



NORTHEAST FISHERIES CENTER

NEWSLETTER

SEPTEMBER 1980

CENTER DIRECTORATE.	1
RESOURCE ASSESSMENT DIVISION.	1
MANNED UNDERSEA RESEARCH AND TECHNOLOGY PROGRAM	7
MARINE ECOSYSTEMS DIVISION	7
RESOURCE UTILIZATION DIVISION	15
DIVISION OF ENVIRONMENTAL ASSESSMENT.	21
AQUACULTURE DIVISION.	26
PATHOBIOLOGY DIVISION	28
NATIONAL SYSTEMATICS LABORATORY	31
ATLANTIC ENVIRONMENTAL GROUP.	33



US DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST FISHERIES CENTER

RESEARCH ADMINISTRATION

CENTER DIRECTOR ROBERT L. EDWARDS
ASSISTANT CENTER DIRECTOR FOR FISHERIES MANAGEMENT/
WOODS HOLE LABORATORY DIRECTOR RICHARD C. HENNEMUTH
ASSISTANT CENTER DIRECTOR FOR ENVIRONMENTAL MANAGEMENT/
SANDY HOOK LABORATORY DIRECTOR CARL J. SINDERMANN
CENTER OPERATIONS OFFICER HERBERT STERN, JR.
CENTER PLANNING OFFICER GEORGE J. RIDGWAY
RESOURCE ASSESSMENT DIVISION CHIEF BRADFORD E. BROWN
MANNED UNDERSEA RESEARCH AND TECHNOLOGY PROGRAM CHIEF RICHARD A. COOPER
MARINE ECOSYSTEMS DIVISION CHIEF/
NARRAGANSETT LABORATORY DIRECTOR KENNETH SHERMAN
RESOURCE UTILIZATION DIVISION CHIEF/
GLOUCESTER LABORATORY DIRECTOR LOUIS J. RONSIALLI
DIVISION OF ENVIRONMENTAL ASSESSMENT CHIEF JOHN B. PEARCE
AQUACULTURE DIVISION CHIEF/
MILFORD LABORATORY DIRECTOR JAMES E. HANKS
PATHOBIOLOGY DIVISION CHIEF/
OXFORD LABORATORY DIRECTOR AARON ROSENFELD
NATIONAL SYSTEMATICS LABORATORY DIRECTOR DANIEL M. COHEN
ATLANTIC ENVIRONMENTAL GROUP DIRECTOR MERTON C. INGHAM

"NORTHEAST FISHERIES CENTER NEWSLETTER"

THE "NORTHEAST FISHERIES CENTER NEWSLETTER" IS A MONTHLY NARRATIVE REPORT ON THE RESEARCH AND DEVELOPMENT ACTIVITIES OF THE NORTHEAST FISHERIES CENTER (NEFC). SUBMISSIONS TO THIS REPORT ARE PREPARED BY THE ABOVE RESEARCH ADMINISTRATORS, AND COMPILED AND EDITED BY JON A. GIBSON, TECHNICAL WRITER-EDITOR, NEFC.

THIS REPORT DOES NOT CONSTITUTE A PUBLICATION AND IS FOR INFORMATION ONLY. ALL DATA HEREIN ARE CONSIDERED TO BE PROVISIONAL. REFERENCE TO TRADE NAMES IN THIS REPORT DOES NOT IMPLY ENDORSEMENT BY THE NATIONAL MARINE FISHERIES SERVICE, NOAA.

TO CANCEL DELIVERY OF THIS REPORT IN THE EVENT YOU NO LONGER NEED TO RECEIVE IT, OR TO CHANGE THE DELIVERY ADDRESS IF YOU ARE MOVING BUT STILL NEED TO RECEIVE IT, PLEASE NOTIFY US BY WRITING: JON A. GIBSON, "NORTHEAST FISHERIES CENTER NEWSLETTER," NORTHEAST FISHERIES CENTER, NATIONAL MARINE FISHERIES SERVICE, NOAA, WATER ST., WOODS HOLE, MA 02543.

CENTER DIRECTORATE

Fishery Technology

A proposal submitted by the Resource Utilization Division at the Gloucester Laboratory has resulted in Saltonstall-Kennedy Act funding to determine the economic feasibility of assuring the quality of US-produced frozen fish fillets. The study is for a 1-yr period, and, as was done in a previous study for fresh fish fillets, it will be an integrated effort with contributions coming from all elements of distribution which include fishermen, processors, transporters, and retailers. While the previous study resulted in a predictably high benefits-to-costs ratio (greater than 150), there are no predictions about this study because of an anomalous economic situation that places a higher value on high quality fresh fish than on high quality frozen fish, even though it costs more to produce the latter, and even though the latter actually has more inherent value and is theoretically a higher quality item than the latter.

Special Scientific and Technical Projects

Ronald Smolowitz participated on the surf clam - ocean quahog survey cruise from 2 to 12 September. The electrohydraulic dredge worked well to depths of 100 m. On Canadian bottom, which is mostly rocky, the dredge blade was spring mounted to avoid damage and thus survived. On the marked clam site 200 marked clams were recovered in the first two tows.

The Woods Hole Laboratory pier construction is progressing on schedule. All piles are driven and decking has started. The new electrical supply for the ships and Laboratory is being installed.

Work has started on a geotechnical and structural survey of the main lab building in Woods Hole. A level survey of the site was conducted to determine settlement.

A memo summarizing the preliminary meeting of the Bottom Trawl Survey Task Force was sent out to interested parties requesting review and comments.

A meeting was held with Eric Turkington, a Town of Falmouth, Massachusetts, Selectman, and Tibbetts Engineering Corporation to review plans for a Woods Hole commercial fishing pier.

Other projects include preparation of technical drawings of the sea scallop survey drag, preparation of a publication on the surf clam - ocean quahog dredge design, work on the mesh study paper, and technical advisory services.

RESOURCE ASSESSMENT DIVISION

Resource Surveys Investigation

The 1980 surf clam - ocean quahog survey cruise was completed when the NOAA R/V Delaware II returned to the Woods Hole Laboratory on 12 September. Tom Azarovitz was the chief scientist. After completion of the routine survey work in Southern New England waters, the Delaware II steamed to the Nova Scotia coast to explore the potential stocks there. Four Canadian scientists were aboard to help in this cooperative effort requested by the Canadian government. Stations were made on Browns Bank, Roseway Bank, LaHave Bank, and nearshore areas of the Nova Scotian shelf. Several good catches of ocean quahog were made, indicating some resource potential, but towable areas were at a premium in the rough bottom. Some tows were made on Georges Bank where good catches of ocean quahog were made. Future

shellfish survey cruises and joint biological programs with the Canadians are planned pending final approval of a cooperative agreement.

Part I of the autumn bottom trawl surveys began on 17 September on Delaware II. Tom Azarovitz was chief scientist. The area surveyed on this leg was from Cape Fear, North Carolina, to southern portions of the New York Bight.

Investigation personnel prepared for and participated on both of the above cruises. They also continued work on the processing of summer bottom trawl survey data.

Electronics support personnel participated and helped prepare for both the shellfish and bottom trawl survey cruises.

Fishery Biology Investigation

Ambrose Jearld, Jr., completed a final draft of a paper on "Some Aspects of the Age and Growth of Surf Clams, Spisula solidissima (Dillwyn) Off the Delmarva Peninsula," to be presented at the annual meeting of the American Fisheries Society (AFS) in Louisville, Kentucky. He also participated in a meeting with Division staff at the Woods Hole Laboratory to discuss summer flounder age and growth needs.

Age and Growth

Vi Gifford completed the first aging for first and second quarter 1972 commercial redfish samples. She also worked with Kris Andrade and John Ropes rephotographing redfish otolith sections for the redfish age validation paper.

Kris Andrade completed aging pollock samples from bottom trawl surveys on Albatross IV Cruises No.'s AL 79-08 and 80-08, and on Delaware II Cruises No.'s DE 79-09 and 80-05. She is also keeping up to date on aging third quarter 1980 commercial samples for both pollock and haddock.

Judy Penttilla worked with Karen Driscoll from Northeastern University to develop a method for sectioning teeth from fishers, a mammal of the mustelid family. She also spent a good deal of time working with Dr. Pieter Gaemers from the Netherlands.

Finfish

Before leaving for graduate school in the School of Fisheries at the University of Washington, Brenda Fields brought up to date all (survey and commercial) 1980 summer flounder age determinations and began age-length summaries.

Louise Dery completed the special summer flounder study commenced in August, evaluating changes in scale growth patterns with geographic area and with fish size at ages I and II. She and Mark Costa continued processing frozen alewife samples from the 1979 spring bottom trawl survey for fish lengths, weights, and otoliths, and began sectioning silver hake otoliths from the 1980 spring bottom trawl survey.

Shellfish

Maurice Crawford aged 278 sea scallops from the third priority strata (No.'s 21-32) from Albatross IV Cruise No. AL 79-04. He and Maureen Griffin completed tabulation of age data of surf clams from Delaware II Cruise No. DE 78-07. It has been sent to the Woods Hole Laboratory's Automatic Data Processing (ADP) Unit. After processing, some revision may be necessary to relate data to the arbitrary 1 October birthdate, and it has not been fully determined that the first annulus

represents a full year of growth or only a few months. About 300 surf clam chondrophores from Delaware II Cruise No. DE 80-01 have been photographed and aged. Also, shells of small surf clams grown under aquacultural conditions at the Milford Laboratory were cut to help in determining when the first annulus is laid down.

Uvetta Dozier, a Co-op student from South Carolina State University, has joined us and will be working on preparation and aging of surf clams.

John Ropes was at sea on the surf clam - ocean quahog survey until 12 September. During the operations off Nova Scotia, Spisula polynyma, Serripes groenlandicus, Cyrtodaria siliqua, and Panonya artica were among the catches. These are all species not previously sampled during past such cruises. Ocean quahogs were taken at a few stations, but they were relatively few in number and many were of small size. Tows on Georges Bank yielded fairly sizable samples of ocean quahogs. Most were medium to large in size, but the most notable feature was that the periostracum was an amber color and more like what is expected for smaller-sized clams. Off Long Island, slightly more than 200 marked ocean quahogs were recovered during only two tows with the dredge. This is the largest number recovered to date and are of marked quahogs that have had 2 yr to grow since marking. They were frozen whole, and since returning from the cruise, meat weights and sex observations have been completed to relate to shell size. Sex has been determined by excising the gonad and observing microscopically the type of germinal cell in squashes of the gonadal tissue. Data on shell length and sex are complete for specimens from the first tow. For 97 quahogs, 43 were males and 54 were females. In the size range of 55-79 mm, the sexes were 24 males and 23 females, but in the size range of 80-115 mm, the sexes were 19 males and 31 females. These observations suggest that females may predominate in beds containing large, old clams, but more observations are needed to substantiate more fully such a conclusion.

Fishery Assessment Investigation

Staff

During 22-24 September, Joan Palmer attended a training seminar given by ADP Network Services, Inc.

Anne Lange worked on the squid section of the "Status of the Stocks Report." On the 6th, Anne returned from a 4½-mo detail with the NOAA Office of the Assistant Administrator for Fisheries in Washington, DC.

Margaret McBride and Rhett Lewis visited NMFS laboratories in Beaufort, North Carolina, and Charleston, South Carolina, and met with Equal Employment Opportunity (EEO) officials about affirmative recruitment for cooperative education programs.

Mike Fogarty worked on the summer flounder assessment. Mike and Thurston Burns prepared an analysis for inclusion in the American lobster fishery management plan.

Gordon Waring reviewed the cruise plans for the adult Atlantic herring survey to be conducted on Georges Bank with Dennis Frappier and Willard Colson of Stinson Canning (Rockland, Maine) and Jerry Wilmont of Zapata Corporation (Port Clyde, Maine). On the 17th and 18th, Gordon met with Carol Killbride, the NMFS Plan Coordinator for the Atlantic herring fishery management plan, to review the Atlantic herring data base and sampling program.

Frank Almeida and Steve Murawski are attending graduate school at Oregon State University in Corvallis and at the University of Massachusetts in Amherst,

respectively. At the Woods Hole Laboratory general staff meeting on the 8th, Frank became the second recipient of the Judith Brennan-Hoskins Memorial Award for outstanding achievement in support of the laboratory's mission.

Senior Assessment Scientists

Brad Brown coordinated the development of the current year task plans. He worked on the transfer of the Statistics Branch from the Northeast Regional Office to the NEFC, consulting with Frank Riley and Ron Schultz of that Branch, Frank Grice of the Northeast Regional Office's Fisheries Management Division, and Darryl Christensen and Thurston Burns of the Resource Assessment Division who will be involved in assisting in transfer activities. Brad also prepared material for the Center Board of Directors meeting relative to the implementation of the merit pay plan. On the 8th and 10th, Brad participated in planning for the Fishery Task Force of the National Academy of Science's Ocean Policy Committee. During the AFS annual meeting held during 20-24 September, Brad chaired a panel evaluating the achievements under the Fishery Conservation and Management Act of 1976, presented a paper on recruitment distribution, served as summarizer of a panel on equal employment opportunity in fisheries, chaired the first business meeting of the AFS's Marine Fisheries Section, and attended the AFS Executive Board meeting. On the 10th, Brad Brown, George Ridgway, Mike Sissenwine, Steve Clark, Ambrose Jearld, Jr., Vaughn Anthony, Emory Anderson, and Frank Almeida met with Rita Schneck, a graduate student at the University of Rhode Island, to review a draft report on her work on silver hake stock identification based on analysis of enzyme systems using isoelectric focusing. On the 29th and 30th, Brad participated in a review of the South Carolina Division of Marine Resources' Marine Resources Monitoring, Assessment, and Prediction Program (MARMAP) at the request of the Southeast Fisheries Center.

Mike Sissenwine was involved mostly with personnel actions for the Division. On the 17th and 18th, he conferred with Carol Killbride of the Northeast Regional Office concerning Atlantic herring and silver hake, and general aspects of communication between the Regional Office and the Center. On the 22nd, Mike and Marv Grosslein met with Dr. John Steele of the Woods Hole Oceanographic Institution concerning plans for a fishery ecology workshop on Georges Bank. On the 30th, Mike met with Dr. Bill Bossert of Harvard University to explore future relations between Dr. Bossert's research and NEFC programs.

Vaughn Anthony worked on the "Status of the Stocks Report." From the 1st through the 7th, Vaughn attended the Northwest Atlantic Fisheries Organization (NAFO) scientific meetings, participating in the planning meetings for the upcoming joint squid surveys and joint mackerel research with Poland, and in the Larval Herring Working Group. At the Larval Herring Working Group meeting, he presented a paper prepared by him and Gordon Waring on the changes in reproductive potential of Atlantic herring from Georges Bank and the Gulf of Maine with changes in abundance. He also assisted Marv Grosslein in the conduct of that meeting and presented several papers written by scientists who could not attend. At the AFS annual meeting, Vaughn presented a paper on the history of the management of Atlantic herring. On the 26th, he participated in the Northeast Arctic Working Group and the dialogue meeting of the International Council for the Exploration of the Sea (ICES) prior to attending the ICES annual meeting.

Emory Anderson completed the assessments of bluefish and Atlantic mackerel. On the 15th, Emory met with Steve Turner and Stu Wilk at the Sandy Hook Laboratory to outline plans for an assessment document on tilefish.

Steve Clark, Ralph Mayo, Loretta O'Brien, and Theresa Etienne continued assessment work on northern shrimp and pollock. Steve Clark and Vaughn Anthony continued working on a review and assessment paper for the Gulf of Maine northern shrimp fishery. Steve began working with Lynn Cleary of the Canadian Department of Fisheries and Oceans on a review and assessment paper on Northwest Atlantic pollock. Steve reviewed Maine's job completion report, "Environmental Physiology of Northern Shrimp," under provisions of the Commercial Fisheries Research and Development Act of 1964, as well as the application for State-Federal Program funding of northern shrimp research by the New Hampshire Fish and Game Department.

Fred Serchuk worked on analysis of surf clam and ocean quahog survey and commercial data and began preparation of updated assessment documents for these species. At the AFS annual meeting, Fred served as moderator for the Marine Session and himself presented the paper, "Population Dynamics of the Southern New England-Middle Atlantic Cod Population."

Meetings, Cruises, and Public Affairs

Meetings

During 1-7 September, a NAFO meeting was held in St. John's, Newfoundland. Vaughn Anthony attended.

On 2 September, the monthly EEO Committee meeting was held at the Woods Hole Laboratory. Gordon Waring, Margaret McBride, and Steve Clark attended.

On 3 September, the Mid-Atlantic Fishery Management Council's Scientific and Statistical Committee met in Philadelphia. Emory Anderson attended.

On 8 and 10 September, the National Academy of Science's Ocean Policy Committee met in Woods Hole. Brad Brown attended.

On 9 September, the Center Task Force on Molluscan Ecology and Management Research met at the Milford Laboratory. Fred Serchuk, Brad Brown, and Mike Sissenwine attended.

During 15-16 September, the East-West Conference on Development of Groundfish Multispecies Plans was held in Woods Hole. Mike Sissenwine attended.

On 19 September, the Seminar on Progress of Climatological Studies Relative to Mackerel Year Class Strength was held at the Atlantic Environmental Group. Brad Brown, Emory Anderson, and others in the Division attended.

During 20-24 September, the 110th Annual Meeting of the American Fisheries Society was held in Louisville, Kentucky. Steve Clark, Fred Serchuk, Brad Brown, Vaughn Anthony, and Ambrose Jearld, Jr., attended.

During 24-25 September, the New England Fishery Management Council met in Danvers, Massachusetts. Mike Sissenwine attended.

On 26 September, the ICES annual meeting was held in Copenhagen, Denmark. Vaughn Anthony attended.

During 26-27 September, the Atlantic Fisheries Biologists annual meeting was attended by Fred Serchuk.

On 30 September, a seminar on "Evaluation of Life History in Pacific Salmon" was presented by Bill Bossert of Harvard University at the Woods Hole Laboratory. Attendees were John Boreman, Fred Serchuk, Mike Sissenwine, Steve Clark, Emory Anderson, Emma Henderson, Vaughn Anthony, and others.

Ambrose Jearld, Jr., attended the international symposium "Will We Use the Oceans Wisely," at the Woods Hole Oceanographic Institution during the last week of September.

Cruises

During 17 September-3 October, the Delaware II conducted a bottom trawl survey from Cape Fear to Long Island Sound. Participants from the Fishery Assessment Investigation were Margaret McBride and Rhett Lewis.

During 23 September-3 October, the Soviet Union's R/V Viandra conducted an Atlantic herring survey on Georges Bank. Gordon Waring represented the Fishery Assessment Investigation.

Public Affairs

Jim Crossen prepared and participated in a hydroacoustic exhibit aboard the Albatross IV for the Third International Congress on the History of Oceanography held during the last week in September. Pat Twohig assembled a videotape comparing a 1938 bottom beam trawler fishing on Georges Bank to a modern scallop vessel. This tape was shown continuously in the Woods Hole Laboratory's public display aquarium during the above meeting.

Ambrose Jearld, Jr., participated in a career day for junior high to college students at St. Paul's African Methodist Episcopal Zion Church in Cambridge, Massachusetts.

On 26 September, Judy Penttila gave a tour of the Age and Growth Unit's facilities at the Woods Hole Laboratory to students from the Cambridge School in Weston, Massachusetts.

Publications

Clark, S. H.; Overholtz, W. J.; Hennemuth, R. C. Review and assessment of the Georges Bank and Gulf of Maine haddock fishery. Northwest Atl. Fish. Organ. Res. Bull. (S)

Fogarty, M. Some aspects of the biology, distribution, and relative abundance of the ocean quahog, Arctica islandica, in Rhode Island Sound. Proc. Natl. Shellfish. Assoc. (S)

Lange, A. M. T. Yield per recruit analyses for squid, Loligo pealei and Illex illecebrosus, from the Northwest Atlantic. Proc. Natl. Shellfish. Assoc. (S)

Murawski, S. A.; Serchuk, F. M. Clams and scallops of the northeast coast. Underwat. Natur. 12(4):25-33. (P)

Ropes, J. W.; Merrill, A. S.; Murawski, S. A.; Chang, S.; MacKenzie, C. L., Jr. Impact on clams and scallops. Part 1. Field survey assessments. Swanson, R. L.; Sindermann, C. J. eds. Oxygen depletion and associated benthic mortalities in New York Bight, 1976. NOAA Prof. Pap. 11:263-275 (Chapter 11);1979. (P)

Reports

Anderson, E. D. A preliminary assessment of the status of bluefish (Pomatomus saltatrix) along the Atlantic coast of the United States. Woods Hole Lab. Ref. Doc. No. 80-30;1980. 29 p.

Anderson, E. D. Status of the Northwest Atlantic mackerel stock. Woods Hole Lab. Ref. Doc. No. 80-29;1980. 43 p.

Lange, A. M. T. The biology and population dynamics of the squids, Loligo pealei (LeSueur) and Illex illecebrosus (LeSueur), from the Northwest Atlantic. Seattle, Wash.:Univ. of Washington;1980. 178 p. M.S. Thesis.

MANNED UNDERSEA RESEARCH AND TECHNOLOGY PROGRAM

No report received. The September report will be included in the October issue.

MARINE ECOSYSTEM DIVISION

Apex Predators Investigation

The report covers activities for both August and September. In August we completed a 3-wk study that involved longline fishing for sharks in the inshore area off Sandy Hook and western Long Island. Under a cooperative agreement with Sea World, Inc. (Orlando, Florida), fishing was conducted at stations where Jack Casey caught sharks on longlines during the 1960's. All expenses, including chartering the same vessel (R/V Challenger) used in the earlier work, were provided by Sea World. Jack served as consultant and Wes Pratt, Nancy Kohler, and Alan Lintala participated in cruises on an intermittent basis. Sea World's interest was to obtain a live white shark for display at Orlando. Our interests were to: (1) compare current catches with the results of the earlier studies; (2) tag a part of the catch; and (3) examine stomachs for food habit studies. From 21 July to 8 August a total of 46 sharks representing seven species were taken on 22 longline sets (100 to 200 hooks per set). The sandbar shark was the dominant species (27 caught), followed by dusky (10), tiger (3), dogfish (3), mako (1), white (1), and thresher sharks (1). Twenty-eight sharks were tagged. The single white shark taken was dead on the line. Preliminary comparisons with the 1962-65 data show fewer sharks were taken in 1980. This was particularly true for white sharks. In 1964, for example, 10 white sharks were caught on one longline set off Sandy Hook. Although that was a highly unusual catch, results of the latest survey suggest sharks in general were less abundant this year in the same area. Detailed comparisons of water temperatures for all years have not been completed, but mean surface water temperatures during June and July of this year appear to be above normal.

During August and September we received information on 43 tag returns. There were 28 blue sharks, 7 sandbars, 2 makos, 2 swordfish, and 1 each for white marlin and tiger, scalloped hammerhead, and lemon sharks. Of the 28 blue shark recaptures, only six were free for more than 90 days. The most interesting blue shark recapture traveled 542 mi in 154 days from the Cape Hatteras region into the Gulf of Maine. This is one of the first recaptures from the Gulf of Maine where we have had only a small amount of tagging effort. Captain Floyd Condit from Brownsville, Texas, longlining aboard the F/V Proud Rebel, recaptured five blue sharks in the Veatch Canyon area between 15 and 24 September. This catch is the largest group of recaptures we have received from a single vessel in a short time period.

Both of the recaptured swordfish were tagged by Captain Phil Ruhle. This brings his recaptured swordfish total to five. Although the latest recaptures were free for 107 and 1052 days respectively, both traveled less than 100 mi. The recaptured white marlin was free for 1146 days and traveled 101 mi along the edge of the continental shelf between Baltimore and Hudson Canyons. Foreign fisheries observers tagging aboard Japanese longliners had recaptures from one mako and one tiger shark.

The tiger shark was tagged and recaptured in the Gulf of Mexico and moved 222 mi from southwest of the Mississippi River inshore to Dauphin Island, Alabama. The mako, tagged and recaptured in the Middle Atlantic Bight, was free for 271 days and traveled 162 mi. Seven short-term recaptures from young sandbar sharks were received from biologists at the Virginia Institute of Marine Science. Under a cooperative agreement we provide tags for an estuarine productivity study they are conducting in the Chesapeake Bay.

During August and September, John Hoey processed the previously mentioned recaptures and started computer coding the rest of the 1980 recaptures for our annual newsletter. He also continued updating the longline data base with recent commercial longline records. A preliminary draft of a paper examining species associations of apex predators based on the longline data base was also started. The paper utilizes product-moment correlations as the basis for the clustering procedure forming apex predator groups.

Two female makos weighing 561 and 741 lb were collected from sport fishermen by Jack Casey at Montauk, New York. These fish will contribute to size-at-maturity data for the shortfin mako. Another mako of 389 lb was claimed to be pregnant by Freeport, New York, fishermen after everything but the teeth was discarded. After interviewing the fishermen involved and examining photographs, Wes Pratt decided that the mako was much too small to be mature. The only pregnant mako recorded for the Atlantic was captured in 1953 off the Bahamas.

Reproductive samples taken this summer were inventoried and will be worked up this fall and winter.

A new approach was tried for aging lamnid sharks this summer. Wes Pratt focused his efforts on the shortfin mako by collecting a discrete sample of vertebrae from small males at the Bayshore Mako Tournament. Because of field work, these samples weren't worked up until recently. After being processed and mounted by Alan Lintala, the vertebral sections were enlarged photographically and each photo was split and compared with other sizes. Using growth estimates from other in-house sources, Wes assigned age marks to the vertebrae. Previous attempts at discerning marks as candidate annuli have largely failed with mako vertebral sections because many false annuli or checks are present on fish that should be 1-yr old. This experiment confirmed these marks as checks and opened the door for correct vertebral interpretation.

The annual Rhode Island Tuna Tournament and the Masters Invitational Tuna Tournament were held over the Labor Day holiday at Pt. Judith, Rhode Island. During the tournaments, eight giant bluefin and one mako shark were examined by Chuck Stillwell, Nancy Kohler, and Michael Couturier for length-weight data and food habits studies. The skull and caudal vertebrae from an intermediate-sized bluefin were collected for age work being conducted at the Southeast Fisheries Center. The eight tuna ranged in weight from 269 to 1066 lb and averaged 467 lb. Four of the tuna stomachs contained bait only, which was comprised of chunks of herring, butterfish, and silver hake. The only contents identified as natural food in four stomachs were American sand lance. The maximum number of sand lances in a stomach was about 30 and occurred in various stages of digestion from disintegrated remnants to recently ingested specimens. The mako contained three whole bluefish in bite-sized chunks that amounted to 47% of the maximum stomach capacity. Earlier findings indicate this is not an unusual volume of food to be observed in this species of shark.

Nancy Kohler and Alan Lintala attended the Lewis Bay Marine Shark Tournament on 23 and 24 August at Hyannis, Massachusetts. Rough weather prevented any fishing on the first day for the 35 boats entered in the tournament. Five blue sharks (196-264 cm FL) and one mako (203 cm FL) were landed on the second day. No natural food items were found in any of the stomachs examined.

Length-weight data from one cruise and five tournaments were keypunched, verified, and added to the length-weight data base by Nancy Kohler, Michael Couturier, and Eric Barszcz. The remaining portion of the blue shark food data (500+ samples) was coded, keypunched, and put onto a computer file and is now awaiting verification and summary analysis.

Recent analysis by Nancy Kohler and Chuck Stillwell on liver-body weight relationships shows no change in the liver weights of immature male and female blue sharks between March and October. Livers of mature males, however, are significantly larger in October than in March and June. Samples from mature females were not available. Length-weight and log length - log weight relationships and a calculated condition index ($K=10^5 W/L^3$) show no change over the year for any of the sizes of sexes examined. A difference in liver weight has been reported to be a more sensitive indication of condition than K for those fish that store fat in their livers (i.e., cods, sharks, skates). This would indicate that a change in condition occurs in the mature males with season. Immature males and females remain in the same relative condition year round. Possible reasons for a change in mature males may involve reproduction and/or migration. Energy for making reproduction products and for offshore migrations during periods of nonfeeding would come from the livers during the winter season. An improvement in condition over the summer is probably due to intensive feeding inshore during that time.

In August, Chuck Stillwell participated on a cruise aboard the Jane R, a Canadian vessel chartered by the St. Andrews (New Brunswick) Biological Station. The vessel was equipped for longlining and fished the edge of the continental shelf from near Cape Hatteras to Hydrographer Canyon. All live fish were double tagged with a Canadian and American tag. Fish taken on board were measured, weighed, and examined for food and reproductive studies. Swordfish were examined in detail and samples of blood, muscle, eye lenses, gonads, gills, lung tissue, and digestive systems were preserved or frozen for analysis by Canadian biologists.

Nine longline sets resulted in a catch of 400 fish and one pilot whale representing 13 species. Of the 400 fish, 128 were tagged, 213 were taken on board, and 59 were lost at the rail. The pilot whale was an immature female (3 m) that became entangled in the mainline and drowned. Scalloped hammerhead sharks were abundant in the southern and northern areas, whereas silky sharks occurred only in the area off North Carolina and Virginia. Sub-adult male sandbars (1.30-1.67 m FL) appeared to be concentrated in the area of Hydrographer Canyon. Swordfish were caught along the entire cruise tract, but were most numerous in Hudson Canyon. Three sets here (1650 hooks) resulted in a catch of 67 fish ranging in weight from 11.3 to 182 kg.

Of the 85 sharks examined for food studies, 58 (67%) contained food comprised almost exclusively of short-finned squid. Fish remains occurred in small amounts and were in advanced stages of digestion. Stomachs considered empty usually contained one or two pairs of squid beaks.

Information on early embryonic development was collected from a bigeye thresher and a scalloped hammerhead. The thresher contained two embryos, each at an early stage of development but fully formed and accompanied in its respective uterus by several soft opaque packets. Each packet contained 10-12 unfertilized ova which serve as nutritive material for the embryo. The scalloped hammerhead contained 28 fertilized eggs. The primitive streak on each was barely visible, suggesting recent fertilization.

The manuscript "Food and Feeding Habits of the Shortfin Mako (Isurus oxyrinchus) in the Northwest Atlantic" is being revised in a third draft and will be ready for review shortly.

Plankton Ecology Investigation

Jack Green and Joe Kane continued to work on Soviet R/V Evrika Cruise No. 80-02 samples prior to the room rearrangements during the asbestos removal and encapsulation at the Narragansett Laboratory. Paul Fofonoff and Robert Halpin began to analyze Niskin bottle samples after finishing plankton pump samples.

Image Analysis

Recent progress towards the development of an automated plankton processing system was reviewed on 30 September at the University of Rhode Island (URI). Two publications combining the efforts of URI and NMFS were outlined. The first consists of a completed study on the length frequency of plankton communities from coastal waters, including Georges Bank. Changes in size composition may be a useful tool in assessing the stability and health of coastal ecosystems. The second publication highlights the use of silhouette photographs to test the existing discriminate models for zooplankton group identification.

Research for 1981 will focus on the development of a prototype system for automatic classification, counting, and sizing of 10 major groups. A new computer, recently acquired by the URI Department of Electrical Engineering through the National Science Foundation, will aid in this effort.

Biostatistics

Lorrie Sullivan began a complete survey of the status of all master files and data sets within the MARMAP Information System.

Zooplankton displacement volumes were merged into the following cruise master files: AL79-03, AL79-06, AL79-11, AL79-13, DL79-03, DL79-04, DL79-05, BE79-01, and WI79-03. Zooplankton counts were merged into the AL79-13 and WI79-03 master files. Intermediate files of master bridge logs and ichthyoplankton sampling logs were edited for merging into the DL80-03 and EK80-04 master files. Zooplankton data for the WI80-02 and BE79-03 master files were sent to the Sandy Hook Laboratory for key-punching. Also sent were the master bridge logs and ichthyoplankton sampling logs for the EK80-06 master file.

Robert Sand began merging dummy records into all master files for those stations where larvae were sorted but none were found. This will allow the standard report programs to distinguish between stations having no larvae (i.e., 0 abundance) and stations not sorted (i.e., unknown abundance).

Steve Eldridge and Paula Caito dedicated a large fraction of their time to copying and reducing computer-generated statistical tables for ICES reports.

Tom Plichta prepared a data tape of zooplankton and ichthyoplankton for Dr. Berry of Yale University. He generated Fager statistics on zooplankton data from about a dozen cruises for Roz Cohen at the Woods Hole Laboratory. The MAP package from Yale University was put up on the ADPNET computer and debugged. It will be tested for our specific needs and improvements will be specified.

Paula Caito's summertime appointment terminated.

Larval Dynamics Investigation

Experimental Studies

A preliminary look at the data from the 1980 joint NOAA and US Fish & Wildlife

Service (USFWS) striped bass study is showing some interesting trends. Our preliminary analyses of data show differences in survival of larvae between locations and between spawns from the same location. Also, the timing of mortality appeared to vary between groups. Some groups showed high mortality during the first week after hatching. Other groups had very low mortality rates during the first 2 wk increasing rapidly thereafter until the larvae were transferred to larger rearing aquaria at 1 mo. In general, the hatchery fish from Dennis, South Carolina, produced the best survival results, the fish from the Chesapeake areas the worst, and all other locations intermediate. Biochemical analyses indicate a good correlation between RNA-DNA ratio and growth rate in all groups. Carbohydrate and lipid analyses have not been completed. The lipid analyses may be especially informative when correlated with the toxicant residue analyses. The overall picture and, most importantly, the linkage to pollution factors will not be known until we can correlate our data with the as yet uncompleted residue analyses being conducted at the USFWS's Columbia National Fisheries Laboratory.

Sorting of the Niskin bottle samples from the Evrika Cruise No. 80-02 was continued. All the 1.7-liter and 8-liter samples were completed for one station. Complete phytoplankton and zooplankton counts are being done to determine the occurrence and extent of "patchiness."

A draft manuscript on nitrogen utilization by larval summer flounder was revised for publication. Data analysis for a manuscript on the relationships between growth rate, temperature, and RNA-DNA ratio in larval winter flounder was continued.

Modifications and maintenance of our physical plant, including site preparation for an emergency power generating station and construction of a new biochemistry lab were continued.

Geoffrey Laurence attended the "Oceans 80" Technology Symposium in Seattle, Washington.

Population Processes

Greg Lough, George Bolz, Dave Potter, and Roz Cohen worked on revisions of manuscripts submitted as NAFO Scientific Council research documents resulting from the Larval Herring Task Force meeting at the NAFO Scientific Meeting held during 3-5 September 1980 at St. John's, Newfoundland. A meeting was held with Mike Pennington and Vaughn Anthony for a critique of the larval Atlantic herring growth model (NAFO Scientific Council research document 80/IX/131) and the abundance and mortality estimates for the Georges Bank - Nantucket Shoals areas, 1971-78 seasons, in relation to spawning stock size and recruitment (NAFO Scientific Council research document 80/IX/129). Final revisions of the larval herring growth manuscript have been made and it was sent off to the Fishery Bulletin (US) for review. The abundance and mortality manuscript is presently undergoing final revisions; it represents a milestone in the analysis of the International Commission for the Northwest Atlantic Fisheries (ICNAF) larval Atlantic herring surveys for which our group has been responsible over the last decade.

George Bolz continued work on compilation and analysis of total ichthyoplankton for the Georges Bank - Nantucket Shoals areas based on 1971-76 larval Atlantic herring surveys. Dave Potter spent most of the month processing vertical distribution data for larval herring collected with our multiple opening-closing net and environmental sensing system (MOCNESS) aboard the West German R/V Anton Dohrn during November 1977. He also wrote Issue No. 7 of the "NEFC Energy Newsletter" concerning the NEFC laboratories' solar energy projects funded by the US Department of Energy. Roz Cohen continued work on the larval herring feeding selectivity paper which includes size

frequency distributions of larvae and their prey from larval gut contents and the plankton samples at each station, and plots of Berg's selectivity index and total prey biomass available to larvae at each station.

Hal Merry, an electronics technician, has been busy with preparations for the November Albatross IV cruise (No. AL 80-11) on interdisciplinary studies of larval fish and prey microdistribution. He also repaired two MARMAP meter blocks and two electrical cords for the Woods Hole Laboratory ADP Unit. Several days were required by Hal to prepare and demonstrate our MOCNESS aboard Albatross IV for an open house on 23 September at the time of the Third International Congress on the History of Oceanography, principally sponsored by the Woods Hole Oceanographic Institution.

Beatrice Hess, a biological aid, completed her final temporary appointment with us on 29 September.

Dave Potter, George Bolz, and Roz Cohen began a calculus course offered in the night school program of Bridgewater State College at the Massachusetts Maritime Academy.

Dave Potter attended a meeting in Gloucester, Massachusetts, on 10 September to discuss the design of the Woods Hole Laboratory's solar heating system with representatives of a firm bidding for the contract. Dave Potter also met with Ken Sherman and Woody Chamberlin on 12 September at the Narragansett Laboratory to discuss the use of remote sensing and its integration into the Marine Ecosystems Division.

Roz Cohen attended an EEO meeting at the Woods Hole Laboratory on 9 September and several Federal Women's Program (FWP) meetings this month with Linda Despres and Mary Laird. She submitted a FWP budget and preliminary arrangements were made for a program in December. She presented a talk and demonstration of her work to a group of high school students from the Cambridge School in Weston, Massachusetts, on 26 September.

Benthic Dynamics Investigation

Analysis of the 1973-76 fish food habits data base was the major task of Rich Langton and Ray Bowman this month. Rich is concentrating on the yellowtail flounder and Ray is continuing his work on silver hake. Various FASTLOOK runs were set up and run to summarize the data in a more detailed fashion than had been done in the routine data listings previously. Ray also used data on silver hake from some of the site-specific studies to evaluate techniques for adjusting stomach contents weights for comparing fish of different lengths.

Roger Theroux added the finishing touches to his 680-page manuscript on the distribution of bivalve mollusks along the US East Coast. Roger spent several days at the Harvard University Museum of Comparative Zoology tracking down references; some species descriptions date back over 200 yr. Roger was also involved in obtaining bids and arranging for some work to finish off the remodeling of the benthic sorting lab at the Woods Hole Laboratory.

Our two summer employees finished their tasks at the Woods Hole Laboratory in September. John Hacunda was working on digestion in juvenile white hake. A very preliminary examination of the results suggests that digestion is a linear function of time rather than exponential as was found for winter flounder. Bob Kaminski spent most of his time working on the benthic data base. He updated files, retrieved data, and created files relating to Georges Bank, and, finally, assisted Roger Theroux in compiling the data on our polychaete worm collection.

One of the five ICES papers we finished last month had to be revised due to an error in the length-weight equations for silver hake and Atlantic cod. In addition to correcting the mistakes in the paper, a memo was prepared which lists and documents the most up-to-date length-weight and growth equations so that similar mistakes will hopefully, be avoided. This information is available on request.

Coding of the 1978 and 1979 food habits data is continuing. All 1978 stomachs have been analyzed. Jim Towns has been working on coding the 1978-79 logsheets while Jacki Murray has worked on logsheets from some of our "special cruises." Jacki has also finished listing data from a 1977-78 Gulf of Maine - Jeffreys Ledge study and begun to update Rich Langton's computerized reference collection.

Finally, Rich Langton attended a Georges Bank Biological Task Force meeting in Boston on 26 September.

Ecosystem Dynamics Investigation

Work continued on the development and refinement of the multispecies model GEORGE. Wendell Hahm focused on the flow analysis methods for GEORGE; the problem involves finding an appropriate algorithm to handle non-steady-state flows derived from community matrices. Wendell completed a description of the flow analysis methods for the URI Marine Environmental Research Laboratory's microcosm work, the benthic portion of which is to serve as an analogue for Georges Bank. Also, progress was made on a user document for GEORGE which describes the structure of the model and how to run it.

Ed Cohen, together with Mike Sissenwine and Marv Grosslein, revised the energy budget for Georges Bank taking into account recent information on circulation and zooplankton grazing, and a critique of the original paper by John Steele. The principal modifications in the budget were changes in the manner of calculating zooplankton production and consumption. Instead of applying a theoretical food chain, production was estimated by applying a production-to-biomass ratio to empirical biomass estimates, and consumption was estimated using experimental (both lab and in-situ) measures of grazing developed by the Brookhaven National Laboratory. The revised calculations reduce the apparent discrepancy between the North Sea and Georges Bank energy budgets in terms of the ratios of zooplankton to pelagic fish production. However, there still appears to be a lower production rate of pelagic fish on Georges Bank as compared with the North Sea.

Marv Grosslein chaired a second meeting of the NAFO Larval Herring Task Force on 3 and 4 September at St. John's, Newfoundland. Further progress was reported on the large backlog of data from the ICNAF time series of sampling surveys. Twenty papers (most by NEFC personnel) were presented covering a wide range of studies on all phases of Atlantic herring recruitment in the Gulf of Maine region. The results and recommendations of the Task Force are summarized in the report of the Standing Committee on Fisheries Science (NAFO Scientific Council summary document 80/IX/32) and copies are available from Dr. Grosslein.

Mike Pennington worked with Greg Lough on refining estimates of growth and mortality of Atlantic herring larvae, and with Rich Langton and W. Robinson (North-eastern University) on revision of the paper on variability of tubule types in clams. Mike also began outlining analytical approaches for evaluating the sampling errors and magnitude of biases in the MARMAP bottom trawl and plankton surveys. Finally, he consulted on statistical problems with a number of other scientists, including Roger Theroux, Steve Ramp, Wally Morse, Ray Bowman, and Robert Edwards.

Ichthyoplankton Investigation

Several members of this Investigation were involved in completing research documents for the October ICES meeting in Copenhagen. Mike Fahay (see publications) prepared an abstract describing his guide to identification of fish larvae in the

western North Atlantic. Wally Smith et al. described the seasonal spawning cycles of marine fishes off the northeastern United States between 1977 and 1979 from the MARMAP time series. They found marked temporal and annual differences in the abundance of eggs and larvae, but several consistent patterns emerged from their broad-scale survey data: (1) the high abundance of sand lance larvae, especially off Southern New England, during the 3-yr period; (2) the continued low abundance of Atlantic herring larvae on Georges Bank; and (3) the recurrent overlap in areas of high chlorophyll-a concentrations, zooplankton biomass, and dense patches of fish eggs and larvae. Initial spawning activity during the peak spring and summer period was greater in 1977 and 1979, when spring warming began in April, than in 1978, when it was delayed by several weeks.

We completed preparations for and embarked on our first survey of FY 1981. This survey marks the beginning of our fifth year of intensified survey effort. John Sibunka, field party chief, and Carolyn Griswold from the Narragansett Laboratory are representing this Investigation.

Nancy Nazar completed her 1-yr appointment. Aside from being a personable co-worker, she provided outstanding support to Mike Fahay in his efforts to work out the identifications of larval hakes. We will all miss her.

Meetings, Talks, Visitors, and Publicity

On 2 September, Linda DeBold of IBM, Inc., visited the Narragansett Laboratory to discuss word processing equipment. Julien Goulet visited Saul Saila at the URI Graduate School of Oceanography to discuss data and computer programs. Lee Elliott of IOCS, Inc., visited to discuss renewal of task order.

On 8 September, Julien Goulet visited the Milford Laboratory to attend a remote sensing meeting with Ken Sherman, Robert Edwards, and others.

On 9 September, Ken Sherman attended an aquaculture integration meeting at the Milford Laboratory. Jim Sargent of IOCS visited to discuss the DATA LINK project, a survey of interlaboratory data communication needs.

On 10 September, Julien Goulet visited the Woods Hole Laboratory to attend a SESAME workshop. SESAME is a generalized user interface program for the future data base on ADPNET's computer.

On 12 September, Ken Sherman, Dave Potter, and Lockwood Chamberlin attended a remote sensing meeting.

On 15 September, Julien Goulet visited Peter Cornillon at the Massachusetts Institute of Technology to discuss remote sensing capabilities of the RASMAS package on a PDP11 computer.

On 16 September, Ken Sherman traveled to Nova Scotia to deliver the galley proofs of the ICES Early Life History of Fish Symposium volume to NAFO.

On 18 September, Julien Goulet visited the Woods Hole Laboratory to meet with Rich Langton concerning future data base needs, with Marv Grosslein concerning data product requests from the MARMAP Information System data base, and with Gene Heyerdahl concerning ADPNET services.

On 22 September, Linda DeBold of IBM visited the Narragansett Laboratory to discuss word processing and document preparation equipment.

On 22 and 23 September, Tom Plichta visited the Woods Hole Laboratory to attend ADPNET training sessions.

On 24 September, Wes Pratt worked with the NMFS Foreign Fisheries Observers Program at Otis Air Force Base (near Woods Hole) on identification of ridge-backed carcharhinid sharks.

On 25 September, Tom Plichta visited New Bedford to deliver a document to Robert Edwards.

On 30 September, Julien Goulet visited Kay Paine at the Woods Hole Laboratory to review data and programming needs and to plan joint conversion to the data base structures of the ADPNET computer.

Publications

Azarovitz, T. R.; Byrne, C. J.; Silverman, M. J.; Freeman, B. L.; Smith, W. G.; Turner, S. C.; Halgren, B. A.; Festa, P. J. Effects on finfish and lobsters. Swanson, R. L.; Sindermann, C. J. eds. Oxygen depletion and associated benthic mortalities in New York Bight, 1976. NOAA Prof. Pap. 11:295-314(Chapter 13);1979. (P)

Reports

Fahay, M. P. A guide to the early stages of marine fishes occurring in the western Atlantic with emphasis on species found north of Cape Hatteras. Int. Counc. Explor. Sea Comm. Mem. 1980/L:65;1980.

Jeffries, H. P.; Sherman, K.; Maurer, R.; Poularikas, A. D.; Katsinis, C.; Melas, I. Processing of zooplankton samples by electronic image analysis. Report by Univ. of Rhode Island. 1980 September.

Smith, W. G.; McMillan, D. G.; Obenchain, C.; Rosenberg, P.; Wells, A.; Silverman, M.; Baranowski, E.; Adamus, W. Spawning cycles of marine fishes off the northeastern United States based on broad scale surveys of eggs and larvae, 1977-79. Int. Counc. Explor. Sea Comm. Mem. 1980/L:66;1980. 22 p.

RESOURCE UTILIZATION DIVISION

Fisheries Engineering Investigation

Construction of a portion of an experimental sea scallop drag was completed and it was delivered to the Gloucester Laboratory where Vern Nulk has been adding the welded-rod mesh which will replace the rings on the commercial drag.

John Kenney has begun working on the frozen fish guaranteed quality program. He is looking for frozen food vending machines for dispensing the fish packages.

A labor productivity study at a fish plant in Danvers, Massachusetts, is being performed by Bob Learson and Tom Conners.

Engineering Assistance to Other Center Programs

The September trip on the M/V Marine Evangeline in cooperation with the Atlantic Environmental Group was completed by Vern Nulk.

Al Blott continued to work with the Woods Hole Laboratory to keep the Delaware II supplied with clam dredge blade assemblies and blade edges for the current cruise.

R/V's Gloria Michelle and Rorqual

Fisheries Engineering's newly acquired 65-ft research vessel, Gloria Michelle, arrived in Gloucester the first week in September as planned. She is temporarily docked at the University of Massachusetts Marine Station in Gloucester and planning is underway for modifications to her rigging, accommodations, etc. Her radar has been serviced, a boiler purchased, and a 110-220 V auxiliary generator has been acquired from the surplus lists.

There was an article in the "Gloucester Daily Times" about the Gloria Michelle and several organizations have expressed interest in possibly using her.

Facilities

A meeting was held with a candidate architectural and engineering firm for the solar energy project at the Gloucester Laboratory, but not enough information was available to make a decision on the qualifications of the firm.

The Gloucester Laboratory heating system is being upgraded in preparation for the heating season.

Resource Development and Improvement Investigation

Nutrition

September blue mussels have been collected and shucked for storage. Time-zero nutritional data are being worked up, and the July mussels are being analyzed for data on specimens being frozen-stored for 2 mo. Jonah crabs, surf clams, and blue crabs are also being examined for nutritional composition after frozen storage.

Preparation has begun on a paper to be given to the National Seafood Nutrition Symposium in October.

Species Identification

Preparation has begun on a paper on the collaborative study of crab species identification to be given at the annual meeting of the Association of Official Analytical Chemists (AOAC) to be held in October.

Dr. Sylvia Braddon from the NMFS Charleston Laboratory arrived with sea turtle samples for identification by the isoelectric focusing method.

Squid

Skinning efficiency and production rates using the Townsend membrane skinner were done on fresh short-finned squid and thawed long-finned squid. The short-finned squid were manually eviscerated and the tails were removed. Only the mantle tubes were skinned. The estimated skin removal was 100% in 64% of the squid mantle, 95-99% in 30% of the squid mantle, 90-94% in 2% of the squid mantle, 80-89% in 2% of the squid mantle, and 79-79% in 2% of the squid mantle. Most of the remaining skin was left on the dorsum of the squid -- where it could easily be scraped (not peeled) off by on-line inspectors. Production rate was about 377 lb/hr and loss of yield due to skin removal was 6.0%. The mantle comprised about 32% of the whole squid, the tail was about 16%, the tentacles were about 24%, the skin was about 6%, and the viscera and head were about 22%.

A similar experiment was conducted on thawed long-finned squid mantles with tails attached, but there was too much damage done to the tails. Sixty-three percent of them were torn and in a few cases the tails were torn off the mantles completely. Another experiment was done on whole unviscerated squid. Again, the damage to the tails was too drastic to give the procedure further consideration.

Blue Crab

A storage study to determine the effects of vacuum packaging on the organoleptic quality of refrigerated blue crab meat showed that there were no significant differences between vacuum-packed meats and air-packed controls over a 15-day period.

New Product Development

Samples of frozen Atlantic cod fillets were withdrawn from the +5°, 0°, -5°, and -20°F rooms after 12 mo of frozen storage. Taste-test results of the steamed product show that the sample stored at +5°F is still borderline, while the other three samples were rated as slightly above fair. In each of the samples that were stored at the three higher temperatures, the texture was rated lowest. In the sample stored at -20°F, both the texture and flavor scores were about the same (borderline to fair). A slight trend was noticed in reviewing the Hunter L. color measurements of the samples stored at the three higher temperatures. No trend was observed in the samples stored at -20°F. The Instron texture measurements show no change in the raw samples while the cooked samples are getting tougher.

Joe Mendelsohn reviewed a paper on storage stability and uses for comminuted (minced) fish.

Product Quality, Safety, and Standards Investigation

Product Quality

Claire McCall terminated her work on the ammonia problem in dogfish in order to begin her graduate studies at Boston University. She is presently stationed at Woods Hole. The storage study on iced dogfish was terminated after 21 days during which time the pH of these fish had risen to a value of 8.0 (from an original value of 6.0), and the trimethylamine (TMA) value had reached a value of 21.5 mg-N/100 g (from an original value of 3.0 mg-N/100 g). By the time the fish at the bottom of box were reached, the amount of ice cooling them from beneath was very small. Had these fish been better protected, the increase in TMA values and pH values after 15 days probably would not have been quite so sharp. Ammonia measurements have not been made yet on the prepared extracts in storage. These will be done as soon as we have settled on a promising method since our preliminary work with the ammonia-sensitive electrode would seem to indicate that this is not the fast, simple method that fish inspectors are seeking for a field test. At the moment we are looking into the possible use of a simple water analysis kit developed by Chemetrics, Inc. At least we know that the presence of TMA offers no interference.

For the freezing rate study, taste tests were conducted on red hake samples which had been stored for 13 wk at 0°F. Panelists scored samples frozen in liquid nitrogen superior to the plate-frozen and shelf-frozen samples in both texture and flavor. The flavor of plate and shelf samples was found to be about equal, the texture of the former was superior to the latter. After 13 wk at 0°F, red hake

fillets frozen in liquid nitrogen remain with a relatively low shear-force value of 218 lb. The shelf-frozen and plate-frozen fillets are not significantly different from each other, measuring 342 and 337 lb, respectively. The trend for plate-frozen fillets at 0, 8, and 13 wk has been 206, 293, and 342 lb, while for shelf-frozen fillets there was a rapid increase from 202 to 356 lb after 8 wk and an insignificant drop to 337 lb on the 13th week. In comparison, plate-frozen red hake fillets held at +5°F for 13 wk showed an increase from 235 to 287 lb.

Red hake samples stored at -80°, +5°, and -20°F for the time-temperature tolerance study were tested after 34 wk of storage. All samples remain acceptable in flavor, and organoleptic scores are commensurate with storage temperature. Texture of all samples is acceptable with the exception of the +5°F sample which was scored borderline. The shear force values for fillets held at +5° and -20°F are 374 and 280 lb, respectively. The +5°F fillets are increasing in shear force more rapidly than the -20°F samples. However, fillets held at +10°F required only 12 wk storage before reaching 380 lb.

Plans are underway to conduct an AOAC-sponsored collaborative study during late fall. A type of isoelectric focusing utilizing agarose rather than polyacrylamide gel will be tested for possible adoption as an AOAC "official method." The new procedure is safer, easier to perform, and very rapid. Twenty potential collaborators have been contacted, and, thus far, eight have agreed to participate.

Four coded squid samples were analyzed for TMA, dimethylamine, and trimethylamine oxide for Dr. Dave Stanley, who is studying texture of squid at the University of Guelph. Our results will be compared with those obtained by Dr. Tom Gill of the Technical University of Nova Scotia who is conducting the same analyses in his lab on duplicate samples.

Ron Lundstrom identified the species of 17 samples by agarose gel isoelectric focusing for the US Army's Natick Laboratory's edibility characteristics study. Two frozen fish fillets submitted by the Wisconsin Department of Agriculture, Trade, and Consumer Protection were also identified. This lot of fish was labeled "winter trout" and invoiced as "whiting." The samples were identified as Argentine whiting (Merluccius hubbsi) using agarose gel isoelectric focusing.

Product Safety

A shipment of fish samples for polychlorinated biphenyl (PCB) analysis was received from Gulf Coast Research Laboratory. This shipment represents the summer portion of the contract collection.

Work-up and analysis of muscle and gonad samples of striped bass are continuing. The samples are part of the first large shipment received from the NMFS Tiburon Laboratory in May.

Vacations during September have cut the work-up of samples by at least 50%.

Product Standardization

Additional comments have been received from industry and the US Department of Commerce (USDC) Inspection Service on the study draft of the "U.S. General Standards for Grades of Shrimp." This was published in the Federal Register of Tuesday, 5 August 1980, as an "Advance Notice of Proposed Rule Making." This standard covers all forms of shrimp except breaded shrimp.

The draft of the expanded "U.S. Standard for Grades of Frozen Fried Fish Portions" has been reviewed by the General Counsel's office and comments are being resolved.

A proposed draft of a USDC "Standard for Lobster" has been reviewed by the General Counsel's office before publication in the Federal Register. It is based upon the "Codex (International) Standard" for the product.

We are continuing to assist in the selection of species for Natick Laboratory's nomenclature project. This month the coverage of species was expanded to include snappers (Lutjanus sp.) from Florida and the Gulf Coast.

The draft "Commercial Item Descriptions (CID) for Canned Tuna and Canned Salmon" was revised in accordance with comments received and forwarded to our Central Office in Washington, DC. The US Department of Agriculture has accepted the drafts and is now issuing them as purchasing documents in lieu of the federal specification for these products.

Atlantic cod portions made from cod napes and stored for 11 mo at 0°F were judged to be still acceptable though only barely so with respect to texture.

The initial draft of a "U.S. Standards for Grades of Fish Steaks" is under review by the USDC Inspection Service.

University Contacts

With Tyre C. Lanier of North Carolina State University there were several phone conversations regarding a forthcoming conference on minced fish technology. Specifically, we offered suggestions on improving the proposed agenda and names of potential speakers from overseas countries.

We provided Dr. Tom Gill of the Technical University of Nova Scotia with Ron Lundstrom's procedure for the gas-liquid chromatographic analysis of volatile amines in fish.

We provided reprints on species identification by isoelectric focusing and samples of agarose to Mr. William Paine of the University of California at Davis for possible application in his work with turtle population studies.

Technical Assistance

Information and technical assistance were given in the following areas: eel capture and marketing; fish plant sanitation; lobsters; scallop gear video tape; hydraulic clam dredging; Dibgy dredges; beam trawls; whitefish caviar; salting fish; vacuum packaging of fish; processing and marketing of sea clams; freezing and storing of fish at home; preserving fish with potassium nitrate; products from minced whiting; packaging fish under modified atmospheres; information on the mechanization of squid processing; net weight versus drained weight regulations for canned seafoods; salting and drying fish; review of tentative draft standards; common and scientific names of sharks in the Carribean and Gulf of Mexico; mercury and official methods of analysis for mercury in swordfish; reviewing a research proposal for raising shrimp in agricultural waste-water systems; technical information on the CID for canned salmon; technical information on the CID for canned tuna; technical information on the CID's for canned tuna and canned salmon; federal specifications being used for federal agencies' procurement; Canadian regulations; pre-rigor, rigor, and post-rigor fish; dogfish; and mercury allowances for Belgium, West Germany, and France.

Meetings, Talks, and Visitors

Meetings

The New England Fisheries Institute (an informal group of about 320 people mostly in the fisheries industry) had two meetings this month. Fred King is the secretary of this organization.

Perry Lane attended the 26th European Meat Research Workers Congress in Colorado and presented a paper on the Gloucester Laboratory's irradiation facility. He also attended the monthly meeting of the New England Fisheries Steering Committee.

Louis Ronsivalli attended the 18th Annual Underwood-Prescott Symposium on "Developments and Problems in Food Science and Technology" at the Massachusetts Institute of Technology. As a member of an ad hoc advisory committee to the New England Fisheries Steering Committee, he attended three meetings to establish a plan for improving the consistency of quality of New Bedford-produced seafoods. He attended a meeting of the Fishermen's Wives of Gloucester who hosted a speaker from the National Federation of Fishermen. The meeting drew several dignitaries including US Congressman Mavroules and Massachusetts State Senator Buell. He also attended a meeting in Washington, DC, which addressed the concern of officials from the Northwest Fisheries Foundation and the National Fisheries Institute regarding the NMFS role in technology transfer to industry.

Talks

Al Blott presented a lecture on "Fishing Gear, Twine, and Webbing" at the Gloucester Fishermen's Museum's fishing course.

Visitors

Mr. Gene Styles of Vermont visited us to discuss utilization of a Lake Champlain eel resource.

Dr. Sylvia Braddon of the NMFS Charleston Laboratory spent a week at the Gloucester Laboratory to learn the agarose gel isoelectric focusing method for application to her work on species identification of turtle meat.

John Farquar of the Supermarketing Institute, Robert Rose of I-Point, Inc. (a distributor of chemical time/temperature integrators), and Kjell Blixt of Kockums Chemical (a Swedish firm and producers of time/temperature integrators) visited to discuss the potential role for this type of product in seafood distribution.

Mr. Richard Hallinan of Aslansis Fisheries Corporation visited to discuss a joint effort between his company and the Gloucester Laboratory to determine economic feasibility of assuring the quality of US-produced frozen fish fillets.

Dr. Oscar Fernandez of the National Fisheries Institute of Uruguay visited to discuss fisheries utilization research.

Publications

Mendelsohn, J. M.; Callan, J. G. Evaluation of a prototype fish cleaning machine with proposals for a commercial processing line. Mar. Fish. Rev. 42(1):38-43;1980. (P)

DIVISION OF ENVIRONMENTAL ASSESSMENT

Behavior of Marine Fishes and Invertebrates Investigation

Studies are continuing on the behavior and ecological requirements of juvenile hake, supported in part by US Environmental Protection Agency funding. Analysis of behavioral observations of juvenile red hake showed the existence of a size-dependent dominance hierarchy, characterized by aggressive encounters between fish. Levels of aggression essentially follow activity patterns with most encounters occurring at night when foraging was at a maximum. These aggressive encounters play a major role in intraspecific competition for food resources.

The competition aspect of this behavior was especially apparent when food density was lowered. Aggression between fish markedly increased with the larger animals generally being more successful in capturing prey. When food densities were maintained at low levels the result was evidenced by differential growth rates between dominant and subordinate fish.

Biological Oceanography of Stressed Ecosystems Investigation

Seabed Metabolism

Bill Phoel and Steve Spina conducted seabed metabolism studies on the Ocean Pulse (OP)/Northeast Monitoring Program (NEMP) cruise of the Albatross IV. Fifty-six stations in the Gulf of Maine, Georges Bank, New York Bight apex, and continental shelf south to about Nags Head, North Carolina, were sampled for total oxygen consumption rates, chemical oxygen consumption rates, and, with Andy Draxler, the flux rates of nutrients and ammonia from the sediments into the bottom water. All cores were sieved through a 0.5-mm screen to determine the macrofaunal biomass in each core. Keven Gashlin, a research associate from the New Jersey Department of Environmental Protection, and Gail Driscoll, a research associate from the New Jersey Marine Sciences Consortium, contributed significantly in the sampling on Legs I and II, respectively.

Total Plankton Respiration

Data from Superflux I and II are being plotted on graph paper and hand contoured in preparation for a data report and presentation at the Superflux Symposium to be held in January 1981 at Williamsburg, Virginia. Cruise organization and preparation for Superflux III during 14-24 October 1980 have begun.

Phytoplankton Growth Potential

A set of samples for algal bioassay studies was obtained on the September NEMP cruise. A new Coulter Counter Model 2B is now in operation and is being calibrated. Coscinodiscus wailesii, a diatom suspected of producing large amounts of mucilaginous excretion was identified in a "floc" sample collected in mid-September from the bottom off Barnegat, New Jersey; some of the material has been preserved for chemical analysis. Revisions were prepared for the paper by Draxler et al. on "Chemical and Physical Measurements in Lower New York Bay and Adjacent Waters."

Phytoplankton Community Structure

At a planning meeting held at the Sandy Hook Laboratory this month between Myra S. Cohn and Dr. Harold G. Marshall of Old Dominion University, plans were made for the following joint publications: (1) the reports of phytoplankton populations on eight cruises, to be issued one cruise at a time as NOAA Technical Reports; and (2) a scientific journal paper analyzing the year's work of data, including the results of all eight cruises and incorporating major statistical analysis. Writing and compiling of data for the first of the reports discussed above is proceeding and the report is targeted for December 1980.

A total of 111 samples was received from an OP cruise on the Albatross IV (No. AL 80-09) and have been processed prior to being evaluated. Samples are currently being obtained on a MARMAP cruise on the Albatross IV (No. AL 80-10).

Work is being completed on an exhibit for an open house to be held on 17 October at Sandy Hook Laboratory.

Remote Sensing

Two Superflux planning meetings were held during the month. The first was held at the NASA Langley Research Center on 12 September and the second at Old Dominion University's Department of Oceanography on 25 September. Both meetings dealt with the planning of Superflux III to occur during 14-24 October 1980. Nineteen individuals representing the principal components of the program attended the first meeting and 20 attended the second. The institutions represented included the NEFC, NASA Langley Research Center, NASA Wallops Flight Center, Virginia Institute of Marine Science, Old Dominion University, Research Triangle Institute, and the NOAA National Ocean Survey's Atlantic Marine Center. Plans are to fly nearly operational sensors. These include two passive sensors (MOCS and OCS) and one active laser sensor (AOL). Data will also be acquired from the NOAA-6, TIROS-N, and Nimbus-7 satellites. Five surface vessels will be involved in the experiment.

A Superflux Symposium is being planned for January 1981 to be held in Williamsburg, Virginia.

Environmental Chemistry Investigation

Several members of this Investigation participated in the September OP survey (Albatross IV Cruise No. AL 80-09) of shelf environments between Cape Hatteras and Nova Scotia. Andrew Draxler collected seawater samples for inorganic nutrient analyses throughout the water column at 70 stations occupied during the survey.

Andrew Draxler, working with Bill Phoel of the Biological Oceanography of Stressed Ecosystems Investigation, made extensive measurements of nutrient flux rates from sediment cores collected at 56 OP shelf stations. These data along with flux measurements made during a spring survey will form the basis for an analysis of the contribution by the seabed to nutrient levels in the water column.

Ruth Waldhauer and Al Matte completed 387 ammonium analyses in seawater collected during the OP survey and completed 600 analyses of inorganic nutrients (i.e., nitrate, nitrite, silicate, phosphate) in seawater, using the Auto Technicon.

During the September OP survey, chlorophyll-a was measured at 69 stations by Robert Fitzgerald and Kathleen Workman, technicians recently assigned to this Investigation.

Vincent Zdanowicz completed analyses of heavy metal concentrations in sediments collected during the summer 1979 OP survey (Albatross IV Cruise No. AL 79-07), and analyses were initiated on sediments collected during the late fall 1979 OP survey (Delaware II Cruise No. DE 79-11). Statistical reduction of sediment heavy metal data and the construction of maps depicting the shelfwide distribution of metals in sediments were initiated.

Jay O'Reilly and Chris Evans worked with Bob Pikanoski (under contract to us) to develop an extensive data matrix for average chlorophyll-a data, integral daily primary productivity, and nutrient concentration data. The data matrix will allow us to evaluate statistically the representativeness of remotely sensed surface measurements of chlorophyll-a to the entire phytoplankton population on a per-square-meter basis. The matrix will also allow us to evaluate systematically, by region and by time, relationships between the ratio of integral primary production/integral phytoplankton biomass (P/B), and the photosynthetically active radiation (PAR) for each of the 17 regions (based on recent phytoplankton biomass patterns) of the shelf. Strong integral P/B versus PAR relationships usually indicate that light, not nutrient concentrations, is the limiting factor in organic carbon production.

Coastal Ecosystems Investigation

Benthic Communities

Dave Radosh was chief scientist for the second leg of the OP cruise on the Albatross IV during 11-18 September. Dave spent most of his remaining time preparing the OP benthic data gathered to date for entry into the ADP system. He also completed and dismantled an aquarium display which he had been maintaining this summer for Monmouth Museum's Year of the Coast exhibit. Dave and Bob Reid completed a report to the New Jersey Department of Environmental Protection concerning the benthic macrofauna of Romer Shoal (a popular fishing ground at the mouth of Raritan Bay), and possible impacts of sand mining there. Bob dove with New Jersey Marine Sciences Consortium personnel to collect blue mussels deployed at several sites in the inner New York Bight in the Consortium's study of PCB and metal bioaccumulation for the US Army Corps of Engineers. Bob and Clyde MacKenzie dove to retrieve trays of relatively contaminated and clean sediment which had earlier been deployed in the inner Bight, to examine effects of sediment quality on setting of surf clams. Clyde began work with the new NEFC task force on molluscan ecology, which met at the Milford Laboratory this month. Ann Frame continued her taxonomic work on the OP benthic samples.

Benthic Energetics

This month Frank Steimle was chief scientist and overall cruise planner for the autumn OP environmental monitoring survey on the Albatross IV. Frank Steimle and Russ Terranova worked in finalizing the bridge and hydrographic log files for last July's OP environmental monitoring cruise. This information is now available upon request. Russ continued to burn benthic energetics material in the calorimeter, worked on submitting existing caloric data to ADP, and began a literature search of caloric equivalents of aquatic organisms. He also worked in cooperation with Dan Patanjo of the Woods Hole Laboratory on plotting vertical dissolved oxygen profiles for some early MARMAP cruises.

Janice Ward and Dorothy Jeffress continued working on biomass determinations for New York Bight apex benthic samples. Dorothy began working on organizing

individual species bibliographies for the invertebrate life history file. Janice is currently revising the NOAA Environmental Research Laboratories' Marine Ecosystems Analysis Program's benthic fauna monograph with John Pearce and David Radosh. She and Frank Steimle are also completing their responses to editors' comments in their atlas of distributions and life histories of New York Bight apex benthic invertebrates.

Physiological Effects of Pollutant Stress Investigation

Physioecology

Attempts to spawn American oysters continued this month. Representative samples were opened to check for ripeness. The animals had ripened gonads; but attempts to induce them to spawn failed.

Surf clams were spawned twice this month. In one spawning, less than 1% of the eggs became fertilized, and in the second spawning all embryos developed abnormally.

Considerable time was spent summarizing the results of completed and incomplete bioassay experiments performed over the last 3 yr.

A study of the long-term effect of silver and copper on the blue mussel (average size of 33 mm) continued through the 15th month.

A poster was prepared for the Fifth Symposium on Aquatic Toxicology to be held in Philadelphia.

Tissue samples of a limpet snail, Crepidula fornicata, and the blue mussel, held in long-term heavy-metal exposure systems, were analyzed this month for copper, silver, cadmium, and lead. The analyses are being provided as input to studies of the effects of heavy metals on marine mollusks exposed for periods of 1 yr or more to various heavy metals.

PCB analyses continued on flounder liver tissues collected in our Long Island Sound "mini" OP study.

Physiological Effects

American lobsters exposed to 5 and 10 ppb cadmium were removed from exposure systems after 30 days and examined for changes in gill-tissue oxygen consumption. Various tissue samples were removed and frozen for heavy-metals analysis at a later date.

Studies continued on determining rates of respiration and feeding in the bay scallop. Scallops are first being allowed to reduce oxygen levels in their test systems to anaerobic conditions; we subsequently return them to well oxygenated water and determine the time they require to return to normal respiratory and feeding rates.

Considerable time was spent in preparing for and participating in the fall OP cruise aboard the Albatross IV and in our "mini" OP study of Long Island Sound.

Biochemical Effects

This month's OP survey (Albatross IV Cruise No. AL 80-09) was the most successful to date in terms of sampling for biochemistry. The northern leg produced sea scallops from the anomalous deepwater population in the Gulf of Maine for the first time, as well as from nearby Fippennies Ledge (100 m shallower) for comparison, and from central Georges Bank near the sites leased for oil drilling; the southern leg produced scallops from eight stations, one of them the Philadelphia dumpsite. Altogether, 161 animals of this key indicator species were sampled for adductor

muscle biochemistry. In addition, 95 hearts were taken from eastern rock crab specimens at six stations (among them the New York sewage sludge dumpsite) for biochemical analysis which we hope to work into the testing schedule. We also took gill, gonad, muscle, and digestive mass from the 161 scallops for chemical analysis to be performed at the Sandy Hook Laboratory.

At the bench, work on scallop adductor muscle samples from three stations on an OP survey on the NOAA R/V Kelez (Cruise No. KE 80-04), and from one station on a National Ocean Survey cruise to the Philadelphia dumpsite, was completed. A good start was made on samples from the scallop survey, Albatross IV Cruise No. AL 80-06, which produced bivalve adductor muscle samples from 27 stations (298 sea scallops, 27 Iceland scallops, and 10 horse mussels). Data from the several experimental exposures of scallops to cadmium or to silver have been compiled with a clear-cut result: as ambient water temperatures increased (greater than 15°C), MDH levels increased in the controls but not in the metal-exposed animals (30 days, 10 ppb), one more example of heavy-metal damping of a normal physiological response.

Anaerobic Bacteriology/Metabolism

This month's activities included the identification to species of the many isolates obtained on the July-August cruises -- OP and New York Bight monitoring. Some 100 isolates have been tested to date for their biochemical activities by our API system. The objective is to correlate the presence of selected bacterial pathogens (i.e., Salmonella sp., fecal streptococcus, Clostridium perfringens, Klebsiella sp., Vibrio sp.) with the coliform indicator bacteria in the samples. The selected bacterial pathogens are being detected in the samples from the stressed areas. For a true incidence value in the samples for the bacteria, more isolates need confirmation and identification, which is continuing.

Meetings, Talks, and Publicity

Dr. A. Calabrese attended a petrochemicals contaminants task group meeting in Hattiesburg, Mississippi, and later visited the NMFS laboratories in La Jolla and Tiburon. He also visited the University of California's Bodega Bay Laboratory.

Dr. J. Graikoski gave a talk on "Ocean Pulse-Bacteriological Aspects" to the Pennfield Power Squadron of Fairfield, Connecticut.

Mr. D. Nelson attended the Atlantic Fisheries Biologists meeting in Hyannis, Massachusetts.

Dr. F. Thurberg participated in a NOAA evaluation panel meeting in Boulder, Colorado, on the fate and effects of oil and related research.

On 3 September, Dr. John Pearce gave an overview on OP/NEMP to the monthly luncheon seminar sponsored by the New Jersey Marine Sciences Consortium and Sandy Hook Laboratory. On 9 September, he gave an evening talk to the Rumson (New Jersey) Garden Club and emphasized the quality of marine life in New Jersey and the future of aquaculture in meeting the nation's food needs in the 21st Century.

During 10-12 September, Dr. Pearce participated in the NOAA Office of Marine Pollution Assessment's workshop on pollution monitoring held at the State University of New York at Stony Brook. He also participated in a hearing held by Dr. Carl Shuster of the Federal Energy Regulatory Commission in regard to energy development on the Hudson River and estuary. This hearing was held in Washington, DC, and involved personnel from several federal agencies.

Frank Steimle attended a 1-day (15 September) briefing on management and executive development programs.

Dr. Pearce participated in an annual US-USSR bilateral symposium on marine pollution held in La Jolla, California, during 15-18 September. He discussed current research and monitoring being conducted by OP/NEMP in the waters off New England and Middle Atlantic States. Presentations were given by six US participants and seven Soviets.

Bob Reid participated in a simulated oil spill response sponsored by the US Coast Guard on Governors Island, New York, on 16 and 17 September.

On 19 September, Dr. Pearce met with personnel of Zapata Industries in Houston, Texas, to discuss current knowledge about the impacts of offshore oil development on marine biota.

Bori L. Olla presented a summation of research completed and in progress on the effects of petroleum hydrocarbons on marine organisms at an interagency briefing of a joint NOAA and US Environmental Protection Agency review committee in Boulder, Colorado, during 22-23 September.

Bob Reid attended in Boston on 25 September a meeting of the Georges Bank Biological Task Force dealing with oil development.

During 29 September-1 October, Dr. Pearce participated in a working group (Group of Experts on the Scientific Aspects of Marine Pollution) organized by the Intergovernmental Maritime Consultative Organization (IMCO) to develop criteria for site selection and monitoring of ocean dumping. The meeting, held in London, was one of several which will result in a published IMCO research report.

Publications

Thurberg, F. P.; Goodlett, R. O. Low dissolved oxygen concentrations and surf clams: a laboratory study. Swanson, R. L.; Sindermann, C. J. eds. Oxygen depletion and associated benthic mortalities in the New York Bight, 1976. NOAA Prof. Pap. 11:277-280(Chapter 11);1979. (P)

Reports

Steimle, F. The benthic macrofaunal invertebrates of Block Island Sound -- an analysis of abundance, biomass and distribution. Greenvale, N.Y.: C. W. Post College, Long Island University; 1980. 57 p. Thesis.

Steimle, F.; O'Reilly, J.; Radosh, D.; Waldhauer, R. Hydrographic data, Ocean Pulse environmental monitoring surveys April 1978 through April 1980. Northeast Monit. Prog. Rep. NEMP I-8-0001;1980. 13 p. + tables.

AQUACULTURE DIVISION

Aquacultural Genetics Investigation

Mass Selection

Data from a study examining selection response in offspring from 4-yr-old and 2-yr-old American oyster brood stock are being analyzed. The largest oysters from the 1976 and 1978 year classes were selected and mated among themselves. The offspring from these matings were periodically measured to determine growth rate. The smallest oysters from the same two year classes were used as parents for contemporary control crosses. Thus far, the data collected do not indicate any selection ad-

vantage of one age group over the other. There are significant larval growth rate differences among the groups. However, a consistent pattern is not displayed nor do growth data from the juvenile offspring of these crosses at 9 and 21 wk post-setting show any distinctive differences among groups.

Experimental Inbreeding and Hybridization of Oysters

Juvenile oysters from the grow-out experiment were brought indoors, weighed, measured, and checked for survival. After 20 mo, survival was high for all groups of oysters in the "offshore" lantern net, in the suspension dock tray, and in the tank raceway. The survival rate was low for subgroups in the recirculating unit, most likely because of toxicity of paint which had chipped off the submersible pump. From initial observations, growth was better in the offshore and dock tray areas. However, stocking densities were higher in the tank raceway. Data need further analyses before final results are given. It appeared that the smaller individuals in the consanguineous groups put on more new shell growth than the larger animals. Fouling was reduced considerably from 1 mo ago when the oysters were last cleaned and checked.

Aspects of Nutritional Requirements of Mollusks Investigation

Long-term experiments on the feeding of the young American oysters held in our continuous-flow chamber are being continued. We are observing that the number of oysters held per unit area influences growth. However, after 16 wk the oysters from the group with the lowest population density, which showed the most rapid increase in size, appear to have reached a static growth phase. We are now increasing the amount of food to determine if further growth can be stimulated. Increasing the food allotment of the most dense population (i.e., slowest growing) did not affect the rate of growth. It therefore seems as if the growth-retarding effects of crowding may be independent of the food supply.

As reported previously, there continues to be virtually no growth of animals being fed with Chlorella autotrophica. The algal foods that support growth of the oysters in increasing order of effectiveness are: Phaeodactylum tricornutum, Dunaliella euchlora, Thalassiosira nana, and Tetraselmis maculata.

The mass culture harvest yielded 1359 liters (PCV = .003) of larval food and 1039 liters (PCV = .003) of juvenile foods. The algal cultures harvested were distributed to the Investigations as follows: Spawning and Rearing of Mollusks, 938 liters; Aquacultural Genetics, 794 liters; and Physiological Effects of Pollutant Stress, 575 liters. Subculture of the algal stock culture strains and experimental strains has proceeded on schedule.

Spawning and Rearing of Mollusks Investigation

The growth of hatchery-reared surf clams maintained in Long Island Sound in different predator-protection devices is being compared. Two groups of clams were held about 20 cm off the bottom in perforated plastic trays containing a sand substrate. Other groups of clams were planted in the natural bottom substrate, enclosed in cages. The growth rate of the off-bottom clams is considerably greater than that of those planted in the natural substrate. Possible explanation for the high growth rate in the off-bottom clams might be due to increased water circulation and less siltation. The physical structure of the on-bottom cage tends to collect sediment, perhaps forming a detrimental microenvironment.

Using SCUBA divers, we have deployed 10 vinyl-coated cages at five different sites along the Connecticut coast and stocked them with hatchery-reared bay scallops at a low density. The cages at these sites are being tested for their influence on growth and mortality differences in the bay scallops.

Preliminary data from our density experiment with bay scallops in 12-mm-meshed lantern nets were collected, and indicate an inverse relationship between growth and stocking densities. The scallops were then pooled and placed in new 12-mm-meshed lantern nets at new densities and redeployed. Preliminary data from our handling experiment with scallops in 12-mm-meshed lantern nets "handled twice" were collected. The scallops were then pooled and placed in new 12-mm-meshed lantern nets at new densities and redeployed. This experiment is designed to determine the frequency of net handling needed to prevent mortality due to fouling or predation.

Meetings, Talks, Visitors, and Publicity

Dr. Thomas Neudecker of the Bundesforschungsanstalt für Fischerei Institut für Küsten- und Binnenfischerei in the Federal Republic of Germany offered to test the growth and survival of Milford Laboratory's crossbred American oysters in his lab grow-out area in Langballigau. He also discussed algal culture with Dr. Ukeles.

A. Longwell participated in an interagency review of US research on petroleum hydrocarbons held in Boulder, Colorado.

Algal cultures were given to Mr. Kim Sievers of a Baja, Mexico, hatchery. In addition, cultures were sent upon request to Hong Jun-Choo at the Tiang Fisheries College in the People's Republic of China.

Steve Fowler of Middlefield, Connecticut, visited the Spawning and Rearing of Mollusks Investigation.

PATHOBIOLOGY DIVISION

Fish Pathology Investigation

As was mentioned in a previous monthly narrative report (March 1980), 4-wk-old haddock and winter flounder larvae were exposed to 500 ppb of Cu^{++} and demonstrated an acute response to the toxicant after 18 hr, thereby necessitating termination of the experiment. Presently, an examination of the olfactory organs of haddock larvae, which were still alive when the above-mentioned experiment ended, has clearly demonstrated lesions of variable severity not observed in the control tissues. These results will be compared with observations soon to be made on the winter flounder specimens and it will be of interest to see if they are equally sensitive to the toxicant, for the winter flounder larvae did not suffer as extensive mortality as the haddock larvae despite being exposed to the contaminant under exactly the same conditions.

After a literature search into the physiological and skeletal effects of heavy-metal challenges, particularly cadmium, on finfish, a proposal was submitted to investigate the relationships between heavy metals and skeletal anomalies such as the bent-fin condition discovered among demersal finfish in the inner New York Bight. In this area, the disease is found on winter flounder, yellowtail flounder, and cunner. Field and lab protocols were developed to sample blood seasonally from 25 individuals of each year class of these fish and to analyze for hemoglobin, hematocrit, glucose, osmolality, calcium, and magnesium ions--those parameters that are affected by heavy metals in the fish. Procedures were developed to draw adequate volumes of blood (at least 1-2 cm^3) with the help of "Vacutainers" after fish

immobilization with the anesthetic MS-222. After blood samples are drawn, the fish eventually will be radiographed and then dissected to remove livers and possibly kidneys for heavy-metal analysis by atomic adsorption methods.

A diagnostic summary of viral erythrocytic necrosis was prepared for presentation at the ICES meeting in Copenhagen.

A seminar on "Infectious Pancreatic Necrosis (IPN) of Clupeid Fishes" was presented by Mr. Newman at the NMFS Beaufort Laboratory on 19 September. The remainder of the day was spent in a fruitful exchange of ideas with investigators in the Atlantic menhaden program to learn more of the movement of these fish in Chesapeake Bay and along the Atlantic Coast in order to try to clarify the puzzling aspects of the epizootiology of this disease.

Arrangements have been made with the University of Maryland and the USFWS's National Fish Health Research Laboratory to pursue studies of other marine and anadromous clupeid fishes as possible hosts or reservoirs of IPN virus.

X-rays of American sand lance collected on summer bottom trawl survey cruises have been completed. Total specimens x-rayed to date exceed 2500.

The staff of the Fish Pathology Investigation spent considerable time and effort in preparing documents and papers for the ICES Special Disease Symposium to be held in Copenhagen during 1-3 October.

Comparative Invertebrate Pathology Investigation

A diagnostic service report was provided to the State of Massachusetts for American oysters collected from the Town of Wareham. Four percent of the oysters were found to be infected with a Minchinia costalis-like organism. Previous samples from Massachusetts have been found to be infected with these parasites. It is most likely that these organisms are endemic to the region and apparently do not cause any major mortalities as they do further south. No other serious parasites or pathogens were detected.

A sample of American oysters from the Piscataqua River, Maine, was received for use in collaborative work with Dr. Keerti Shah at the Johns Hopkins School of Hygiene. Cryostat-section diagnosis was successful for the papavolike virus and sections were prepared for immunological (FA) comparisons. Tissues were also fixed for electron microscopy and light microscopy.

The molluscan disease index was revised for the ICES meeting and a diagnostic summary on viral gametocyte hypertrophy is in preparation.

Observations on euphausiid gills processed for scanning electron microscopy showed an unusual appearance on the surface of the lamellae. To determine if this were the actual surface structure or an artifact of processing, subsequent samples of gills were processed for both transmission and scanning electron microscopy. Gills of Meganyctiphanes norvegica and Euphausia krohnii were treated by the following procedures: (1) fixed and stored in 2% glutaraldehyde seawater, (2) fixed in 10% formal seawater and stored in 70% EtOH, and (3) fixed and stored in 10% formal seawater. In addition to determining actual versus artifact structure, these fixation and storage procedures serve to compare material processed by standard electron microscopy procedures with material fixed for light microscopy and subsequently worked up for electron microscopy examination.

The Histological Services Unit prepared over 400 sections of fish and invertebrates for study by staff pathologists.

Staff members of the Comparative Invertebrate Pathology Investigation spent considerable time and effort in preparing documents and papers for presentation at the ICES Special Disease Symposium to be held in Copenhagen during 1-3 October.

Diseases of Larval Mollusks Investigation

Two of the five bacterial isolates received from Monterey Abalone Farms were retested twice in American oyster larval challenges and compared with a known Californian shellfish pathogen, CA-10. The results clearly indicated that none of the five isolates were pathogenic to larvae or bore any biochemical relation to CA-10. A report detailing all results of these analyses was forwarded to Monterey Abalone Farms with a recommendation that they bioassay the isolates on larval abalone, since our Milford Laboratory cannot rear abalone for bacterial challenge tests.

During a period of poor oyster embryonic development, protein and carbohydrate determinations were made to characterize further the toxic fraction of the filtrate of a pathogenic Vibrio sp. Because there appears to be a large amount of carbohydrate, as well as some protein, the toxic band eluate will be concentrated in order to attempt further separation. One challenge using oyster embryos with samples of the toxic band eluate which had or had not been filtered through a PM10 membrane was completed. This membrane retains molecules with a molecular weight greater than 10 000. As in previous challenges, it has been impossible to remove the toxic material.

Three experiments were run to examine the properties of agar and agarose in repelling the attachment of oyster hemocytes. Examination of three types of agar and five types of agarose revealed that only one agarose prevented cell attachment sufficiently enough to be used as a coating for containers during in-vitro work. Only 15% of the cells attaching to cell culture dishes were able to attach to the agarose. This value is higher than the 3% attachment initially reported, but considerably better than the 41% to 85% attachment found on the other agar or agarose types. In addition to improving cell recovery during in-vitro work, these experiments may provide a method for measuring changes in the surface (receptor) properties of hemocytes in animals under stress.

Final experiments to characterize the activation of larval oyster phagocytes during exposure to a bacterial pathogen have been interrupted by loss of virulence of bacteria. Attempts are being made to increase the virulence by high-dose infection of oyster larvae.

Two other monthly bacterial sampling cruises ("mini-OP") to Long Island shellfish beds were completed this month. A total of 66 isolates were taken to locate naturally occurring shellfish pathogens. A crash program allowed completion of biochemical data on 400+ other cruise isolates to provide information for our paper on "Occurrence of Bacteria Pathogenic to Oyster Larvae: A Long Island Study" presented by Lisa Petti on 27 September at the joint meeting of the New York - Connecticut American Society for Microbiology. The month was mostly spent on preparation for this paper.

Samples of dead and dying juvenile surf clams were examined for the presence of bacterial pathogens. Samples were prepared and shipped to the Oxford Laboratory for histological examination, especially in noting the apparent presence of gas-induced lesions. Since this is the second time the Aquaculture Division's Spawning and Rearing of Mollusks Investigation has had this problem in the grow-out tanks, we plan to monitor the system to learn the sequence of events leading to the mortality.

With the recent paralytic shellfish poisoning incident in Maine, the Pathobiology Division has again become involved in cooperative exchange of toxic shellfish extracts with Fairfield University. Toxic and nontoxic surf clams were extracted and made available to the University's Chemistry Department where work on Gonyaulax sp. toxic separation and purification continues. Highly toxic material obtained should make the separations much "cleaner."

Meetings, Talks, Visitors, and Publicity

On 2 September, Dr. Rosenfield presented a debriefing to the NOAA Assistant Administrator for Research and Development in Washington, DC, on his recent trip to the Peoples Republic of China; and on 26 September, he attended a meeting of the Joint Subcommittee on Aquaculture in Washington, DC.

Dr. Blogoslowski attended the 9 September meeting at the Milford Laboratory on aquacultural population enhancement.

Ms. Linda Dorigatti participated in an OP cruise aboard the Albatross IV 3 to 18 September.

Ms. Smith and Ms. Swann were designated to monitor and evaluate a training course on "Problem Solving and Leadership" designed for women in the federal government in grades GS-5 to GS-10 held at the Department of Transportation in Washington, DC, on 17 September.

The Mid-Atlantic Regional Meeting on the Introduction and Transfer of Nonindigenous Species was held on 23 September at the Oxford Laboratory. The following conferees attended: New Jersey--Mr. Joseph Dobarro, Dr. Harold Haskin; Delaware--Mr. Charles Lesser; Virginia--Dr. Jay Andrews; Maryland--Mr. William Jensen, Mr. Howard King, Mr. William Outten, Mr. William Sieling, Miss Sara Otto, Mrs. Janet Hammed; and NMFS--Dr. Carl Sindermann, Dr. Aaron Rosenfield, Mr. Fred Kern, Mr. Austin Farley.

Mr. William Rose, Mr. Stephen Tettelbach, and Ms. Lisa Petti attended a joint meeting of the Eastern New York - Connecticut Valley and Northeast Branches of the American Society for Microbiology at Lake George, New York, during 26-28 September.

Mr. Stephen Tettelbach left on 5 September to enter a PhD program at the University of Connecticut, and Ms. Joyce Bowling returned to Duke University on 27 August.

Mr. Farley was awarded a 20-yr service pin and several employees received promotions during the month: Susie Hines, Fred Kern, Sharon MacLean, Muriel McNelis, Ceil Smith, and Jane Swann.

The Helminthological Society held a picnic on the grounds of the Oxford Laboratory on 20 October.

The Oxford Laboratory also held its annual picnic on 27 September and approximately 140 visitors attended.

Visitors during the month included Mr. Howard King of the Maryland Department of Natural Resources, Mr. and Mrs. Richard Nelson of the Cotuit (Massachusetts) Oyster Company, Mr. Kim Sievers of Cultivos Marinos de Baja in Mexico, Mr. Thomas Neudecker of the Institute for Coastal and Inland Fisheries in West Germany, Dr. Gary Pruder of the University of Delaware, and Reverend S. Elder of Fairfield University.

NATIONAL SYSTEMATICS LABORATORY

Pelagic Fishes Investigation

The data base on morphometrics of Spanish mackerels (Scomberomorus) was used to test a computer program (PROSTAT) written in DEC-10 FORTRAN, which calculates proportional values and basic statistics for morphometric data. Output is in tabular form that can be inserted directly into manuscripts and reports.

Work progressed on halfbeak fishes from New Guinea and India, and on an analysis of mangrove swamp fishes from New Guinea.

Benthic Fishes Investigation

Work was completed on six families for a checklist of eastern tropical Atlantic fishes and on ophidiiform fishes for the publication, Fauna of Madagascar. Work was done on descriptions of two new species of bythitid fishes, one from Colombia, the other from Western Australia.

D. M. Cohen participated in an National Science Foundation (NSF)-sponsored bottom trawling cruise on board the R/V Columbus Iselin working at depths from 800 to 5200 m around the Bahamas and in the Sargasso Sea. Ophidioids and synphobranch eels were the dominant fishes. Five species of ophidioids were taken for the first time in the western Atlantic and included two new genera and species from 5000 m and a new Monomitopus from the Blake Plateau. Scientists from the Virginia Institute of Marine Sciences directed the cruise, which also included personnel from NSF, the University of Miami, and the University of Copenhagen.

Penaeoid Shrimp Investigation

Progress was made on a systematic revision of American Pacific rock shrimps (Sicyonia). Also, a large new species of Solenocera from the Philippines is being described.

Crustacea Investigation

Preparation continued of a handbook of the decapod crustaceans of the temperate western North Atlantic. A paper was written on the taxonomy of the caridean shrimp genus Ogyrides.

Academic Activities

Dr. I. Canet was appointed external examiner for a PhD dissertation at the University of Witwatersrand, Republic of South Africa, and Dr. B. Collette for one at Macquarie University in Australia.

Visitors

Visitors included Dr. J. G. Nielsen, Director of the University of Copenhagen Zoological Museum, who worked with D. Cohen on ophidioid fishes. Other visitors were Drs. Lamarr Trott and Dick Stone of the NMFS Central Office; Dr. Gary Mayer of the State University of New York at Stony Brook and Susan Stoeppelworth of the University of South Carolina who discussed editing the production of the NOAA Environmental Research Laboratories' Marine Ecosystems Analysis Program's New York Bight Symposium with A. Williams; S. E. Horton of Texas A&M University; Dr. Labbish Chao of the Universidade do Rio Grande in Brazil; and M. Hatziolos of the Inst. Tecnológico de Monterrey in Sonora, Mexico.

Publications

Cohen, D. M. Saccogaster melanomycter (Ophidiiformes: Bythitidae), a new fish species from the Caribbean. Proc. Biol. Soc. Wash. (S)

Cohen, D. M. Families Argentinidae, Bathylagidae, Melanonidae, Moridae, Gadidae, Bregmacerotidae. In Check list of the fishes of the eastern tropical Atlantic. UNESCO. (S)

Pérez Farfante, I. Review of "El Mar de Puerto Rico" by J. A. Suárez Caabro. Ciencia. (A)

Pérez Farfante, I.; Grey, D. L. A new species of Solenocera (Crustacea: Decapoda: Solenoceridae) from northern Australia. Proc. Biol. Soc. Wash. 93:421-434. (P)

Williams, A. B. A new crab family from the vicinity of submarine thermal vents on the Galapagos Rift (Crustacea: Decapoda: Brachyura). Proc. Biol. Soc. Wash. 93:443-472. (P)

Williams, A. B. Western Atlantic species of the caridean shrimp genus Ogyrides. J. Crustac. Biol. (S)

ATLANTIC ENVIRONMENTAL GROUP

Ocean Monitoring and Climatology Task

The cooperative Ship of Opportunity Program obtained six expendable bathythermograph (XBT) transects and two continuous plankton recorder (CPR) transects in September: two XBT and one CPR transect in the Gulf of Maine, one XBT transect off Southern New England, one XBT and one CPR transect across the shelf and slope off New York, one XBT transect across the Gulf of Maine, and one XBT transect across the Gulf of Mexico.

The following announcement of eddy conditions in the Georges Bank - Middle Atlantic Bight area was sent to the Commander of the Atlantic Area for the US Coast Guard for publication in the October issue of Atlantic Notice to Fishermen:

AEG/September 18, 1980

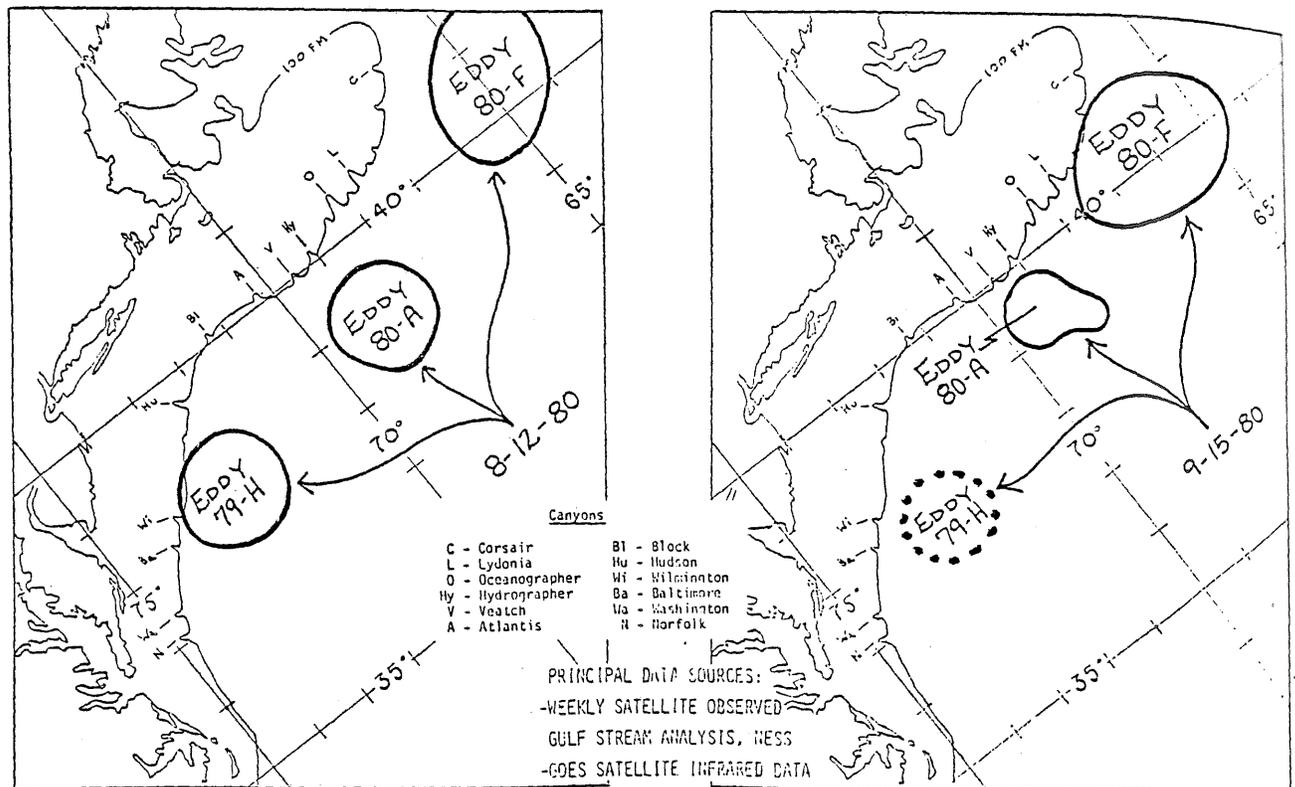
GULF STREAM EDDY LOCATIONS

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

Eddy 79-H apparently reappeared in satellite imagery after being partially overrun by a Gulf Stream meander in late August. In mid-September the eddy was located about 48 km (30 nm) south of the mid-August position, and is centered at 37.8°N, 72.7°W, east of Baltimore Canyon. Eddy 80-A moved about 65 km (35 nm) to the northwest, and is now centered south of Hydrographer Canyon at 39.3°N, 69.2°W. Eddy 80-F traveled southwest about 102 km (55 nm) to a center position of 40.2°N, 66°W, near the 100 fm line, south of Corsair Canyon.

During the next 30 days Eddy 79-H may travel southwest to a position east of Washington Canyon. Eddy 80-A may move west to a location south of Atlantis Canyon and Eddy 80-F may move west to a center position south of Lydonia Canyon.

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



Meetings, Talks, Visitors, and Publicity

Mert Ingham met with John Pearce in Newark, New Jersey, on 4 September to discuss upcoming NEMP matters.

Jack Jossi attended the OCEANS '80/IEEE Conference in Seattle, Washington, from 5 to 9 September where he presented a paper by James Aiken (UK's Institute for Marine Environmental Research), Grayson Wood, and Jack Jossi (the latter two from AEG) titled "The Undulating Oceanographic Recorder Mark 2: A New Ship-of-Opportunity Ocean Monitoring Instrument."

On 8 September, Mert Ingham attended a remote sensing meeting which was held at the Milford Laboratory.

On 8 and 9 September, Woody Chamberlin traveled to the Milford Laboratory to attend a remote sensing meeting and also an aquaculture task force meeting.

Mert Ingham attended a marine pollution monitoring workshop which was held at the State University of New York at Stony Brook during 10-12 September.

During 15-18 September, Mert Ingham traveled to Washington, DC, to attend: (1) a workshop held on 16 and 17 September on waste disposal from deep ocean mining, and (2) a conference which was held on 18 September on the production of a marine pollution newsletter.

Steve Cook went to Brooklyn, New York, on 10 and 11 September and again on 17 and 18 September to confer with engineers for the MORMAC Lines about installing equipment on MORMAC vessels.

On 18 September, Jim Bisagni traveled to Washington, DC, to confer with personnel of the NOAA National Ocean Survey's Ocean Dumping Program.

On 19 September, Mert Ingham and Talbot Murray went to the Woods Hole Laboratory where Talbot spoke on "The Impact of Climatic Factors on Early Life Stages of Atlantic Mackerel."

Doug Lipka of the US Environmental Protection Agency in Washington, DC, visited AEG for discussions with Mert Ingham on 22 September.

Sandy Lundin went to the Woods Hole Laboratory on 22 and 23 September to attend a briefing on the new DEC 10 System.

Woody Chamberlin went to Washington, DC, and the Maryland area to confer with personnel on remote sensing from 29 September to 1 October.

Publications

- Aiken, J.; Woods, G. B.; Jossi, J. W. The Undulating Oceanographic Recorder Mark 2: a new ship-of-opportunity ocean monitoring instrument. OCEANS '80 Conf. Rec.;1980 September; Seattle, Wash. p. 37-43. (P)
- Armstrong, R. S. Transport and dispersion of potential contaminants at the Buccaneer Oil Field. EXPOCHEM '80;1980 October; Houston, Tex. (A)
- Bisagni, J. J.; Kester, D. R. Physical variability at an East Coast United States offshore dumpsite. Proc. First Int. Ocean Dump. Symp.;1978 October. (A)
- Crist, R. W.; Chamberlin, J. L. Bottom temperatures on the continental shelf and slope south of New England during 1979. Ann. Biol. 36. (A)
- Fitzgerald, J. L.; Chamberlin, J. L. Anticyclonic warm core Gulf Stream eddies off the northeastern United States during 1979. Ann. Biol. 36. (A)
- Hilland, J. E. Variation in the shelf water front position in 1979 from Georges Bank to Cape Romain. Ann. Biol. 36. (A)
- Hughes, M. M.; Cook, S. K. Water column thermal structure across the shelf and slope southeast of Sandy Hook, New Jersey in 1979. Ann. Biol. 36. (A)
- McLain, D. R.; Ingham, M. C. Sea surface temperatures in the northwestern Atlantic in 1979. Ann. Biol. 36. (A)

Reports

Crist, R. W.; Chamberlin, J. L. Real time thermal front monitoring. Northeast
Area Remote Sens. Notes 5:15.

Fitzgerald, J. L.; Crist, R. W. Satellite shows record diameter warm core
eddy off Hudson Canyon. Coast. Oceanogr. Climatol. News 2(4):39.