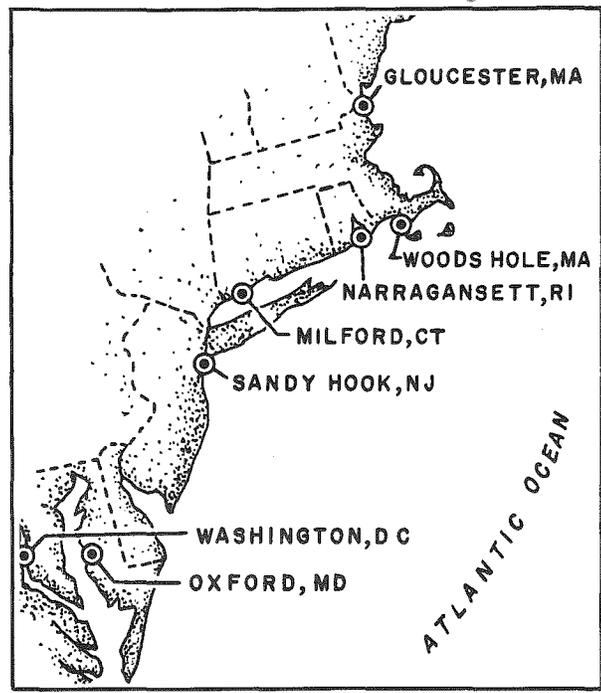


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NEFC Northeast Fisheries Center NEWS

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AUGUST 1979

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



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CENTER DIRECTORATE

Center Director's Office

International Meetings

Recently members of the NEFC staff attended two meetings under the auspices of the US-USSR Working Group on Biological Productivity and Biochemistry of the World Ocean (US-USSR Working Group V), a part of the US-USSR World Ocean Studies Program. Dr. Robert L. Edwards, Director of the NEFC, is the US Area Coordinator for Working Group V.

The NEFC and the All-Union Research Institute of Fisheries and Oceanography (VNIRO) in Moscow, USSR, sponsored the Joint US-USSR Meeting on Hydroacoustical Methods for the Estimation of Marine Fish Populations convened by John Suomala at the Charles Stark Draper Laboratory in Cambridge, MA, from 25 to 29 June 1979. Forty-four scientists and engineers from 13 countries and the United Nations Food and Agriculture Organization (FAO) participated. The purpose of the meeting was to define the status of echo sounding as it applies to estimating marine fish populations. Following the meeting, an editorial group met at the Massachusetts Institute of Technology (MIT) Endicott House from 1 to 7 July. This group produced an initial draft of Volume I of the meeting documentation, Deliberations, Determinations and Findings of the Scientific and Technical Specialists, to be published in November 1979. Volume II, Contributed Papers, Discussion, and Comments, is going to be published early in 1980. A preliminary summary report of the meeting has been submitted to the Fishing Technology Committee of the International Council for the Exploration of the Sea (ICES). It will obviously be useful in connection with the broader meeting being planned by ICES.

The US-USSR Workshop on Systematics of Cold Water Fishes of the World Ocean was held in conjunction with the Annual Meeting of the American Society of Ichthyologists and Herpetologists at Orono, ME, during 3-7 August 1979. The main objective of the workshop was to review and evaluate research in systematics in the US and USSR, discuss possible future research, and make recommendations for future activities of this joint subgroup. Dr. Dan Cohen of the National Systematics Laboratory, and Dr. William Eschmeyer, Department of Ichthyology of the California Academy of Science, convened this meeting of approximately 40 American, 6 Soviet, 3 Canadian, and 2 Japanese experts. The Soviet delegation was headed by Dr. Parin of the Institute of Oceanology in Moscow.

Fisheries Utilization Office

About 4 yr ago, NEFC technologists encouraged industry to collaborate in an effort to demonstrate that there existed a large unfilled demand for high quality seafoods and that the added cost to assure high quality at point of sale would be small and that it would not affect the size of the demand significantly.

With persistence on the part of the government technologists and the foresight and generosity of only a few small but innovative industrialists, the effort got underway sometime in late 1975 to early 1976. The effort lasted about 2 yr, costing the government about \$200,000, the bulk of which came from the NEFC Gloucester Laboratory, and about \$35,000 from the New England Fisheries Steering Committee which was largely funded by NOAA. The enterprise that was started collaboratively by the government and industry made the transition to industry alone, and the NEFC technologists terminated their affiliation with the enterprise

in late 1977. The evolution and status of the enterprise are best summarized in Table 1.

Table 1. Evolution and progress in the NEFC-originated guaranteed quality (of seafoods) program.

| Year | Activity | Annual production rate in lb | Approximate retail value | No. of supermarkets involved |
|------|---------------------------------------------------------------------------------------------------|------------------------------|--------------------------|------------------------------|
| 1976 | Start of project | ~10 thousand | ~\$18 thousand | 2 |
| 1977 | Continuance of project with significant industry assimilation | ~780 thousand | ~\$1.5 million | 200 |
| 1978 | Federal involvement terminated with continual growth of industry assimilation and consumer demand | ~1.6 million | ~\$3.0 million | >300 |
| 1979 | Continued growth of consumer demand and industrial assimilation | >6.5 million | >\$12.0 million | ~1000 |

Estimates provided to NMFS by industry indicate that by the middle of 1979, the demand for guaranteed quality seafoods had reached an annual rate of about 13.0 million lb, and there were 2000 supermarkets trying to place orders for the product. The data in the table for 1979 reflect the limit of the available supply of seafoods having the required quality. At this writing, the demand appears to be twice the available supply.

The burgeoning demand and potential associated with the results of the study have brought an increasing number of visitors to the laboratory from as far away as Alaska and from a variety of people from businessmen to consultants to regional and state development personnel to buyers and to technical personnel from large and small supermarket chains.

Special Scientific Investigations Office

Arthur Posgay is revising and rewriting a manuscript on the development, construction, and use of the bongo nets used to sample plankton as part of the Marine Resources Monitoring, Assessment, and Prediction Program (MARMAP).

Special Technical Projects Office

An edited 50-min video tape of the scallop gear cruise was completed. Plans are to refine this down to a 30-min tape when proper editing equipment becomes available to us.

The clam dredge test cruise aboard the NOAA R/V Delaware II was conducted from 13 to 22 August. It took 4 days to stage the vessel and 6 hr to de-stage. During

the cruise video-taped observations were made by divers on the dredge while it was in operation. The divers also conducted path surveys providing data on efficiency, selectivity, and incidental mortality. Forty-three tows were made on a site where marked clams were planted 1-yr ago; 75 marked clams were recovered. During these tows several operating parameters were varied; results were recorded, and those results presently are being analyzed.

RESOURCE ASSESSMENT DIVISION

Resource Surveys Investigation

Part I of the summer bottom trawl survey ended on 4 August when the Delaware II returned to Woods Hole. Tom Azarovitz was the chief scientist. The area surveyed was from Cape Fear, NC, to Cape Charles, VA.

Part II of the summer bottom trawl survey, aboard NOAA R/V Albatross IV terminated in Woods Hole on 10 August. Mal Silverman was the chief scientist. The area surveyed was from Cape Charles through Southern New England.

Henry Jensen was chief scientist during Part III of the summer survey. The Albatross IV was utilized for this leg. The Albatross IV departed Woods Hole on 13 August to conduct the Georges Bank and nearshore Gulf of Maine segment and was scheduled to return on 24 August. However, due to mechanical difficulties with the main winch, the Albatross IV was forced to return to Woods Hole on 20 August after completing the survey of Georges Bank. Since the Albatross IV was unable to complete the survey, the Delaware II was readied to continue the bottom trawl survey in conjunction with a mid-water trawl cruise. On 27 August, the Delaware II departed Woods Hole to continue the final part of the summer bottom trawl survey. On 1 September, the Delaware II, after completing the bottom trawl survey, visited Portland, ME, to exchange scientific personnel. After the exchange, the Delaware II departed Portland to conduct the mid-water trawl cruise.

During 13-23 August, the new electrically powered submersible pump clam dredge was tested aboard the Delaware II. The week prior to the starting date was spent equipping the ship. Jim Crossen coordinated the electrical system, which included updated controller safety circuits and a new synthetic jacket for the electrical cable. The new cable covering which was successfully tested consisted of a layer of Kevlar for strength covered by an outside layer of woven dacron for abrasion resistance.

Fishery Biology Investigation

Age and Growth

Judy Penttila, Vi Gifford, Kris Andrade, Gary Shepherd, and Jim Fletcher worked on a considerable backlog of yellowtail flounder age samples originating from both commercial and research survey sources. Commercial samples collected in 1977, 1978, and 1979 were aged.

Fall bottom trawl survey samples aged included 644 from Delaware II Cruise No. DE 77-12 and 1,036 from the Delaware II Cruise No. DE 78-06. Spring bottom trawl survey samples aged totaled 7,834 from Albatross IV and Delaware II cruises extending from 1972 through 1979. In all, a total of 16,294 yellowtail flounder samples were aged and the data put on sheets, coded, summarized, and sent to Automatic Data Processing Unit (ADP) personnel at the Woods Hole Laboratory for keypunching.

Gary Shepherd ended his tour with the Age and Growth Task to enter Rutgers University as a first-year graduate student.

Shellfish

John Ropes presented a paper on the new method of aging surf clams (Spisula solidissima) at the Corpus Christi, TX, meeting of the American Malacological Union (AMU), Inc., on 6 August. After returning from the meeting, a manuscript was prepared for inclusion in the AMU Bulletin. Also, a manuscript by J. Ropes and Loretta O'Brien on "A Unique Method of Ageing Surf Clams" was completed for presentation at the 67th statutory meeting of ICES at Warsaw, Poland, during 1-10 October 1979.

Loretta O'Brien devoted full time to aging sea scallops (Placopecten magellanicus) after returning from a 24 July - 4 August cruise. Loretta also supervised preparations of sea scallops for aging by Ellen Patanjo, a volunteer. She also assisted in processing meat weights and shells for a special research project conducted by Paul Wood.

After returning from a 30 July - 10 August cruise, Jim Whalen measured the shell dimensions of 222 surf clams from Delaware II Cruise No. DE 78-07 and completed sectioning of 83 chondrophores. Jim also prepared photographs of chondrophores from surf clams and assisted with work on sea scallops. Jim completed his summer appointment and returned to studies at Trinity College in Connecticut.

Finfish

Cathy Rearden completed aging and summarizing butterfish samples from the 1979 spring bottom trawl survey.

Louise Dery prepared a report summarizing alewife age-length keys from bottom trawl survey cruises during 1973-78, and began aging silver hake samples from the 1979 spring bottom trawl survey.

Lisa Diaz completed her summer appointment to return to Duke University, and Laurie Savelkaul ended her tour of duty to accept a full-time job with an airline company.

Sandy Hook Investigation

Darryl Christensen completed revisions to two manuscripts and submitted them for publication. John Clifford continued field collections of bluefish and summer flounder scale samples from the recreational fishery.

Wally Morse worked on revisions to a summer flounder report for submission to a scientific journal. In addition, the coding and keypunching of approximately 5,000 maturity observations, collected during the 1979 summer bottom trawl survey, were completed.

Stuart Wilk and Erin Feeney continued to update the "Synopsis of Biological and Fisheries Data on Bluefish, Pomatomus saltatrix" which will be reprinted in the near future.

Fishery Analysis Investigation

Ralph Mayo has been working with Otis Jackson in incorporating all final changes to the revised Biostat programs. Two versions currently exist: (1) for analysis of species which are sexed on a post-sampling basis, and (2) for analysis of market categories on a pre-sampling stratification basis. The execution of both programs has been simplified to permit any combinations of time and location

analyses through use of a set of user-oriented control records processed at the initiation of a run. User manuals will be available in the near future.

Paul Wood participated in the second leg of the summer bottom trawl survey on the Albatross IV during 30 July - 10 August. Paul also coordinated three sea sampling trips during August: (1) F/V Barracuda, a groundfishing day boat out of Provincetown, MA, on 8 August (Jim O'Connell, sea sampler); (2) F/V Sherry Ann Dale, a lobster vessel out of Westport, MA, during 6-9 August (Tom Morrissey, sea sampler); and (3) a handline cod day boat out of Chatham, MA, on 21 August (Steve Selden, sea sampler).

Steve Murawski participated in the ocean quahog (Arctica islandica) and surf clam gear testing cruise aboard Delaware II during 13-23 August. Seventy-five ocean quahogs, previously marked and released in August 1978, were recaptured during the cruise. These individuals should provide data on growth rates and the nature of annual shell markings. Steve also began developing computer programs for analysis of the newly re-stratified surf clam and ocean quahog research survey cruise data sets, and completed an ICES document with Fred Serchuk on ocean quahog population dynamics.

Joan Palmer continued preparation of a document describing the stochastic properties of recruitment in finfish populations. Joan also began analysis of recruitment data for an ICES paper on general patterns of recruitment in species worldwide.

Tonga Brennan joined the investigation on 27 August and assisted Joan Palmer in her recruitment studies. Tonga also provided assistance to Frank Almeida in his silver hake stock identification studies.

Fred Serchuk and Paul Wood completed an assessment report on the status of Southern New England - Middle Atlantic cod populations. Fred and Paul continued assessment analyses of the 1979 sea scallop survey results and began a growth rate analyses of Atlantic cod collected from spring and autumn bottom trawl surveys since 1970.

Fishery Assessment Investigation

Thurston Burns, Steve Clark, and Ronald Essig completed an assessment of the offshore American lobster (Homarus americanus) resource (Georges Bank - Middle Atlantic) for submission as a document to the ICES Shellfish Committee at the 67th statutory meeting to be held in October in Warsaw, Poland. Steve also completed an update of "other finfish" assessment analyses.

William Burns, Steve Morrison, and Pat Carter were aboard Delaware II during 25 July - 5 August; Frank Almeida and Dennis Hansford were aboard Albatross IV during 30 July - 10 August; and William Overholtz and Ronald Essig were aboard Albatross IV during 13-24 August, all for the summer bottom trawl survey.

Pat Carter completed a lengthy series of commercial and research vessel survey data summaries and analyses requested by Canadian scientists for Brown's Bank haddock and assisted with assessment work on haddock, pollock, and northern shrimp (Pandalus borealis).

Thurston Burns worked with Dennis Hansford on preparing commercial length-frequency sample data for May - July 1979 for keypunching. Dennis also continued compilation and editing of northern shrimp research vessel survey data files. Thurston organized the equipment to be used in a silver hake tagging feasibility study to be conducted aboard a USSR research vessel in September.

Emory Anderson completed assessments on Atlantic mackerel and the two red hake stocks. Frank Almeida and Emory Anderson completed assessments on the three silver hake stocks. Frank also worked with Mike Thompson of ADP in completing a revised virtual population analysis program, and began (with Joan Palmer) to examine data collected from a summer study conducted at the Gloucester Laboratory by Rita Schenck. This study utilized isoelectric focusing to analyze proteins from silver hake taken off Point Judith, RI, and Gloucester, MA, as part of an overall effort to examine the stock structures and differences of silver hake in the Gulf of Maine - Middle Atlantic area.

William Burns and Steve Morrison nearly completed processing silver hake samples in the stock delineation study.

Fishery Systems Investigation

Assessment activity continued during August. Anne Lange worked on squid, Gordon Waring summarized work on little skate and tagging results from Atlantic herring with Jim O'Connell, and Kathy Rodriguez, Mike Sissenwine, Karen Johnson, and Rhett Lewis revised draft assessments on summer flounder.

The Northeast Fisheries Management Task Force dominated the activity of Mike Sissenwine and Margaret McBride during August. Margaret worked on a review of the status of the stocks which will serve as an appendix to the task force report. Mike (with Jim Kirkley) worked on a review of fisheries management techniques to serve as an appendix to the task force report and attended meetings of subcommittees of the task force on 6 August in Narragansett, RI, on 23 August in Narragansett, and on 14 August in Boston.

Mike also attended a pre-statutory meeting for ICES in Narragansett on 10 August, and a State-Federal Striped Bass Scientific and Statistical (S&S) Committee meeting in Hartford, CT, on 7 August.

Fishery Economics Investigation

During August, this Investigation analyzed the socioeconomic value of the resource complex in the Cobscook/Passamaquoddy Bay, Bay of Fundy, and Washington County (ME) regions. The primary purpose of this evaluation was to provide information on the potential loss in value to society of an oil spill in this region. Other work included a draft on fishery management techniques under the supervision of Mike Sissenwine; a draft regulatory analysis on the Surf Clam and Ocean Quahog Management Plan; and a draft on socioeconomic data for the Northwest Atlantic fisheries.

Meetings, Talks, Visitors, and Publicity

On 2 August, Emory Anderson met with Larry Russell of General Host and William Diederich of Van de Kamp's Frozen Foods to discuss the resource potential of silver hake relative to the possible location of a major processing facility in New Jersey.

On 6 and 7 August, Stuart Wilk attended the State-Federal Striped Bass S&S meeting in Windsor Locks, CT.

Joan Palmer attended the joint statistical meetings of the American Statistical Association, Biometrics Society, and the Institute of Mathematical Statistics in Washington, DC, during 13-16 August.

On 15 August, Guy Marchesseault, staff biologist for the New England Fishery Management Council, presented a paper titled "A Biological Predictor Model Developed in Support of an Operations Research Approach to the Management of the New England Groundfish Fishery," which was authored by Emma Henderson and Guy, at the NATO Symposium on Applied Operations Research in Fishing held at Trondheim, Norway.

On 15 August, Darryl Christensen gave a lecture on the current status of marine fisheries during the Brookdale Community College's Coastal Awareness Seminar in Lincroft, NJ.

Fred Serchuk presented two lectures on stock assessment and fisheries management to the Field Marine Science Class at the Shoals Marine Laboratory (Cornell University and University of New Hampshire) at Isles of Shoals, NH, on 20 and 21 August.

On 21 and 22 August, Stuart Wilk attended the State-Federal Summer Flounder S&S Committee meeting in Philadelphia, PA.

Jim Kirkley met with Stan Wong of the New England Fishery Management Council and with Joe Mueller of the Northeast Regional Office to discuss problems in managing the groundfish resources.

Jim Kirkley visited John Gates at the University of Rhode Island (URI) to discuss measures of harvesting and processing capacity.

Publications

Christensen, D. J.; Clifford, W. J. A comparison of daytime and nighttime catches of bluefish (Pomatomus saltatrix). Trans. Am. Fish. Soc. (S)

Christensen, D. J.; Clifford, W. J. The 1978 spring recreational catch of Atlantic mackerel (Scomber scombrus). Fish. Bull., US. (S)

Wilk, S. J.; Smith, W. G.; Ralph, D. E.; Sibunka, J. The population structure of summer flounder between New York and Florida based on linear discriminant analysis. Trans. Am. Fish. Soc. (S)

Reports

Anderson, E. D.; Overholtz, W. J. Status of the Northwest Atlantic mackerel stock - 1979. Woods Hole Lab. Ref. Doc. No. 79-35; 1979. 35 p.

Burns, T. S.; Clark, S. H.; Anthony, V. C.; Essig, R. J. Review and assessment of the USA offshore lobster fishery. Inter. Coun. Explor. Sea, Shell. Crust. Comm. Memo. 1979/K:25; 1979. 31 p.

Murawski, S. A.; Serchuk, F. M. Distribution, size composition, and relative abundance of ocean quahog, Arctica islandica, populations off the Middle Atlantic Coast of the United States. Inter. Coun. Explor. Sea, Shell. Crust. Comm. Memo. 1979/K:26; 1979. 22 p.

Ropes, J. W.; O'Brien, L. A unique method of ageing surf clams. Inter. Coun. Explor. Sea, Shell. Crust. Memo. 1979/K:28; 1979. 4 p.

Serchuk, F. M.; Wood, P. W. Review and status of the Southern New England - Middle Atlantic cod, Gadus morhua, population. Woods Hole Lab. Ref. Doc. No. 79-37; 1979. 77 p.

Sissenwine, M. P.; Waring, G. T. Analysis of sea herring fisheries off the Northwest Atlantic from Cape Hatteras to Southwest Nova Scotia. Inter. Coun. Explor. Sea, Pel. Comm. Memo. 1979/H:56; 1979.

MARINE ECOSYSTEMS DIVISION

Ecosystem Dynamics Investigation

Ecosystem Modeling

Marv Grosslein, Ed Cohen, Cabell Davis, Jack Green, and Donna Busch assembled equipment and materials for the plankton studies on the USSR R/V Belogorsk scheduled for September. A Coulter counter from the Woods Hole Oceanographic Institution (WHOI) was checked out and installed on Belogorsk for use in phytoplankton and zooplankton grazing studies. Also, single species phytoplankton cultures and shipboard culture equipment were prepared, and materials gathered for primary production work. The USSR research proposal for the zooplankton grazing studies was reviewed by Ed Cohen, Jack Green, Cabell Davis, and Mike Dagg (of the Brookhaven National Laboratory), and possible improvements were discussed with the USSR zooplankton specialist, Slava Sushin.

Ed Cohen began updating the energy budget for Georges Bank and will be receiving inputs from Ken Sherman, Jack Green, Donna Busch, James Thomas, Jay O'Reilly, Frank Steimle, and Ron Schlitz. The revised energy budget is to be presented at a conference on marine productivity in Canada next November. Also, Ed Cohen continued review of parts of two USSR books on marine ecosystem modeling which have been translated this summer by Debbie Dwyer and Anna Crikevich; the models focus on primary and secondary production including effects of circulation dynamics -- we are exploring the possibility of linking them to our multispecies fish production model, GEORGE.

Marv Grosslein worked all month on the New York Bight monograph on fish ecology and final drafts of the first half of the monograph (21 species synopses) were sent to the New York Sea Grant Office. The synopsis on spiny dogfish was updated by Ed Cohen.

Mike Pennington continued work with Wally Smith on larval fish production estimates for the MARMAP surveys. He also attended the ICES young Gadoid Working Group meeting in Ijmuiden, Netherlands, during 13-17 August where he assisted with analysis of North Sea survey data and provided advice on statistical estimation procedures. Mike has begun analysis of the fishery recruitment time series for the Georges Bank area with emphasis on developing a stochastic recruitment function for GEORGE. Finally, Mike Pennington, Marv Grosslein, and Ed Cohen attended a series of meetings on statistical approaches to solving general estimation problems at the NEFC with visiting statisticians G. P. Patil and C. Taillie of Pennsylvania State University and G. Seber of Auckland University (New Zealand).

Wendell Hahm and Brian Hayden continued to work on the statistical and graphical analysis of the fish food habits data in conjunction with Rich Langton and Ray Bowman. Wendell also began investigating the possibility that some of our modeling work might be done more cheaply and efficiently on the PDP-11 computer at the Marine Biological Laboratory (MBL) in Woods Hole.

Recruitment Processes

The remaining ichthyoplankton data summaries of 29 International Commission for the Northwest Atlantic Fisheries (ICNAF) larval Atlantic herring surveys for

the 1971-76 seasons arrived from the Narragansett Laboratory's Biostatistical Unit by mid-August. George Bolz continued quality control of these summaries and analysis of the distribution and abundance of ichthyoplankton collected on the surveys. A cluster analysis was performed on one cruise using Bray-Curtis dissimilarity coefficients and group average sorting to determine site (station) and species groups. Three main site groups were identified: (1) Nantucket Shoals, (2) Great South Channel and central Georges Bank, and (3) eastern Georges Bank. George Bolz also began otolith analysis of larval Atlantic herring reared in the laboratory last autumn by Geoff Laurence. Otoliths have been found in all larvae examined so far, including newly hatched yolk-sac larvae, but the point at which rings are first deposited is still to be determined.

Dave Potter and Harold Merry continued to work on the flowmeter tank to calibrate our MOCNESS (Multiple Opening-Closing Net and Environmental Sensing System) electronic flowmeters, and they prepared equipment to analyze average volume of water filtered in each MOCNESS net from the data tapes. Dave Potter, Harold Merry, George Bolz, and Ed Cohen spent part of a day, 24 August, on the NOAA R/V Phalarope checking out the ENDECO in situ fluorometer. Dave Potter participated on a food chain study cruise, Delaware II Cruise No. DE 79-09, during 27 August - 7 September to assist with the testing of various mid-water gear.

Roz Cohen has been busy organizing zooplankton data for computer files, analysis, and report writing. She met with Kay Paine and other ADP personnel to discuss programming needs for the available 0.053-mm, 0.165-mm, and 0.333-mm-mesh zooplankton data for the autumn-winter seasons of 1974-76, to match the larval Atlantic herring gut content-condition factor station data. Two drafts of a protocol manual have been prepared for the lab and data processing methods used in the larval herring gut content-condition factor study. Also, an abstract was prepared for the February 1980 American Society of Limnology and Oceanography (ASLO) meeting in Los Angeles at the University of Southern California, for a poster session on fine and coarse-mesh net zooplankton samples from two autumn and two winter ICNAF larval Atlantic herring cruises. Janet Murphy and Roz Cohen have nearly completed the 1974-75 larval herring seasons gut content data organization and analysis. They are still revising the copepod identification key for publication. Tim Cole, who has been processing fine-mesh zooplankton samples, terminated his temporary appointment with us on 28 August to take a permanent research position at the University of Maryland.

Greg Lough and Red Wright completed an ICES report on the fall 1978 larval Atlantic herring patch study. Greg also reviewed the draft manuscript of the NEFC microdistribution studies task force as well as other manuscripts mentioned above. Greg Lough met with Mert Ingham (AEG) to discuss analyses of larval Atlantic herring dispersal data and environmental factors affecting larval haddock survival.

Benthic Dynamics Investigation

John Dickinson continued with the study of gammaridean amphipods of the Georges Bank region. He found highest densities of amphipods in the southwestern and south-central parts of the bank. Lowest densities were found in the shallow, north-central part of the bank. Ecological relationships and distributional patterns of approximately 100 species are currently being studied. A data report was completed this month by Roger Theroux and Roland Wigley titled "Collection Data for U.S. East Coast Bivalve Mollusks in the Northeast Fisheries Center Specimen Reference Collection, Woods Hole, Massachusetts." It was issued in the Woods Hole Laboratory reference series as document No. 79-29. The report contains 215 tables listing the collection data for 225 taxa of bivalve mollusks. Roland

Wigley continued with the preparation of summary tabulations of the macrobenthic fauna occupying the continental shelf south of Martha's Vineyard and Nantucket for the purpose of determining the relationships between faunal groups and the types of bottom sediments and water depths they inhabit.

The manuscript by Rich Langton and Ray Bowman describing flatfish food habits is now being revised before being sent out for publication. Information on the food habits of individual fish from the 1969-72 data base was quality controlled and entered on computer tape. A work schedule for the food habits task for the next 6 mo has been prepared as an update of the version outlined at the beginning of FY79. Ray Bowman is completing a report on the food habits of juvenile haddock. Ray is also examining feeding chronology of selected fish species. Preparations for the modified groundfish/mid-water trawl experiment (Delaware II Cruise No. DE 79-09) was completed.

Fishery Oceanography Investigation

Preparation for Albatross IV Cruise No. AL 79-09 occupied most of the staff during August. The entire array of current meters in the Nantucket Shoals flux experiment is to be recycled during the cruise which takes place early in September. Steve and Derek Sutton have prepared all the mooring hardware and deck gear, including spare lights and batteries for the guard buoy. Gil Dering has prepared the releases and vector-averaging current meters (VACM) to be put in the water and has seen to it that the Niskin rosette and CTD (conductivity-temperature-depth) recorder are in order. Ron Kirschner prepared an oxygen rig for the USSR R/V Belogorsk and trained two Soviet operators for that ship's MARMAP cruise.

Dan Patanjo has been establishing a data file for 1977-79 MARMAP cruises. With the help of Cindy Chappell he has developed a format for data lists and in consultation with Frank Steimle and Jay O'Reilly of the Sandy Hook Laboratory he has worked out a format for vertical and horizontal plots. Tim Cain went to Yarmouth, NS, and back on the ferry M/V Marine Evangeline to obtain the monthly expendable bathythermograph (XBT) observations across the Gulf of Maine on that run. He has also nearly completed a ship-of-opportunity (SOOP) run report for June and July for the Gulf of Maine. Derek Sutton has been moving ahead with analysis of current meter data from the third Northeast Channel deployment. Anne Dorkins left in late August to return to her studies at the University of Massachusetts.

Ichthyoplankton Investigation

Our summer survey on the Belogorsk is nearing completion. Tom Morris reports that weather has been cooperative and all phases of sampling are going well. The survey area, however, will not include the disputed boundary area between the US and Canada on the eastern parts of Georges Bank and Gulf of Maine. The next MARMAP survey is scheduled for October on Albatross IV. In the meantime, we will participate in a phytoplankton and zooplankton study with USSR scientists in the Southern New England and Georges Bank areas during September.

Mike Fahay and Wally Smith met with Kenneth Sherman, members of the staff at the Narragansett Laboratory, and Marak Baranowski from Morski Instytut Rybacki in Szczecin, Poland, to discuss divisions of labor and taxonomic priorities for larval fish studies in the immediate future. There was unanimous agreement to get on with active work on the genera Urophycis and Ammodytes. Mike Fahay will

tackle the hakes. Marak Baranowski will study Ammodytes. Bill Brennan spent 3 days at the Sandy Hook Laboratory discussing field equipment needs for FY80 and his involvement in working up neuston samples collected on MARMAP surveys. He will work closely with Mike on the latter as members of the genus Urophycis numerically dominate neuston collections during late summer and autumn.

Plankton Ecology Investigation

A manuscript was completed on "Zooplankton of Continental Shelf Nursery and Feeding Grounds of Pelagic and Demersal Fish in the Northwest Atlantic." Results of the 1978 MARMAP macrozooplankton monitoring surveys are described in relation to fisheries ecosystem studies off the Northeast Coast of the US. Among the 80 taxonomic categories represented in the samples only eight were dominant; of this number, three copepod species undergo massive pulses in abundance-- Pseudocalanus minutus, Calanus finmarchicus, and Centropages typicus. Increases in abundance of these species coincide with the annual temperature cycle in each of the three areas surveyed--Gulf of Maine, Georges Bank, and Southern New England. P. minutus undergoes two pulses in reproduction, one in early spring and a secondary pulse in autumn between 5° and 15°C; Calanus finmarchicus is less tolerant of high temperatures and reaches maximal abundance in spring between 4° and 7°C. In contrast, Centropages typicus favors warmer waters with maximal numbers in autumn occurring between 13° and 22°C. The relationship between cohort production of copepods and survival of larval fish was examined. Atlantic mackerel and yellow-tail flounder larvae may be in synchrony with Centropages typicus population increases in Southern New England. In the Gulf of Maine, larval Atlantic herring growth and survival are related to the secondary pulse in P. minutus abundance in autumn, and on Georges Bank the spawning of haddock and Atlantic cod generally coincides with the spring pulse in Calanus finmarchicus abundance. Integration of MARMAP mesoscale and microscale studies is being pursued to obtain improved estimates of the growth and survival of larval fish on the continental shelf spawning and nursery grounds.

Biostatistics

The group completed a nonparametric Fager's analysis on 1979 zooplankton data. There were 3 areas, 6 seasons, 30 stations, and up to 90 taxa identified per station. The data were initially stored in three formats: MARMAP Information System (MIS) master files, MIS intermediate call files, and an MIS system data file. Data were extracted from each of these file types and merged into an SAS (Statistical Analysis System) data file. The data were then extracted, by area and season, from this SAS file for further analysis and plotting.

Two summertime employees, Marie Carter and Louis Coakley, returned to school. Gary Johnson obtained a research position with Northeast Utilities. Lorrie Sullivan was promoted to GS-9.

Roger Taylor and Christopher Brooks of Roger Williams College have completed their 1040 assignments with the Sorting and Identification Task Group. Work is continuing on the identification and enumeration of ichthyoplankton from USSR R/V Argus Cruise No. 77-01 neuston samples. Special emphasis has been devoted to resolving problems in larval and juvenile hake identification.

Larval Physiology and Biochemistry Investigation

The final samples for dry weights of last winter's-spring's studies of activity-level influence on metabolic rate are being processed. Adult summer flounder and scup are being conditioned for hormone-induced spawning (summer flounder) and out-of-season temperature-induced spawning (scup) to provide early life stages for experiments. Studies of trypsin, a major digestive enzyme in larval fish, were continued. Larvae which had been starved to the point where trypsin activity was no longer detectable rapidly filled their gut when food was presented; however, trypsin levels showed only a slow recovery. After 4 hr the levels increased to only 25% of the control values.

Work on the yellowtail flounder embryo mortality manuscript continued. Geoff Laurence, as task force chairman, spent considerable time on the "Report and Recommendations for Process-Oriented Larval Fish Survival Studies," which was completed during the month.

Apex Predators Investigation

Jack Casey and Wes Pratt examined an unusual 841-lb mako shark taken at Montauk (Long Island), NY, on 1 August. This 338-cm female was 10-cm longer than the 1250-lb mako harpooned off Montauk in July 1977. The latter is the maximum reported size for this species. The 409-lb difference between the two sharks was due to the poor condition of the 841-lb specimen; very likely because it had recently borne young. On 26 August, Jack Casey and Chuck Stillwell examined a second large mako landed on rod and reel (R&R) at Montauk. This 323-cm female weighed 1080 lb and is a new R&R world record, if accepted by the International Game Fish Association (IGFA). Very little is known about the reproductive biology of the mako shark. Females do not mature until they are over 500 lb. It is only in the past 3 yr that four individuals exceeding this weight have been landed off the Northeast Coast and have been available for our examination.

Tournaments

Data from the Freeport Fishing Festival on 4 August were gathered by Scott Emory, one of our graduate student cooperators. Jack Casey and Wes Pratt attended the Roger Williams Tournament at Point Judith, RI, during 10-13 August, but due to inclement weather only three sharks were landed. On 11 August, Wes Pratt, Nancy Kohler, Alan Lintala, and Mary Braisted attended the Hudson Anglers Tournament at Freeport (Long Island), NY, where 67 boats caught 14 sharks. A relatively rare 211-lb white shark won this tournament and provided a sample that helps to fill a size gap in our current data base for age and growth studies.

Reproduction and Age & Growth

Vertebrae from white sharks collected this summer, including the 2075-lb male, were sectioned along with vertebrae from mako sharks as part of our effort to age lamnid sharks. Reproductive tissues from the 2075-lb white and other summer collections were histologically prepared by Alan Lintala through the paraffin block stage and await sectioning this fall.

Cruises

Larry Lindgren and John Hoey conducted a longline cruise aboard the R/V Geronimo (from St. Georges School in Newport, RI) along the edge of the continental shelf in the area south of Nantucket. From 12-18 August a total of 313 sharks including 286 blue sharks, 12 mako sharks, 3 common threshers, and 3 sandbar sharks, was caught on 10 longline sets. All sharks caught were tagged for migration studies.

Food Habits

Chuck Stillwell, Nancy Kohler, and John Hoey attended the second annual Ocean City Marlin and Tuna Club Swordfish Open Tournament during 7-10 August. Ten yellowfin tuna, eight white marlin, five albacore tuna, three swordfish, two makos, and one dolphin were examined for stomach contents. Squid (Illex illecebrosus) was a common food item in all stomachs. Small butterflyfish, 3-4 cm, were also found in the stomachs of the yellowfin, albacore, and white marlin. Stomachs from 15 makos and 2 blue sharks were collected from the Grand Banks and brought in by a cooperating commercial longliner. These samples contained small amounts of squid and redbfish. A computer program for the analyses of data on food habits is being developed. All blue shark food data collected to date have been tabulated and summarized for analyses by area, sex, and size of shark.

Cooperative Tagging Program

During June, July, and August, about 2000 sharks were tagged under the cooperative tagging program. In the same period, 92 sharks were recaptured. Over 20 of the recaptures were retagged with new tags by fishermen involved in the program. Most of the tag returns came from blue sharks at liberty for a few months and within 100 mi of the tagging site. However, recaptures from blue sharks included individuals at liberty for over a year and distances of over 1600 mi (New Jersey to Columbia, South America). Long distance recaptures of other species included a sandbar shark tagged off Montauk in August 1975 and recaptured off Tampico, Mexico, (1700+ mi) in July 1979; a tiger shark tagged in the Gulf of Mexico off Dauphin Island, AL, in August 1978, and recaptured in the Bahama Islands a year later (750 mi). This latter recovery is the first evidence of movements of tiger sharks between the Gulf and the Atlantic. Tagging assistance from the NMFS Foreign Fisheries Observer Program under the direction of James Medeiros (Otis AFB, MA) and Perry Thomson (SEFC Pascagoula Laboratory) has been outstanding. Fishery observers aboard foreign trawlers and longline vessels have tagged several hundred sharks and provided additional data on shark catches.

Shark Tagging Data Base

ADP programs have been completed for merging all tag and recovery data into compatible formats. Good progress has been made in entering, verifying, and summarizing tag data from research cruises, sport fishermen, commercial vessels, and other sources for 1964-78. Larry Lindgren and Eric Barszcz (student programmer) have nearly completed final verifications that will allow us to be in "real time" for obtaining outputs including the 1979 data by the end of November. Additional summary and analytical programs are also being developed for preparing recapture results for publication.

Meetings, Talks, Visitors, and Publicity

Roz Cohen attended a workshop on 8 August at the Woods Hole Laboratory, sponsored by that lab's ADP Unit and Input-Output Computer Services, Inc., (IOCS) consultants on: "Groundfish Application Program Modifications and New Graph System."

Greg Lough, Mike Pennington, Marv Grosslein, Richard Hennemuth, and Ken Sherman attended a special meeting with statisticians G. Patil, C. Taillie, and G. Seber, to discuss statistical problems in analysis of plankton data.

Red Wright participated in two discussions with Soviet scientists from research vessels in Woods Hole: a scheduling session for Belogorsk on 8 August and (with Ron Schlitz) a conference with Dr. Igor Sigaev of the Aliot about future cooperative research involving warm-core Gulf Stream rings.

On 10 August, Red Wright, Ken Sherman, Robert Edwards, Helen Mustafa, and Eilene Maturi attended a meeting of the US delegation for ICES at the US Environmental Protection Agency (USEPA) Laboratory in Narragansett, RI.

Ken Sherman attended a Workshop on Oceanic Remote Sensing at Estes Park, CO, during 19-25 August.

We note with sadness that Dr. Ahlie Ahlstrom died suddenly on 27 August. Ahlie was a giant among ichthyoplanktologists. He served as a teacher and guide in the careers of virtually all of our ichthyoplankton specialists in NMFS as well as scientists in other laboratories around the globe. Thanks to his creative vision, his unique sense of architectural detail, and his ability in solid building, he has left for us a rich legacy of commitment in NMFS to getting on with studies of ichthyoplankton as an important component of fishery assessment programs. His was a full and rich life. We of the Marine Ecosystems Division enjoyed sharing our brief times with him. Ahlie will be sorely missed, but we all take satisfaction in his unsurpassed accomplishments. His was a life that will be emulated and praised for those of us lucky enough to have known and worked with him.

On 6 August the multispecies management group met with Brad Brown at the Narragansett Laboratory.

Carolyn Griswold has been appointed as the NOAA representative on the North Atlantic Regional Technical Working Group of the Intergovernmental Planning Program for OCS Oil and Gas Leasing. The working groups will advise the Secretary of the Interior on proposed development of Georges Bank. The first North Atlantic Group meeting will be in early November.

A NOAA task force headed by Dr. Robert Lippson has been established by Richard Frank to evaluate the possible ecosystem impacts of the Pittston refinery and marine terminal in Eastport, ME. Bernie Skud and Carolyn Griswold are working with Vaughn Anthony and Jim Kirkley on the marine resources of the Eastport area. Carolyn Griswold attended a 3-day meeting and site inspection in St. Andrews, NB, and Eastport, ME, during 28-31 August 1979 with other NOAA task force members and Canadian scientists. The Canadians who represented many federal agencies offered to provide the NOAA group with specific up-to-date information on the Passamaquoddy Bay/Bay of Fundy area within the next month.

Chris Powell attended the American Society of Ichthyologists and Herpetologists annual meeting in Orono, ME, from 30 July to 3 August. He presented a poster paper titled, "The Early Development and Larval Distribution of the Mooneye Cusk-Eel *Ophidion sclenops* Robins and Böhlke."

Robert Marak, Jack Green, and Donna Busch attended a precruise meeting of the Belogorsk to set up MARMAP I and special primary and secondary production cruises which will take place from August to December.

An experiment to find out if a simple solution of Ludox could be used to separate large numbers of fish eggs from other plankters was completed. This method as well as one using a gradient can be used depending on the constituency of the sample.

Renata Lipska of the Plankton Sorting Center in Szczecin, Poland, worked with Ray Maurer comparing use of the microscope versus the image scanner.

Four scientists from the Plankton Sorting Center spent 14 days at the Narragansett Laboratory discussing cooperative work.

Plankton data sheets for the following cruises were received and are being incorporated into the MARMAP data base: (1) ichthyoplankton--Albatross IV Cruise No. AL 78-13 and 78-15, Anton Dohrn Cruise No. 78-03; (2) zooplankton--Delaware II Cruise No. DE 78-07; and (3) food habits of gadoids--Albatross IV Cruise No. AL 78-04. Plankton Sorting Center personnel responded very aptly to an urgent request for Ammodytes data to meet a deadline for an ICES report.

Publications

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Reports

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Cohen, R. E.; Lough, R. G. Laboratory and data processing methods recommended for larval fish gut content and condition factor analysis studies using larval sea herring (Clupea harengus L.) as a prototype. Woods Hole Lab. Ref. Doc. No. 79-39; 1979.

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MANNED UNDERSEA RESEARCH AND TECHNOLOGY PROGRAM

Diver Training

Cliff Newell and Roger Clifford conducted advanced diver training for members of the Milford Laboratory dive team. Simulated work dives were conducted at Woods Hole during 30 April - 4 May, along with formal instruction in accident management and diving operations planning. This activity was continued on 17 and 18 May with inspection of the Milford Laboratory diving facilities and simulated work dives with Milford Laboratory divers at specific study sites in the Milford, CT, area.

Scallop Dredge Studies

NEFC divers Newell, McCarthy, Gross, and Meyer, and NEFC engineers, along with industry representative John Sweeney, conducted field tests of scallop dredge efficiency from the R/V Rorqual during 12-29 June. Fishing performance of two types of dredges, an 8-ft-wide survey dredge and an 8-ft-wide commercial type, were observed by divers under varying conditions of depth and bottom topography. Dredge behavior was documented using a diver-held Sub-Sea-Systems CM-30 underwater color television camera; some excellent video tapes resulted, from which, rational reappraisal of gear design may follow. During 9 days of at-sea operations, 37 tows were made, some with divers riding the dredge, and others at depths or speeds beyond diver capability, with the television camera mounted just above the dredge on the towing cable.

Ocean Pulse Studies

MURT divers and guest scientists from the University of New Hampshire, Southwestern Massachusetts University, Maine Department of Marine Resources, and the Audubon Society conducted benthic ecology studies from 5 to 28 July at Pigeon Hill, an offshore Ocean Pulse monitoring station off Rockport, MA. A wide range of diving activities was conducted on a day-trip basis out of Gloucester, MA, using the Rorqual. Results included collection of representative 0.25-m² quadrat samples of benthic fauna at preestablished sites at 100 ft; representative 0.25-m² quadrat photographs at a preestablished station at 125 ft; photodocumentation of substrates and benthos along permanently established transect lines; and species-specific invertebrate collections for contaminant-level analyses.

Submersible Operations

Dick Cooper, Joe Uzmann, and Roger Clifford participated in an 18-day submersible survey of parts of Oceanographer Canyon, Block Canyon, and Hudson Canyon using the R/V Atlantic Twin and research submersible Nekton Gamma. Guest scientists

Churchill Grimes and Kenneth Able of Rutgers University participated as observers initially, and later as submersible users in tilefish-oriented behavior and habitat studies. NEFC-MURT operations were supported by NOAA-MUST (Manned Undersea Science and Technology Office) and Rutgers participation, and by Sea Grant funding. A total of 29 dives was completed and documented extensively with 35-mm color still photographs and color video. The cruise plan included close collaboration with two commercial tilefish longline vessels out of Barnegat Light, NJ. These arrangements permitted the unique opportunity to dive upon and follow freshly baited longline gear for the purposes of observing tilefish catch over time and evaluation of bait loss to known, or suspected competitors such as amphipods, Cancer spp. crabs, starfishes, hermit crabs, etc. A major highlight of the dives was discovery of yet another kind of tilefish burrowing behavior on the shelf proper; essentially, the burrows appear as large conical excavations (up to 2 m in diameter) with a near-vertical cylindrical "bore hole" at the base into which disturbed tilefish dart head first; egress from these burrows is invariably tail first as the diameter of the "bore hole" is little larger than the girth of the fish.

Clam Dredge Studies

Continuing support studies begun in 1978, Pecci, Newell, Meyer, and McCarthy made observation dives on the electric pump clam dredge system during Delaware II Cruise No. DE 79-08 during 13-24 August. Numerous dives were made to observe dredge efficiency, path disruption from jets and blade, and associated clam breakage. Underwater color video recordings were made of dredge performance with and without the electric-pump-driven jets. Additionally, divers collected replicated samples both within and outside the dredge path to obtain measurements of dredge harvest efficiency, clam size distribution, and incidence of clam breakage.

Current Meter Replacement

From September 4 to 9 Ken Pecci and Roger Clifford participated in an NEFC cruise aboard the Albatross IV to change offshore current meters in situ. Four current meters were changed by the divers at fixed observation sites from south of Martha's Vineyard to the vicinity of Veatch Canyon. Meter replacement times ranged from 25 to 45 min at subsurface depths of about 10 m.

Publications

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

Meyer, T. L.; Cooper, R. A.; Langton, R. W. Relative abundance, behavior, and food habits of the American sand lance, Ammodytes americanus, from the Gulf of Maine. Fish. Bull., US 77(1):243-255; 1979. (P)

DIVISION OF ENVIRONMENTAL ASSESSMENT

Behavior of Marine Fishes and Invertebrates Investigation

Studies examining patterns of behavior related to the ecological requirements for post-larval and juvenile red hake, spotted hake, and white hake have been initiated. Presently, planktonic hake are being collected and observed in the

laboratory both day and night. Observations are concentrating on defining and quantifying behaviors related to feeding, interfish associations, swimming patterns, and daily rhythms of activity. One area of special interest is the behavior of red hake which appears, at least in certain geographical areas, to live symbiotically within the sea scallop. In addition to the collection of scallops, facilities and procedures for maintaining and observing scallops and hake in the laboratory are being developed. These studies will provide a baseline for assessing the effects of contaminated sediments on the juveniles at the time of settlement when they become closely tied to the benthos.

Biological Oceanography of Stressed Environments Investigation

Bill Phoel participated as a member of NOAA's Oil Spill Response Team investigating the impact of the IXTOC I (Bay of Campeche) oil spill on the Texas Coast. Diving investigations were initiated to quantify the amount of subsurface oil in the water column and on the sediment. These data, combined with tidal velocities and duration, and inlet cross sections, provided an estimate of the subsurface oil moving under the oil booms into the environmentally sensitive Laguna Madre. The subsurface oil particles from the wash zone of Padre Island, offshore to about 300 m, were also observed and reported upon.

The Seabed Metabolism Task initiated 2 wk of seabed oxygen consumption cruises aboard the NOAA R/V Kyma to determine summer oxygen consumption rates by the seabed in the heavily impacted Newark Bay, Kill van Kull, and the somewhat less impacted Raritan Bay. Although these day-trips had been planned in advance, local newspaper articles on the intention of the US Army Corps of Engineers (COE) to dredge these areas and dump the spoils in the present dump area 6 mi off the New Jersey Coast added impetus to the investigation.

Preparations were continued for algal bioassay studies beginning with the September Ocean Pulse cruise. Revisions were begun on a manuscript titled "Normal Seasonal Fluctuations and Changes Due to a Fin Rot Disease, in the Blood of the Winter Flounder, Pseudopleuronectes americanus, in New York Harbor."

Dr. Harold Marshall of Old Dominion University and Mrs. Myra Cohn of the Sandy Hook Laboratory are preparing a statement of their methods for phytoplankton community evaluation -- sea truth for the Large Area Marine Productivity/Pollution Experiment (LAMPEX) to be conducted with the National Aeronautics and Space Administration (NASA), Langley Research Center, Marine Environments Branch. These methods will be circulated among internationally recognized phytoplankton experts in order to arrive at an agreement on the most effective methods for this experiment.

Dr. James Thomas attended two NOAA-sponsored workshops in August. The first was concerned with determining the carrying (waste assimilation) capacity in US coastal waters. Participants were from industry, academia, and government, and represented all coastal areas of the US. Proceedings of the workshop are to be available about February 1980. The second meeting was a NOAA workshop on remote sensing, also attended by Drs. Robert Edwards, John Pearce, Kenneth Sherman, and J. Lockwood Chamberlin. All main-line components of NOAA were represented. The purpose of the workshop was to organize NOAA's remote sensing effort. The meeting generated a LAMPEX proposal to increase our understanding of regional marine ecosystem processes and provide over the long term an extensive, synoptic, integrated and timely data base for application to problems of ocean resource and environmental management. The distribution and abundance of organic production, as well as the location, orientation, and duration of fronts and the flux of nutrients and contaminants from estuarine to shelf waters are to be examined.

Craig Robertson and James Thomas visited Brookhaven National Laboratory for 1 day to discuss with Drs. Vidal, Dagg, and Falkowski, zooplankton research and methods of measuring zooplankton respiration via oxygen electrodes.

Coastal Ecosystems Investigation

Jan Caracciolo Ward and Frank Steimle completed the final draft of their New York Bight apex benthic atlas. Frank also completed a manuscript on the benthic macrofauna of Block Island Sound, an estimate of benthic meiofaunal production on Georges Bank (for the energy budget working group) and the summer 1979 "Ocean Pulse Newsletter," and began a report on the importance of artificial reefs as fish foraging grounds. Frank and Chuck Idelberger completed calorimetry measurements on organisms collected on the July Albatross IV Ocean Pulse cruise. A paper is being prepared on results of the calorimetry done to date. Chuck began plotting dissolved oxygen (DO) values from MARMAP data collected since 1977. Distributions of bottom DO have been charted for eight cruises, and plots of vertical profiles are planned for eight transects across the shelf for each cruise. This joint Ocean Pulse-MARMAP project will yield an atlas of DO distributions indicating seasonal and geographical variations -- such baselines will be valuable to the Ocean Pulse effort.

Dissolved oxygen in parts of the New York Bight appeared to be decreasing toward critical levels in early August. Frank Steimle and Dave Radosh coordinated a 3-day monitoring effort, in which Chuck Idelberger, Greg Parker, and Toni Miller took part, aboard the R/V Xiphias. No alarmingly low values were found on this cruise; a mid-August northeaster probably helped to reduce stratification and aerate bottom waters. Frank and Dave also made final preparations for the September Ocean Pulse cruise aboard Albatross IV. Dave and Greg Parker tried on several days to use radio-direction-finding (RDF) equipment to track buoys deployed at Deepwater Dumpsite 106 by the Atlantic Environmental Group's Ocean Dumping Investigation. No buoys could be located.

Bob Reid worked on a benthic sampling methodology manual and a technical work plan for the Ocean Pulse benthic studies. Bob arranged for the first meeting of the Ocean Pulse Benthic Ecology Review Committee, which consists of benthic ecologists from the USEPA and several eastern universities, to be held at the Sandy Hook Laboratory in September. Clyde MacKenzie continued diving studies of surf clam populations (i.e., setting success, growth, and predation) and factors limiting local oyster setting. Sukwoo Chang worked on his manual for statistical design and analysis in Ocean Pulse studies.

Environmental Chemistry Investigation

Members of the Environmental Chemistry Investigation participated in the MARMAP survey aboard the Belogorsk. Sue Barker and Jim Duggan measured chlorophyll-a concentrations at 151 stations. Ralph Bruno measured ^{14}C -primary production at 40 stations. Andrew Draxler processed seawater samples for nutrient (i.e., nitrate, nitrite, silicate, phosphate, ammonium) determinations at 86 stations and trained Soviet colleagues in shipboard processing of nutrient samples.

We developed a first draft of a manual which describes standardized shipboard methods used for processing seawater nutrient samples during Ocean Pulse and MARMAP surveys. We completed analyses for ammonium concentrations in samples of seawater collected during the first leg of the August MARMAP survey aboard the Belogorsk. We completed liquid scintillation counting of ^{14}C -primary productivity samples collected during the June-July MARMAP and July Ocean Pulse surveys.

Around the end of August, preparations were made for the September primary/secondary productivity survey aboard the Belogorsk and for the September Ocean Pulse survey aboard the Albatross IV.

Chris Evans completed a course in basic computer programming at Brookdale (NJ) Community College.

Physiological Effects of Pollutant Stress Investigation

Physioecology

The long-term exposure of the slipper limpet (Crepidula fornicata) to silver continued this reporting period. Keeping the larvae alive has been a problem in recent months. Water quality and oxygen availability have been ruled out, and temperature variability now seems the likeliest culprit. When the air conditioning in the building is turned off for the night or for the weekend, the temperature in the culturing containers rises from 20°C to as high as 30°C, a temperature which the slipper limpet larvae apparently cannot tolerate. We are now culturing the slipper limpet larvae in our chronic lab where the air conditioning is constantly on and the temperature maintained at 20° + 2°C.

Four 1-mo-old laboratory-grown blue mussels (Mytilus edulis) remained healthy and have reached the size of 1.5-1.7 cm by the middle of August. Two different kinds of exposure experiments using some of these animals were performed this month. Two static acute bioassays (72 hr) were performed on them using copper, mercury, cadmium, and silver. The results of these tests are presented in Table 2 below.

In the other continuous study which began in early July, a different group of juvenile mussels is being exposed chronically to copper and silver (1, 5, and 10 ppb) individually in a flow-through system. Their survival and growth are being monitored weekly, and as of this time, no differences were observed between the exposed animals and the controls.

Table 2. Seventy-two-hour acute toxicity of heavy metals to 1-mo-old, laboratory-grown blue mussels. (a)

| Heavy metal | LC ₅₀ (ppm) | 95% confidence interval (ppm) |
|-----------------------------------------------|------------------------|-------------------------------|
| Copper (CuCl ₂ ·2H ₂ O) | (b) | (b) |
| Mercury (HgCl ₂) | 0.18 | 0.15-0.21 |
| Cadmium (CdCl ₂) | 3.85 | 3.36-4.41 |
| Silver (AgNO ₃) | 0.24 | 0.20-0.29 |

(a) Static bioassay.

(b) Too variable to determine.

Physiological Effects

The fourth group of blue mussels for this season from Narragansett Bay, RI, was examined this month. Preliminary examination of data indicates measurable stress in the group retrieved from the more polluted station. One more month of sampling should be possible before a 5-mo profile of physiological condition is completed.

Studies on changes in respiration rates of American lobsters over the molt cycle continue. It now appears that the only significant elevations in oxygen consumption occur just after molting.

The two experimental series with lead-exposed lobsters described last month were completed this month. Respiratory and hematological measurements were made by this group and will be compared to measurements made by the biochemistry and chemistry groups.

The remainder of the month was spent working on samples collected on the July Albatross IV cruise (No. AL 79-07).

Biochemical Effects

Along with the Physiological Effects Subtask personnel, we took tissues from the fourth month's sampling of blue mussels from the USEPA's Narragansett Bay sites. Work has begun on the five sample sets (four months and a baseline) of frozen gill homogenates and on adductor muscle, which are being variously examined for activities of several enzymes selected from last year's preliminary exercise with this species.

Analysis has been completed for kidneys of winter and windowpane flounders taken during the recent Ocean Pulse cruise (Albatross IV Cruise No. AL 79-07). We have also almost finished analysis of scallop adductor muscles taken during a bottom trawl survey (Albatross IV Cruise No. AL 79-04). Rock crab (Cancer irroratus) hearts remain at -80°C , awaiting an opening in the testing schedule.

Heart, antennal gland, skeletal muscle, and male gonad were taken from American lobsters following completion of the two experimental exposures wherein the animals were first subjected to 60 ppb lead (as the nitrate) for 4 wk, then held for 2 days in aerated seawater at either ambient ($26^{\circ}/\text{oo}$) or low ($17^{\circ}/\text{oo}$) salinity. With the exception of the male gonad, tissues from every two animals were pooled and divided into 2 portions, to permit examination for both biochemical activity and metal uptake.

Analysis of data continues, as does manuscript preparation for this fall's European Marine Biology Symposium.

Anaerobic Bacteriology/Metabolism

Ocean Pulse activities included work on samples and cultures obtained on Albatross IV Cruise No. AL 79-07. Sediments and water samples were obtained from some 19 inshore-offshore stations from Delaware Bay north to Georges Bank for bacteriological analysis. Some 200 isolates obtained from the various samples are being characterized.

Anaerobes belonging to the genus Clostridium, predominately the perfringens type, were detected in all sediment samples, although the incidence was low in offshore stations. Detection of the anaerobes in the water column occurred only in inshore stations, although previously they were detected at two offshore stations on Georges Bank. The incidence remains high in the sewage sludge area.

Isolates were obtained from all sediments cultured in our Vibrio media. This contrasts with our results for sediments obtained from the R/V Advance II cruise in April. At that time, growth occurred only in sediments obtained from the sewage-sludge area of the New York Bight.

Of interest is the detection of Vibrio parahaemolyticus (tentatively identified from surface water samples taken from central Georges Bank. This organism is usually considered an estuarine or near-inshore inhabitant, and is not often found in offshore waters.

A fourth experiment on the potential outgrowth of Type E spores in mildly heated American oysters (Crassostrea virginica) was completed. This is a joint effort with SEFC's Charleston Laboratory. Toxic outgrowth by Type E spores was possible.

Chemistry

Analyses of samples of winter flounder exposed to lead last winter and spring have been nearly completed. Preliminary results show that only the kidney takes up lead to any substantial extent.

Some work was done on atomic-absorption methodologies for copper and lead in seawater. Previously, we were not able to distinguish whether or not high readings from ambient seawater concentrations were caused by interference. Work on the graphite furnace has apparently alleviated this problem.

Work also continued on methodologies for polychlorinated biphenyl (PBC) and petroleum hydrocarbon analyses. PCB analyses probably will be started in the fall on samples collected from our Long Island Sound study, but further work is required with petroleum hydrocarbons.

Meetings, Talks, Visitors, and Publicity

Frank Steimle and Stan Gorski attended a joint US Fish and Wildlife Service/NMFS workshop on the saltwater application of habitat evaluation procedures in Fort Collins, CO, during 14-16 August.

Dr. John Pearce participated in the first meeting of the New Jersey Shellfish Council on 20 August. Dr. Pearce has recently been appointed to the council as chairperson. The council is responsible for interfacing with the shellfish industries of New Jersey and the state regulatory and enforcement agencies. One of the principal interests of the council has to do with pollution abatement in estuaries and coastal waters, especially those forms of pollution which directly affect the resources in their desirability for human consumption.

During 21-24 August, Drs. John Pearce and James Thomas met with other NEFC personnel and NOAA scientists involved in remote sensing programs. The meeting was held at Estes Park, CO, and one of the principal results was the drafting of a pre-proposal for continued remote sensing using the Ocean Pulse and MARMAP programs. Plans were made for a continuation of the LAMPEX program which would be extended from the previous areas of effort south of Cape Hatteras to Florida, and into the Gulf of Mexico. As in the earlier experiments, personnel from the NOAA Environmental Research Laboratories Marine Ecosystems Analysis (MESA) Program and the NOAA National Environmental Satellite Service, as well as numerous other academic centers would be involved.

On 29 August, Dr. Pearce met with Dr. Kenneth Gold and other scientists at the Osborne Laboratories of the New York Aquarium. The purpose of the meeting was to develop an understanding of the Ocean Pulse program and current research opportunities that might be available to scientists working at the aquarium.

Dr. Pearce noted that there was a range of scientific endeavors, including physiological, genetic, and autecological investigations ongoing at the aquarium which would relate directly to the Ocean Pulse Program.

Chris Evans attended a meeting at the Woods Hole Laboratory to establish sampling protocols for chlorophyll analyses which will be performed during the cooperative US/USSR primary-secondary productivity survey aboard the Belogorsk.

Vincent Zdanowicz visited the Heat System-Ultrasonics Company in Plainview, NY, to inspect combined fume hood/fume scrubber apparatus for potential use in the heavy metals lab at the Sandy Hook Laboratory.

Publications

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- Wenzloff, D. R.; Greig, R. A.; Merrill, A. S.; Ropes, J. W. A survey of heavy metals in the surf clam Spisula solidissima and the ocean quahog Arctica islandica, of the Mid-Atlantic Coast of the United States. Fish. Bull., US 77:280-285; 1979. (P)

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Thomas, J. P.; Robertson, C. N.; Evans, C. A. LAMPEX II - sea truth data report. Sandy Hook Lab. Rep. No. SHL-79-28; 1979.

AQUACULTURE DIVISION

Aspects of Nutritional Requirements of Mollusks Investigation

Recently completed experiments utilizing American oyster larvae were conducted to investigate utilization of three freeze-dried algal foods individually or in combination. The three species chosen for these experiments were Isochrysis galbana, Monochrysis lutheri, and Dicrateria inornata. Size determinations made after 8 days indicated that, in all food combinations, living cells sustained a greater increase in larval size than did dried material of the same species. When fed on the dried food particles, larvae were about 60% of the size of larvae being fed living algal cells. There was no essential difference between larvae being fed different species of the dried food. The mortality in larval cultures that were being fed on dried algae was not excessive, but about 10% higher than that of larvae being fed living algae.

The harvest of algal foods from carboys in the mass culture room amounted to 16 080 liters of larval foods and 17 820 liters of juvenile foods. Open-tank cultures were also maintained to provide a continuous supply of algal foods to trays of juvenile and adult bay scallops (Argopecten irradians) and surf clams. This material was distributed to various investigations as follows: Aquacultural Genetics, 988 liters; Spawning and Rearing of Mollusks, 1106 liters; Physiological Effects of Pollutant Stress, 1208 liters; and Larval Diseases of Mollusks, 43 liters.

Preparation of a manuscript for publication was completed by Gary Wikfors and Ravenna Ukeles, titled "Utilization of Copper- and Cadmium-Contaminated Algae as Food Sources by Crassostrea virginica Veliger Larvae."

Spawning and Rearing of Mollusks Investigation

Observations made on hatchery-reared surf clams planted in a sandy bottom in Long Island Sound at a depth of 25 ft have shown a high rate of burrowing after 24 hr. This rate of burrowing determines the amount of possible, immediate predation, since unburrowed clams are highly vulnerable to predators. In this experiment, the number of clams that had not burrowed appears to be related to the size of the clams planted. Twenty-five percent of the smallest group of 15-mm clams was observed on the surface with many dead shells. Sixteen percent of the 30-mm clams and only ten percent of the 40-mm clams were found either dead or unburied.

Clams planted in these field experiments have had their shells marked with fluorescent spray paint. This allows the rapid marking of many individuals and remains identifiable for several months.

Some of the bay scallop field experimentation is now underway. We are looking primarily at a few types of small-scale, grow-out habitats that have either scale-up possibilities for future use or could serve as standard experimental units to compare scallop growth in different sites. Most important for the present is our ability to deploy the habitats, find and recover them, and take reasonable samples. We are also attempting to determine the appropriate stocking densities for each habitat type and thus far have used densities of 250-2000 per square meter for 20-mm scallops.

We tagged nearly 3000 hatchery-reared bay scallops with an underwater epoxy and pigment mixture. These will be used in a free-plant release experiment in a shallow estuary in Groton, CT, in early September and preliminary observations made on movement and predation.

Aquacultural Genetics Investigation

Experimental Inbreeding and Hybridization of Commercial Oysters

Emphasis this month was on the preparation of two papers. One, titled "Experimental Inbreeding and Hybridization in the Commercial American Oyster," was prepared and 200 copies made to be read at the ICES meeting scheduled for October. The other was a summary of geographic and interspecific hybridization studies on the American oyster, which was presented at a joint meeting of the Genetics Society of Canada, the Genetics Society of America, and the American Society of Naturalists during 20-22 August at the University of Alberta in Edmonton. Four hundred eighty-five persons registered. Because of the combined effort, interests and topics varied, but were all related to genetics research. The program was comprised of oral and poster presentations.

Mass Selection

Spawning of meat yield selection and larval growth rate selection genetic stocks has been completed for 1979. A total of 26 matings was made in the high-meat-yield line, with set being collected from 14 of those crosses. Twenty-five matings were made in the low-meat-yield line, with set collected from 10 crosses. In the larval growth rate selection experiment, 13 crosses were made in the fast-growth line and 29 crosses were made in the slow-growth line. Set was collected from five of the fast-line crosses and eight of the slow-line crosses.

American oysters were collected and shipped to Dr. Norman Buroker of the University of Maryland for his work on isozyme distribution in American oyster populations along the Atlantic Coast. A manuscript was prepared for presentation at the ICES meeting in Warsaw, Poland, during October 1979.

Cytological and Cytogenetic Effects of Contaminants on Fish Eggs

By now the chorion ultrastructure of a sizable sample of Atlantic mackerel eggs has been examined at most of the 1978 cruise stations in the New York Bight. Generally, those stations with poor quality embryo development at the cytological or cytogenetic level are the stations displaying pathological states of the egg chorion (outer egg membrane). These pathological states generally fall into the categories of obscure pore patterns, distinct lesions in otherwise intact normal chorions, and a generally advanced breakdown of the chorion. There are exceptions to the general association of embryo difficulties and chorion pathology. These

are taken to mean that chorion pathology may sometimes precede embryo difficulties. It appears that including chorion examination among egg parameters studied in field collections is worthwhile.

Abnormal chorion state occurs more frequently and at more sample sites in the heavily polluted Bight apex than outside of it. Data are to be treated statistically. For now these data appear to corroborate cytological and cytogenetic findings.

Experimental studies are underway to define the effects of different hydrocarbon pollutants on the egg membranes. Also, the normal pathology of the chorion of eggs with moribund embryos is to be described for eggs which: (1) can still stay afloat (as would be included in field plankton samples), and (2) eggs which can no longer maintain themselves in the water column (not sampled at least in the neuston). Such work should make more meaningful the interpretation of the mackerel field data. Unlike the cytological and cytogenetic work where observations on other groups could be related to the mackerel, there is no literature on chorion pathology.

Meetings, Talks, Visitors, and Publicity

Bay scallops were provided to Steven Conway of the University of Bridgeport.

Publications

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Reports

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Stiles, S. Experimental inbreeding and hybridization in the commercial American oyster. Inter. Coun. Explor. Sea, Maricul. Comm. Memo. 1979/F:43; 1979.

PATHOBIOLOGY DIVISION

Water samples and bottom sediments were collected from Baltimore Harbor, MD, at four stations along a transect from Fort McHenry to the Francis Scott Key Bridge. Sediments were cultured on agar plates and examined for amoebae, and water samples were filtered and examined for free-living protozoans (e.g., amoebae, ciliates, and flagellates). Bottom sediments were made up of olive-brown mud and silt that was mixed with coal black sludge-like material. Bottom-water samples showed that the sediment was covered with particulate organic detritus and abundant growth of large bacteria, probably Spirillum. The decaying organic matter supported low numbers of a diverse invertebrate community (Table 3). Six replicate agar cultures from each of the four stations all yielded luxuriant growth of amoebae, including one large species that transformed to an amoeboflagellate. The amoebae are now being cultured at 38-40°C to determine if any of them are potentially pathogenic. Acanthamoeba polyphaga appeared in room temperature

sediment cultures of all four stations. Although not infective for experimental mice, A. polyphaga has been isolated in cases of human eye disease in the US and England. Arrangements have been made with the US Public Health Service Communicable Disease Center in Atlanta, GA, for testing all heat-tolerant strains in experimental mice. The Baltimore Harbor study was made in response to a request from the Governor's Harbor Committee of the State of Maryland.

Table 3. Protozoa collected in bottom-water samples from Baltimore Harbor, MD.

| Ciliates | Amoebae | Miscellaneous |
|----------------------------|--------------------------|-----------------------|
| <u>Euplotes woodruffi</u> | <u>Vannella</u> sp. | <u>Peridinium</u> sp. |
| <u>Euplotes dadanilous</u> | <u>Flabellula</u> sp. | <u>Paranema</u> sp. |
| <u>Pleuronema</u> sp. | <u>Oscillosignum</u> sp. | <u>Heteronema</u> sp. |
| <u>Frontonia</u> sp. | <u>Hartmannella</u> sp. | Heliozoa |
| <u>Chondylostoma</u> sp. | <u>Naegleria</u> sp. | Foraminifera |
| <u>Litonotus</u> sp. | <u>Acanthamoeba</u> sp. | |
| <u>Cyclidium</u> sp. | <u>Clydonella</u> sp. | |
| <u>Mesodinium</u> sp. | | |
| <u>Cinetochilum</u> sp. | | |
| <u>Porpostoma</u> sp. | | |
| <u>Tintinnopsis</u> sp. | | |
| <u>Eutintinnus</u> sp. | | |
| <u>Dysteria</u> sp. | | |
| <u>Spirophrya</u> sp. | | |

Dr. Eugene Small and Mr. Paul Minola of the University of Maryland collected clams from the Tred Avon River at Oxford, MD, for studies on ciliates which reside in the siphons. Two highly specialized ciliates, Hemispeira and Ancistrum, were recovered and will be used for new species descriptions and scanning electron microscopy. Further cooperative studies are planned to evaluate the possibility that inquiline or endocommensal protozoa in mollusk siphons might be useful as indicators of water quality.

Fish Pathology Investigation

A major effort was made during August to conduct Ocean Pulse activities in order to assess the prevalence of disease in marine fishes. Two cruises were conducted in the western North Atlantic and one in the North Sea. Ms. Ann Charles participated in the Ocean Pulse cruise on the Albatross IV from 17 to 27 July, and Mr. Ron Landy in an inshore bottom trawl survey on the Albatross IV from 30 July to 10 August. Dr. Robert Murchelano and Mr. Martin Newman were invited guests of the Institut für Küsten und Binnenfischerei in the Federal Republic of Germany on a cruise of the Anton Dohrn in the German Bight and North Sea from 26 July to 9 August.

The two cruises on the Albatross IV did not uncover any significant new information. On the Ocean Pulse cruise, only 845 fishes were examined during the 10-day cruise period; 436 of these fishes were juvenile butterfish. The five most abundant species examined for external lesions were winter flounder (121), red hake (76), haddock (63), silver hake (56), and Atlantic cod (32). The only significant lesions observed were an ulcer in an Atlantic cod and winter flounder and a pseudobranch tumor in an Atlantic cod. Sample size typically was small throughout the cruise and, therefore, it was not possible to examine large numbers of fishes. The data from the inshore bottom trawl survey on the Albatross yet must be collated. Catches again were small, however, and no significant external lesions were noted.

The Anton Dohrn cruise was conducted specifically to assess the prevalence of several diseases -- epidermal papilloma, lymphocystis, ulcers -- in dab (Limanda limanda) from the German Bight and Dogger Bank in the North Sea southeast of Scotland. German scientists are trying to correlate increased prevalence of these diseases with coastal pollution. Large numbers of fish were caught at all of the 79 stations sampled. Approximately 50,000 dab and at least as many other fish species were examined. The Anton Dohrn is an extremely commodious vessel for the conduct of both survey and laboratory fishery biology.

The total man-hours expended on these three cruises were substantial (Albatross IV - 240; Anton Dohrn - 312). The information acquired, however, is invaluable in that it continues to augment that from other groundfish disease surveys. The surveillance of gross lesions is best accomplished during the conduct of groundfish assessment surveys. Once a particular disease has been demonstrated to be numerically prevalent or inimical to the health of the fish or a possible consequence of environmental quality, then a substantial effort should be made to determine the specific etiology of the disease. Herein lies the role of fish pathology.

Larval Diseases of Mollusks Investigation

Two experiments were completed in which the frozen, concentrated filtrates obtained from a red pseudomonad and a Vibrio sp. were used to challenge American oyster larvae. Another experiment was run using two strains of live pathogenic Vibrios. Preliminary results indicate that the toxic metabolite of the Vibrio sp. remains stable when frozen.

Four additional challenge tests of a suspect bacterium (green slime organism) isolated from International Shellfish Enterprises, Inc. (ISE), in Moss Landing, CA, confirmed pathogenicity to American oyster larvae. Initial densities of 1000 cells inocula caused over 90% mortality while 10 cells/ml inocula produced 50% mortality in 48-hr-old larvae. Two other challenge experiments performed at ISE on European oyster (Ostrea edulis) larvae also indicated high (99%) mortality to 24-hr old larvae.

Another sampling cruise was completed on 22 August to continue collection of water and mud samples for field isolation of larval oyster pathogens. The ozone-UV quarantine system was repaired and is expected to be "on line" by 30 August.

In cell culture experiments it has been found that oyster hemocytes were so "sticky" that a significant proportion became lost by attachment to surfaces of containers. Use of siliconized glass and hydrophobic plastic containers did not solve the problem; however, it was found that no losses occurred if cells were held in paraffin-coated tubes. Slow centrifugation of oyster cells in paraffinized tubes for 10 min reduced by 25% their ability to attach to cell culture plates;

this indicated that centrifuge forces as low as 100 g caused cell stress. Holding cells in pellets for several hours restored their ability for plate attachment.

Comparative Invertebrate Pathology Investigation

The Delaware Division of Fish and Wildlife submitted a number of abnormal blue crabs (Callinectes sapidus) taken from shedding tanks. These crabs were in advanced and prolonged pre-molt condition. Many had lost portions of the old cuticle, which was thin, friable, and shattered easily. Histological examination showed that parasites and bacteria were not present in the crabs. Necrosis of the glia of the central nervous system was the most consistently seen sign. There were also necrotic hemocytes and necrosis of the hemopoietic tissue in some of the animals. There is a possibility that these lesions are due to viral infection. It may be that overt infection was due to an underlying stress condition, since signs indicate that the most likely virus is the rhabdovirus, which has only been found in crabs suffering from other viral infections, or in ones stressed in other ways. Electron microscopy will be performed on tissues from some of the crabs, in order to identify the virus, if any is present.

Final typing of the manuscript Histology of the Blue Crab was begun this month.

Samples of oysters and mussels were collected from Raritan Bay, NJ (a degraded area), and Great Bay, NJ (a relatively unpolluted area), for comparative pathology studies. In addition to histological examination for lesions and disease entities, tissues of these animals will be screened for the presence of mutagenic activity and assayed for the types and amounts of contaminants present. Samples of Mytilus collected by the USEPA for its Mussel Watch Program are being examined to provide a histopathologic baseline for comparison of tissues taken from diverse geographic areas. Mussels collected from six different areas of the Atlantic, Pacific, and Gulf Coasts are being examined.

Service samples of oysters from Fall River, MA, and mussels from Walpole, ME (i.e., the University of Maine Darling Center) have been examined for parasites, microbial pathogens, and histopathologic lesions. No parasites and only minor pathologic manifestations were noted in the oysters. Observed in the mussel samples were: a 20% prevalence of larval trematodes; 28% prevalence of tissue abscesses; and a 20% level of infection with the gregarine Nematopsis.

A teaching collection of histopathologic sections representing all types of parasitic infection and pathologic lesions is being assembled. The Histology Unit processed over 1,300 histologic sections for light microscope study during this reporting period and the unit is now revising and updating its manual on histologic procedures and staining protocols.

A considerable amount of time was spent this month on assembling data and developing formats for reporting our Deepwater Dumpsite 106 observations to the National Ocean Survey (NOS).

Meetings, Talks, Visitors, and Publicity

During 9-13 August, Dr. Rosenfield met with staff members of the Pathobiology Division at the Milford Laboratory; he discussed Ocean Pulse mutagenesis work with personnel at the Gloucester Laboratory and met with personnel at the Northeast Regional Office.

Mr. Farley traveled to Smithville, NJ, on 8 August to pick up mollusk samples.

Ms. MacLean attended a USEPA course on "Bioassay for Toxic and Hazardous Materials" in Cincinnati, OH, on 14 and 15 August.

During 8-16 August, Dr. Sawyer participated in a symposium at the Wildlife Disease Association Workshop in Norman, OK, where he presented a paper on "Habitat Diversity Among Parasitic and Opportunistic Amoebae - A Complicating Factor in the Diagnosis of Fish Diseases." He also participated in the Protozoan Ecology Workshop at Stillwater, OK, where he presented a paper on "Species Diversity Among Marine Protozoa in Sediment from a Sewage Disposal Site."

Dr. Johnson and Mr. Kern attended the Society for Invertebrate Pathology (SIP) meeting at Gainesville, FL, during 25-31 August. Dr. Johnson is Vice President of the SIP.

Dr. Murchelano discussed progress of fish disease surveillance activities with the staff of the Resource Assessment Division at the Woods Hole Laboratory on 27 August.

Mr. William A. Walsh will be leaving the Pathobiology Division on Friday, 31 August, to enter graduate school at the University of Connecticut.

Publications

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- Brown, C. Identification of a bacterial pigment thought to be toxic to embryos and larvae of Crassostrea virginica. *Appl. Environ. Microbiol.* (S)
- Brown, C. Evidence of a toxic effect on embryos of Crassostrea virginica by pigment of a red marine pseudomonad. *Appl. Environ. Microbiol.* (S)
- Johnson, P. T.; Farley, C. A. A new enveloped helical virus from the blue crab, Callinectes sapidus. *J. Invertebr. Pathol.* (A)
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- Robohm, R. A.; Brown, C., Murchelano, R. A. Comparison of antibodies in marine fish from clean and polluted waters of the New York Bight: relative levels against 36 bacteria. *Appl. Environ. Microbiol.* 38: 248-257; 1979. (P)
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- Sawyer, T. K. Species diversity among marine protozoa in sediment from sewage disposal site (abstract). J. Protozool. 26 (Pt. I): 22A; 1979. (P)
- Sawyer, T. K.; MacLean, S. A.; Bodammer, J. E.; Harke, B. A. Gross and microscopical observations on gills of rock crabs (Cancer irroratus) and lobsters (Homarus americanus) from nearshore waters of the eastern United States. Proceedings of the Second Biennial Crustacean Health Workshop. Texas A&M University Sea Grant Publ. No. 79-114:68-91; 1979. (P)
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- Murchelano, R.; Azarovitz, T. Fish disease surveys in the western North Atlantic. Inter. Coun. Explor. Sea, Mar. Environ. Qual. Comm. Memo. 1979/E:24; 1979.
- Murchelano, R. A.; Ziskowski, Z. Fin rot disease - a sentinel of environmental stress? Inter. Coun. Explor. Sea, Mar. Environ. Qual. Comm. Memo. 1979/E:25; 1979.
- Murchelano, R. A.; Ziskowski, J. Some observations on an ulcer disease of red hake, Urophycis chuss, from the New York Bight. Inter. Coun. Explor. Sea, Mar. Environ. Qual. Comm. Memo. 1979/E:23; 1979.
- Newman, M. W.; Stephens, E. D.; Hetrick, F. M. Etiology of "spinning disease" of menhaden. Inter. Coun. Explor. Sea, Mar. Environ. Qual. Comm. Memo. 1979/E:26; 1979.

RESOURCE UTILIZATION DIVISION

Fisheries Engineering Investigation

The recently designed and built 60-inch surf clam and ocean quahog sampling dredge was tested. Vern Nulk and Jack Moakley spent 10 days aboard the Delaware II calibrating dredge performance and efficiency. The tension load cell designed last month was used to monitor tension in the haul-back wire; it performed satisfactorily. A contract was let to build the new docking ramp for the stern-chute dredge-handling system. Design is continuing on a level-wind mechanism for the dredge's electrical cable winch.

John Kenney is preparing for participation in an Albatross IV juvenile fish survey where he will be observing and measuring gear performance.

Energy Conservation

Work is continuing on an energy audit of the Gloucester Laboratory, refurbishment of the Lab's unique low-temperature, precisely controlled freezer system, and a method to recover waste engine heat to provide heat and hot water for a vessel.

Resource Development and Improvement Investigation

New Product Development

Work is continuing on the Instron Texturometer. From previous work and this month's results, the single-bladed Kramer-Shear press appears most suitable in these experiments and will be used to measure the texture changes developed during frozen storage of fish fillets. Arrangements are being made to obtain fresh fish for the storage experiments.

Joe Mendelsohn met with three representatives of the Cryovac Packaging Company to discuss the packaging presently in use in the fisheries and the need for new and better packaging to retain the high quality of the seafoods being processed.

A demonstration and discussion of smoked salmon processed in a retort pouch has been scheduled for 11 September in the Gloucester Laboratory library. About 25 invitations have been sent out to local fish processors.

Species Identification

Samples were prepared in anticipation of the collaborative study for crab species identification.

We are lending assistance to Dr. Sylvia Braddon of the SEFC's Charleston Laboratory in her speciation of sea turtles and have received three samples for preliminary trials by isoelectric focusing.

Seafood Composition and Nutrition

Work continues on lipid cleanup and separation by column and thin-layer chromatography.

Automation proved successful on a portion of the Kjeldahl method and should expedite the determination of nitrogen in the composition work.

Surf Clams

One year of frozen storage has elapsed on the aquacultured yearling surf clams from the Milford Laboratory. A paper is in progress for submission to the Proceedings of the Shellfish Institute of North America (SINA) Conference.

Blue Crabs

Taste tests are continuing on a storage experiment on the shelf life of refrigerated, pasteurized, roller-extracted blue crab meat. After 2 mo of storage, the roller-extracted meats were significantly higher in quality than the commercially picked, pasteurized, refrigerated control. Roller-extracted blue crab meat was given the second finish cook within crab shells containing

some of the internal juices. The flavor of the crab meat was improved by this process, indicating a good avenue of approach for the flavor enhancement of roller-extracted meats.

Squid

Due to the variability of Instron Texturometer readings obtained from raw and cooked squid, work is now centered on standardizing the machine so as to obtain consistent results. Measurements of squid mantle length, sample thickness, size, and weight are being taken and compared statistically with Instron readings. Results, so far, show a logarithmic relationship between sample weight and total force (peak height).

Recreational Fish Preservation

The manuscript outlines for three divisions (salting, smoking, and pickling) have been completed and should be ready for review by about mid-September.

Artificial Bait

Artificial bait for sportfishing is being made by combining ground fish waste with gelatin. Baits made so far hold their structural stability in salt water very well and are now in the process of being tested.

Product Quality, Safety, and Standards Investigation

Product Quality

Various treatments were compared for their effectiveness in retarding oxidative rancidity in minced silver hake (whiting) sticks stored at 20°F. The addition of sodium erythorbate to the minced flesh or to the batter, or vacuum packaging, was effective in this regard; however, storage at 0°F or below was more effective. The combination of vacuum packaging plus erythorbate provided no greater protection from rancidity than erythorbate alone.

Whiting blocks prepared from fillets processed by the Arenco line were evaluated organoleptically after 1 yr of storage at Quincy Market Cold Storage Warehouse. The product, which was served as breaded sticks, was scored good to very good in both flavor and texture.

An accelerated study at approximately 100°F was initiated to determine the storage characteristics of canned Atlantic mackerel prepared by Sudip Jhaveri at URI.

The Torrymeter was evaluated for its utility in assessing quality of whole Atlantic mackerel and mackerel fillets stored on ice. As with other species, the instrument readings declined with storage time. The instrument readings will be correlated with organoleptic scores and certain chemical tests which were conducted concurrently. There was no difference in readings between vacuum-packaged and nonvacuum-packaged fish. A recent Canadian study showed that storage of fish under hypobaric conditions affected the Torrymeter readings.

Sarah Roderick will finish the work with the silver hake population analysis samples shortly. Work will then begin on the analysis of data and preparation of a manuscript.

Two storage studies were initiated this month. The first study involves the effects of Addi-Fro 71 (a proprietary animal protein hydrolysate from Sweden) and L-Lysine on the texture of frozen-stored minced whiting. The second study

involves the effects of tripolyphosphate on the texture of frozen-stored minced whiting. The tripolyphosphate was added to the mince both by conventional mixing and by spraying into thin ribbons of minced whiting. The spray treatment is designed to incorporate additives without generating excessive shear force which has been shown to be a cause of textural degradation.

We have begun collecting whole goosefish (monkfish) samples in an attempt to solve the mystery of the two sarcoplasmic protein patterns we obtained during the collaborative study of the isoelectric focusing-species identification method. Muscle tissue samples were taken from each fish, and both tissue samples and the whole animal were frozen. After analysis of the tissue samples, the whole fish will be tagged as either "Type A" or "Type B" and submitted for examination at the National Systematics Laboratory.

The Hewlett-Packard (H-P) automatic sampling system was tested and found to be inadequate for our samples. Small amounts of KOH in the solvent were crystallizing between runs causing several bent plungers on the syringes. H-P supplied us, at no extra charge, a new circuit board allowing us to rinse automatically the syringe with solvent between runs. Since the exchange of circuit boards, the auto sampler has worked very well. An ice storage study of fresh whiting was initiated to examine the development of volatile amines.

Product Safety

Workup of samples of hot and cold-smoked sablefish, spiked sablefish, and controls has been completed. Analysis of the above fish extracts for volatile N-nitrosamines by gas liquid chromatography is nearly complete. Work on volatile N-nitrosamines will be terminated at the end of the month. We have finished this work 1 mo ahead of schedule. The only other aspects of this work will be to decontaminate samples, fish extracts, and standard solutions accumulated after 5 yr of work. A final report and submission of data to the US Food and Drug Administration (FDA) and the NWAFC's Seattle Laboratory, and publication of results remain to be finished.

A contract has been issued to Gulf Coast Research Laboratories to collect fish samples in the Gulf of Mexico region.

A new rubidium bead source was installed in the nitrogen-phosphorous detector of the Perkins Elmer Sigma-1 gas chromatograph.

We have received 63 bids for the analysis of polychlorinated biphenyls (PCB) in fish tissues. Many of these were received in the form of proposals. We have carefully and thoroughly reviewed each proposal and bid. We have also made inquiries to Dr. Moemann and Mr. Watts of the USEPA as well as Dr. Trotter and Mr. Kamps of FDA concerning the methodology of the lowest bidder.

Most of the chemicals, glassware, and equipment for the PCB work at the Gloucester Laboratory have been received. Only the micro-column chromatography glassware is needed. We plan to start working on PCB's utilizing the Association of Official Analytical Chemists (AOAC) method the first week of September.

Product Standardization

Information was given to the Air Force member of the Armed Forces Product Evaluation Committee concerning additional species of fish for which new federal catalog stock numbers should be sought. She had been asked by the chairperson of the committee to recommend such action.

A proposed Federal Specification for Scallops was reviewed and comments submitted. A Federal Specification for Fiberboard Shipping Containers for

Foods is being reviewed and comments are being transmitted to the USDA. A new handbook covering the development of federal food specifications is also being reviewed. It will serve as a basis of the new policies and procedures for food specification management by the USDA.

Several trial runs were completed at local fish processors of an intensified candling lens to be used for detecting bones. Full-scale production trials are being conducted to further evaluate this method. A proposed trial of an X-ray technique for detecting bones has been postponed because of an equipment failure.

A storage study of large napes and small nape blocks is underway. They are being tested to evaluate their use in fish sticks and portions. At the end of 4 mo of storage at 0°F, the taste panel results are still satisfactory.

John Ryan gave testimony in a patent litigation concerning fish sticks.

Technical Assistance

Division personnel provided information and technical assistance in the following areas: dogfish; squid; fish species; fishery cooperatives; eels; seawater temperature changes; underutilized species studies; packaging rock lobsters; materials for science classes; sources of training courses for fishermen; requirements of various European countries as to limit of mercury in fish; clear up confusion as to common names of dolphin (Coryphaena sp.); advice on air shipment of live lobsters to Europe; scientific name of butterfish; temperature requirement for shipment of fish to Greece; nutritive value of fish portions; growth of sea urchins; size of South American fish; toxicity of fish viscera; mortality of small lots of lobsters under presumably good temperature conditions; fish sticks and their invention 28 yr ago; determination of Kjeldahl nitrogen in fish samples; handling squid after capture; marketing of squid and whiting; freezing of fish; use of soy products in minced fish; use of the modified LaPine heading and gutting machine to process fish; use of the meat/bone separator in processing fish frames; use of citric acid and chelating agents in fishery products; gutting machines; FDA Standard of Identity for Oysters; information on breeding techniques; processing and sanitation standards from every state; information on Pacific Coast fishermen; information on drum trawling techniques.

Meetings, Talks, Visitors, and Publicity

Dr. Fred King participated in the Torry Jubilee Conference in Aberdeen, Scotland. This conference celebrated the 50th year of activity for the Torry Research Station.

Visitors to the Gloucester Laboratory during August included: Martha Blaxall and Tom Billy from the NMFS Office of Utilization and Development; Mr. Martin Chang of the Taiwan Fisheries Bureau; Mr. Dave Crestin of the Northeast Regional Office, with a trade delegation from Nigeria; Dr. Earl Droessler from the NOAA Administrator's Office; and Thomas Freeman, Donald Fellenz, and John Geminder of the Pfizer Chemical Company, James Ackert of the Gorton Group, and Dr. Herb Hultin of the University of Massachusetts to discuss application of antioxidants to whiting fillets.

Joseph Carver and Perry Lane put on an exhibit and gave out over 1000 samples of marinated squid at the New Bedford (MA) Seafair 1979.

NATIONAL SYSTEMATICS LABORATORY

Shrimps Investigation

Work progressed on the description of a new species of Solenocera from the Indo-West Pacific. Research continued on the systematics of rock shrimps of the genus Sicyonia in American waters. A manuscript on the geminate penaeid shrimp species Parapenaeus longirostris and P. politus was revised.

Other Crustaceans Investigation

A draft was completed of a paper describing a new species, genus, and family of crabs from deepwater thermal vents along the Galapagos Rift. Revised was a manuscript on a taxonomic revision of the crab genus Latreilla. Preparation continued of a manual of temperate-water western Atlantic marine decapod crustaceans.

Pelagic Fishes Investigation

Revision continued on a field guide to tropical Atlantic longline-caught fishes. Also summarized were counts and measurements for three species of Spanish mackerels--Scomberomorus guttatus, S. lineolatus, and S. plurilineatus.

Meetings, Talks, Visitors, and Publicity

Meetings

The Workshop on Systematics of Fishes Living in Cold and Temperate Waters of the World Oceans, a part of the US-USSR agreement on Studies of the World Oceans was held at the University of Maine in Orono. D. M. Cohen and W. Eschmeyer of the California Academy of Sciences served as co-convenors. Participants included six ichthyologists from the USSR, two from Japan, and about 40 from Canada and the US.

D. M. Cohen and B. B. Collette attended the annual meeting of the American Society of Ichthyologists and Herpetologists in Orono, ME. Collette was elected President-Elect of the Society.

Visitors

Dr. Canet was visited by Dr. Omar Jaen, Ambassador from Panama, who is in charge of a symposium on the construction of a sea-level canal which will be held in August 1980 on the occasion of the 100th anniversary of the beginning of the present canal.

A visit was also made by Dr. Matilde Méndez of the Peruvian Instituto del Mar.

Other

D. M. Cohen was asked to serve on the Editorial Board of a new journal, Biological Oceanography.

Publications

Pérez Farfante, I. Catalogo de las especies de camarones comerciales marinos y de aguas salobres de la costa del Pacifico de Latinoamérica, con notas sobre su distribución, habitat y a provechamiento económico. Manuscript submitted to United Nations Food and Agriculture Organization, Rome, Italy. (S)

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Williams, A. B. A new crab family from shallow waters of the West Indies (Crustacea: Decapoda: Brachyura). Proc. Biol. Soc. Wash. 92:399-413; 1979. (P)

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ATLANTIC ENVIRONMENTAL GROUP

Ocean Monitoring and Climatology Investigation

Observations from the deep-sea red crab vessel Clear View IV and URI R/V Endeavor in mid-August allowed us to locate and characterize a Gulf Stream warm-core eddy (79-A) which had been totally undefined in satellite infrared imagery during the previous 6 wk.

During the 5.5 yr that these eddies have been tracked off the Northeast Coast, their disappearance in "clear sky" infrared imagery has been a problem. This is the case particularly off the Middle Atlantic Coast during the summer when surface temperatures of the shelf and slope waters become similar, and about the same as in eddies. Once an eddy has disappeared from the imagery, uncertainty grows from week to week, not only regarding its location, but eventually regarding even its continued existence, unless other data such as shipboard or aircraft XBT's reveal it.

Although no evidence regarding eddy 79-A was available after the end of June, we tentatively located it near Hudson Canyon each week in our analysis charts during July and the first half of August, because experience has shown that these eddies persist until interfered with by the Gulf Stream. This analytical stubbornness paid off, because Mr. William D. Whipple, owner of the F/V Clear View IV, telephoned on 17 August to report that the "doubtful" eddy 79-A on our weekly charts was probably "real." His captain had reported by radio that the currents in the vicinity of his traps southwest of Hudson Canyon had been strong and persistently toward the northeast (opposite of normal) for several days.

That night Clear View IV sailed about 12 mi offshore and located the eddy with XBT's. The next night they repeated this operation and determined that the eddy was moving closer to the location of the traps. Furthermore, when they returned to the gear early on 19 August, the northeast current was found to have strengthened. On the basis of the observations from Clear View IV on 17 August, an AEG staff member, John Hartley, who was aboard the Endeavor, was contacted by radio on 18 August through the assistance of Mr. Clifford Buehrens, the Marine Officer of the URI Graduate School of Oceanography. This resulted in a detailed

XBT section through 79-A during the night of 18-19 August as Endeavor deployed drifting transponding buoys in Deepwater Dumpsite 106. Gulf Stream surface salinities (>36 ‰) were also observed within the eddy. As a result of all these observations, Mr. Whipple decided on 19 August to protect his gear from the currents by moving it into the Hudson Canyon before his vessel returned to port.

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

GULF STREAM EDDY LOCATIONS

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

The continued existence of eddy 79-A remains questionable. Weak thermal contrasts in satellite imagery have provided no evidence during the past thirty days on the location or even continued existence of this eddy.

Eddy 79-B moved southwest about 80 nm (148 km) from its mid-July position to a position west of Atlantis Canyon and far south of the continental slope.

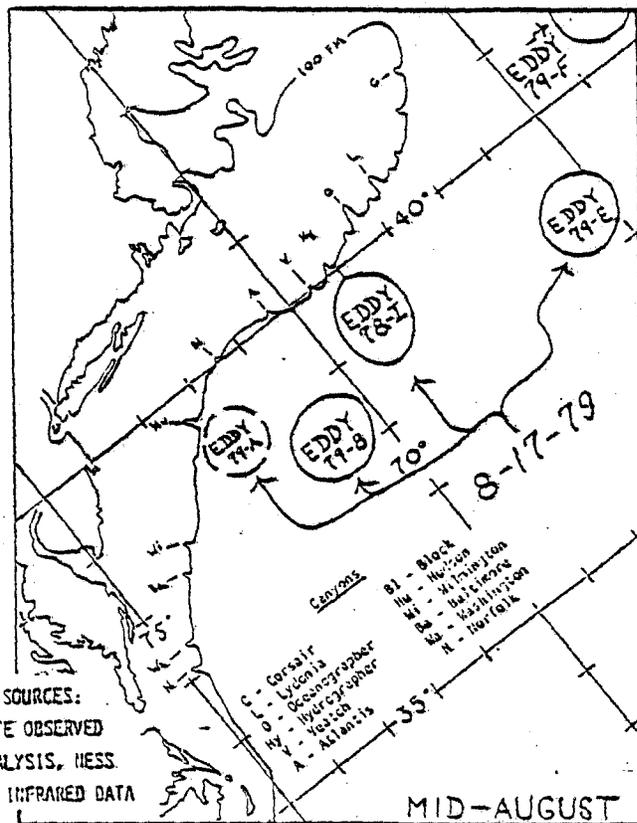
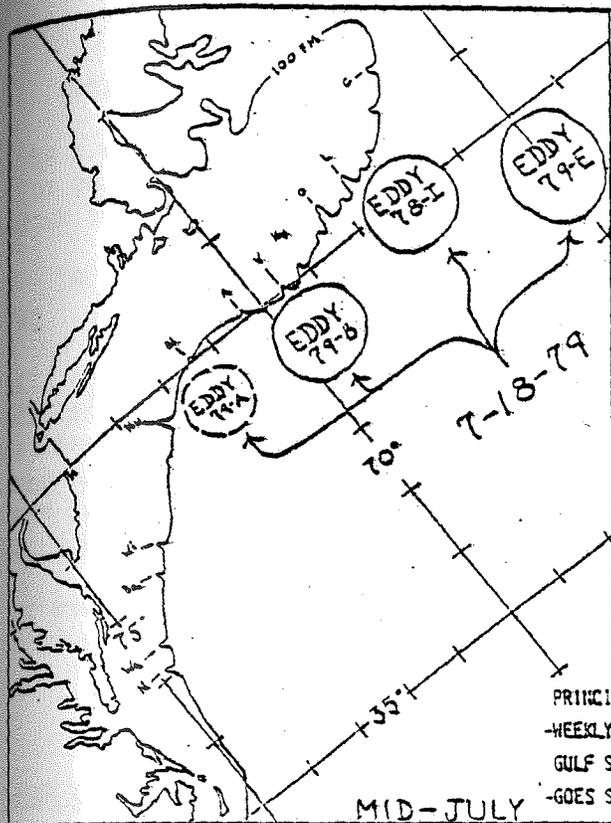
Eddy 78-I moved west-southwest about 100 nm (185 km) since mid-July to a position centered at about 39.2°N , 69.0°W , off Hydrographer Canyon.

Eddy 79-E probably moved west during the latter part of July, and then southeast in early August. In mid-August it was centered at about 38.7°N , 65.5°W , over 140 nm (260 km) southeast of Lydonia Canyon.

A new eddy, 79-F, formed about 30 July far to the east of Georges Bank. Its mid-August position was centered at about 41.0°N , 63.5°W .

During the next 30 days, eddy 79-A, if it still exists, may move southwest to the vicinity of Wilmington Canyon, 79-B to the southwest of Hudson Canyon, but will probably remain far offshore of the continental slope; 78-I approach Block Canyon; and 79-F to the vicinity off Corsair Canyon. Eddy 79-E will probably be absorbed by the Gulf Stream during the next 30 days.

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, RR7, 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).



PRINCIPAL DATA SOURCES:
 -WEEKLY SATELLITE OBSERVED
 GULF STREAM ANALYSIS, N.E.S.S.
 -GOES SATELLITE INFRARED DATA

COASTS
 C - Cassair
 L - Lydonia
 O - Oceanographer
 W - Weston
 A - Atlantic
 B1 - Block
 W - Wiscas
 W - Washington
 B - Baltimore
 N - Norfolk

MID-JULY

MID-AUGUST

The cooperative Ship of Opportunity Program obtained eight XBT and four continuous plankton recorder (CPR) transects in August: two XBT and one CPR transect in the Gulf of Maine; one XBT transect across the Southern New England shelf along the 71°W meridian; two XBT and one CPR transect across the shelf and slope off New York City; one XBT and one CPR transect across the shelf and slope off Norfolk, VA; and two XBT and one CPR transect in the Gulf of Mexico. August marked the commencement of our combined CPR/XBT transects in the Gulf of Mexico. The transect occupied between Galveston, TX, and the Yucatan Straits traversed the Gulf of Mexico, the Loop Current and associated eddies, and finally the tropical Caribbean water masses; the transect should be an interesting addition to our other biological monitoring north of Cape Hatteras.

Ocean Dumping Investigation

The summer RDF buoy experiment at Deepwater Dumpsite 106, which began on 20 August, was not successful due to faulty receivers supplied by the manufacturer (Telecommunications Enterprises of Panama City, FL). However, we will not be charged for the buoys which were used for the experiment. Repair and recalibration of the receivers will be accomplished by the manufacturer at his expense and should be ready for the next scheduled experiment in November.

Meetings, Talks, Visitors, and Publicity

Talbot Murray left Narragansett, RI, from 5 to 10 August on a trip to Maryland, New Jersey, Pennsylvania, and New York to gather information from newspaper files for an Atlantic mackerel study.

Jack Jossi visited Washington, DC, on 7 August to discuss procurement of the Undulating Oceanographic Recorder with headquarters personnel and also to hold a contract meeting with representatives of the Virginia Institute of Marine Science.

John Hartley went to Morehead City, NC, on 9 August and joined the URI Endeavor for the purpose of deploying RDF buoys in Deepwater Dumpsite 106. He returned on 19 August.

From 10 to 13 August, Steve Cook and Bob Benway traveled to Galveston, TX; New Orleans, LA; and Gulfport, MS, to discuss with US Coast Guard personnel the new Ship of Opportunity Program (SOOP) activities in the Gulf of Mexico and to confer with the US Maritime Administration, Delta Steamship Company, and the Louisiana State University SOOP contractor on ongoing SOOP activities in the Gulf of Mexico.

Woody Chamberlin attended a Remote Sensing Workshop held at Estes Park, CO, from 19 to 25 August.

On 27 and 28 August, Jim Bisagni went to Rockville, MD, and from there to Solomons Island, MD, with NOS Ocean Dumping Program personnel to test a pumping system to be used on an upcoming cruise.

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- Cook, S. K.; Hughes, M. M. Water column thermal structure across the shelf and slope southeast of Sandy Hook, NJ, USA in 1978. *Ann. Biol.* 35. (S)
- Cook, S. K.; Crist, R. W. Estimates of bottom temperature from fish captured in lobster traps. *Mar. Fish. Rev.* (A)
- Cook, S. K. The effect of the anomalously cold winters of 1976-1977 and 1977-1978 on the May minimum cold cell temperatures in the Middle Atlantic Bight. *Estuar. & Coast. Mar. Sci.* (S)
- Cook, S. K. Water column thermal structure across the shelf and slope southeast of Sandy Hook, NJ, USA, in 1977. *Ann. Biol.* 34 (Pt. 1): 14-20; 1977. (P)
- Crist, R. W.; Chamberlin, J. L. Bottom temperatures on the continental shelf and slope south of New England during 1978. *Ann. Biol.* 35. (S)

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- Mizenko, D.; Chamberlin, J. L. Gulf Stream anticyclonic eddies (warm core rings) off northeastern United States during 1977. *Ann. Biol.* 34 (Pt. 1):39-44; 1977. (P)

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- 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).
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- 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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