

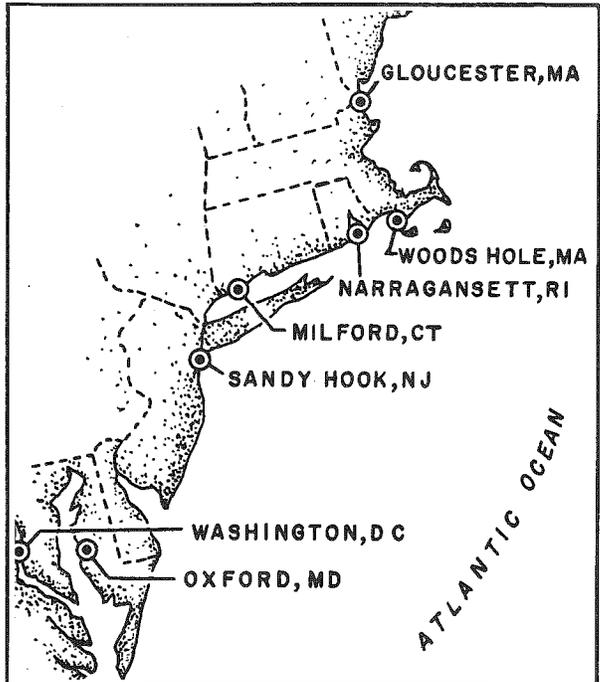
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# NEFC

Northeast Fisheries Center

# NEWS

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NOVEMBER 1979

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US DEPARTMENT OF COMMERCE  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
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## CENTER DIRECTORATE

### Environmental Management Office

Drs. Sindermann and Pearce participated in several meetings with representatives of the NOAA Office of Research and Development and the NOAA Office of Oceanic and Atmospheric Services to prepare a prospectus and program development plan for a "Northeast Pollution Monitoring and Research Program." The program will integrate pollution monitoring and related research work of these three NOAA components (the above two offices plus the Office of Fisheries) beginning in FY80. NEFC's Ocean Pulse Program will be the principal ingredient in the proposed study.

NEFC provides financial support for a very successful symposium series on pollution effects on the physiology of marine animals. The fourth in the series was held during 7-9 November at the Milford Laboratory with Drs. Calabrese and Thurberg as cochairmen. Sessions included effects of pesticides, heavy metals, and petroleum; participants included a number of outstanding research people from many laboratories in the US. The proceedings will be published as a book, as have the proceedings of the previous three symposia.

### Special Scientific Investigations Office

Arthur Posgay completed revision of a paper describing the design and testing of the Marine Resources Monitoring, Assessment, and Prediction Program's (MARMAP) bongo plankton samplers. He also began an analysis of the movements of tagged sea scallops.

### Special Technical Projects Office

Ronald Smolowitz spent much of this month arranging for financial support for NEFC gear and technology research. A presentation was given in Washington, DC, to staffs of the NMFS Office of Utilization and Development and the NMFS Office of Science and Environment, on the role of conservation engineering in fisheries development.

Numerous conversations were held with members of the fishing industry on possible joint projects involving gear and technology research.

A meeting was attended in Norfolk, VA, during 27-29 November on vessel operations.

## RESOURCE ASSESSMENT DIVISION

### Resource Surveys Investigation

During November, investigation activity centered around completing the autumn bottom trawl survey. The third part, covering Georges and Browns Banks between 19 October and 2 November was completed by the NOAA R/V Delaware II. Part four, covering the waters around Cape Cod and the central and eastern Gulf of Maine, was completed also by the Delaware II between 7 and 19 November. Linda Despres and Malcolm Silverman were chief scientists on these respective cruises. An additional trawl cruise was completed by the NOAA R/V Albatross IV between 1 and 9 November. This cruise, with Henry Jensen as chief scientist, was made to increase the coverage in the western Gulf of Maine area.

Linda Despres, starting 26 November, will be working for 3 wk at the Oxford Laboratory to develop skills to help the investigation identify pathobiological conditions at sea during resource surveys that are of interest to the NEFC as a whole. The ultimate aim of this cooperative work is for all Woods Hole Survey Unit personnel to become sufficiently informed of problems in fish pathology so data and samples can be routinely and properly collected on survey cruises.

Pat Twohig continued his participation in the video recording of a scientific conference at the Woods Hole Oceanographic Institution (WHOI) Clark Laboratory. This taping was the first in an attempt to create a video tape library of important scientific meetings held in the Woods Hole scientific community (NEFC, WHOI, Marine Biological Laboratory, and US Geological Survey). Pat Twohig also completed a studio video training course which consisted of directing, camera operation, audio, lighting, talent preparation, and video.

## Fishery Biology Investigation

### Finfish

On 5 and 6 November, the Finfish Group conducted the NMFS State-Federal Program Scup Age and Growth Workshop. Results of the workshop are being analyzed.

Cathy Rearden continued work on the age-and-growth archiving project, dealing with samples and data from the 1979 spring bottom trawl survey. She also continued impressing bluefish scales collected from the 1979 recreational fishery. Louise Dery sectioned silver hake otoliths collected during the 1979 summer bottom trawl survey, and began updating age records of various species on file with the Woods Hole Laboratory Automatic Data Processing (ADP) Unit.

### Shellfish

Upon returning from sea, Loretta O'Brien continued to prepare a study proposal for young-of-the-year and pre-recruit sea scallop growth, and continued to examine shells for age determination. She also assisted in supervising Maureen Griffin's and Steve Morrison's work on surf clams. Maureen Griffin monitored computer print-out of surf clam aging data collected under contract with the University of Maryland, prepared surf clam aging samples to complete the collection gathered during Delaware II Cruise No. DE 78-07, and instructed Steve Morrison in aging methodology. Steve Morrison has been instructed in the shell measurement procedures, method of excising chondrophores from the shells, and gluing the specimens to slides. The production of thin sections and photographic printing steps remain to complete his instruction.

John Ropes continued on the manuscripts mentioned in the October issue. Preliminary trials of polishing groups of hard clam shells were also conducted, preparatory to developing methods of processing ocean quahog shells for aging.

### Age and Growth

Kris Andrade assisted Vi Gifford in preparing redfish age samples collected from the 1978 commercial landings for use in the redfish age validation study.

Pollock age data from Albatross IV Cruise No. AL 79-03 and Delaware II Cruise No. DE 79-04 were audited and okayed for putting onto computer tape.

The following yellowtail flounder age data were developed and sent to ADP for keypunching: Albatross IV Cruise No. AL 79-03 and Delaware II Cruise No. DE 79-04 (spring bottom trawl survey) age samples; Albatross IV Cruise No. AL 79-08 and Delaware II Cruise No. DE 79-09 (summer bottom trawl survey) age samples; and Albatross IV Cruise No. AL 79-12 and Delaware II Cruise No. DE 79-10 (fall bottom trawl survey) age samples from Strata 1-25 and 61-76.

#### Fishery Assessment Investigation and Senior Assessment Scientists

Frank Almeida, Jim O'Connell, and Otis Jackson prepared a 100-m depth contour line for use with the FISHMAP program on the WHOI computer. Frank continued analysis of morphometric data for the silver hake stock identification study and is preparing a packet of computer programs, used in assessment activities, which will be sent to the Sea Fisheries Institute in Gdynia, Poland, as part of a cooperative effort to expand its computer capabilities.

Emory Anderson completed the red hake assessment update and worked on assembling pelagic shark catch statistics to be included in a document being prepared for the Mid-Atlantic Fishery Management Council (MAFMC) fishery management plan (FMP) on sharks.

Liz Bevacqua completed the 1978 USA Statlant 21B Report for the United Nations Food and Agriculture Organization (FAO) and International Commission for the Northwest Atlantic Fisheries (ICNAF). Also, Liz has entered all domestic logbook data through November into the inventory file.

Thurston Burns summarized lobster length-frequency data for 1970-77 by desired parameters for Chris Kellogg of the Lobster Plan Development Team as part of an economic analysis of the lobster fishery.

Steve Clark completed the assessment of the Gulf of Maine northern shrimp stock, and completed and distributed the final report of the first NMFS State-Federal Program Southern New England Assessment Workshop, which was held at the Woods Hole Laboratory on 24 and 25 July 1979.

Anne Lange provided papers on indicated subjects to the following personnel: sharks to William Apold of INTEROCEAN; squid to J. Baker of Wachapreague, VA; temperature data on bottom trawl survey squid catches to Geoff Hurley of the Canadian Department of Fisheries and Oceans; and groundfish assessments to Peter Greenwood of the University of New Hampshire.

Margaret McBride is preparing a current assessment of yellowtail flounder stocks and gathering information on recent trends and events in that fishery. She is reviewing the recent increase in yellowtail flounder landings by the sea scallop segment of the fishing industry. Margaret provided information to Dave Hayes of the Washington Office on the weight of yellowtail flounder caught by vessel tonnage class from 1 July 1978 to 30 September 1979 for designated areas.

Steve Murawski completed a study of the spatial distribution of ocean quahogs and its effects on the survey indices as indicators of relative abundance. He also completed, with Dea Fried, the lab analysis of marked-recaptured specimens of ocean quahogs for length-weight and condition factor analysis. Steve reviewed a federal aid proposal for an estuarine clam study and, with Frank Almeida, met with Stephen Smith of the Canadian Department of Fisheries and Oceans regarding statistical analysis of catch-per-unit-of-effort data.

Fred Serchuk began preliminary analyses of the mean stratified catch per tow of Atlantic cod, by preselected strata sets, from the 1979 autumn bottom trawl survey. Fred continued the analysis of sea scallop catch-per-unit-of-effort data for 1979 and previous years.

Mike Sissenwine, Ralph Mayo, and Rhett Lewis completed the analysis of spatial and seasonal distribution of summer flounder.

Gordon Waring updated the 1979 Atlantic herring age composition data for Dick Seamans of the NMFS Northeast Regional Office.

#### Meetings, Talks, Visitors, and Publicity

On 1 November, Steve Murawski attended a public hearing on the surf clam-ocean quahog management plan at Ocean City, MD.

On 1 and 2 November, Brad Brown and Mike Sissenwine attended the NEFC Board of Directors meeting in Gloucester, MA. Discussions involved detailed interactions concerning roles in environmental assessment activities.

On 5 November, Emory Anderson attended a MAFMC Scientific and Statistical (S&S) Committee meeting in Philadelphia, PA.

On 6 November, Fred Serchuk attended a New England Fishery Management Council (NEFMC) Groundfish Oversight Committee meeting in Danvers, MA.

On 7-8 November, Fred Serchuk attended the NEFMC monthly meeting in Danvers, MA.

Tom Azarovitz attended an Ocean Pulse Program meeting at Princeton, NJ, on 13 and 14 November.

During 13-16 November, Steve Clark participated in the activities of the Ad Hoc Working Group on Shrimp of the Northwest Atlantic Fisheries Organization (NAFO) Standing Committee on Fisheries Science (STACFIS) in Dartmouth, NS.

On 14 November, Thurston Burns attended the Lobster Plan Development Team meeting in Boston, MA.

On 15 and 16 November, Brad Brown presented a talk on "The State of the Fisheries" and participated in a panel discussion dealing with improved interactions with the New England Marine Advisory Service in Woods Hole, MA.

On 19 November, Fred Serchuk and Paul Wood attended the NEFMC Sea Scallop Oversight Committee meeting in Danvers, MA.

On 20 November, Gordon Waring attended a sub-committee meeting of the NEFMC Herring Oversight Committee in Peabody, MA.

During 26-29 November, Brad Brown chaired a session of the Multi-Species Fisheries Management meeting in St. Johns, NF. Mike Sissenwine presented two papers at the meeting: (1) "An Energy Budget of Georges Bank," and (2) "An Empirical Examination on Population Interactions for the Fishery Resources off the Northeastern USA."

On 27 November, Fred Serchuk attended a Vessel Logbook Task Force meeting in Peabody, MA.

On 28 November, Steve Clark represented the NMFS State-Federal Program Northern Shrimp Scientific Committee at the Atlantic States Marine Fisheries Commission (ASMFC) Northern Shrimp Sector meeting in Portsmouth, NH.

The first meeting to plan a joint US-Norway hydroacoustic experiment of fish target strength verification was held at the Marine Research Institute in Bergen, Norway. Jim Crossen attended with Jack Suomala and Dean Hamilton of the C. S. Draper Laboratories in Cambridge, MA. This project is a result of findings from a recent US-USSR joint hydroacoustics meeting on fish abundance estimates. A tentative agreement was made to conduct experiments on caged fish during June 1980 in a fjord at Sortag, Norway.

Thurston Burns, Gordon Waring, and Paul Wood participated in the 1979 autumn bottom trawl survey (Albatross IV Cruise No. AL 79-12) during 1-9 November.

Pat Carter, Anne Lange, and Joan Palmer participated in the 1979 autumn bottom trawl survey (Delaware II Cruise No. DE 79-10) during 7-19 November.

Fred Serchuk completed the following courses: (1) National Science Foundation "Risk Benefit Analysis" at the University of Hartford (CT) during 11-13 November; and (2) "Effective Supervision" in Wakefield, MA, during 25-30 November.

Judy Penttila completed the NOAA training course on "Effective Supervision" offered in Wakefield, MA.

Malcolm Silverman completed a course in "Effective Supervision."

John Messersmith has finished his temporary appointment and is heading for Australia to live and continue to work in marine science.

Jan Harbowy, a mathematician from the Sea Fisheries Institute in Gdynia, Poland, returned home on 13 November after spending a month at the NEFC. Andrzej Paciorkowski, an assessment scientist from the aforementioned institute, visited the Resource Assessment Division during 21-23 November.

Don Flescher spoke on fish surveys to a group of biological oceanography students from DeWitt, NY.

Rhett Lewis and Harold Foster visited the University of Long Island in Southampton, NY, and La Guardia Community College in Long Island City, NY, during 6-8 November, and Rhett Lewis and Dennis Hansford visited Trinity College in Hartford, CT, on 20 November. At all three schools information on career development in marine sciences and on opportunities in student cooperative programs at the NEFC was presented.

The following Resource Assessment Division personnel are members of the Equal Employment Opportunity Program (EEO) Committee: Brad Brown, Pat Carter, Harold Foster, Dennis Hansford, Rhett Lewis, Margaret McBride, Fred Serchuk, Mike Sissenwine, and Gordon Waring.

#### Publications

Lange, A. M. T.; Johnson, K. L. Dorsal mantle length-total weight relationships of squid (Loligo pealei and Illex illecebrosus) from the Northwest Atlantic, off the coast of the United States. NOAA Tech. Rep. NMFS SSRF. (S)

#### Reports

Almeida, F. P.; Anderson, E. D. Assessment of the silver hake resource off the Northeast Coast of the United States - 1979. Woods Hole Lab. Ref. Doc. No. 79-48;1979.

Anderson, E. D.; Almeida, F. P. Status of the red hake resource off the Northeast Coast of the United States - 1979. Woods Hole Lab. Ref. Doc. No. 79-49;1979.

Clark, S. H.; Essig, R. J.; Hansford, D. Gulf of Maine northern shrimp - current status and future outlook - 1979. Woods Hole Lab. Ref. Doc. 79-51;1979.

### MANNED UNDERSEA RESEARCH AND TECHNOLOGY PROGRAM

#### Remote Controlled Vehicle

Richard Cooper (14-22 September) and Joseph Uzmann (5-9 November) participated in cruises aboard the R/V Atlantic Twin at Hudson Canyon and the R/V Undersea Hunter off Freeport, Grand Bahamas, to observe operations of a commercial remote-

controlled vehicle (RCV), the Recon II, owned and operated by Perry Oceanographics of Palm Beach, FL. Dives with the RCV were made at specific sites in Hudson Canyon where research submersible operations were conducted in August.

#### Diving Safety Board Meeting

Cooper and Cliff Newell participated in the annual NOAA Diving Safety Board meeting in Rockville, MD. Significant changes are being instituted in areas of NOAA diver certification and training. Associated with this annual meeting was a 5-day workshop directed at proficiency training with variable-volume diving suits, used primarily in cold and/or polluted water.

#### UNOLS - National Submersible Requirements

Cooper was named by the University National Oceanographic Laboratory System (UNOLS) and NOAA to serve on a submersible science committee to define national scientific requirements for research submersibles over the 1980's and 1990's. The first meeting of this group was held at Columbia University's Lamont Doherty Geological Observatory in Palisades, NY. Mission-oriented and basic research needs are being considered for both shallow water (continental shelf) and deepwater environments.

#### NOAA - Fisheries Research Scientific Diving Requirements

A committee has been formed of NOAA/NMFS and academic scientists to define the research strategies, missions, and goals of NOAA requiring scientific diving, manned and unmanned, for the next 10 yr. This strategy will be used by NOAA management in reviewing NOAA and non-NOAA proposals of undersea research. The Fisheries Committee, chaired by R. Cooper, is one of four groups to examine undersea research requirements; the other three are titled: (1) Ocean Pollution; (2) Sea Floor Processes and Dynamics; and (3) Ocean Services. The redefinition of NOAA's role in undersea research by these four committees is part of a "revitalized effort" to provide more and better support for NOAA's undersea requirements.

#### Georges Bank Undersea Study

MURT team personnel, in response to NOAA management, has prepared a proposal titled "Georges Bank Undersea Study of Fishery Assessment, Ecosystem Response to Stress and Habitat Protection." This would represent a 5-yr study by MURT and assisted by the US Geological Survey, National Ocean Survey (NOS), and several academic institutions (University of New Hampshire, Boston University, Southeastern Massachusetts University, University of Connecticut, and Rutgers University). Shallow water and deepwater submersibles would revisit specific monitoring sites along the southern slope of Georges Bank and within six Georges Bank submarine canyons. The proposal has been signed off by the Assistant Administrator for Fisheries, Terry Leitzell, and the Assistant Administrator for Research and Development, Ferris Webster, and has been presented to NOAA Administrator Richard Frank. A decision is expected by mid-December.

## Publications

Cooper, R. A.; Uzmann, J. R. Ecology of juvenile and adult lobsters, Homarus americanus and Homarus gammarus. Cobb, S. J.; Phillips, B. F. eds. Biology and management of lobsters. Academic Press. (A)

Valentine, P.; Uzmann, J. R.; Cooper, R. A. Geology and biology of Oceanographer Canyon. Mar. Geol. (A)

## Reports

Valentine, P.; Uzmann, J. R., Cooper, R. A. Geological and biological observations in Oceanographer Submarine Canyon--descriptions of dives aboard the research submersibles Alvin (1967, 1978) and Nekton Gamma (1974). Open file report, prepared for US Geological Survey; 1979.

## MARINE ECOSYSTEMS DIVISION

### Ecosystem Dynamics Investigation

Marv Grosslein continued work on the Middle Atlantic Bight atlas. The final sections on effects of fishing, pollution, and natural environmental factors were completed and are under review. Marv also attended a multispecies fisheries management workshop in St. John's, NF, where he presented the updated energy budget for Georges Bank, coauthored with Ed Cohen, Mike Sissenwine, and Frank Steimle. After expansion and revision, the paper is to be published along with other papers of the workshop in the Journal of the Fisheries Research Board of Canada, or as a special publication of the board.

Wendell Hahm and Brian Hayden continued work on the food habits data base. Probability distribution functions of prey capture, based on the relative predator/prey size relationship, are being produced. With the scatter diagrams and these initial prey-preference curves in hand, the next step is to re-sort the data sets to see whether other factors such as geography or predator maturity have modifying effects on the tentative feeding preference functions. This work is just beginning. Brian has spent most of the month reformatting and completing the ICNAF zooplankton file for analysis by Roz Cohen.

### Recruitment Processes

Two Woods Hole Laboratory reference documents were completed this month by Greg Lough and George Bolz summarizing the basic ICNAF larval Atlantic herring data base and analysis of the Gulf of Maine larval herring data in relation to spawning stock size and recruitment. George Bolz continued the summarization and analysis of the ICNAF ichthyoplankton data base for 1971-77, and with the exception of two surveys, all summary tables and graphs have been completed in rough form. Stephen Grimm arrived at the Woods Hole Laboratory on 23 November and will stay until the end of December to help us summarize the ICNAF larval herring data base.

Dave Potter spent most of the month working on a revision of a neustonic ichthyoplankton manuscript. A few days were spent with Cabell Davis to develop our silhouette photography capabilities for the microplankton component. In this regard, Dave Potter and Cabell Davis met with Dr. H. Edgerton of the Massachusetts Institute of Technology (MIT) on 20 November to return borrowed equipment and discuss techniques.

Dave Potter presented a slide show lecture on oceanographic instrumentation to Marine Biological Laboratory-Boston University Marine Program students in a marine science course and wrote an NEFC Energy Newsletter Special Bulletin at the request of the Woods Hole Laboratory Director on, "The Massachusetts H.U.D. Solar Hot Water Systems Grants." Both Dave and George have been attending a series of sessions on solid state electronics given by WHOI personnel after working hours.

Roz Cohen has been dealing with the computer formatting and organization of the ICNAF zooplankton data (0.333-mm and 0.165-mm mesh) from the 1974-75 and 1975-76 seasons to match up with the larval herring gut content data. She has also been dealing with a report on the prey selection of various mesh sizes for the American Society of Limnology and Oceanography (ASLO) winter meeting. She also worked on the larval herring gut content protocol manual and reviewed the copepod identification manuscript with Janet Murphy. Janet participated on the Polish R/V Wieczno MARMAP survey during 13-21 November. William Michaels, a University of Massachusetts co-op student, served on the Albatross IV hydrography and ichthyoplankton survey during 14-17 October.

Dave Potter, George Bolz, and Roz Cohen are attending a short, in-house statistics course for experimenters, given by Mike Pennington. Roz Cohen and George Bolz attended two EEO meetings at the Woods Hole Laboratory this month.

Electronics technician Hal Merry repaired five meter blocks for use on MARMAP surveys and removed and installed three expendable bathythermograph (XBT) systems on the Wieczno and Soviet R/V Belogorsk. He also repaired the radar system on the Wieczno. Work continued on our multiple opening-closing net and environmental sensing system (MOCNESS) data processing system linking the PET (a small programmable microcomputer) and Loran C to our printer.

#### Larval Physiology and Biochemistry Investigation

Comparisons of the standard rearing aquarium and a newly designed funnel aquarium for determining daily mortality rates and growth were completed using summer flounder larvae as the test organism. The funnel system was found to be suitable, and replicated experiments to determine daily mortality rates and growth of summer flounder during the first 2 wk after hatching at constant temperature and prey density are in progress. Preliminary tests with miniature environmental chambers were conducted in the laboratory to determine the proper mesh size for in situ growth and survival tests this spring with first-feeding winter flounder larvae. A mesh size of 333  $\mu$  was found suitable for retention of larvae and unhampered movement of food organisms.

A study of the effect of temperature on the RNA/DNA ratio and growth of summer flounder was initiated. Experimental work for completion of a nitrogen budget for larval summer flounder was continued.

Larry Buckley attended a conference at the Milford Laboratory on physiology and biochemistry of marine organisms affected by pollution.

Geoffrey Laurence and Larry Buckley attended a planning meeting of principal Ocean Pulse investigators at Princeton University, and Geoff attended a LAMPX (Large Area Marine Productivity Experiment) Ecosystem Experiment Workshop at the NASA Langley Research Center in Virginia.

#### Plankton Ecology Investigation

Dave Cook of Raytheon Ocean Systems Company has furnished us with print-outs of NIMBUS 6 Satellite-tracked buoy positions obtained on quarterly Lagrangian studies of Georges Bank and contiguous waters during 1978 and 1979. We are now summarizing

tracks of buoy movement and plan to use these data in connection with studies of the effect of warm-core-eddy-induced entrainment of shelf water from the Georges Bank area on the distribution and transport of boreal fish eggs and larvae.

A "Technological Development Plan for Automated Zooplankton Processing and Scale Reading" was finalized. This program document describes a 5-yr cooperative project with the NOAA Office of Ocean Engineering, University of Rhode Island (URI), and the Narragansett Laboratory.

The 1979 US-USSR cooperative program aboard the Belogorsk was completed with Cruise No. 79-05, a phytoplankton, primary productivity, oceanography, microzooplankton, and ichthyoplankton survey. Jack Green, Joe Kane, and Donna Busch participated in the cruise. Work conducted on the cruise was part of an integrated approach to characterize aspects of ecosystem dynamics in the southern Gulf of Maine, Georges Bank, and the New York Bight. This cruise, in addition to Belogorsk Cruise No. 79-03, will provide basic information on the timing of the phytoplankton-zooplankton-ichthyoplankton cycle in the survey area and results should contribute to the refinement of recommendations of the Task Force on Process-Oriented Studies of Larval Fish Survival. The initial arrangements for the cruises were the result of efforts by Marv Grosslein and Wally Smith at the US-USSR meeting on cooperative fisheries research in Moscow during February 1979.

Jack Green coordinated zooplankton field work among Soviet and US scientists and was chief scientist for both cruises. Donna Busch coordinated phytoplankton-related field work, and Joe Kane was responsible for zooplankton sampling to compare results of two plankton preservation methods. Interrelated measurements on the cruise included profiles of: temperature, salinity, oxygen content of water, chlorophyll-a, nutrients, light penetration, community primary productivity, phytoplankton composition and abundance, and individual species primary productivity. Microzooplankton composition and abundance were determined from integrated net tows and whole-water samples at the 3% light level. Grazing rates of Pseudocalanus minutus and Centropages typicus were estimated using gear designed and built by Jack Green, analyses from a Coulter Counter (loaned by WHOI), and laboratory-reared pure phytoplankton cultures provided by WHOI. Gut contents based on ingested chlorophyll measured fluorometrically were estimated for Centropages typicus, Calanus finmarchicus, and Metridia spp. An experiment to compare the effects of preservation methods on estimates of zooplankton standing stocks was begun.

Donna Busch and Jack Green are currently preparing a summary report of all the data made available by both US and USSR scientists for the autumn cruise series aboard Belogorsk.

Jerry Prezioso shipped via the Wieczno the recently collected MARMAP plankton samples and the last of the international larval Atlantic herring patch study samples to be sorted by the Plankton Sorting Center in Szczecin, Poland. Jerry also made available one-half aliquots of two Albatross IV cruises (No. AL 79-06 and No. AL 79-11) for Soviet scientists to augment their studies of the distribution and abundance of microzooplankton.

### Biostatistics

New master files were made for the following cruises: Albatross IV Cruise No. AL 79-03, Soviet R/V Aliot Cruise No. 78-01, German Democratic Republic R/V Eisbar Cruise No. 79-01, and NOAA R/V Mt. Mitchell Cruise No. MM 79-02. Cruise data were entered and edited for Delaware II Cruise No. DE 79-03, and Albatross IV Cruise No. AL 79-06. Cruise data cards were received for Belogorsk Cruise No. 79-01. Zooplankton data cards were received for the Middle Atlantic portion of Albatross IV Cruise No.

AL 78-07, and Belogorsk Cruises No.'s 78-01 and 78-03, and for the patch studies of Albatross IV (Cruises No.'s AL 78-13 and AL 78-15).

All of the ichthyoplankton data from the 1978 MARMAP cruises have been extracted from MARMAP Information System (MIS) master files and put up to SAS data sets in preparation of statistical data analysis. Physical hydrographic data and chlorophyll data collected on MARMAP surveys are being assessed for integration to SAS data sets for co-analysis with the ichthyoplankton and zooplankton data sets. The hydrographic data from our own MARMAP cruises are easily obtainable through NOAA's National Oceanographic Data Center contact man in Woods Hole, George Heimerdinger. The hydrographic data collected on foreign vessels, however, are only available as Xerox copies. The chlorophyll data exist on magnetic tape. However, the data set carries only the old MARMAP fixed station number, rather than the currently used cruise-sequential station number of the present MARMAP surveys.

Mary Braisted was assigned to our group for a few afternoon's work. She generated a table of all cruises in the MIS with the types of data collected on each, noting whether or not these data types are in the MIS, in other storage formats, or on unedited log sheets.

Steven Eldridge came on board as a computer aide for a 1040-hr appointment. Julien Goulet attended the Federal Computer Conference in Washington, DC. The conference was well organized and most of the sessions were well presented and well attended. The topics covered in the various sessions ranged from acquisition of ADP services to concepts of data base management.

Cindy Jones and Julien Goulet visited Jay O'Reilly and John LeBaron at the Sandy Hook Laboratory to discuss data cooperation between that laboratory and the Narragansett Laboratory. Julien Goulet attended a course on "Effective Supervision."

#### Ichthyoplankton Investigation

Doris Finan returned from Szczecin, Poland, where she spent 6 wk working with members of the staff at Morski Instytut Rybacki (MIR) on identification of ichthyoplankton collected on our MARMAP surveys. Most of her efforts were directed toward a review of criteria used to identify larvae of troublesome species which occur in the southern and/or offshore part of the survey area. She was very impressed with the level of expertise and the quality of work being done at MIR.

Patty Rosenberg received from Szczecin the larval length sheets for the second part of Delaware II Cruise No. DE 79-03, our February survey, and Delaware II Cruise No. 79-04, the spring bottom trawl survey on which we collected samples on an opportunistic basis. Data from both cruises have been keypunched and the cards forwarded to the Narragansett Laboratory where they will be included in the MIS. Cindy Fahay is analyzing a set of discrete-depth plankton samples taken off Shinnecock Inlet during the 15-mo New York Bight survey. Myron Silverman and Wally Smith are cooperatively working on the MARMAP ichthyoplankton collections to observe seasonal and annual shifts in the distribution and abundance of fish eggs and larvae within the four analytical subareas between Cape Hatteras and the Gulf of Maine.

Again, the Albatross IV has been crippled by mechanical problems which have seriously impacted upon our late autumn MARMAP survey. After a 1-day delay at the outset of the cruise, it worked only 3 days before returning to port. Repairs took 13 days to complete. The ship sailed on 29 November to take up where it left off in the Gulf of Maine. Despite a revised vessel schedule, the delay virtually eliminates any chance of completing the survey.

## Benthic Dynamics Investigation

Benthic invertebrate studies conducted this month concentrated on two subjects: (1) the invertebrate fauna inhabiting the Southern New England continental shelf, and (2) bivalve mollusks of the US East Coast. Analyses of data pertaining to the macrobenthic multispecies invertebrate fauna on the shelf south of Martha's Vineyard and Nantucket were the major activity. Particular attention was devoted to the relationships between water depth and faunal density and biomass. Briefly, the results indicated that the density and biomass were highest at mid-shelf depths (60 - 80 m). Moderate quantities were found along the inner shelf (20 - 60 m), and low quantities along the outer shelf (80 - 200 m). Roger Theroux continued to work on the preparation of a report describing the distribution of East Coast bivalves. This report is in an advanced stage of preparation and a completed first draft is expected early next month.

Roger attended a course in Falmouth, MA, dealing with the basics of TV directing, producing, and taping. This course was given by the media services instructors at Falmouth High School. He also participated in video taping the Ocean Industry Symposium held at WHOI on 15 November.

Food habits studies dealt with several different research topics. Rich Langton has recently begun an analysis of the food habits of yellowtail flounder. Ray Bowman continued to work on a report dealing with the food of juvenile haddock. Ray and Ed Bowman are continuing work on a study of the feeding chronology and catchability of silver hake. In anticipation of detecting predators of Atlantic herring eggs and/or larvae, the stomach contents of fish collected during the international larval Atlantic herring patch study (conducted during the fall of 1978) are now being analyzed. Rich Langton and Judy Heubner prepared an internal document titled, "An Experimental Protocol for Determining the Rate of Digestion of Prey by Selected Northwest Atlantic Fishes." This was written in preparation for lab studies soon to be initiated at the Woods Hole Laboratory. Setting up the experimental system is progressing slowly. Judging from recent local collections of fish, it appears that winter flounder will be the species studied first in the lab digestion experiments.

## Fishery Oceanography Investigation

Gil Dering and Ron Schlitz were aboard Federal Republic of Germany's (FRG) R/V Anton Dohrn from 23 October to 16 November to provide hydrographic measurements during a trawl survey of the continental slope (400 to 1000-m depths) from Georges Bank to Cape Canaveral. The cruise provided our first good opportunity to use the new Neil Brown CTD (conductivity, temperature, and depth recorder) and Tektronix Graphic Terminal at sea. There were some minor electronic problems, but generally the equipment worked well. Ron Schlitz modified some of the programs. Two sections of CTD stations were made along the Nantucket Shoals flux experiment current meter array line.

The MARMAP I cruise on Albatross IV was more complicated. Originally, Dana Densmore and Tim Cain were scheduled for Part I from 14 to 27 November, but on sailing day Tim reported he had injured his back loading the ship the previous day. Luckily, Bob Halpin was willing to go as a last-minute replacement. Two days later the ship returned because of a holding tank plumbing failure. Derek Sutton agreed to replace Halpin for the balance of Part I, but it was called off when the ship was not ready to sail on 24 November. Albatross IV finally sailed on Friday, 30 November, scheduled to return on 21 December. Our fisheries oceanography cruise, Albatross IV Cruise No. AL 79-14, scheduled for 17-21 December, was cancelled to allow more time for MARMAP

work. John Sibunka, chief scientist, agreed to make one detailed section along the flux line at the end of the cruise.

Salinity samples from Albatross IV Cruises No. AL 79-10 and AL 79-11 were run by Sam Nickerson, Cindy Chappell, Ron Kirschner, Tim Cain, and Derek Sutton. Sam also plotted positions and read and plotted surface and bottom temperatures for both cruises. Ron Kirschner checked into the oxygen titration apparatus and reagents for Albatross IV Cruise No. AL 79-13 and plotted several flux sections of temperature, salinity, and dissolved oxygen.

Steve Ramp has been completing a computer program to transform NOAA weather buoy data into WHOI Buoy Group format for comparison with our current meter data. In the absence of Ron Schlitz and Red Wright, he also helped organize the MARMAP cruise. Derek Sutton has been computer processing STD (salinity, temperature, and depth recorder) data from the larval herring patch study. Dan Patanjo, with Cindy Chappell's help, has been pulling together material for data reports on MARMAP I hydrography. Tim Cain's report on the August-September Gulf of Maine Ship-of-Opportunity Program (SOOP) runs was completed by Ron Kirschner and Red Wright. Red spent the first week of November in Lisbon, Portugal, at a workshop designed to improve the university curriculum in the marine sciences in Portugal. A final report is in preparation. At the end of the month Red spoke to a visiting delegation from the People's Republic of China.

Kathryn Bush has completed her work in the unit and has gone to work for a private oceanographic firm in Rockville, MD.

#### Apex Predators Investigation

Six tagged sharks were recaptured in November. Of these, three were returned by NMFS observers on foreign fishing vessels. These sharks had been at liberty for up to 2 yr. The most interesting recovery came from a mako shark tagged near the Grand Banks by an American longline fisherman and recaptured 260 mi west of the tagging site by a Japanese longliner. This is the northernmost recapture location for a mako shark.

As part of our cooperative investigations on the behavior of large predators with WHOI, Dr. Frank Carey conducted sonic tagging experiments on blue sharks aboard the Wieczno (30 October - 11 November). One shark that was tracked for 5 days over a distance of 147 mi showed cycles of vertical movement between the surface and 250 m at 2 - 3 hr intervals. Another specimen tracked for 2 days showed a southward movement at a steady speed of about 1 knot over 42 mi. Additional information on swimming speed, temperature equilibrium, and vertical movement represents the most complete set of telemetry data obtained from a pelagic shark. Results of this cruise were particularly germane to our efforts in studying the migrations and food habits of the blue shark. Additional cooperative work with Dr. Carey has been planned for the coming spring and summer.

Chuck Stillwell and Nancy Kohler completed analysis of data for a publication on the food habits of the mako shark. A draft of the manuscript will be completed by early January.

Food habits data collected for the blue shark over the last 7 yr were transcribed to coded forms for keypunching.

We encountered difficulties in aging mako sharks during the trial run of a broad sample of transverse vertebral sections. A second attempt is in preparation using a discrete size sample from one source (Brielle, NJ, on 7 July 1979). These histological sections are being prepared by Alan Lintala and will be analyzed by H. Wes Pratt.

Wes Pratt developed a technique for verifying early age classes of mako sharks using length/weight against time of capture. The resultant age curve predicts mean growth from birth to age II where it breaks down due to overlap.

Jack Casey and John Hoey prepared a draft report, "Estimated Catches of Large Sharks by Recreational Fishermen in the Atlantic and Gulf of Mexico." This report was proposed for the Mid-Atlantic Fishery Management Council to be used in preparation of a fishery management plan for sharks.

#### Meetings, Talks, Visitors, and Publicity

Donna Busch, Jack Green, Bob Marak, and Debbie Dwyer met with the Soviet scientists from Belogorsk on 29 November at the Woods Hole Laboratory. The meeting was held to discuss the results of the autumn 1979 series of cooperative cruises between NEFC and AtlantNIRO. A very productive exchange of data and plans for further exchanges took place.

Donna Busch attended an IYABA meeting at the Milford Laboratory.

On 8 November, Carolyn Griswold, NOAA representative for the North Atlantic Region, attended an organizational meeting of the North Atlantic Technical Working Group Committee which is part of the Bureau of Land Management's (BLM) OCS (outer continental shelf) Advisory Board. The committee will make recommendations regarding BLM's environmental studies program, comment on tract selection for pending OCS sales, and advise the Department of the Interior regarding pipeline corridors and routes in the region.

Carolyn Griswold attended a meeting of the BLM Biological Task Force on 13 November in New York City. A report on a BLM-funded study of Lydonia, Oceanographer, and Baltimore Canyons was presented by researchers from Lamont-Doherty Geological Observatory of Columbia University. The study focused on biological communities and in particular on coral populations in each canyon.

On 15 November, Richard Donaldson of the General Accounting Office (GAO) in Boston visited Carolyn Griswold to discuss the marine sanctuaries program and how it might relate to Georges Bank.

Tom Halavik represented the Narragansett Laboratory in the reconvening of an old committee - the Bay Campus Treatment Plant Committee. The committee plans to make the scientific community more aware of the use of the treatment facility for both sewage and chemical wastes and plans and steps to lessen demands on the facility. The committee also plans to study the outfall area and its relationship to the seawater intakes of the various laboratories.

Ray Maurer hosted a visiting class from Pilgrim High School on 14 November at Narragansett Laboratory.

Preliminary plans were made for joint NEFC/SEFC cruise of Albatross IV to collect fish specimens during the spring of 1980 for analysis for petroleum hydrocarbons in fish flesh.

A complete package of our (NEFC) standard log forms was assembled and sent to committee chairmen of FIBEX (First International Biological Experiment in the Antarctic) for their consideration and possible use.

Jan Harbowy, a mathematician from the MIR visited the Narragansett Laboratory on 5 November for discussions with laboratory personnel from NMFS, the US Environmental Protection Agency (USEPA), and URI Graduate School of Oceanography.

Peter Bykowski, also from the MIR, presented a seminar on Antarctic krill on 19 November at the Narragansett Laboratory.

From 31 October to 2 November, Ken Sherman attended the NEFC Board of Directors meeting held at the Gloucester Laboratory to discuss program initiatives for FY81 and FY82.

On 13 November, Bob Edwards, Jack Pearce, Woody Chamberlin, Helen Mustafa, and Ken Sherman met with Paul Holloway, Janet Campbell, and other members of the NASA Langley Research Center staff to brief them on NEFC programs and areas of potential application of aerial remote sensing to fisheries ecosystem studies.

On 14 November, Bob Edwards, Helen Mustafa, Lou Ronsivalli, Ron Smolowitz, and Ken Sherman met with Martha Blaxall, Joe Slavin, John Everett, Tom Billy, Lamarr Trott, and Bob Wolf to discuss: (1) new fisheries development projects for the NEFC, and (2) the National Microconstituent Program.

On 19 November, Bob Edwards and Ken Sherman met with Don Phelps of the USEPA laboratory in Narragansett to explore how best to coordinate "scope for growth studies" with the Ocean Pulse Program. Follow-up activities here will include placement of mussels with physiological history in cages at strategic locations on the continental shelf.

On 23 November, Vic Klemas (University of Delaware), Bob Lippson (NMFS Northeast Regional Office Environmental Assessment Branch), Aaron Rosenfield, Jack Pearce, Bob Edwards, Helen Mustafa, and Ken Sherman met to explore alternative strategies for the development of the Superflux Project and to prepare a prospectus for the project.

On 24 November, the Center Directorate met with a delegation from the People's Republic of China to provide them with an overview of marine ecosystem research.

On 27 November, Ken Sherman completed reviewing all contributions to the International Council for the Exploration of the Sea (ICES) Early Life History of Fish Symposium with Reuben Lasker during a 2-day editing session in the Washington Office. The initial submission of papers should be accomplished no later than 14 December.

On 28 November, Ken Sherman joined Bob Edwards, Jack Pearce, and Helen Mustafa in a meeting with Ron Greenwood (Director of the NASA Environmental Observations Division), Stan Wilson (Chief of NASA Ocean Processes Planning), and Paul Holloway (Director of Space Programs at the NASA Langley Research Center). Topics discussed included developing agreements for the superpatch and superflux experiments.

On 29 November, Bob Edwards, Helen Mustafa, and Ken Sherman met with members of the NOAA Office of Ocean Engineering, including Steve Anastasion (Director), Bill Barbee (Deputy Director), and Luther Bivins to discuss a joint proposal for the FY82 budget dealing with the development of prototype pollution and ecosystem monitoring sensors. In the afternoon, Bob Edwards, Helen Mustafa, and Ken Sherman met with Admiral H. R. Lippold, Jr., of the NOS and his senior staff to discuss options for proceeding with joint studies in NEFC marine pollution monitoring initiatives.

Greg Lough and Geoff Laurence attended a meeting of the LAMPEX Ecosystem Experiment Working Group at the NASA Langley Research Center in Hampton, VA, during 27-28 November with other participants from WHOI and Brookhaven National Laboratories (BNL).

### Publications

Pratt, H. W. Reproduction in the blue shark Prionace glauca. Fish. Bull., US 77(2):445-470. (P)

### Reports

Bivins, L.; Maurer, R. O. Automated zooplankton processing and fish scale reading. Technology development plan. Report prepared for NOAA Offices of Fisheries and Research and Development, Washington, DC;1979.

Casey, J.; Hoey, J. Estimated catches of large sharks by recreational fishermen in the Atlantic and Gulf of Mexico. Narragansett Lab. Ref. Doc. No. 79-86;1979.

Cohen, E. B.; Grosslein, M. D.; Sissenwine, M. P.; Steimle, F. An energy budget of Georges Bank. Presented at workshop on multispecies approaches to fisheries management. St. John's, NF; 1979. November 26-30.

Kirschner, R.; Wright, R.; Cain, T. August-September 1979 temperature transects of the Gulf of Maine. NEFC SOOP Rep.

Langton, R.; Heubner, J. An experimental protocol for determining the rate of digestion of prey by selected Northwest Atlantic fishes. Report prepared for internal distribution;1979.

Lough, R. B.; Bolz, G. R. Abundance of sea herring (Clupea harengus L.) larvae in relation to spawning stock size and recruitment for the Gulf of Maine and Georges Bank, 1968-1978. Woods Hole Lab. Ref. Doc. No. 79-50;1979.

Lough, R. G.; Bolz, G. R. Summary of larval herring (Clupea harengus L.) survey data, 1968-1978, used in abundance estimates for the Georges Bank and Gulf of Maine areas. Woods Hole Lab. Ref. Doc. No. 79-45;1979.

#### RESOURCE UTILIZATION DIVISION

##### Fisheries Engineering Investigation

Work has begun on the design of a scallop drag that would be more size-selective and have less gear-related mortality than present commercial gear. These are two areas of gear improvement that could result in a significant increase in yield and yield per recruit.

A speed log has been developed for use on board the NOAA R/V Rorqual, and it is now in the testing stage. Winterization of the Rorqual has been completed. A few days were available this month aboard the Rorqual to perform hydrodynamic studies of the Isaacs-Kidd mid-water trawl. These studies are continuing.

Preparations are underway for the installation of the new clam dredge docking platform aboard the Delaware II and participation in the January survey cruise. Work has also begun on the design of a new upper ramp for the dredge. It will accommodate both the old 48-inch dredge and the new 60-inch dredge and will be able to be disassembled into component parts for ease of handling.

A number of proposals are being drafted for fishery development related to gear work.

Efforts have continued to procure a US Customs-seized fishing vessel under 65 ft in length in order to update and enhance the NEFC's small-boat capabilities.

Al Blott completed a paper on pair trawling for squid.

Technical assistance went this month to William Bergen of Kennebunk, ME, in trawl design, construction, and operations, and to Sandy Bay Lobster Co. of Gloucester in refrigerated, closed-circuit, seawater systems.

## Facilities Engineering

The review of literature pertaining to chemical waste disposal methods is continuing as is the energy audit.

Tom Connors attended an energy conservation workshop sponsored by the US Department of Energy and the Massachusetts Executive Office of Energy Resources.

The new freezer #7 is operational and is currently undergoing testing and calibration. Both freezers #4 and #5 underwent repair and maintenance this month.

Steps are being taken to remove the obsolete steam boiler outside the pilot plant.

## Resource Development and Improvement Investigation

### Blue Crabs

A storage study on the quality of roller-extracted pasteurized frozen blue crab meat was terminated due to unexpected spoilage of the thawed roller-extracted meats. The experiment is being repeated to determine if the process is feasible.

In another storage experiment, roller-extracted meats dipped in a flavor enhancer solution, pasteurized, and stored at 35<sup>o</sup>F for 5 mo were as acceptable as commercially picked pasteurized meats. Non-dipped roller-extracted meats were spoiled after this storage time.

### Storage of Blue Mussels

This will be the last month of active sampling in Duxbury, MA. Our contact at Ipswich Shellfish no longer wishes to supply us and feels we should switch to a constant supply from Maine.

Requests for reprints of the mussel paper have preceded our receipt of them. The amount of enthusiasm for the paper may determine a continued effort starting afresh with Maine mussels.

### Seafood Composition and Nutrition

Automation of some methodology was attempted in anticipation of many samples for proximate analyses from John Ryan.

The gas chromatograph is functional, and the automatic sampler has been installed.

A proposal for nutritional evaluation of seaweed for human consumption was submitted for Saltonstall-Kennedy Act funding consideration.

The second draft of a manuscript on the nutritional aspects of squid muscle is being revised.

### Species Identification

The final report on the species identification of the fish implicated in ciguatera poisoning is being written with the help of legal counsel from the NMFS Northeast Regional Office.

### New Product Development

Samples of frozen Atlantic cod fillets were withdrawn from the +5, 0, -5, and -20<sup>o</sup>F rooms after 2 mo of storage. They were inspected, given taste tests, and analyzed for changes in color and texture. After 2 mo, they were still "U.S. Grade A"

and similar organoleptically to the fresh frozen controls. The color changes very little, but the texture stress values increased somewhat. It is too early in the experiment to determine whether these texture measurement changes are significant. Measurements of pH were to be taken, but the surface electrode broke and is being replaced. A second surface electrode is being ordered for a spare.

An exploratory experiment to determine the refrigerated shelf-life of fresh Atlantic cod fillets packed in a carbon dioxide atmosphere was completed.

Commercial, tray-packed, "U.S. Grade A" Atlantic cod fillets were sealed in a gas-impermeable pouch that had been evacuated and carbon dioxide flushed. Non-treated fillets were run as controls. Both the carbon-dioxide-treated samples and non-treated samples were stored at 33°F and taste tested periodically. The non-treated cod fillets were scored as spoiled by the Gloucester Laboratory taste panel after 10 days, while the carbon dioxide treated samples were still edible after 16 days. The pH was to have been measured to show the effect of carbon dioxide on the surface of the fish; but due to a broken electrode, this parameter was not measured. More work with fresh fish stored in modified atmospheres is planned, and a formal proposal for this work is being prepared.

## Product Quality, Safety, and Standards Investigation

### Product Quality

After 60 wk of storage at 0°F, bluefish fillets were rated fair-to-good in both flavor and texture. Samples packaged in poly bags were judged to be about equal in quality to vacuum-packed samples.

Excellent smoked fillets were produced from bluefish, and samples stored at 35°F were still highly acceptable after 4 wk. An experimental canned pack (smoked and non-smoked) will be produced as soon as the steam boiler is repaired or replaced.

Torryster readings were lower on silver hake (whiting) held overnight in either RSW (refrigerated seawater) (33°F) or ice water (33°F) compared to fish stored on ice. This result would probably preclude the use of the Torryster on fish that had been held in RSW or CSW (chilled seawater).

We are in the process of procuring all material and equipment required for the Ames test.

We identified a fillet labeled as red snapper as actually weakfish by the Association of Official Analytical Chemists (AOAC) isoelectric focusing species identification method. The identification was made by comparison of the suspect fillet's protein pattern with patterns from authenticated red snapper and weakfish. This was done at the request of the City of New York Department of Consumer Affairs.

We confirmed the identification of several fillets for the US Army's North American Research and Development Command (NARADCOM's) edibility characteristic study by the AOAC isoelectric focusing species identification method.

Ultrafiltration of crude DMA/HCHO enzyme extracts from hake liver or muscle tissue through 500-Dalton and 2000-Dalton cutoff membranes resulted in no detectable enzyme activity. All activity was found in the retentate fraction. Addition of EDTA or cystine to crude extracts or ultrafiltrates resulted in no change in activity. The addition of  $\text{Sn}^{+2}$  to crude extracts or ultrafiltrates, however, doubled the activity. Previous experiments with various ultrafiltration membranes have shown that no activity is found in the filtrate below 10 000 Daltons. We are preparing a Sephadex gel filtration column to obtain a better molecular weight separation and partial purification of the factor(s) responsible for reduction of TMAO to DMA and HCHO.

## Product Safety

The AOAC general method for chlorinated and phosphated pesticides has been selected for trial. Samples of Atlantic cod fillets and liver oil were worked up by the AOAC procedure and analyzed for polychlorinated biphenyls (PCB's) by gas liquid chromatography (GLC). These same samples were also fortified at the 1-ppm level with Aroclor 1254. The average percent recoveries for cod fillets and cod liver oil were 85 and 87, respectively. Although the method demonstrates high recoveries, its analysis is a difficult and tedious procedure and requires considerable laboratory skill. Interpretation of the resulting data is equally demanding in sophistication. There are inherent disadvantages in these traditional sample preparation procedures including time-consuming steps and consumption of large amounts of expensive solvents for extraction purposes. Extensive sample preparation and cleanup increase analytical error and affect sample recovery. We are presently doing some work on trace measurement. We hope to eliminate time-consuming liquid/liquid extractions and eliminate the need for large quantities of expensive solvents.

Three working standards of p,p'-DDE and Aroclors 1254 and 1260 were prepared and chromatographed under normal conditions. Plots of response versus injected mass were made using the coefficients determined from a least-square fit for these plots. The response of each standard at some arbitrary injection mass, e.g.,  $5 \times 10^{-10}$  g, was calculated. From these values, a new response factor and standard deviation were calculated via standard statistical procedures. The absolute standard deviation was converted to a percentage deviation and applied directly to the individual concentrations of the standards to provide an estimate of the absolute precision of these measurements. The relative standard deviation did not exceed 3%.

We plan to develop a faster, more accurate, and more reliable method for PCB residues in fish tissues. Work in this area will be done whenever time permits.

A shipment of 10 samples was received from New York. Samples of winter flounder, weakfish, summer flounder, and spot were composited, homogenized, packaged, and shipped to John G. Reutter Associates for PCB analysis.

The high performance liquid chromatograph has been installed. The instrument is interfaced to our Sigma 10 Data Unit. Familiarity in the operation of this new instrument has begun.

## Product Standardization

Additional comments on an advance copy of a proposed Standard of Identity and Quality for Flounder Fillets were prepared and transmitted to the Chief of the NMFS Seafood Quality and Inspection Division for consideration by the US Food and Drug Administration (USFDA).

John Ryan attended a meeting at the Washington Office on 16 November with representatives of the USFDA, Roy Martin of the National Fisheries Institute, and Larry Beacham of the National Food Processors Association. The purpose of the meeting was to consider development by the USFDA of a Standard of Identity and Fill of Container for Canned Tuna and Bonito and also for canned crab meat. The proposed unified shrimp standard was also reviewed and commented on.

A Shrimp Decomposition Workshop sponsored by the National Fisheries Institute, National Shrimp Breeders Association, NMFS, and USFDA was held at the Gloucester Laboratory during 6-8 November. Close to 50 industry and government personnel participated in the workshop. John Ryan spoke on Standards of Quality, Identity, and Fill of Container, and the proposed unified shrimp standard. Certificates of successful completion of the Shrimp Decomposition Workshop were awarded to John Ryan, Fred King, and Joseph Carver.

An informal review was held on 9 November at Natick, MA, on NARADCOM's current study of comparative edibility of fish species. Mr. James R. Brooker of the NMFS Seafood Quality and Inspection Division in Washington, DC; Fred King of the Gloucester Laboratory; and NARADCOM personnel were the participants.

Attention was given to the Codex proposed draft Standard for Fish Sticks and Fish Portions and the related proposed draft Standard for Fish Blocks. Comments are being sought relative to physical defects to include adequacy of definitions, assignment of category, and numerical value.

Pollock and Atlantic mackerel fillets were procured from a local fish processor. After a portion of the pollock fillets was treated with sodium tripolyphosphates, all fillets were processed into fish blocks. The blocks will be divided into 4-oz portions and analyzed for protein, water, oil, and ash by the analytical group. The purpose of the project is to determine the effect of cooking on the protein content. The information obtained will be used by industry in formulating items to be developed for the school lunch program.

### Technical Assistance

In cooperation with a local fish processor, scallop meats were processed as a dried product (~10% moisture) for a potential export market.

Minced fish flesh was collected from haddock and Atlantic cod frames (with head) using our Bibun meat/bone separator for Sanders Associates in Nashua, NH. They are using this minced fish to feed lobsters.

A canned conch product was prepared in cooperation with Amoriggi Sea Foods in Johnston, RI.

Resource Utilization Division personnel provided information and technical assistance in the following areas: characteristics of an Australian fish (Silligo sp.); radiation of fish; origin of black smudgy areas in ocean perch fillets; market forms of fish, grade standards, and list of common and scientific names of fish produced in the US; how to ship live lobsters to Europe; fish processing equipment; freezing of whole lobsters; scientific name of striped mullet; polar cod; authenticated frozen red snapper, weakfish, true sole, and true turbot; sablefish; how to ship live eels; US Grade Standards; parasite in summer flounder; help an international broker to match up common names with scientific names of 11 species of fish native to Chilean waters; squid processing; controlled-atmosphere packaging; storage of fillets in iced brine; and the use of soy protein in minced fish.

### Meetings, Talks, Visitors, and Publicity

L. Ronsivalli, R. Learson, V. Nulk, and Lt. Moakley attended the New England Fisheries Development Program meeting in Boston on 28 November.

R. Learson gave a presentation at the New England Marine Advisory Service meeting in Woods Hole on 15 November.

Dr. Peter Bykowski and R. Learson traveled to the Narragansett Laboratory on 19 November. Dr. Bykowski gave a seminar on krill utilization.

On 22 November, Dr. Bykowski returned to Poland after a 6-wk visit to the Gloucester Laboratory. Dr. Bykowski is the chief of the shellfish technology group of the Polish Sea Fisheries Institute in Gdynia. During his stay, he participated in the Atlantic Fisheries Technological Conference, toured several fish processing plants, and worked with the laboratory staff on squid processing studies related to skinning.

Mrs. Geri Beuzit, secretary to the Gloucester Laboratory Director, retired on 30 November after 20 yr of Federal Service.

## Publications

- Kaylor, J.; Learson, R. Utilization of krill. NOAA Tech. Rep. NMFS SSRF. (S)
- Krzynowek, J.; Learson, R.; Wiggin, K. Biological and technological studies on the aquaculture of yearling surf clams. Part II. Technological studies on utilization. Proceedings of the National Shellfisheries Association. (S)
- Krzynowek, J.; Wiggin, K. Seasonal variation and frozen storage stability of blue mussels (Mytilus edulis). J. Food Sci. 44:1644;1979. (P)

## DIVISION OF ENVIRONMENTAL ASSESSMENT

### Biological Oceanography of Stressed Ecosystems Investigation

A series of meetings at Princeton, NJ, and at the Sandy Hook Laboratory occurred to refine Ocean Pulse Program sampling and station location strategy. An expanded sampling scheme for algal bioassay was chosen to provide more comprehensive coverage. Stations for algal bioassay were increased from the 14 that were sampled on the September 1979 Ocean Pulse cruise to 26 to be sampled during the December 1979 Ocean Pulse cruise. Approximately 70 stations along the continental shelf from the Gulf of Maine to Cape Hatteras were selected for total plankton respiration sampling. Likewise, locations for seabed oxygen consumption and benthic macrofauna were chosen for an integrated sampling strategy that also considered the interrelationships between the seabed and water column. Sampling for phytoplankton species composition will continue at selected MARMAP and Ocean Pulse stations for the broadest possible distributional coverage.

To date, the Phytoplankton Species Composition Subtask has 765 whole-water phytoplankton samples from the Gulf of Maine to Cape Hatteras. These samples represent all months of the year except December, January, and February. December and February are to be sampled during this fiscal year. A Texas Instruments Model 59 programmable calculator and associated thermal printer have been received and will be used to calculate species diversity, equitability, and other community indices. Myra Cohn of this subtask has enrolled in a statistics course being taught by Dr. Michael Pennington of the Woods Hole Laboratory.

The Algal Bioassay Subtask corrected problems which occurred on the September cruise with regard to collection and filtration of sample water to be used in bioassays to determine growth potential of various water masses over the Northwest Atlantic continental shelf. The samples collected during September are presently being used in bioassay tests. The results of these tests will be reported during future months. Additionally, preparations, including acid cleaning of bottles and filters, were made for the upcoming December cruise.

Photographs of the coast from Oregon Inlet, NC, to the Canadian border were received from Craig Ohlhorst of the NASA Langley Research Center. These photographs were taken with a Mitchell-Vinton camera mounted on a U-2 aircraft flying at 19.7 km (65 000 ft) during LAMPEX I (19-21 April 1979). The area of coverage is from the coastline to about 12 mi offshore. Enlarged photographs of selected areas along this strip were requested. They were particularly useful in delineating estuarine plumes from the Chesapeake, Delaware, Hudson, and Boston Harbor estuaries. These photographs were used during Ocean Pulse meetings to assist in determining where certain stations ought to be located to come best under the influence of estuarine plumes. The entire set of U-2 photographs is to be posted at the Sandy Hook Laboratory in the small conference room in building #74 for all to examine.

We are now receiving on a regular basis at the Sandy Hook Laboratory seven different remote sensing products. They are: (1) the National Weather Service's sea surface temperature charts, (2) the US Naval Oceanographic Office's experimental ocean frontal analysis charts, (3) NOAA's Gosstcomp sea surface temperature charts, (4) the National Environmental Satellite Service's sea front analysis charts as modified by the Atlantic Environmental Group, (6) the US Coast Guard's surface isotherms charts, and (7) the US Coast Guard's weekly sea current charts. These charts are posted in the room adjacent to the small conference room in building #74 and are available for all to examine.

A proposed standardized methodology for total suspended matter was developed by Craig Robertson for collecting sea truth for remote sensors. The proposed standardized methodology has been sent out to nine authorities in the field for their review. Following review and modification, the methodology will become part of the standardized sea truth for LAMPEX. Coastal zone color scanner (CZCS) sea truth data for LAMPEX III were collected during the November MARMAP cruise of the Albatross IV. LAMPEX I involved federal, state, and private research facilities along the coast from North Carolina to Maine. LAMPEX II involved the Ocean Pulse Program on a cruise from Maine to Virginia. LAMPEX III will demonstrate the added involvement of MARMAP in the remote sensing program.

## Physiological Effects of Pollutant Stress Investigation

### Physioecology

Studies with slipper limpets (Crepidula fornicata) exposed to silver continued this reporting period. We acquired F<sub>2</sub> larvae from both a control set and a 5-ppb-exposed set of F<sub>1</sub> parents this month. These juvenile limpets are growing well, but have not paired up as yet. A 10-ppb-exposed F<sub>2</sub> female released larvae which recently set, thereby giving us our first F<sub>3</sub> population.

Egg masses have been taken from adult female limpets of the parent population which has been exposed to 0, 1, 5, and 10 ppb silver for 1 yr. All egg samples have been soxhletted and will be examined cytologically for chromosomal abnormalities.

Juvenile blue mussels have been exposed to copper and silver for 140 days. Because of reduced temperatures, no growth was observed in either the control or exposed animals for over 2 mo. No significant differences in growth or respiration were observed between mussels exposed to the highest concentrations of the metals tested and the controls.

Studies were initiated this month to determine the best conditions for analyzing for benzo(a)pyrene on a capillary gas chromatograph. Initial results appear promising and attempts will be made to extract this compound from seawater. These studies will be made in preparation for doing further work with this compound in possible lab exposure studies.

### Biochemical Effects

Work has begun on the analysis of tissues taken from last summer's experimental exposure of American lobsters to 50 ppb lead (as the nitrate), with a subsequent holding period of 3 days at either low (17<sup>o</sup>/oo) or ambient (27<sup>o</sup>/oo) salinity. Male gonads and antennal gland analyses have been completed thus far; samples from the most recent Ocean Pulse cruise were included in the latter group.

Optimal protocols have been worked out for octopine dehydrogenase in sea scallop and blue mussel adductor muscle. This enzyme, a comparatively recent discovery, is

prominently involved in anaerobic glycolysis in marine mollusks, primarily the more active ones (cephalopods and swimming bivalves), and is considered functionally analogous to lactate dehydrogenase. It will be used in monitoring work with the sea scallop, along with MDH, PK, and AAT.

Two long-term sublethal exposures were begun with sea scallops, our first experimental work with this animal. In the initial study -- a chronic exposure to 10 ppb cadmium (as the chloride) -- a 30-day sampling has already been completed. The second study employs 10 ppb silver (as the nitrate) for the sublethal metal stress.

Presentations were completed for a scallop-monitoring report and a cooperative paper (with the USEPA laboratory in Narragansett, RI) on a field study of blue mussel along a pollution gradient; both were presented at a symposium at the Milford Laboratory this month. Work is currently under way to put them into form for publication.

#### Anaerobic Bacteriology/Metabolism

Monthly activities include the analysis of 29 bottom sediments obtained from the Ocean Pulse cruise (both legs) aboard the NOAA R/V Kelez in October.

A significant difference, i.e., lower numbers of two groups of bacteria, Vibrio and Clostridium, was observed in the top layer of sediments obtained from the second leg. The range of values per gram of sediment from the first leg on Vibrio media was 19 400 to <20 (minimal detection limit), and on Clostridium media was 1850 to <20; the range from the second leg on Vibrio media was 80 to <20 (mostly <20), and on Clostridium media was 120 to <20.

Identifications show that only 50% of the clostridial counts are C. perfringens; the others are unidentified as yet, but are toxic to mice. This trend was also observed in the samples from the July cruise. The data obtained are good for comparative purposes to previous cruise data.

#### Behavior of Marine Fishes and Invertebrates Investigation

Efforts during the past month have concentrated on developing a methodology for estimating prey consumption in piscivorous predators. Factors related to and/or influencing prey capture and consumption which are being examined include intervals between meals, motivation to feed, satiation levels, weight and number of prey consumed, season, and temperature. Once a prototype method is formulated it will be tested on a school of free-swimming adult bluefish. Our aim is to refine the method to be suitable for use in the laboratory and applicable to study of other piscivorous predators.

#### Coastal Ecosystems Investigation

Frank Steimle, Sukwoo Chang, and Bob Reid spent considerable time working with other Ocean Pulse investigators and with Jack Pearce, the program coordinator, to refine the Ocean Pulse sampling pattern, based on our increasing knowledge of the shelf environment, and present and predicted impacts. In the revised pattern, the Ocean Pulse (OP) study region is divided into 15 major monitoring areas, each containing a set number of specific sites as well as some variable sites designed to study changing hydrographic conditions such as those produced by Gulf Stream eddies. Integration of the various disciplines' sampling needs and strategies has also been achieved to a greater degree than previously. Frank also planned and organized the winter OP cruise, beginning 3 December aboard the Delaware II. Frank

drafted a manuscript describing an area off northern New Jersey in which chronically depressed dissolved oxygen levels were found in 1977-79. He also worked with Russ Terranova to enter all Ocean Pulse bridge and hydrographic log information into the ADP system and to recalibrate the calorimeter for further use in December. With Jan Caracciolo Ward, he proofread and corrected their atlas on distribution of important benthic species in the New York Bight, planned for examining biomass of bight apex benthos, and continued work on a life history catalog for Middle Atlantic and Georges Bank benthos. Willy Krencik and Keith Vinal, volunteers from Southampton (Long Island) College, plotted dissolved oxygen values from MARMAP cruises and aided the chemistry group in nutrient analyses.

Dave Radosh used radio-direction finding (RDF) equipment from Sandy Hook, NJ, during 5-19 November in a partially successful attempt to track sonic buoys deployed by the Atlantic Environmental Group at Deepwater Dumpsite (DWD) 106. We also supplied gear and advice to help Dr. Gary Multer of Fairleigh Dickinson University (NJ) in a multidisciplinary study of benthic populations and contaminant cycling in Raritan Bay. Bob Reid worked on a manuscript concerning effects of dredge spoil disposal on the benthic macrofauna off New London, CT, and, with Dave Radosh, on a paper describing benthic recovery after the 1976 anoxia off New Jersey. Bob had discussions with several university and consulting groups about specifications of a contract which we plan to let in the near future for processing of the OP macrofauna and sediment samples.

#### Environmental Chemistry Investigation

Jim Duggan, Jackie Frisella (Marine Ecosystems Division) and Charles Menzies (EG&G, Environmental Consultants, Waltham, MA) measured netplankton and nanoplankton chlorophyll concentrations during the November MARMAP survey aboard the Albatross IV. Mr. Menzies was aboard the MARMAP survey to observe NEFC's standardized shipboard methods for measuring chlorophyll-a, primary productivity, nutrients, and ichthyoplankton abundances. Ralph Bruno and Chris Powell (Marine Ecosystem Division) measured phytoplankton primary productivity during the MARMAP survey. Walter Macabe, Enrique Hernandez, Gary Sanderson, and Robert Kerbel (all volunteers from Jersey City State College) were responsible for shipboard filtration of seawater for nutrient analyses.

Sue Barker measured chlorophyll at 16 stations occupied during the recent primary/secondary productivity survey of Georges Bank and New York Bight on Belogorsk Cruise No. 79-05. Donna Busch (Marine Ecosystem Division) was responsible for measurements of primary productivity. Donna, working with Soviet colleagues, assisted our investigation with collections of seawater for nutrient analyses. Data on ammonium concentration in seawater samples collected during Belogorsk Cruise No. 79-03 were provided to Soviet colleagues prior to Belogorsk Cruise No. 79-05.

Al Matte and Ruth Waldhauer finished analyses for inorganic nutrients in seawater samples collected during the Fishery Oceanography Investigation's hydrographic survey of the Nantucket current meter array. Al and Ruth spent several days with Fred Dunn (Fluidyne Co.) refining the software used with the Technicon Autoanalyzer. Salinity determinations were completed on the 365 samples of seawater collected during the September Ocean Pulse survey aboard the Albatross IV.

Vincent Zdanowicz and Jay O'Reilly continued to work closely with the maintenance department, division chief, and laboratory director at the Sandy Hook Laboratory on the final stages of construction of the heavy metals laboratory. We expect to install the Perkin-Elmer 5000 atomic absorption analyzer the first week in January.

## Meetings, Talks, Visitors, and Publicity

Drs. Anthony Calabrese and Frederick Thurberg were cochairmen of a symposium on "Pollution and Physiology of Marine Organisms" held at the Milford Laboratory during 7-9 November 1979. This symposium was the third physiology and pollution symposium cosponsored with the University of South Carolina. This annual meeting stressed the physiological responses of marine organisms to pollutant stress and Dr. John Pearce chaired a special section concerned with the use of physiological and biochemical measurements in biological effects monitoring programs. Bill Phoel and Frank Steimle also attended the meetings.

During 13-14 November, Dr. Pearce chaired the continuation of the working group concerned with melding three NOAA monitoring programs into the unified Northeast Pollution Monitoring and Research Program.

On 15 November, Dr. Pearce presented a special paper to a meeting of marine advisory groups in the Northeast and Middle Atlantic States. This meeting was held at the WHOI Redfield Auditorium and Dr. Pearce presented information on the estuarine and coastal water quality and the implementation of the Ocean Pulse monitoring and research programs.

On 23 November, Dr. Pearce met with Dr. Robert L. Edwards, Kenneth Roberts, Dr. Vic Klemas, Dr. Robert Lippson, and Dr. Aaron Rosenfield, to discuss the implementation of the Superflux Program in Chesapeake Bay. This program will be an integral part of the Ocean Pulse monitoring activities and will emphasize the use of remote sensing in measuring changes in water quality in major estuaries and their offings. Initially, the program will be centered in Chesapeake Bay and to a lesser extent in Delaware Bay.

On 27 November, Dr. Pearce met with Louis Ronsivalli, Harry Seagran, Dr. Malcolm Meaburn (SEFC), and Bud Cross (SEFC). The meeting was concerned with developing the necessary collection and analytical protocols for the collection and analyses of finfish and key invertebrates for the assessment of petroleum hydrocarbons in fish tissues. The study will involve more or less synergistic collections from the Canadian border to the Mexican border. The necessity for such a program has become apparent with the review of several recent reports concerned with petroleum hydrocarbons in fish tissues collected from assumedly unpolluted areas. In several instances, significant amounts of petroleum hydrocarbon contaminants have been found in musculature from fish taken from areas not known to be polluted with petroleum hydrocarbons.

On 28 November, Dr. Pearce met with Dr. Robert L. Edwards, Dr. Kenneth Sherman, and NASA personnel involved with remote sensing applications and technology transfer. The meetings were held to exchange information and to ensure both the adequate communication between NMFS/NEFC and NASA personnel and the effective development of joint proposals.

Bob Reid attended a US Geological Survey-sponsored meeting concerning mathematical modeling of Long Island Sound, in Islip (Long Island), NY, on 1 November.

Edith Gould presented a paper at the symposium on "Pollution and Physiology of Marine Organisms." Her paper was titled "Monitoring Sea Scallops in Offshore Waters of New England and the Mid-Atlantic States: Adductor Muscle Biochemistry."

Drs. Anthony Calabrese, John Graikoski, and Frederick Thurberg, and Miss Edith Gould attended an Ocean Pulse workshop at Princeton, NJ, during 13-14 November 1979.

Ms. Margaret Dawson attended a 2-day training course on the use and repair of a Radiometer Blood Gas Analyzer during 12-13 November 1979.

Mr. Richard Greig attended a training course on capillary gas chromatography during 1-2 November 1979.

Miss Edith Gould attended an NEFC Incentive Awards Committee meeting at the Milford Laboratory during 15-16 November 1979.

Frank Steimle attended an Ocean Pulse Physiology Review which followed the "Pollution and Physiology of Marine Organisms Symposium" at the Milford Laboratory on 9 November.

Dave Radosh, Frank Steimle, and Bob Reid participated in an annual Ocean Pulse review meeting at Princeton, NJ, on 13 and 14 November, and in subsequent meetings to determine site locations for future OP sampling.

Jay O'Reilly attended a course on "Effective Supervision" during 26-30 November.

Clyde McKenzie attended a course, "Technology Forecasting and the Management of Innovation" in Washington, DC, on 19 and 20 November.

On 14 November, Drs. Robert Edwards, Kenneth Sherman, and James Thomas of the NEFC met with personnel at the NASA Langley Research Center to discuss involvement with them in a combined remote sensing/sea truth program. Two studies were mutually proposed, "Super Patch" to occur over Georges Bank, and "Superflux" to occur in the Chesapeake Bay plume.

On 28 November, Drs. James Thomas, Geoffrey Laurence, and Gregory Lough of the NEFC met with NASA Langley Research Center personnel to further define "Super Patch", "Superflux", and other studies being proposed by BNL, WHOI, University of Delaware, and others in relation to remote sensing involvement. During the afternoon, extensive discussions were held at Langley between Dr. Harold Marshall (Old Dominion University) and NASA personnel involved in the use of remote airborne fluorosensors. Such fluorosensors require phytoplankton species-identification sea truth information for sensor calibration.

Bori Olla participated as a member of the USEPA review team evaluating the "Investigation of Levels and Effects of Pollutants in Saline Lakes and Littoral Marine Environments" project of the Academy of Scientific Research and Technology and Institute of Oceanography and Fisheries in Cairo, Egypt. During the visit he met with the staffs of the Mediterranean, El Ghardaga, and Lake Quaroun Laboratories.

#### Publications

MacInnes, J. R. Response of embryos of the American oyster, Crassostrea virginica, to heavy-metal mixtures. Mar. Environ. Res. (S)

MacKenzie, C. Biotic potential and environmental resistance in the eastern oyster (Crassostrea virginica) in Long Island Sound. Aquaculture. (A)

Pearson, W. H.; Sugarman, D. L.; Woodruff, D. L.; Blayloc, J. W.; Olla, B. L. Petroleum hydrocarbons detection by the Dungeness crab, Cancer magister. Can. J. Fish. Aquat. Sci. (S)

#### AQUACULTURE DIVISION

##### Aspects of Nutritional Requirements of Mollusks Investigation

Special efforts were made to prepare fresh batches of culture media and bring all subcultures of stock culture strains up to date. Cultures were mailed to fill requests of Professor Lucas in Brest, France; Mr. K. Simon of Normandeau Associates in New Hampshire; and Mr. D. Morgan of Marine Research Co. in Connecticut.

We are maintaining a population of American oyster spat to develop methods of handling them for nutrition studies. Alternative means of measuring size changes in these spat are being investigated.

The algal carboy culture apparatus has been very productive this month. The harvest for larval food cultures amounted to 2059 liters and that for juvenile foods to 1774 liters. These were distributed to other investigations as follows: Spawning and Rearing of Mollusks, 610 liters; Aquacultural Genetics, 630 liters; Physiological Effects of Pollutant Stress, 1163 liters; and Larval Diseases of Mollusks, 5 liters. In addition, open tanks of mixed algal species were maintained to provide a constant flow of food culture to trays of juvenile and adult mollusks in the pilot plant hatchery.

### Aquacultural Genetics Investigation

#### Selective Breeding of the Commercial American Oyster

The genetic oyster stocks have been moved into indoor holding facilities where they will remain until next spring. The outdoor seawater raceway system has been cleaned and dismantled and equipment has been stored for winter.

As reported in the preceding months, measurement of the 1978 year class selection stocks is underway. Some 7223 oysters have been measured to date. It is estimated this work will continue into February.

#### Experimental Hybridization of Oysters

Twenty-five oysters were received from South Carolina through the cooperation of J. Babinchak of the SEFC's Charleston Laboratory. Breeding attempts apparently were made too late in the season as both South Carolina and local American oysters failed to spawn. Stripping of the little remaining gonadal material from a few of the animals and subsequent fertilization yielded a low number of embryos. However, the adductor muscles from the stripped oysters were frozen for isoelectric focusing (electrophoresis) trials to determine possible protein differences in the geographic populations. An initial experiment seemed to indicate a similarity of banding patterns in the two groups of oysters. By estimating relative relationships among various oyster populations and species, such data could lend support to breeding studies and hybrids' evaluation for commercial and management use. Stocks have been transferred to an inside tank for the winter.

Aspects of aquacultural genetics were discussed with Ms. Patricia Rogers from Mexico (presently a graduate student at the University of Texas Marine Science Institute) and Dr. D. Farney, a genetics professor at Lincoln University in Pennsylvania.

#### Cytology and Cytogenetics of Developing Fish Eggs and Ocean Pulse

Technical work plans, sampling strategies, and cruise plans have been developed for monitoring Ocean Pulse strata with early-developing ichthyoplankton. A. Longwell and J. Hughes attended the late November Ocean Pulse meeting at Princeton University to discuss sampling requirements.

Present monitoring proposals include cytogenetic, cytological, and developmental parameters of developing fish eggs of various commercial and other important species. These studies are to be supplemented by cytological and cytogenetic studies of fish

gonads and blood. Analytical chemical, and, in special instances, microbiological analyses will be done on the same material. Sampling strategy has been shaped by requirements for the biological and chemical analyses, but also by needs for statistical interpretation of data, and need for supportive data on mass movement of surface water masses. It is expected that samples will be obtained on a combination of Ocean Pulse and MARMAP cruises and on one or two small cruises especially designated for making large collections of the same species of fish eggs. In the event of large spills or dumps on major spawning grounds at or near the time of breeding, intense sampling is to be done in and out of the immediate spill vicinity and samples subjected to a similar range of analyses as done on routine cruises.

An assortment of species of early developing fish eggs already collected on prior trial Ocean Pulse cruises has been sorted and identified and is ready for cytological study.

### Spawning and Rearing of Mollusks Investigation

Encouraging results have been obtained in late summer experiments utilizing Japanese-style lantern nets for grow-out of hatchery-reared bay scallops in Long Island Sound. Scallops were planted into these mesh nets in late August while averaging 24 mm in length. We analyzed their growth 11 wk later in early November. Survival was 80-90% in all nets. No differences in growth with depth were observed for these 3-m high nets. Growth rates of scallops were inversely proportional to stocking densities between 500 and 1500/m<sup>2</sup>, with the lowest and highest density groups attaining average lengths of 47 mm and 41 mm, respectively. Although these scallops were not of harvestable size in the traditional sense, we shucked representative groups and projected yields of adductor muscle of 4.3 kg/net at 1500/m<sup>2</sup>, 3.7 kg/net at 1000/m<sup>2</sup>, and 2.0 kg/net at 500/m<sup>2</sup>. We are still at least a growing season short of making a thorough economic analysis of this system, but some potential exists for its commercial use.

Recent experiments concerning the nutritional requirements of young surf clams have attempted to quantify algal utilization. Groups of 16 clams about 12 mm in length were maintained in a 35-liter recirculating system, fed daily, on an initial algal cell concentration of 4x10<sup>5</sup> ml/l. Fluorometric analysis indicates that the cell concentration was reduced to half in 12 hr and the rate of clearing began to decline. Over a 24-hr period, individual clams cleared approximately 8.75x10<sup>8</sup> algal cells. Clams grew about 2 mm in length in 2 wk. This rate of growth is about 30% less than the fastest growth rate recorded in previous experiments.

Nearly 5000 "yearling" surf clams produced in the tank farm this summer were sent to the Gloucester Laboratory to be used in consumer-acceptance and frozen-storage studies.

### Meetings, Talks, Visitors, and Publicity

Warren S. Landers, Investigation Chief of the Spawning and Rearing of Mollusks Investigation, retired in October after a 20-yr career at the Milford Laboratory and 33 yr with NMFS and its predecessor, the US Bureau of Commercial Fisheries. Warren made numerous scientific contributions in the field of shellfish biology. Throughout his career he was involved in developing methodology for the aquaculture of bivalves. Prior to his position at Milford, Warren worked with the Bureau of Commercial Fisheries laboratories in Woods Hole, MA, and Narragansett, RI.

S. Stiles and E. Losee attended the "Effective Supervision" training course in Wakefield, MA, during 26-30 November.

S. Stiles attended the NOAA EEO Counselor's training course in Bethesda, MD, during 28 October-2 November.

Karen Roberts of Yale University in New Haven, CT, and Doug Morgan of Marine Research, Inc., in Groton, CT, visited the Milford Laboratory during the month.

### Publications

Goldberg, R. Biological and technological studies on the aquaculture of yearling surf clams. Part I. Aquacultural production. Aquaculture. (S)

### PATHOBIOLOGY DIVISION

#### Comparative Invertebrate Pathology Investigation

Mr. Kern returned to the Oxford Laboratory on 15 November after spending 1 mo at the Universidade Federal da Bahia (Brazil) as a consultant to Dra. Iracema A. Nascimento concerning mortalities of mangrove oysters (Crassostrea rhizophorae) in Todos os Santos Bay. Approximately 2000 histologic sections of oysters were examined from the affected area. Several parasites were observed, but none of these occurred in significant numbers or frequency to be considered responsible for any major mortality or reduction in the quality of the oysters. Since other mollusks, barnacles, and fish were also reported to have died at the same time as the reported oyster mortalities, it appears that an environmental factor(s) was responsible for the oyster mortalities in Todos os Santos Bay. Exchange programs of technical information as well as personnel between the two laboratories are being discussed.

Service samples of mussels from the York River, ME, collected in March and September 1979 were examined for parasites and pathology. The March sample was collected from a suspended (off-bottom culture) population and had few lesions or parasites; the other collected from the bottom substrate had a very high prevalence of: (1) trematodes and metacercaria; (2) copepods and associated abscesses; (3) pearls, and (4) a light infection of Minchinia sp., with plasmodia in the gill of one animal. This organism has now been seen in mussel samples from both northern and southern Maine. Aggregations of hemocytes were common in most animals from the suspended sample; however, etiology was not determined.

Gross examinations of over 1900 euphausiids collected on a Puerto Rico dumpsite cruise have been completed. Less than 0.2% showed slight signs of focal gill melanization, and less than 0.1% had apostome ciliate infestations. Specimens from bongo samples frequently had swollen carapaces or depressed dorsal musculature which may be stress effects of towing. A histological examination of selected specimens will be conducted. All data from these examinations will be added to that being accumulated on euphausiids of various areas of the western Atlantic.

After conversation with F. Steimle concerning other Ocean Pulse target crustacean species, it was decided to wait until OP stations and collecting schedules are firmly established, at which time a final conference with Steimle should clear up the issue on the most appropriate species. Arrangements for receipt of copepods from MARMAP stations also must wait until OP stations and collection times have been determined.

The Histological Services Unit blocked, cut, or stained over 750 fish and shellfish tissues or slides this month. These histological preparations included tissues of fish that were specially prepared and plastic embedded for ultrathin sectioning for light microscopic examination.

## Fish Pathology Investigation

This month the Fish Pathology Investigation hosted an extended visit by Dr. Toshihiko Matsusato of the Nansei Regional Fisheries Research Laboratory in Hiroshima, Japan. Dr. Matsusato is a fish pathologist; his visit is sponsored by the Japanese Ministry of Agriculture, Forests, and Fisheries in support of the United States-Japan Natural Resources Panel on Aquaculture. During the past month, Drs. Matsusato and Murchelano jointly examined approximately 125 microslides depicting histologic lesions of marine fishes cultured in Japan. Dr. Matsusato has been at the Oxford Laboratory since 5 November.

Several years ago, the Oxford Laboratory established a National Registry of Marine Pathology (ROMP). With the acquisition of the slides from Japan, ROMP has substantially increased the number of its microslides in its collection. Eventually, the collection will be an invaluable aid for the diagnosis of diseases of marine fish and shellfish.

Experimental studies of IPN virus in clupeid fishes were continued. Waterborne transmission has been shown to be possible, at least in the lab. The virus appears to remain infective for at least 1 wk in an aquarium in which fish have died from the disease. American shad and blueback herring have been infected in addition to Atlantic menhaden.

Additional samples of American sand lance have been received from the Resource Surveys Investigation, and radiographs of vertebral anomalies are being prepared. Discussions with Dr. Matsusato indicate that the level of anomalies being seen is quite high, but that the sample size has not yet reached significant levels.

Behavioral studies on chemoreception in larval fish were conducted at the Narragansett Laboratory from 30 November to 4 December. Larval summer flounder (25 days posthatching) were deprived of food and placed in a simple maze where they were presented with a nonvisual food stimulus (food extract). The scores for the stimulated larvae were slightly higher than those moving through the maze by random migration.

A second set of experiments was conducted in which larval summer flounder were exposed to seawater containing 1 ppm of copper sulfate for 24 hr. These fish and their controls were subjected to the chemoreception maze test. The exposed fish had random movement scores which were numerically equal to their stimulated scores and "appeared" to be more active than the control animals. Exposed and unexposed fish from this study were fixed for electron microscopy and Mr. Richard Greig of the Milford Laboratory has been contacted with regard to analyzing the test solutions.

## Microbial Ecology Investigation

Rock crabs collected near the New York Bight apex sewage dumpsite in October were examined microscopically for evidence of gill fouling and tissue pathology. Although only 14 crabs were collected, visual signs of disease (blackened foci of shell erosion on appendages and carapace) were noted in four specimens (29%), and discolored or partially blackened gills were noted in eight (57%). Historical data were in good agreement with data obtained from the 14 specimens collected in October as shown in Table 1.

Table 1. Incidence of discolored gills of rock crabs during October-December.

Site	Years of collection	Specimens examined	Incidence of discoloration
New York Bight	1975-79	177	80%
Sandy Hook-Raritan Bay	1975-79	193	66%
Philadelphia-Camden dumpsites	1975-79	98	37%
New York Bight	1979	14	57%

One gill lamella from each crab was fixed for histologic study and the remainder and the digestive gland were taken for heavy metal analyses. All of the previously categorized tissue pathology was observed in crabs from the October collection, including excessive fouling by bacteria and sessile ciliate protozoans, swollen lamellae, lamellae with tissue necrosis and melanization, bacterial phagocytosis, and copepod infestations. Sediment samples were collected in triplicate from 21 stations located between the mouth of the Chesapeake Bay and the New York Bight apex and cultured for the presence of bacterivorous protozoans. Amoebae belonging to the genus *Acanthamoeba* were isolated from three of eight sewage stations in the Philadelphia-Camden dumpsite and from one control station to the southwest of the site. Colorless flagellates were isolated from two sewage stations, one Chesapeake Bay station, and two control stations. The protozoans serve as indicators of ocean sediments with high bacterial populations. Cooperative studies being conducted at the USEPA's Annapolis, MD, field station will provide data on coliform bacteria, heavy metals, PCB's, and coprostanol for each of the 21 stations.

#### Diseases of Larval Mollusks Investigation

Bacterial samples from pipe water, bay water, and oyster tissue were received from Marine Bioservices of South Bristol, ME. It is suspected that an isolate from these samples may be identical to the "green slime" organism isolated from International Shellfish Enterprises (ISE) of Moss Landing, CA. A series of biochemical tests will be run to confirm the identity of this Maine isolate.

Another Long Island Sound sampling cruise was completed. Additional biochemical tests, including flagella staining and gram staining, have been done on 320 organisms collected from previous cruises to Long Island Sound oyster beds.

The investigation into the identity of the toxic metabolite produced by a shellfish-pathogenic *Vibrio* sp. will be continuing shortly. To prepare for this, a large part of the month has been devoted to learning gel electrophoretic techniques and to finding an appropriate procedure for separating the toxic metabolite from other proteins. Hopefully, by the time the new temporary hire comes on board, the procedures to be used will have been worked out.

Ferritin, an electron-dense marker that is often used in electron microscopy to delineate surface proteins or primary lysosomes inside cells, is taken up by the cells in a process known as pinocytosis. It could also be a useful marker in the study of phagocytosis (or the uptake of large particles by cells) if it could be produced in an aggregated form. Ferritin was clumped by two protein coupling reagents, glutaraldehyde and 4-methyl-m-phenylene diisocyanate, and then partially disrupted by grinding or sonic treatment. Ferritin particles in the 1-3  $\mu$  size range were then isolated by differential centrifugation. These will be tested for uptake and toxicity in oyster cells.

## Meetings, Talks, Visitors, and Publicity

Ms. Brown completed the US Office of Personnel Management's (OPM) "Women in Management" course in Boston, MA, during 24-26 October.

Dr. Blogoslawski attended the Third Water Chlorination: Environmental Impact and Health Effects Conference in Colorado Springs, CO, during 30 October-2 November, and presented a paper titled "Effects of Chlorinated Seawater on Shellfish."

Ms. Wheatley participated in the first session of the NOAA EEO Counselor's training seminar held in Bethesda, MD, during 28 October-2 November.

Ms. Hines attended the Fifth Annual Conference of the International Association of Marine Science Libraries and Information Centers held in Charleston, SC, during 6-9 November.

Mr. O'Connell attended OPM's Personnel Conference at Williamsburg, VA, during 6-9 November.

Dr. Joel Bodammer attended the symposium on Pollution and Physiology of Marine Organisms at Milford, CT, during 7-8 November.

Dr. Rosenfield, Dr. Murchelano, Dr. Johnson, Ms. MacLean, Mr. Newman, Mr. Farley, and Mr. Ziskowski attended an Ocean Pulse planning meeting at Princeton, NJ, during 13-14 November.

Ms. MacLean presented a seminar at the Oxford Laboratory on 16 November titled "Poland - Yesterday, Today, and Tomorrow."

Dr. Sawyer and Mr. Lewis collected crabs for metal analysis and pathology at the Sandy Hook Laboratory during 28-29 November.

Mrs. Ceil Smith and Mrs. Dorothy Howard were presented an award for their sustained superior performances.

Ms. Linda Despres of the Resource Assessment Division at the Woods Hole Laboratory is visiting the Oxford Laboratory for approximately 1 mo to receive instruction in the recognition and diagnosis of diseases of marine fishes.

A Chesapeake Bay Chapter of the American Littoral Society was recently formed and its headquarters is now located at the Oxford Laboratory. Mr. Ned Gerber, a 1979 graduate of Cornell University, will work on a volunteer basis as the society's coordinator for the bay chapter.

Drs. Clyde Dawe and William Banfield of the National Cancer Institute visited the Oxford Laboratory to discuss with Dr. Johnson the possibilities of using electron-probe analysis of the contents of reserve inclusion cells of the blue crab.

Mr. W. P. Jensen and Mr. Howard King of the Maryland Department of Natural Resources met with Dr. Rosenfield, Dr. Murchelano, Dr. Lippson, and Mr. Newman at the Oxford Laboratory on 7 November to discuss federal/state research involving Chesapeake Bay.

The Maryland Conservation Council, consisting of some 30 participants from throughout the state, held a meeting at the Oxford Laboratory on 17 November. Dr. Rosenfield presented a lecture and held a discussion session on the activities of the laboratory and of the NEFC.

Dr. Ann Scarborough of the Marine Biological Laboratory in Woods Hole, MA, visited the Oxford Laboratory on 28 November to discuss her recent research on smelts and to explore the possibility of future collaborative research.

Mr. Jack Foreman from the NOAA Environmental Data and Information Service in Washington, DC, visited the Oxford Laboratory and met with Dr. Rosenfield and Ms. MacLean to discuss and initiate the data management plan for the biological data obtained from deepwater dumpsite cruises.

Drs. F. B. Christliff and J. MacFarland of the NOAA Office of Coastal Zone Management in Washington, DC, met with Dr. Murchelano and other members of the staff to discuss potential Chesapeake Bay sites suitable for a National Estuarine Sanctuary.

### Publications

NMFS, NEFC, Oxford Laboratory. (The) Oxford Laboratory. Fisheries 4: 12-14; 1979. (P)

Sawyer, T. K. Marine amoebae from clean and stressed bottom sediments of the Atlantic Ocean and Gulf of Mexico. J. Protozool. (S)

### NATIONAL SYSTEMATICS LABORATORY

#### Shrimps Investigation

Work continued on a revision of the rock shrimp genus Sicyonia in the American Pacific.

#### Other Crustaceans Investigation

Manuscripts were drafted on Carolinian records for two genera of decapod crustaceans (Nephropidae, Homarus; Portunidae, Callinectes) and a new crab family from submarine thermal vents on the Galapagos Rift. Austin Williams identified a small series of crabs from the State of Santa Catarina in Brazil for Carlo Emilio Bemvenuti of Fundacao Universidade do Rio Grande.

#### Pelagic Fishes Investigation

Research continued on the systematics and biology of the Spanish mackerel by dissecting additional specimens and preparing synonymies for 10 of the 18 species in the genus Scomberomorus. New Guinea halfbeaks of the genus Zenarchopterus were studied to describe a new species.

#### Benthic Fishes Investigation

Work was done on a note being prepared cooperatively with one ichthyologist from California and two from Japan recording four species new to the eastern Bering Sea, which were caught during the NWAFC's 1979 groundfish survey there. Data on Urophycis and Phycis meristics were compiled for the use of Sandy Hook Laboratory ichthyoplankton researchers. Preparation continued on a paper on the deepwater ophidiid genus Enchelybrotula. D. Cohen left to join the deep submergence research vessel Alvin for dives on the Galapagos Rift thermal vent area, where he will study fish populations.

#### Meetings, Talks, Visitors, and Publicity

Austin Williams presented a seminar at the Smithsonian Institution titled "Two New Crab Families Recently Found in the Western Hemisphere."

Mr. J. D. Hanson of the University of Hawaii visited D. Cohen to discuss names of Chinese fishes. Dr. G. D. Johnson of the South Carolina Department of Wildlife and Marine Resources visited B. Collette to discuss evolution of scombroid fishes. Mr. T. Potthoff of the SEFC in Miami, FL, began a several-week visit studying the osteology of gempylid fishes.

#### Publications

Russo, J. L. Field guide to fishes commonly taken in longline operations in the western Atlantic Ocean. NMFS Tech. Rep. NMFS CIRC. (A)

Collette, B. B. FAO species identification sheets (families Belonidae, Hemiramphidae, and Scombridae) for the East Central Atlantic. Rome, Italy:FAO. (S)

Collette, B. B. Family Hemiramphidae. Checklist of the freshwater fishes of Africa. (S)

#### ATLANTIC ENVIRONMENTAL GROUP

##### Ocean Monitoring and Climatology Investigation

The cooperative Ship of Opportunity Program obtained seven XBT and two CPR (continuous plankton recorder) transects in November; two XBT and one CPR transect in the Gulf of Maine, one XBT transect across the shelf and slope off New York, one XBT and one CPR transect across the shelf and slope off Norfolk (VA), and three XBT transects in the Gulf of Mexico.

Annual reports of the status of the environment for 1976 and 1977 were published recently as NOAA Technical Report NMFS Circular-427 for 1976 and as an article in the May-June 1979 issue of Marine Fisheries Review (MFR) for 1977. Limited numbers of extra copies of Circular 427 and reprints of the Atlantic and Gulf section of the MFR article are available from AEG.

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

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#### GULF STREAM EDDY LOCATIONS

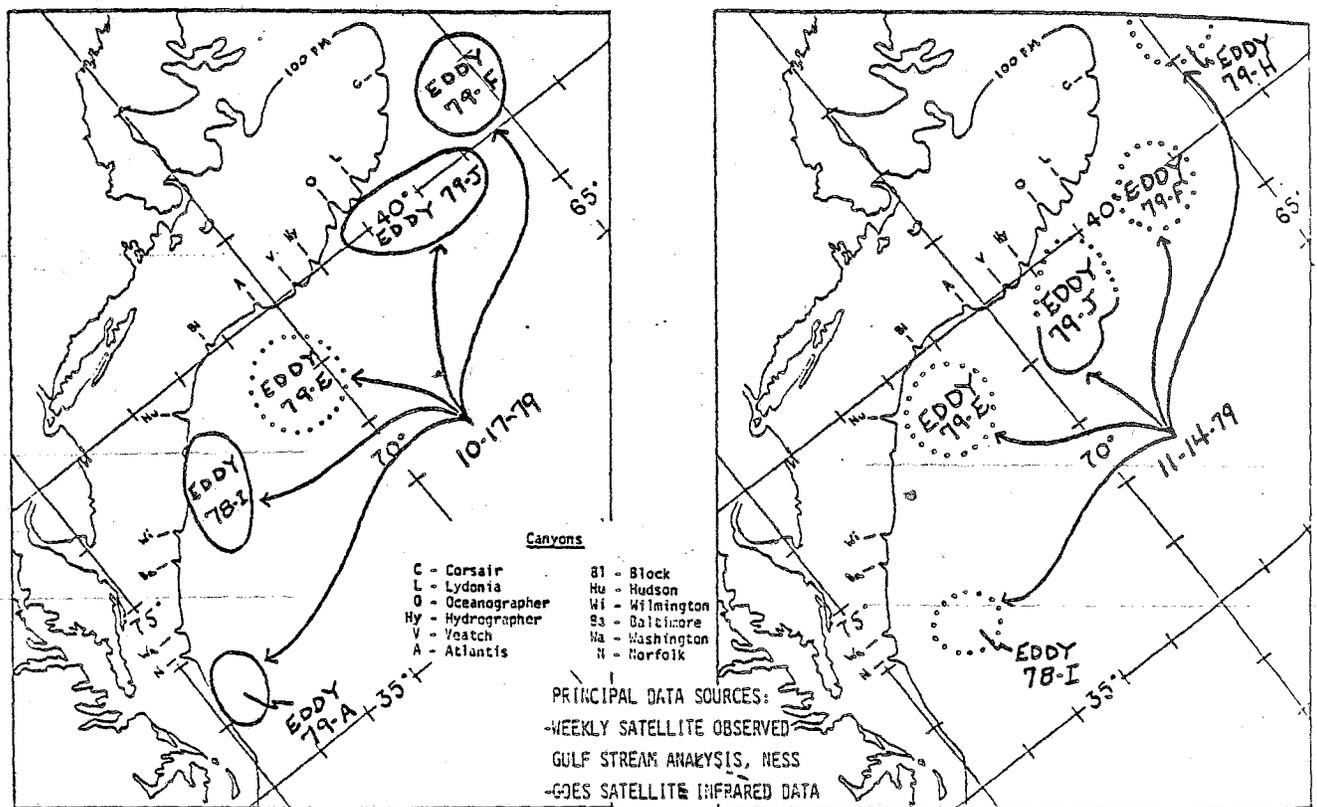
The Atlantic Environmental Group of the National Marine Fisheries Service reports that there were five warm core Gulf Stream eddies present off the northeast coast of the United States in mid-November.

Eddy 79-A was resorbed by the Gulf Stream during the third week of October, south of Norfolk Canyon. Eddy 78-I moved SSW about 110 nm (200 km) to a location centered at about 37.85°N, 73.5°W, off Norfolk Canyon, where it was being resorbed by the Stream in mid-November. Eddy 79-E, although not reliably located in satellite infrared imagery during the past 30 days, is estimated to have travelled SSW about 50 nm (90 km) to a location centered at about 39.2°N, 71.4°W, off Hudson Canyon. Eddy 78-J moved WSW about 85 nm (160 km) to a location centered at about 39.3°N, 69.8°W, off Hydrographer Canyon. Eddy 79-F moved SW about 75 nm (135 km) to a location centered at about 39.9°N, 66.5°W, SE of Lydonia Canyon. Eddy 79-H, which

detached from the Gulf Stream during the third week of September, moved westward into the area of chart coverage (see below) in early November, and by mid-month was centered at about 41.5°N, 64.6°W, E of Corsair Canyon.

Eddy 78-I will probably be completely resorbed by the Gulf Stream by the end of November. During the next 30 days, eddy 79-E may move SW to the vicinity of Wilmington Canyon, 79-J westward to past Atlantis Canyon, 79-F westward to near Hydrographer Canyon, and 79-H SW, approaching 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, RI 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).



### Ocean Dumping Studies Investigation

The fourth RDF buoy experiment began on 5 November. Six 4-MHz and three 6-MHz buoys were released from the URI R/V Endeavor at the approximate center of DWD 106 on this date. Buoys were tracked for 11 days following their release and indicated a northerly, followed by a northeasterly, drift. The last positional

fixes indicate that one 6-MHz buoy was located northeast of DWD 106. The suite of 4-MHz buoys performed poorly, possibly due to a manufacturing error. These results are being analyzed at present.

The cruise report from the September 1979 cruise effort to DWD 106 aboard the Kelez was distributed to all principals and the program office. Also completed during this past month was the physical oceanographic report from the April 1978 cruise to DWD 106 aboard the Mt. Mitchell. Results from this report show the great seaward extension of the shelf slope front which took place during the cruise. Waste dumped at the site during this period was injected directly into shelf water.

#### Meetings, Talks, Visitors, and Publicity

Mert Ingham and Woody Chamberlin attended a Workshop on Environmental Data in Coastal Regions held at the headquarters of the American Meteorological Society in Boston, MA, on 5 November.

On 13 and 14 November, Mert Ingham and Jim Bisagni traveled to Princeton, NJ, to attend an Ocean Pulse conference.

Woody Chamberlin attended a planning conference for cooperative experiments in remote sensing held at Langley Air Force Base in Virginia during 13-15 November.

Steve Cook went to Milford, CT, on 15 and 16 November to attend an NEFC Incentive Awards Committee meeting.

On 19 November, Mert Ingham, Woody Chamberlin, and Reed Armstrong attended a meeting of the editorial board of the anoxia-fish kill volume, which was held at State University of New York at Stony Brook on Long Island.

#### Publications

Bisagni, J. J.; Kester, D. R. Physical variability at an East Coast United States offshore dumpsite. Proceedings of the 1st International Ocean Dumping Symposium; 1978 October. (A)

Celone, P. J.; Chamberlin, J. L. Anticyclonic (warm core) eddies off the northeastern United States during 1978. *Annal. Biol.* 35. (A)

Cook, S. K.; Crist, R. W. Estimates of bottom temperature from fish captured in lobster traps. *Mar. Fish. Rev.* 41(8):23-25. (P)

Cook, S. K.; Hughes, M. M. Water column thermal structure across the shelf and slope southeast of Sandy Hook, NJ, USA in 1978. *Annal. Biol.* 35. (A).

Crist, R. W.; Chamberlin, J. L. Bottom temperatures on the continental shelf and slope south of New England during 1978. *Annal. Biol.* 35. (A)

Hilland, J. E.; Armstrong, R. S. Variation in the shelf water front position in 1978 from Georges Bank to Cape Romain. *Annal. Biol.* 35. (A)

Ingham, M. C.; McLain, D. R. Sea surface temperatures in the northwestern Atlantic in 1978. *Annal. Biol.* 35. (A)

Langone, H. K.; Hilland, J. E. Unusual spring conditions at the 106 mile dumpsite. Gulfstream. (S)

Leming, T. D.; Jossi, J. W. Observation of temperature and currents in the coastal waters near Cape Canaveral, Florida, during 1970 and 1971. NOAA Tech. Rep. NMFS SSRF. (S)

### Reports

Armstrong, R. S. Current patterns and hydrography: final report;1978. In: Environmental assessment of an active oil field in the northwestern Gulf of Mexico. USEPA;1979.

Bisagni, J. J. July 1977 physical oceanographic studies at Deepwater Dumpsite 106;1978. In: Deepwater Dumpsite 106 assessment report. NOS;(1979).

Jossi, J. W.; Marak, R. R. MARMAP survey manual;1978. 43 p. Contribution to NOAA fisheries technology shipboard manual;(1979).

Mizenko, D.; Chamberlin, J. L. Gulf Stream anticyclonic eddies and shelf water at Deepwater Dumpsite 106 during 1977;1978. In: Deepwater Dumpsite 106 assessment report. NOS;(1979).

Murray, T. E. A summary of waste inputs to Deepwater Dumpsite 106 during 1976 and 1977;1978. In: Deepwater Dumpsite 106 assessment report. NOS;(1979).

## NEFC PUBLICATIONS AND REPORTS

Recent papers by NEFC authors are noted in the final section of each laboratory, divisional, or programmatic write-up. Papers targeted for scientific journals are listed as "Publications;" all others are listed as "Reports." Publications are labeled as submitted, accepted, or published with an appropriate "S," "A," or "P" at the end of each entry. Reports are included only upon completion.

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