostridium perfringens*, *Vibrio* spp., and fecal coliforms, in water, sediment, and animal (lobsters, mussels) samples, to be monitored at the Central Long Island Sound dumpsite and the harbor areas of Black Rock, Bridgeport, and New Haven. The objectives of this study are to determine the impact of dredge material disposal on fishery resources, and the degree of dispersion and persistence of the material after dumping using bacterial indicators. The study is part of ongoing efforts within the Investigation and with the Environmental Protection Agency, Narragansett. We are also evaluating bacteriological techniques to be used for the monitoring of future dredging and disposal operations. In addition, the Central Long Island Sound dumpsite has been studied the past several years by the Corps of Engineers under the Damos Project, a project comparing several dumpsites along the eastern seaboard. As part of the latter project, there will be an opportunity to study the bacteriological aspects of capped versus uncapped contaminated material at the site.

C. perfringens counts of 10^5 /gm sediment from Black Rock Harbor are similar to those in sediments from the New York Bight sewage disposal area. A count of 10^3 /gm in Bridgeport Harbor sediments is somewhat lower, but 10 fold higher than that observed in New Haven Harbor sediments. Sediment counts of 10^3 /gm at the Central Long Island Sound dumpsite are

more reflective of our mildly impacted Long Island Sound Ocean Pulse station. The high counts of *C. perfringens* observed in Black Rock Harbor sediments should facilitate following the dispersion of the material at the disposal site. Sampling of pre-dumping sediments from the dumpsite support this prediction.

Counts of *Vibrio* spp. are low in the samples tested, but are probably reflective of the low ambient temperature during the period of sampling.

The counts for the target group of bacteria in lobsters and mussels from the dumpsite were low, indicating a minimal level of contamination.

Other laboratory studies during this period included characterization of bacterial isolates obtained on previous cruises.

Monitoring during the dumping operations showed a marked increase in *C. perfringens* in bottom waters. The counts decreased in the top and mid-waters within five days, but continued to be elevated in bottom waters for at least three weeks after dumping ceased. Sediment counts at the site were very similar to those in Black Rock Harbor sediments indicating little dilution during the dumping of the sediments in the Sound. Dispersion of sediments occurred early, being detected at stations located at 400 meters east and west of Ground Zero (GZ), the actual disposal site. Minimal dispersion was observed at stations located 1000 meters east and west of the site and 500 meters south.

Unfortunately, mussels and lobsters from the disposal point (GZ) were not obtained for bacteriological examination. Lobsters and mussels were captured, however, from a station 400 meters east of GZ; these animals were exposed to the dredge material. The bacterial flora of these animals were similar to those obtained from the control site and those examined prior to the dumping operation. Data obtained to date, therefore, indicate no detectable effect of dumping on the bacterial flora of animals from areas peripheral to the dumpsite.

We will continue to monitor established stations at periodic intervals to follow the dispersion of materials along an east-west transect, the prevailing pattern of current movement.

Coliform counts, although detected in the dredge material, were not as high as those of *C. perfringens*. Counts of *Vibrio* were low, but are beginning to increase both at the dumpsite and control sites, because of increasing seawater temperatures.

Chemistry

Clyde MacKenzie and Dave Radosh of the Sandy Hook Laboratory provided us with surf clams that were deployed at various polluted and non-contaminated areas in the New York Bight. Analyses of PCBs indicated levels of 8 to 50 ug/kg, wet weight.

Sea scallops exposed in the laboratory by Biochemistry to either cadmium or copper were analyzed for the presence of these metals in various tissues. Several hundred samples were analyzed.

Seawater samples from the heavy-metal diluters were analyzed weekly for determination of the concentration of test metals present.

The synthesis of metal-binding proteins by marine animals challenged by "elevated" metal levels in seawater has been proposed as a mechanism of the animals' ability to detoxify metals. We have been evaluating a technique to determine metal-binding proteins in various marine animals exposed to metals in our laboratory diluter systems. The technique we are examining uses a high-performance liquid chromatograph (HPLC) with a column

from Waters Associates (I-125 protein column) that separates proteins by their molecular weights.

Several hundred tissue samples from sea scallops collected on a number of Ocean Pulse/Northeast Monitoring Program cruises were analyzed for cadmium and copper.

Seawater samples from the heavy-metal diluters were analyzed weekly for determination of the concentrations of test metal present.

PUBLICATIONS

- Caracciola, J.V. and F.W. Steimle, Jr. 1983. An atlas of the distribution and abundance of dominant benthic invertebrates in the New York Bight apex with reviews of their life histories. NOAA Technical Report NMFS SSRF-766. 58p. (P)
- Gould, E., and R.A. Greig. Short-term low-salinity stress in lead-exposed lobsters, *Homarus americanus* (Milne Edwards). J. Exp. Mar. Biol. Ecol. (A).
- MacKenzie, C., D. Radosh and R. Reid. Effects of sewage sludge on settlement of larval invertebrates. Coastal Ocean Poll. Assess. News (A).
- Nelson, D.A., A. Calabrese, R.A. Greig, P.P. Yevich and S. Chang. Long-term silver effects on the marine gastropod *Crepidula fornicata*. Marine Ecology-Progress Series (A).
- Olla, B.L., A.J. Bejda and W.H. Pearson. 1983. Effects of oiled sediment on the burrowing behavior of the hard clam *Mercenaria mercenaria*. Mar. Environ. Res. 9:183-193. (P).
- Steimle, F.W. (In Press) Chapter 9.2 Benthic Faunal Production: In *Georges Bank*. P. Backus (ed), MIT Press. (A).
- Thomas, J.P. A. Tvirbutas, and A. McPherson. 1983. Spatial relationships between temperature and pigment in the Gulf of Maine - Georges Bank region. EOS. Transactions, American Geophys. Union. 3 May 64(18) Abstract 012B-09.

MISCELLANEOUS

Travel, Meetings, and Presentations

In March Jim Thomas (NEFC), Andy Tvirbutas and Tony McPherson of C.S. Draper Laboratory, Inc., submitted an abstract, "Spatial relationships between temperature and pigment in the Gulf of Maine - Georges Bank region", to the American Geophysical Union for presentation at its meeting.

E. Gould attended the 2nd International Symposium on Responses of Marine Organisms to Pollutants, held at the Woods Hole Oceanographic Institute, April 27-19.

Bob Reid attended a symposium on assessment and management of ocean waste disposal at the University of Rhode Island, 2-6 May.

Anne Studholme and Allen Bejda attend the 4th Biennial Conference on Ethology and Behavioral Ecology of Fishes held at Illinois State University, Normal, Illinois, May 9-12.

On May 25, Bob Reid and Stu Wilk attended Congressional hearings on the 12 vs 106 mile sludge dumpsite issue. Bob and Stu represented Jack Pearce at the NEFC Board of Directors meeting on June 1-2.

Bob Reid, Ann Frame, Clyde MacKenzie, Frank Steimle, Dave Radosh and Steve Fromm attended the East Coast Benthic Meetings in Melbourne, Florida on 25-27 March.

During the period 28 May - 4 June, Dr. Pearce participated in the meetings of the Advisory Committee on Marine Pollution (ACMP), International Council for the Exploration of the Sea (ICES). Principal topics of interest to NMFS and NOAA include developing new programs on quality assurance (intercalibrations), the development of international regional assessment programs, and planning for an upcoming workshop on biological effects monitoring. The workshop will involve scientists from a number of nations working aboard a West German research vessel in early 1984. Various measurements will be made using different physiological and biochemical techniques to determine the efficiency of the techniques in monitoring programs.

F. Thurberg participated in a site review of research conducted at the Environmental Protection Agency Laboratory, Gulf Breeze, Florida 31 May to 3 June.

Clyde MacKenzie attended the annual meeting of the National Shellfisheries Association on 6-9 June at Hilton Head, SC.

Jack Pearce, Bob Reid, Frank Steimle, and Carl Berman met with Environmental Protection Agency-Region II personnel on 8 June and 29 June to discuss an integrated New York Bight cruise this August.

On 10 June Dr. Pearce attended a meeting of the Federal Executives Association at Fort Monmouth, New Jersey. The principal topic discussed included impacts of Bell System reorganization on the Federal Telecommunications System (FTS).

On 10 May and 15 June, Drs. Pearce and Sindermann participated in meetings of the Northeast Monitoring Program (NEMP) Management Team. The meetings were held in Milford, Connecticut, and were involved with developing criteria for the evaluation of various programs ongoing within NEMP. During the 15 June meeting, the results of programs to date were ranked and evaluated by the NEMP Management Team.

On 16-17 June, Drs. Pearce and Sindermann participated in the board meeting of the Regional Action Plan (RAP) group. The new habitat conservation policy document was discussed. Revisions to the RAP planning document were projected and assignments made.

From 21-23 June, Mr. Stu Wilk and Drs. Jim Thomas and Jack Pearce participated in the NOAA Estuarine Workshop, University of Delaware. Drs. Pearce and Thomas gave a presentations on the use of remote sensing in the assessments of wetlands and estuaries and the results of Ocean Pulse and Northeast Monitoring Programs, as these relate to estuaries and coastal waters.

M. Dawson attended a fish disease workshop at the U.S. Fish and Wildlife Service Laboratory, Leetown, W. Virginia.

D. Nelson and J. Pereira spent 4 days at the Environmental Protection Agency Narragansett, Rhode Island Laboratory learning how to construct mini-diluters.

Bill Phoel attended the 1983 Oil Spill Conference in San Antonio, Texas. As NMFS Diving Officer, Bill made site visits to diving groups at La Jolla and Terminal Island, California and the U.S. Naval Academy, Annapolis, Maryland.

Pete Kube presented a poster paper, "In situ Quantification of Oil Entering Laguna Madre Estuary Under Protective Booms", authored by Bill

Phoel, at the Atlantic Estuarine Research Society (AERS) meeting, Cape May, New Jersey. Peter also presented an underwater videotape of the actual IXTOC blowout, along with the poster paper.

Al Matte and Ruth Waldhauer attended a Hewlett-Packard seminar on data acquisition systems using the 41C calculator and the series 80 computer.

In May, Jim Thomas presented a paper, Spatial relationships between temperature and pigment in the Gulf of Maine - Georges Bank region, at the American Geophysical Union meeting in Baltimore, Maryland.

J. Graikoski visited the Pascagoula Laboratory, 28-29 March, to confer with the Laboratory Director on safety of vacuum packed fresh fish.

Visitors

Bob Reid and Frank Steimle met with personnel from Regional and Washington Habitat Conservation Units to discuss our statement on sewage sludge dumping at the 12- or 106-mile sites.

Frank Steimle and Bob Reid joined other NOAA participants in the Northeast Monitoring Program to draft the NEMP Annual Report, on 22 March, and 19-21 April, and 10 May.

On 9 March and 12 April, Frank Steimle was visited and interviewed by students from New Jersey Institute of Technology and Ramapo College, New Jersey and by Bruce Freeman, Chief, New Jersey Division of Marine Fisheries, on the subject of artificial reefs.

On 17 June, Dr. Pearce met with Washington Office staff personnel including Richard Schaffer and Ed MacLeod.

On 29 June, Dr. Pearce met with Ms. Leah Guterman of Camp, Dresser, and McKee. She visited Sandy Hook Laboratory to obtain information to be used in the development of statements on ocean dumping at the 12, 60, and 106 mile sites. Her research is being done under contract with U.S. Environmental Protection-Region II.

On 23 May, Mr. Frank Steimle met with Dr. B. Corning, EG&G, who is under contract to NOAA to census various data bases for the NOAA OPDIN data system.

Anne Studholme and Allen Bejda met with Dale Heinz of Sea Coast, Inc., on several occasions to advise Mr. Heinz on the development and construction of a seawater system and holding facilities for marine invertebrates, as well as experimental designs for chemosensory choice experiments with lobsters.

Anne Studholme met with Bruce Freeman of New Jersey DEP to discuss background information and areas of future research in relation to studies on the feeding ecology of bluefish.

University Affairs

On Wednesday, 9 March, Anne Studholme presented an invited seminar entitled: "Comparative behavioral responses of three marine fishes to temperature", to the graduate students and faculty of the Biology Department, Lehman College, New York City.

F. Thurberg presented a seminar on biological monitoring techniques used in the Ocean Pulse program to the University of Massachusetts, Zoology Department, Amherst, on March 16.

In April, Jim Thomas presented a lecture on remote sensing to Dr. John Lindsay's class, Ecology and Management Resources of the Georges Bank - Gulf of Maine Region, at the University of New Hampshire.

Bob Reid participated in a meeting of the International Council for the Exploration of the Sea Benthos Working Group held in Hamburg, Germany on 4-8 April. Bob Reid presented a talk on environmental problems and monitoring programs in the Northeast to an ecology class at University of New Hampshire on 14 April.

On Monday, 11 April, Allen Bejda and Anne Studholme met with marine science students from Stockton State College to discuss various aspects of ongoing behavioral research.

Bob Reid gave a talk, on problems of the New York Bight and how diving is used to study them, to the Shrewsbury Grammar School on May 16.

During the month of May, 1983, Craig Robertson attended a meeting at the University of Delaware sponsored by NOAA/NOS and outlining their planned survey activities in the Delaware Bay estuary for FY 1984-85. Standard hydrographic surveys, including tide, circulation and bathymetry studies, will be conducted from the Delaware Bay mouth up the Delaware River to Trenton, New Jersey. NOS personnel expressed their desire to cooperate with any agency or university engaged in supportive studies (biology, chemistry, geology) within the Delaware estuary and that status reports of on-going work would be sent to any interested party.

A. Calabrese was appointed member of the State of Connecticut Advisory Committee for the Connecticut Sea Grant Program.

Public Affairs

J. Graikoiski was a judge at the Connecticut Science Fair, March 15 and also taught Oceanography, Boy Scout Merit Badge College, February - March.

Bill Phoel appeared on a local (Ocean County, New Jersey) cable TV show where he was interviewed on oceanography and scientific diving and answered questions phoned in by the viewers.

J. Pereira gave lectures on marine science to sophomore and senior biology students at Naugatuck High School on June 6 and 13. He also hosted a 4-H Youth Marine Awareness Day at the Milford Laboratory on June 28.

Personnel

Dave Radosh received a \$250 award for several modifications to grab sampling gear and procedures which make sampling quicker and more precise.

EEO Activities

A. Calabrese participated in the Milford Lab's EEO Committee meeting on May 19 and the Center EEO meeting at Woods Hole on June 2.

AQUACULTURE DIVISION

submitted by

Dr. James E. Hanks, Chief

ASPECTS OF NUTRITIONAL REQUIREMENTS OF MOLLUSKS INVESTIGATION

Oyster Feeding

An experiment is currently in progress in which the nutritional values of two flagellates, *Dunaliella euchlora* and *Tetraselmis maculata*, cultured in three enriched seawater medium formulations are being tested as food for juvenile oysters, *Crassostrea virginica*. Seven groups of 50 laboratory-reared oysters with equal mean weights were placed in experimental rearing chambers. With the exception of one unfed control group, each group of oysters is being fed a daily ration of an equal cytoplasmic volume of *D. euchlora* or *T. maculata* cultured in E, X₁, or N/P medium. Initial results indicate that the nutritional values for oysters of these algal species thus cultured differ significantly. We were surprised, however, to observe a sudden increase in weight and the production of fecal material by unfed oysters between the 5th and 6th weeks of the experiment. Microscopic examination of seawater taken from the rearing chamber containing unfed oysters revealed the presence of a small flagellate that seems to have an alternate amoeboid stage. Seawater entering the chambers is filtered in a series of polypropylene wound cartridges ranging from 50 µm to 0.5 µm pore size. It is not known how this organism was able to enter the chamber except through inefficiency of the filters. Extra precautions have been taken to clean all pipes, tubing, and components of the rearing chamber seawater system, to eliminate this unknown nutritional input. An effort is being made to isolate and culture this organism.

Analyses of Algal Constituents

Axenic carboy cultures of *D. euchlora* and *T. maculata* grown in enriched seawater formulations E, X₁, or N/P have been analyzed for protein, total carbohydrates, and total lipids. In addition, dry weights and mean length and area measurements were determined for these algal cells. We are investigating relationships between algal growth media, gross biochemical composition of algal cells, and nutritional value of algae to juvenile stages of *C. virginica*. Several interesting trends are apparent in our preliminary data and we are pursuing these questions by repeating analytical procedures and continuing the present oyster feeding study.

Algal Culture Collection

The Milford Laboratory algal culture collection has been recently registered with the United States Federation for Culture Collections.

Semicontinuous Algal Cultures

Algal cultures were harvested from carboys to yield net volumes of 1,224 liters and 2,885 liters at a packed cell volume of .003 for larval and juvenile molluscan foods, respectively. These algal food suspensions were distributed upon request to the Milford Laboratory Investigations as follows: Spawning and Rearing of Molluscs, 1,660 liters; Aquaculture Genetics, 1,307 liters; Physioecology, 1,142 liters.

Carboy cultures of *Dunaliella euchlora* and *Tetraselmis maculata* in standard enriched seawater medium (E), reduced nutrient-enriched seawater (X₁), and an experimental formulation designated N/P have provided a dependable daily harvest of axenic suspensions for the current oyster feeding study being conducted by this Investigation.

Open Tank Cultures

Mixed algal species cultured in an enriched reconstituted seawater medium in open fiberglass tanks containing 500 liters have been made available to Milford Laboratory Investigations. These cultures are intended for feeding adult molluscs in situations wherein a critically defined food source is not required. The presence of potentially toxic algal species, such as certain dinoflagellates, is precluded by the use of reconstituted seawater; whereas, this would not be the case in blooming natural populations. *Prorocentrum micans*, for example, was observed in Milford Harbor at the end of June. Approximately 1,800 liters of culture at a mean packed cell volume of .012 have been harvested from two tanks during the period covered by this report. These cultures have been utilized by the following Investigations: Spawning and Rearing of Molluscs, Aquacultural Genetics and Physioecology.

SPAWNING AND REARING OF MOLLUSKS INVESTIGATION

We have completed our study of the growth of hatchery reared surf clams, *Spisula solidissima*, during the winter months in the southeastern United States. In a cooperative effort with the State of South Carolina, surf clams were reared from October through May in a land-based pumped seawater upflow system. Differing biomasses of clams were reared at constant flow rates to determine the carrying capacity of the system at ambient conditions of temperature and nutrition (phytoplankton). The overall growth rate was similar to that recorded in the northeast during the summer months where seed-sized clams (15 mm) can reach a potentially marketable size (50 mm) in one growing season. In the south, the most rapid growth occurred during the months of October and May, while steady moderate growth was maintained even through the coldest month of February when seawater temperature was 7°C. Ambient seawater temperatures in South Carolina rise above a physiological maximum for the surf clam (27°C) during the month of June. This summer we are conducting growth trials in Milford in similar systems to compare growth more closely at the two latitudes.

Several possibilities exist for utilizing northern and southern latitudes for culturing two or more crops annually of yearling surf clams. Strategies might include hatcheries producing seed clams for grow-out in the opposite region. Future cooperative efforts may include

applying field grow-out techniques developed in Milford to the southern winter culture efforts. It is apparent that aquaculture of the surf clam has a great potential for significant production of food biomass.

We have applied the results from earlier larval feeding experiments that showed best growth at relatively low phytoplankton concentrations to a test of continuous feeding. Using a low volume, constant delivery pump we maintained an *Isochrysis* concentration of 10,000 cells/ml in a 10 l culture of 100,000 oyster larvae for the entire larval period. This culture required the addition of fewer than 33 million cells to maintain algal concentration on the first day when the larvae were 74 μ m mean shell height; by day 11 when the larvae were 230 μ m mean shell height 1.04 billion cells were required. This 31.5-fold increase in the daily phytoplankton requirement dramatically demonstrates the increase in larval appetite as they grow. Larvae in control cultures, fed once daily up to 50,000 cells/ml, grew at least 29% slower than those fed continuously. These results point out the need for commercial shellfish hatcheries either to increase daily phytoplankton rations or decrease larval densities as the larvae grow.

A substantial number of bay scallop, *Argopecten irradians*, seed 10 mm shell has been produced this spring. We have suspended a series of pearl nets in Long Island Sound containing some of these small scallops as part of a test of the effects of depth on survival and growth.

AQUACULTURAL GENETICS INVESTIGATION

Oyster Breeding

The second selected generation of oysters in a bi-directional selection experiment for growth has been spawned and eggs cultured. Spat are presently being obtained. The fastest growing 25% of the fast-growth line contributed spawners to this generation, and the smallest 70% of the slow-growth line. Spawning was restricted to a 6-week period so that at maturity the various cultures can be treated as contemporaneous. In the low line there were 91 female parents and 60 male parents. In the high line there were 93 female parents and 102 male parents. The mean parental area of the high-line parents was 27.7 mm and of the low-line parents 15.0.

The prospects for successfully inducing gynogenesis and androgenesis in oysters were examined cytologically. Also examined were the effects of high pressure on the chromosome apparatus of unfertilized, fertilized, and cleaving eggs of the oyster. It was concluded that oysters, and most likely other shellfish, may be as good - or better - candidates for chromosome engineering as are finfish. For the latter there is currently considerable interest in the breeding possibilities offered by such chromosome manipulations as gynogenesis, which even occurs naturally in some groups of fish.

Mutation and the Environment

The analyses of Atlantic mackerel blood and hematopoietic kidney tissue for chromosome mutation frequencies using a micronucleus test adapted to fish are nearing completion. A statistical study of the completed nearly 450 blood samples was conducted, and also a preliminary study of the partially finished hematopoietic samples. Of three groups of fish sampled in the New York Bight but near the edge of the continental shelf, the most

northerly, closest to polluted apex waters, shows the highest frequencies. Though the means differ slightly, they prove highly significant statistically. Yet higher values were obtained for fish caught in Hempstead Bay, Long Island. Efforts to relate mutation frequencies statistically to age, length, or maturation have not been successful, and water mass appears to be the major contributing factor to frequency differences. In polluted Hempstead Bay maturation though may be showing some influence on mutation. Data being collected on remaining fish in the three offshore groups should make possible a further examination of relationships with natural variables using immature erythrocytes which reflect the more immediate biological condition of the fish, and environment than do the mature erythrocytes. Mature cells are better for obtaining an integration of conditions and events over several weeks or even a few months.

Experimental work establishing a basis for using the micronucleus test on the spermatogonia of shellfish has been completed with the surf clam as a model species. Field samples have been obtained from three locations for an examination of the feasibility of using this test in the monitoring mode. If practical for that purpose, it should be very useful, as it can be conducted on a sedentary species of resource value, and directly on a reproductive cell. This latter possibility eliminates the need to extrapolate from somatic to germinal mutation in assessing likely impacts on reproductive effects.

Data have been compiled in final format for a principle component analysis of Atlantic mackerel egg health, measures of environmental contamination and physical oceanographic conditions in the New York Bight using '77 and '78 combined samples. Egg parameters being finally compared over variously contaminated sample sites are: developmental malformations, mortality, development rate, and mitotic errors in early-stage eggs. An earlier study was done on '77 samples alone, and was limited by sample size.

PUBLICATIONS

Ukeles, R., and G.H. Wikfors. 1982. Design, construction, and operation of a rearing chamber for spat of *Crassostrea virginica* (Gmelin). J. Shellfish Res. 2(1):35-39. (P)

MISCELLANEOUS

Travel, Meetings, and Presentations

June 5-9 Ed Rhodes presented a talk on bivalve larval feeding strategies at the National Shellfisheries Association meeting, Hilton Head, South Carolina.

June 26-30 Ed Rhodes participated in a U.S. aquaculture delegation visit to Cuba and presented three lectures on U.S. molluscan aquaculture.

Visitors

Joe Twarog provided a tour of our facilities and information on our program for Mr. Olivier Pilley, a visiting student from France. In addition, we provided short talks for several groups of students that have visited the laboratory.

May 3 - Cynthia Dietz, State University of New York, Stonybrook, New York; June 28 - Gail Grossman, Fairfield, Connecticut; June 30 - John Manzi, State of South Carolina Marine Resources Research Institute, Charleston, South Carolina; June 16 - Olivier Pilley, Institute National Agronomique, Paris.

University Affairs

May 19 Ron Goldberg discussed the use of unexplored ecological niches for the culture of surf clams and provided seed animals to Glen Lopez, State University of New York, Sea Grant.

May 20 Ed Rhodes discussed seawater system design with Ian Morris, University of Maryland, and later reviewed a draft proposal concerning this system.

May 27 Ed Rhodes discussed bay scallop predation with Steve Tettlebach, University of Connecticut.

Mutation (micronuclear) frequency field data on Atlantic mackerel, turned over to the Statistics Department, Yale University, were used in the completion of a formal graduate technical work/study project. A copy of the report as accepted by the Department was given to the Milford Laboratory.

Cooperation with Other Groups in NOAA and Other Government Agencies

A. Longwell reviewed and commented at length on two documents dealing with offshore oil development in the North Atlantic. A small amount of additional work was done in conjunction with the National Academy of Sciences Report on Petroleum in the Marine Environment relevant to earlier input as a participant in the NAS study.

Requested comment was also made on a Draft Genetics Plan for Interior's Sport Fisheries.

Public Affairs

Axenic starter cultures were provided upon request to Mr. Michael Caffrey, Fairleigh Dickinson University, and to Dr. H. Haskin, Rutgers University, for use in the new Shellfish Research Laboratory, Bivalve, New Jersey.

Mr. Arthur Petrini of the Milford Municipal Sanitation Department submitted samples of "murky" coastal water for observation of algal populations. Results of our observations were communicated via telephone conversations. Although several species of algae were observed, there was no indication of the presence of an algal bloom in the sample.

May 3 Ed Rhodes hosted a student group for the Gunnery School, Washington, Connecticut.

May 20 Ed Rhodes discussed shellfish depuration with Jim White, Fellsmere, Florida.

May 25 Ed Rhodes talked with Biff Cuthbert, Mulberry Farms, Guilford, Connecticut, about hard clam grow-out.

Personnel

June 13 Tonianne French, summer hire, and Joyce Bowling, Junior Federal Fellow, began work with the Spawning and Rearing Investigation for the summer.

June 27 Kathryn Chiba entered on duty with a one-year appointment.

EEO Activities

Ron Goldberg and Tony Calabrese arranged for the presentation of four workshops on statistical methods to members of the staff.

NATIONAL SYSTEMATICS LABORATORY

submitted by

Dr. Bruce B. Collette, Director

SYSTEMATICS OF FISHES

Completed a monograph on the 18 species of Spanish mackerels (*Scomberomorus*) and submitted the manuscript to the *Fishery Bulletin*.

Revised draft manuscript on beloniform fishes for the Symposium on Ontogeny and Systematics of Fishes.

Completed a manuscript demonstrating that *Grammatorecynus*, the Indo-West Pacific double-lined mackerel is not monotypic but contains two species.

SYSTEMATICS OF CRUSTACEANS

Continued preparation of a revision of the eastern Pacific rock shrimps (genus *Sicyonia*). Completed a synonymy of each of the 12 species treated and prepared a bibliography as exhaustive as has been possible to assemble. Twenty illustrations and three graphs were revised.

Continued with study of the mud shrimps of the eastern Pacific. Revised the key to 27 species that will be recognized in the Western Hemisphere. Twenty of these are from the eastern Pacific, 16 of them previously undescribed. Descriptions and illustrations are in progress. Undescribed forms from the Atlantic await future study.

SCIENTIFIC SERVICES

Information was provided on: commercial marine mollusks from the Caribbean and common birds of South America to Adelfa Fernandez Spanish Editor, Revista Americas, Organization of American States (OAS); the family Sicyoniidae (rock shrimps) to Roger Kłoczek, Curator of Fishes, John G. Shedd Aquarium, Chicago. Curatorial assistance was provided to the Smithsonian Institution by loaning 85 lots (529 specimens) of penaeoid shrimps from the Indo-west Pacific to Dr. A. Crosnier, of the Office de la Recherche Scientifique et Technique outre Mer (ORSTOM).

Furnished information on *Panulirus* (spiny lobsters) species from the eastern Pacific to G. Kiel, NMFS Western Field Inspection Office, Bell, California; on references to and families of decapod crustaceans for D. Hardy, National Oceanographic Data Center.

Manuscripts were reviewed for Transactions of the American Fisheries Society and for one author at his request.

PUBLICATIONS

Collette, B.B. Review: Resources of tunas and related species and their fisheries in the Indian Ocean by E.G. Silas and P.P. Pillai. *Copeia* 1983(2):575 (P).

Collette, B.B. Review: Multilingual dictionary of names of marine food-fishes of world fauna by G.Y. Lindberg, A.S. Heard, and T.S. Rass. *Copeia* 1983 (2):575-576 (P).

- Moore, K.H. and B.B. Collette. Review: Dictionary of Japanese fish names and their foreign equivalents. Ichthyological Society of Japan. Copeia 1983(2):576-577 (P).
- Collette, B.B. Recognition of two species of double-lined mackerels (*Grammatoreynus*: Scombridae). Proc. Biol. Soc. Washington 9(4) (S.A).
- Perez Farfante, I. 1982. Camarones. In Chirichigno, N., W. Fisher, and C.E. Nauen. INFOPECA. Catalogo de especies marinas de interes economico actual o potencial para America Latina, Pt 2. Pacifico centro y suroriental. Rome, FAO/PNUD, SIC/82/2/2: p. 363-381
- Williams, A.B. 1983. Marine decapod crustaceans of the Carolinas. *Fishery Bulletin* 65:1-298, 1965. Citation Classic. Current Contents 14(7):20.

MISCELLANEOUS

Travel, Meetings, and Presentations

B.B. Collette attended the annual meeting of the American Society of Ichthyologists and Herpetologists at the Florida State University in Tallahassee, Florida from June 19 to June 24. He participated in the Board of Governors' meeting as Past-President of the Society and presented and a paper "Revision of the double-lined mackerels, *Grammatoreynus*."

Visitors

Dr. Williams was visited by John Clamp, North Carolina State Museum, Raleigh, to discuss parasites of portunid crabs and other decapod species, and for work in the U.S. National Museum crustacean collection.

ATLANTIC ENVIRONMENTAL GROUP

submitted by

Dr. Merton C. Ingham, Director

OCEAN MONITORING AND CLIMATOLOGY TASK

The cooperative Ship of Opportunity Program obtained thirteen expendable bathythermograph transects (XBT) and four continuous plankton recorder (CPR) transects in May-June, four XBT and two CPR transects in the Gulf of Maine, three XBT off southern New England, four XBT and two CPR transects across the shelf and slope off New York, and three XBT transects across the Gulf of Mexico.

The announcements on the next two pages of eddy conditions in the Georges Bank-Middle Atlantic Bight area were sent to Commander, Atlantic Area, U.S. Coast Guard, for publication in the April and May 1983 issues of the *Atlantic Notice to Fishermen*.

Undulating Oceanographic Recorder (UOR) Deployed with New Data Acquisition System

On June 29, 1983 the newly designed Undulating Oceanographic Recorder Data Acquisition System was successfully tested during a 13 hour tow through Sargasso Sea, Gulf Stream and Slope water by the M/V *Oleander*. Some 1320 measurements of temperature, salinity, and depth were made during the tow and have been processed and displayed by computer. One or two months of additional testing are planned to precede regular monthly ship-of-opportunity deployment.

PUBLICATIONS

- Armstrong, R.S. Variation in the shelf water front position in 1982 from Georges Bank to Cape Romain. *Annls biol. Copenh.* 39. (S)
- Armstrong, R.S. Variation in the shelf water front position in 1981 from Georges Bank to Cape Romain. *Annls biol. Copenh.* 38. (A)
- Celone, P.J., and C.A. Price. Anticyclonic warm core gulf stream rings off the northeastern United States during 1982. *Annls biol. Copenh.* 39. (S)
- Celone, P.J., and C.A. Price. Warm Winter Water on Southwestern Georges Bank. *Coastal Oceanog. and Climatol. New*, 5(3):25-26 (P)
- Crist, R.W., and R.S. Armstrong. Bottom temperatures on the continental shelf and slope south of New England during 1982. *Annls biol. Copenh.* 29. (S)
- Cook, Steven K. Water column thermal structure across the shelf and slope southeast of Sandy Hook, New Jersey in 1982. *Annls biol. Copenh.* 39. (S)
- Cook, Steven K. Temperature Conditions in the Cold Pool 1977-1981: A comparison between southern New England and New York Transects (S)
- Fitzgerald, J.L. and J.L. Chamberlin. Anticyclonic warm core Gulf Stream eddies off the northeastern United States during 1981. *Annls biol. Copenh.*, 38. (A)

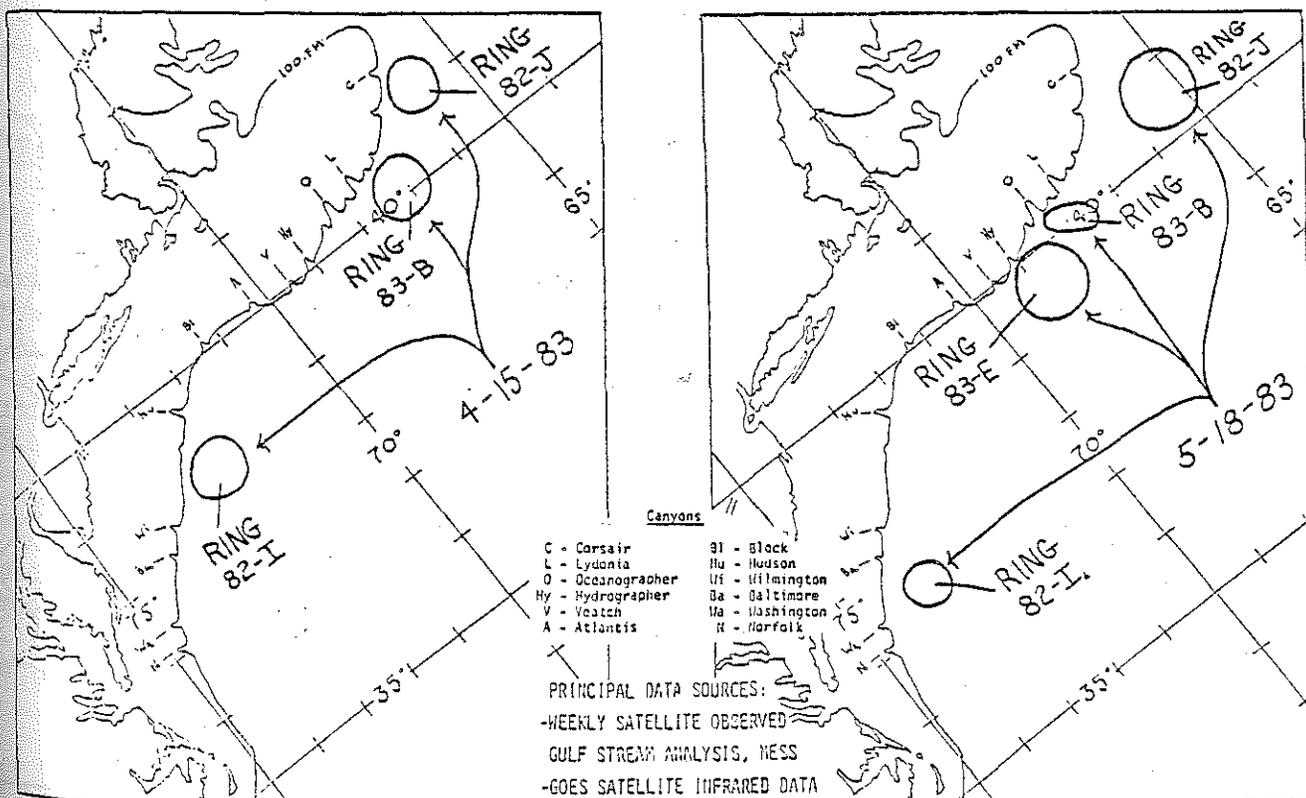
GULF STREAM EDDY LOCATIONS

The Atlantic Environmental Group of the National Marine Fisheries Service reports that four warm-core Gulf Stream rings were off the northeast coast of the United States in mid-May.

Ring 82-I travelled southwestward 167 km (90 nm) to a position centered at 37.4°N 73.6°W, east of Washington Canyon. Ring 82-J increased in size while moving in a southeasterly direction 78 km (42 nm) to a position centered at 40.6°N 65.3°W southeast of Corsair Canyon, but far offshore. Ring 82-B, its continued existence uncertain, travelled westward 67 km (36 nm) to a position centered at 40.0°N 67.8°W, south of Lydonia Canyon. A new ring, designated 82-E, formed the third week of April, and moved in a west-northwest direction 131 km (72 nm) to a position centered at 39.5°N 68.8°W, southeast of Hydrographic Canyon.

During the next thirty days, Ring 82-I can be expected to move in a southerly direction towards the offing of Cape Hatteras and may be resorbed by the Gulf Stream. Ring 82-J should travel southwestward along the edge of Georges Bank, and approach Lydonia Canyon. If Ring 82-B continues to exist, it can be expected to move in a westerly direction to a position centered near Hydrographic Canyon. Ring 83-E can be expected to move westward along the edge of the continental shelf to a position centered south of Block Canyon.

Fishermen are requested to report unusual conditions or catches occurring in the vicinity of these rings to the Director, Atlantic Environmental Group, National Marine Fisheries Service, RR 7, South Ferry Road, Narragansett, Rhode Island 02882, by mail. Updates on ring positions and general information on Gulf Stream rings may be obtained by calling the Atlantic Environmental Group (401-789-9326).



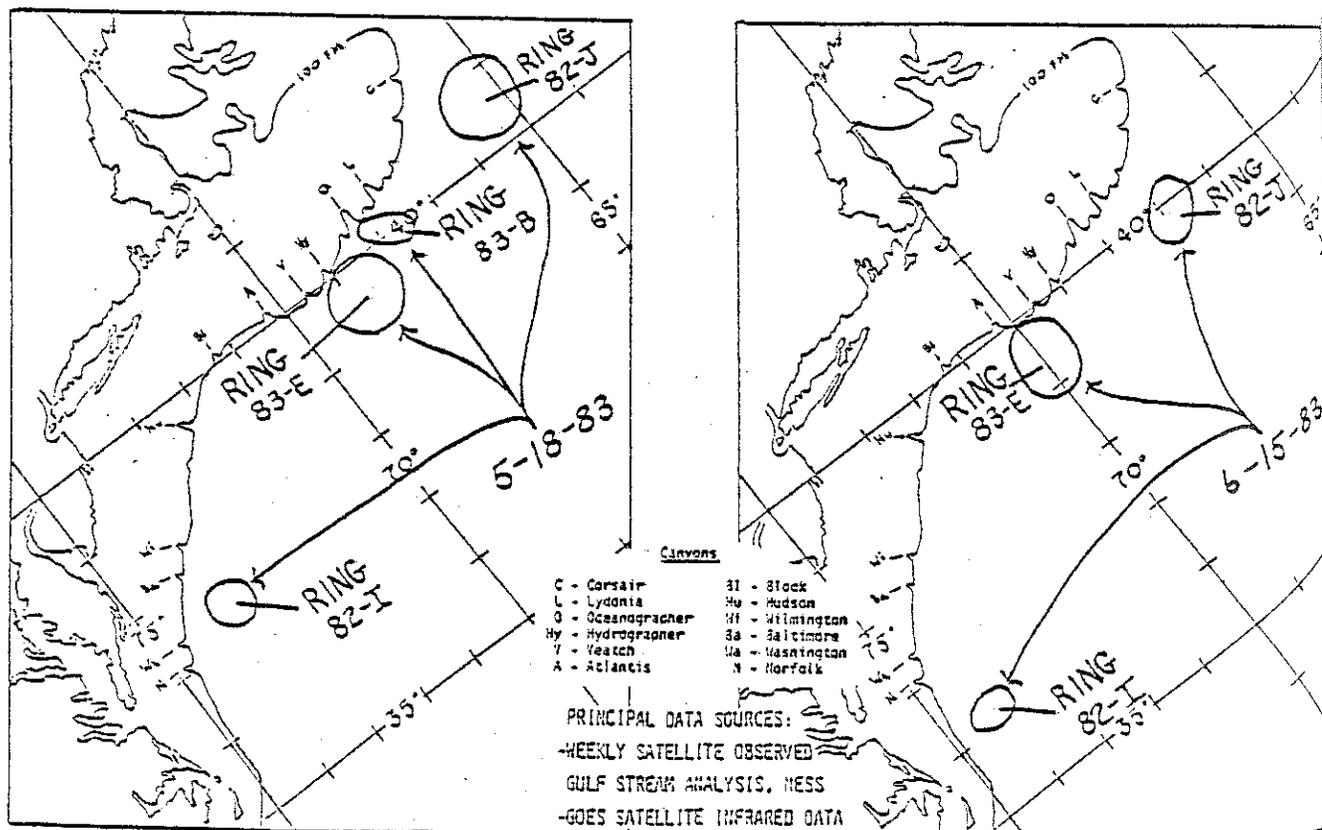
GULF STREAM RING LOCATIONS

The Atlantic Environmental Group of the National Marine Fisheries Service reports that three warm-core Gulf Stream rings were off the northeast coast of the United States in mid-May.

Ring 82-I travelled southwestward 148 Km (80 nm) to a position centered at 36.2°N 74.1°W. Ring 82-J moved southwest 176 Km (95 nm) to a position centered at 39.9°N 66.9°W, southeast of Lydonia Canyon. Ring 83-B was presumed to have been absorbed by 83-E in the vicinity of Hydrographer Canyon late in May. Ring 83-E moved slowly westward along the edge of the continental shelf 93 Km (50 nm) to a position centered at 39.4°N 69.9°W, between Atlantis and Veatch Canyons.

During the next thirty days, 82-I can be expected to move southwest and be resorbed by the Gulf Stream. Ring 82-J can be expected to travel westward along the southern edge of Georges Bank, and approach Hydrographer Canyon. Ring 83-E can be expected to move west-southwest to a position centered southeast of Hudson Canyon.

Fishermen are requested to report unusual conditions or catches occurring in the vicinity of these rings to the Director, Atlantic Environmental Group, National Marine Fisheries Service, RR 7, South Ferry Road, Narragansett, Rhode Island, 02882, by mail. Updates on ring positions and general information on Gulf Stream rings may be obtained by calling the Atlantic Environmental Group (401 789-9326).



- Hughes, M.M., and S.K. Cook. Water column thermal structure across the shelf and slope southeast of Sandy Hook, New Jersey in 1981. *Annls biol. Copenh.*, 38. (A)
- Hughes, M.M., and S.K. Cook. Water column thermal structure across the shelf and slope southeast of Sandy Hook, New Jersey in 1981. *Annls biol. Copenh.*, 38. (A)
- Ingham, M.C., and D.R. Maclain. Sea Surface temperatures in the northwestern Atlantic in 1982. *Annls biol. Copenh.*, 39. (S)
- Jossi, J.W., D.E. Smith, and G.A. White. Continuous plankton records: Massachusetts to Cape Sable, Nova Scotia, and New York to the Gulf Stream, 1982. *Annls biol Copenh.*, 39. (S)
- Jossi, J.W., D.E. Smith, and G.A. White. Continuous plankton records. The sampling program of the U.S. National Marine Fisheries Service. *Annls. biol. Copenh.*, 38. (A)
- Jossi, J.W., and R.R. Marak. Marine Resources Monitoring, Assessment, and Prediction Program Plankton Survey Manual. NOAA Tech. Memo (NMFS-F/NEC-21). (P)
- McLain, D.R., and M.C. Ingham. Sea surface temperatures in the northwestern Atlantic in 1981. *Annls biol. Copenh.*, 38. (A)
- Smith, D.E. and J.W. Jossi. New phytoplankton and Zooplankton in the New York Bight, January 1976 to February 1978, with comments on the effects of wind, Gulf Stream eddies, and slope water intrusions. NOAA Tech. Rep. (NMFS-SSRF). (A)

MISCELLANEOUS

Travel, Meetings, and Presentations

On May 1-2, Mert Ingham attended a NEFC Board of Directors Meeting at the Woods Hole Laboratory. Mert also attended the Risk Analysis Conference held at Sandy Hook Laboratory on May 17.

May 10, and May 25, Grayson Wood traveled to Newton, Massachusetts to visit the Sea Data Corporation and to repair the undulating oceanographic recorder.

May 9 and May 13, Robert Benway traveled to Port Newark, New Jersey to train new personnel and resupply the M/V *Oleander*.

Reed Armstrong gave a lecture on Physical Oceanography to the fifth grade science classes of Lincoln School (Providence, Rhode Island) on May 12.

Stephen Matteson went to help train new personnel and resupply the M/V *Oleander* for Ship of Opportunity Program run on June 9. June 29, Steve also went to help outfit a vessel in Brooklyn, New York. The vessel was the *Marciebo de Olievro*.

Robert Benway traveled to train new personnel and resupply the M/V *Oleander* for Ship of Opportunity Program run on June 9. Bob went to Brooklyn, New York to outfit a vessel on June 29.

June 7, Grayson Wood traveled to Newton, Massachusetts to confer with Sea Data Corporation personnel. Grayson also went to meet and resupply the M/V *Oleander* in Port Newark, New Jersey. From June 27-30, Grayson Wood conducted sea trails with the Undulating Oceanographic Recorder between Bermuda and New York.

Peter Celone traveled to the World Weather Building to obtain HRPT data in Washington, DC.

Merton Ingham attended a meeting of Environmental Sub-Committee of Northwestern Atlantic Fishery Organization (NAFO) on June 6 in Halifax, Nova Scotia, Canada. Mert travelled to LaGuardia, New York, to attend a meeting with New York/New Jersey Port Authority on Remote Sensing Aids for fishermen.

Daniel Smith visited the *Queeny*, to deliver equipment and to calibrate a machine in New Haven, Connecticut on June 18. Daniel delivered customs information to the President of Sea Data Corporation to use in Bermuda on June 23 in Newton, Massachusetts.

On June 22, Steven Cook travelled to Atlantic City, New Jersey, to visit a weather service station to discuss sea surface temperature measurement. On the same day he travelled to meet with Kings Point Academy Training Representative and the Captain of the M/V *Oleander* in New York, New York.

Stephen Matteson accompanied by Mark Lussier attended a Seminar on the Hewlett Packard Computer and Software in Boston, Massachusetts on June 28.

Visitors

June 10 the members of Atlantic Environmental Group staff accompanied Eric Schneider and Gregory Withee, both of the NOAA Administrator's Office, on a visit of facilities of the Graduate School of Oceanography, at the University of Rhode Island, in regard to the location for a proposed eastcoast, NOAA Ocean Service Center.