



# NORTHEAST FISHERIES CENTER

## NEWSLETTER

MARCH-APRIL 1982

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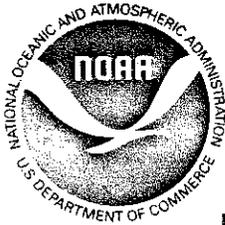
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US DEPARTMENT OF COMMERCE  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
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"NORTHEAST FISHERIES CENTER NEWSLETTER"

The "Northeast Fisheries Center Newsletter" is a bimonthly report on Northeast Fisheries Center (NEFC) activities. Submissions to this report are prepared by the above administrators, and compiled and edited by Jon A. Gibson, Technical Writer-Editor, NEFC.

This report does not constitute a publication and is for information only. All data are considered provisional. Reference to trade names does not imply endorsement.

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# BAY SCALLOP MARICULTURE -- PROGRESS AND PROSPECTS

by

Edwin Rhodes, James Widman, and Patricia Boyd  
Spawning and Rearing of Mollusks Investigation  
Aquaculture Division

## INTRODUCTION

We Americans have long treasured bay scallops (Argopecten irradians) for their simple artistic beauty and delectably sweet flavor. A major oil company has even immortalized them as its corporate symbol. As an item of commerce, bay scallops are important because of their high value. Annual landings from 1976 to 1980 averaged 0.811 million kilograms (1.784 million pounds) of adductor muscle, with an ex-vessel price during 1980 at \$8.84/kg (\$4.02/lb) (National Marine Fisheries Service 1981).

The bay scallop lives only about 20 months before senescence, can spawn only once, and apparently needs eelgrass (Zostera marina) for larval settlement. Understandably, recruitment varies greatly and local populations can explode or crash in a single year. The seasonal income from bay scallop harvests is often the "make-or-break" item in the economic well-being of East Coast fishermen. Thus, poor local harvests can severely impact shoreline communities.

The high value of bay scallops, coupled with their unreliable wild supply, creates interesting biological, economic, and political challenges. Mariculture holds the promise of meeting these challenges by initially stabilizing production, and eventually increasing dramatically total U.S. production. The Northeast Fisheries Center's Aquaculture Division, located at the Milford (Connecticut) Laboratory, has been the U.S. focus of bay scallop mariculture research for the past five years, emphasizing the biological challenge. Below, we look at our progress and prospects.

## PERSPECTIVE

The bay scallop is a prime maricultural candidate (Gates et al. 1974; Webber and Riordan 1976). Its high value, available markets, and rapid growth make it very attractive to mariculturists. Several researchers have induced bay scallop spawning and accomplished larval rearing (Wells 1927; Loosanoff and Davis 1963; Castagna and Duggan 1971; Castagna 1975). Considerable information also exists on other aspects of reproduction (Sastry 1968). Bay scallop seed, in fact, is relatively easy to produce in a shellfish hatchery.

The major impediment to bay scallop mariculture is lack of an effective grow-out method. Castagna and Duggan (1971) and Castagna (1975) showed the feasibility of bay scallop grow-out in pens in Virginia, but the physical and legal requirements for such structures have prevented their use. Our work within the Aquaculture Division has increased the reliability and economy of hatchery seed production, and has yielded effective nursery and final grow-out strategies.

## SEED PRODUCTION AND NURSERY GROW-OUT

We have tried to collect natural bay scallop seed on artificial collector made of various materials, but have had limited success. Even if such collector were feasible, the removal of public seed for private use would undoubtedly cause local excitement! Consequently, we must rely on hatchery seed production for the foreseeable future.

After appropriate conditioning, bay scallops can be spawned year-round. Every individual is hermaphroditic and produces millions of eggs. The larvae grow rapidly in static culture (i.e., in tanks with standing, or nonflowing, water) on cultured phytoplankton. At metamorphosis the larvae attach to the sides of their containers. We then transfer these 0.2-mm scallops to flowing water systems and provide large vertical surfaces for their attachment. By carefully controlling the water flow rate, and by monitoring natural phytoplankton levels and the increasing scallop biomass, we can sustain the rapid growth and produce 3-mm scallops in about five weeks. We can then raise the 3-mm scallops to a larger seed size in: (1) a land-based raceway through which seawater is pumped, or (2) in small-mesh net enclosure suspended in the natural environment.

### Raceways

We have worked long and hard to determine the physical, biological, and economic constraints to raceway culture of bay scallops (Rhodes and Widman 1980; Rhodes et al. 1981). The scallop biomass that can be supported in a raceway using ambient phytoplankton as the food source is not limited by how little space we allow to each animal, but by how fast a water flow we subject them to. Kirby-Smith (1977) reported that flow rates greater than 1 cm/sec reduced scallop growth. In our 1-m-wide and 0.5-m-deep raceways (Figure 1), this flow rate limitation restricts maximum water flow to 200 l/min, and our maximum scallop biovolume to 20 liters per raceway. This biovolume translates to 1.6 million scallops at 3 mm, 60 000 scallops at 10 mm, and 7000 scallops at 20 mm. In the most economically efficient raceway, the water flow rate is controlled so that phytoplankton chlorophyll-*a* levels exceed 1.0 µg/l in the raceway outlet. This "feeding" level assures maximum scallop growth with minimum pumping costs.

### Nets

Alternatively, we can grow bay scallops in small-mesh enclosures. We have commercially available pearl nets (Figure 2) to grow scallops in Long Island Sound. We can plant 4-mm scallops in these nets in the spring at temperatures as low as 5°C without causing death. Scallop biovolumes of 1.5 liters are possible in these pearl nets. This biovolume translates to 4500 scallops at 10 mm and 525 scallops at 20 mm.

The selection of raceway culture or suspension culture for the nursery phase of bay scallop aquaculture will depend upon available sites and pumping and labor costs.

## FINAL GROW-OUT

Initially, we felt the best approach to final grow-out of bay scallops would be some type of bottom culture, perhaps "estuarine ranching." When we first produced large numbers of scallop seed as the result of our raceway experiment in 1977 and 1978, we free-planted them in estuaries in eastern Connecticut. Our observations and some parallel ones by Morgan et al. (1980) showed that predators, chiefly crabs, rapidly destroyed the planted scallops. Mortalities of 90 percent in less than two weeks were common.

The futility of free-planting prompted us to adapt the successful Japanese net culture technique for the Asiatic sea scallop (Patinopecten yessoensis) to our bay scallop. The three years of our experiments with this adopted technique have shown much promise (Rhodes and Widman 1980).

We use commercially available lantern nets (Figure 3) that are 2 m in length, 0.5 m in diameter, and divided into 10 compartments. We anchor the nets to the floor of Long Island Sound and buoy them with styrofoam floats. Our experimental site, about 0.3 km off the Connecticut shore, is in 8 m of water. Bottom anchoring eliminates much of the net bouncing that would occur with surface-buoyed nets; the deployed units are well below the surface and do not interfere with recreational boating or the aesthetics of open water.

Our experiments are targeted for single-season grow-out of bay scallops to market size. Scallop seed, produced from hatchery spawnings between February and April, and grown in raceways or pearl nets until late June or early July, reach a length of 20 mm. Our lantern net experiments start with these 20-mm scallops and identify the stocking density and net handling frequency for best scallop production.

We have found growth at stocking densities between 100 and 2500 individuals per square meter to be inversely related to density. In a single season, densities up to 750 individuals per square meter produce bay scallops with shell heights greater than 50 mm--the minimum market size. Because only the adductor muscle is consumed in the United States, the yield of this tissue is most important. Since adductor muscle weight is highly correlated with shell height (Figure 4), the largest adductor muscles come from scallops grown at the lowest density. However, the moderate adductor muscle size attained by those individuals stocked at a higher density produces a larger total adductor muscle yield per net, but at the expense of a greater number of seed scallops. At 750 scallops per square meter, adductor muscle yields of 3.7 kg (8.1 lb) per net were obtained; at 2000 per square meter, maximum yields of 5.2 kg (11.4 lb) per net were obtained. The costs of seed production and manual labor, including shucking, will decide the more profitable approach: (1) low density culture producing larger individual adductor muscle size, or (2) high density culture producing greater total adductor muscle yield.

The lantern net experiments also show that a single handling of scallops between mid-August and mid-September is best. This handling removes young-of-the-year starfish before they grow large enough to become serious predators. Placing scallops into clean nets at this time also reduces the effects of fouling organisms on the nets. It is convenient to change the stocking density during the net handling. Our results show that densities up to 1500 scallops per square meter can be used initially, and then reduced to 750 per square meter during the net handling.

## PROSPECTS

Several questions remain unanswered; some we are addressing now and some we shall address in the future. We are currently investigating the effects of depth on growth, developing overwintering strategies to improve survival, and investigating the growth of hatchery-reared scallop seed at various geographic locations. We shall likely study, in cooperation with the Division's Aquacultural Genetics Investigation, the use of scallops selectively bred for faster growth. A slight increase in growth rate, due to environmental or genetic improvement, would yield larger scallops, and thus larger adductor muscles, at the end of the first season. This improvement would make financial investment in aquacultured bay scallops considerably more attractive.

The potential production of aquacultured bay scallops is significant. The production level of 3.7 kg (8.1 lb) per net for this lantern net system extrapolates to 188 000 kg/hectare (167 000 lb/acre). An area of only 4.3 hectares (10.8 acres) could theoretically match the total current U.S. production of this species! Of course, we cannot saturate an area with nets without limiting scallop growth and interfering with net handling. However, this system's combination of high production and a low fossil fuel energy requirement for maintaining and harvesting it, seems an appropriate strategy for these times.

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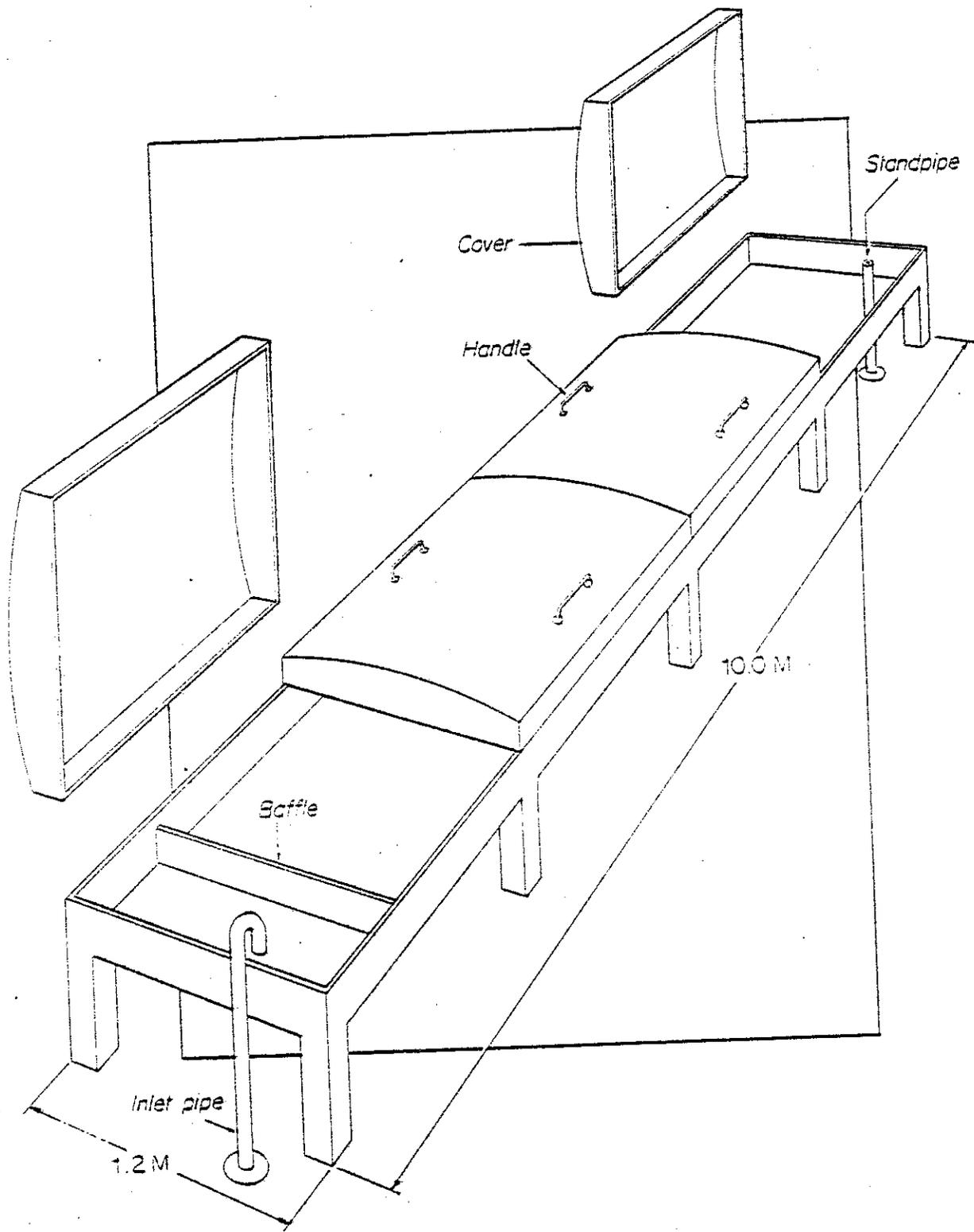


Figure 1. Schematic diagram of single raceway.

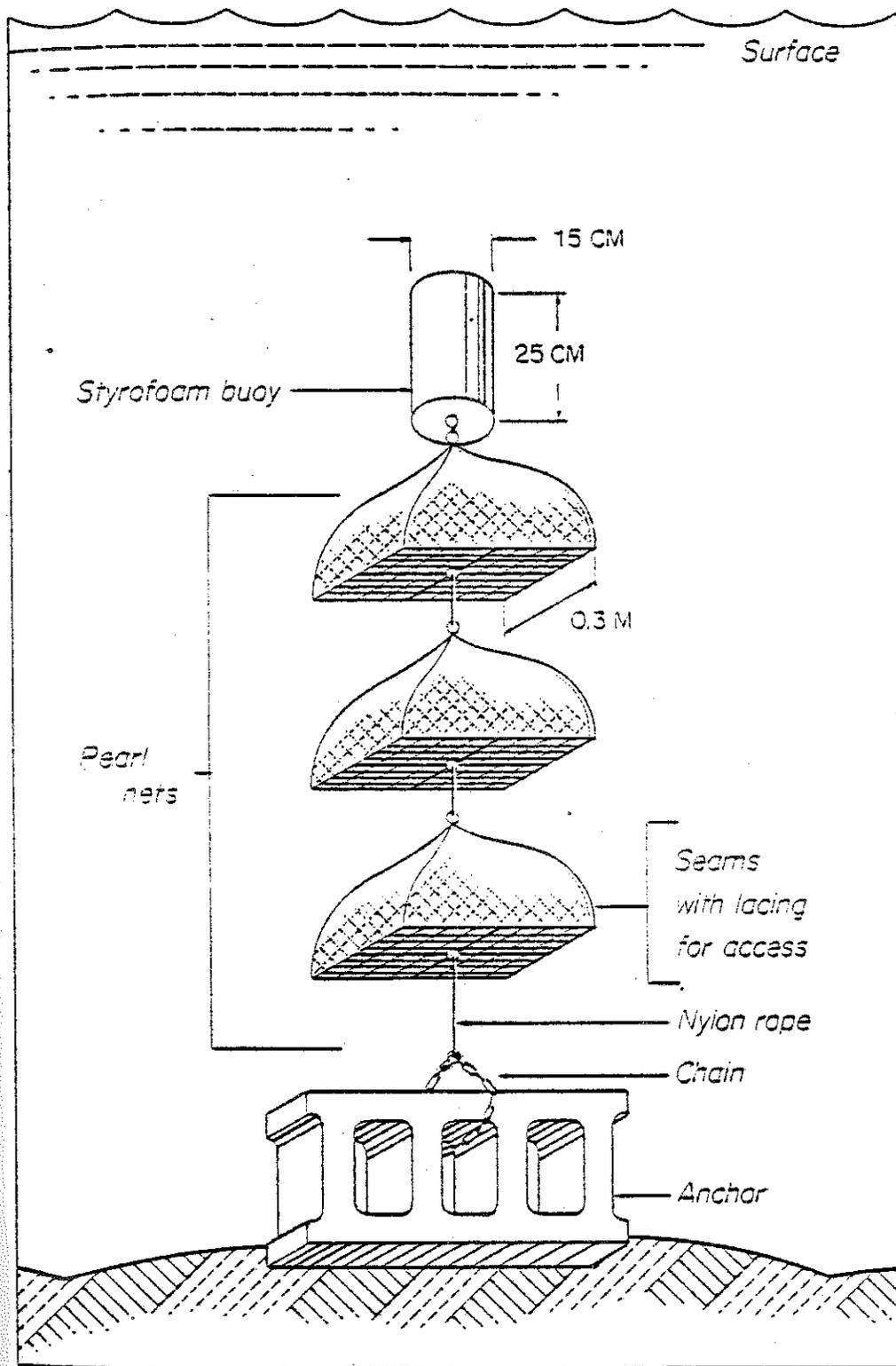


Figure 2. Schematic diagram of deployed pearl net.

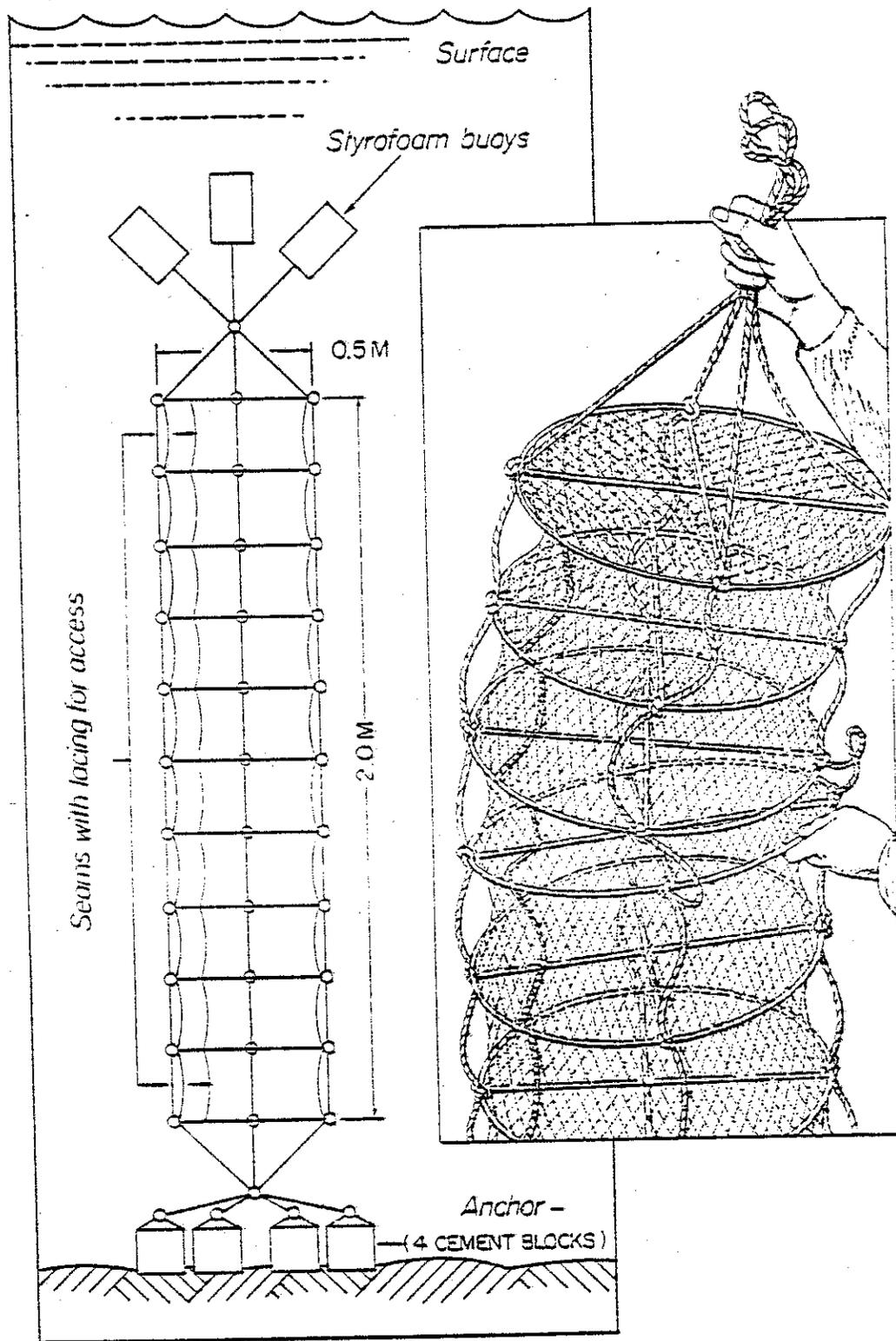


Figure 3. Schematic diagram of deployed lantern net.

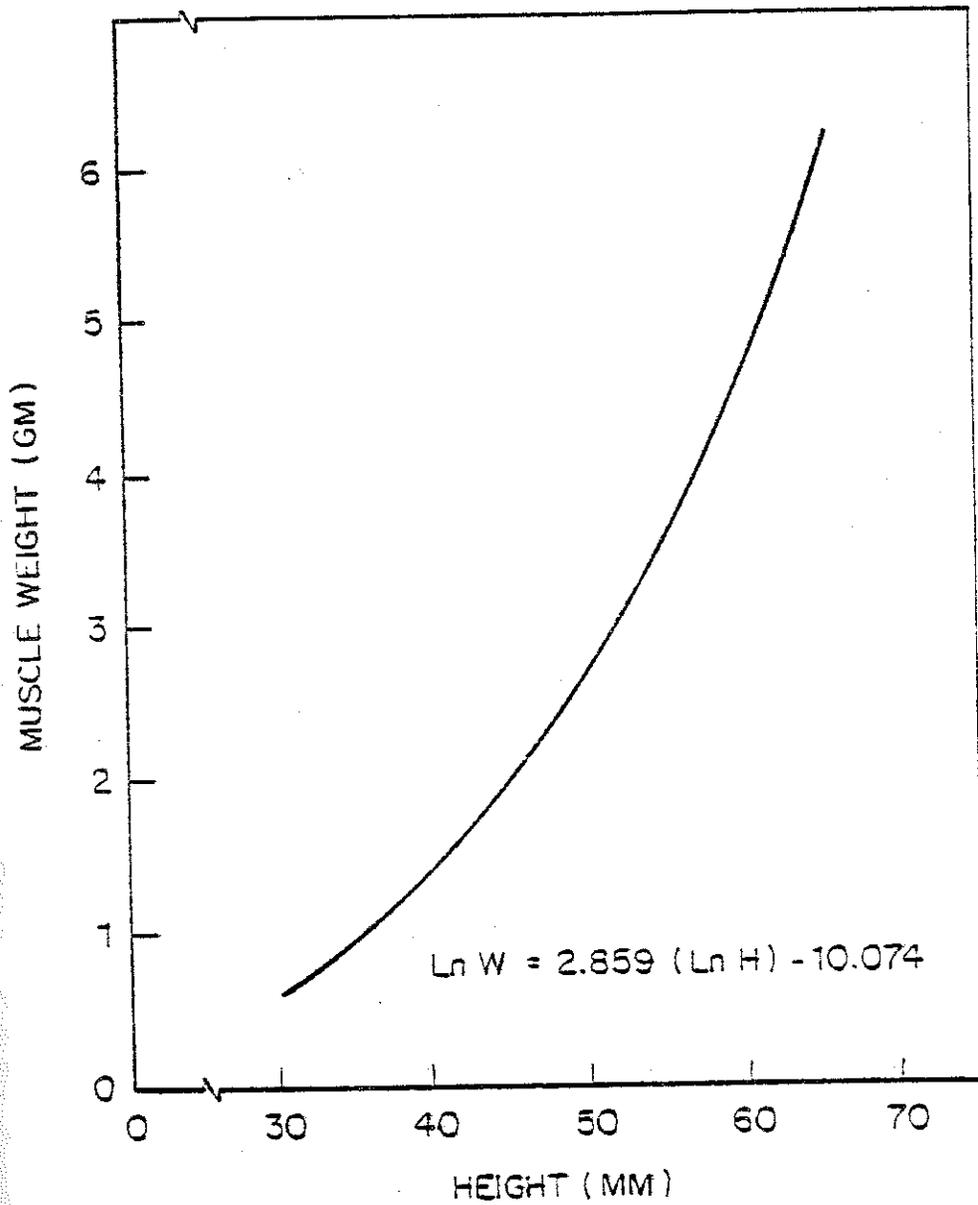


Figure 4. Relationship between bay scallop shell height and adductor muscle weight.

## CENTER DIRECTORATE

### Fishery Technology

Bob Learson traveled to Morocco for 2 wk in March as part of the NOAA/NMFS mission to study Moroccan fisheries. At the request of the Moroccan government, the mission reviewed all aspects of the Moroccan fisheries, ranging from organization of the government's fisheries agency to seafood marketing. Bob visited all major fishing ports to review the capability of the Moroccan industry in processing and preservation, and to make recommendations for quality improvement, increased processing efficiency, and optimum utilization of the resource.

Bob also traveled to Washington, D.C. to attend a series of meetings relating to future directions in fishery product quality, safety, and nomenclature research.

### Publications

SKUD, B. E. Dominance in fishes: the relation between environment and abundance. Science 216 (No. 4542):144-149;1982. (P)

### RESOURCE ASSESSMENT DIVISION

Editor's Note: The following report covers the January-February period. The March-April report will be included in the May-June report.

#### Resource Surveys Investigation

On 18 January, the R/V Delaware II departed from Woods Hole to conduct a bottom trawl survey for Atlantic herring. The survey was conducted in two parts, from 18 to 29 January and from 1 to 12 February. The area surveyed was from Atlantic City, New Jersey, to Mt. Desert Island, Maine, including Long Island, Block Island, Rhode Island, Vineyard, and Nantucket Sounds. The survey was coastal in nature, extending from the minimum depth of about 4 m out to the maximum depth of about 100 m (most tows were shallower than 70 m). During the first three days of Part I, Dr. John Suomala of the Charles Stark Draper Laboratory, and Jim Crossen collected hydroacoustic data using Atlantic herring as targets, and both sonar and conventional and color echo sounding for instrumentation. Chuck Byrne was the Chief Scientist during Part I and Henry Jensen was Chief Scientist during Part II.

Andy Thoms is participating in a U.S.-Poland cooperative Atlantic mackerel research cruise aboard the Polish R/V Admiral Arciszewski. The ship departed Woods Hole on 20 February and is operating in waters from Cape Hatteras to the Hudson Canyon area. The cruise is scheduled to end on 8 March in New York City.

Jim Crossen and John Suomala met with representatives of the Epsco Co. to plan hydroacoustic instrumentation for the U.S.-Poland cooperative Atlantic mackerel research. The Polish ship was outfitted with a color echo sounder and a loran C plotter.

Andy Thoms has started preparations for the surf clam-ocean quahog assessment cruise scheduled for July. A contract was let to refurbish the dredge after the last 3 yr of use. Damaged blade assemblies were repaired, and one new assembly and several blades were fabricated.

Dennis Hansford checked for errors on the master station selection chart overlays used for selecting survey stations. Errors were noted and will soon be corrected.

Warren Handwork completed preparing NEFC-standardized Yankee No. 36 otter trawls for the upcoming spring bottom trawl survey. In addition, he constructed two new trawls for future use.

Don Flescher sent 78 more photographs of fish to the National Fish Academy, located in Leetown, West Virginia, to be included in the American Fisheries Society collection of fish photographs.

Linda Patanjo continued her training in the identification of pathological conditions while visiting the Oxford Laboratory during 24-30 January. In addition, Linda and Dr. Murchelano developed a new pathology sampling protocol for bottom trawl surveys and explained it to potential chief scientists, watch chiefs, and other interested people on 12 February during a pathology workshop.

Many Investigation personnel continue to work on the development of an expanded survey data management system made possible with the change to the new VAX computer system.

### Fishery Biology Investigation

Sherry Sass began aging butterfish from the 1981 fall bottom trawl survey. Aging of surf clams from the winter 1980 cruise was completed, as was part of the summer 1980 cruise. Ms. Sass continued work on the larval-yearling summer flounder age-and-growth project, introducing Jacob Richardson, a cooperative education student from Savannah (Georgia) State College, to aquarium procedures, sampling, and photography. A sample of winter flounder larval otoliths was prepared for scanning electron microscopy, and analysis of all larval winter flounder age-and-growth data was begun for presentation at the April 1982 regional meeting of the American Fisheries Society.

Alicia Kelly and Leslie DeFilippis completed sectioning 1981 fall bottom trawl survey silver hake otoliths and began work with 1981 fall survey red hake otoliths.

Louise Dery completed processing and aging Atlantic mackerel otoliths from 1981 U.S. cruises and the first two cruises of the Polish 1982 winter survey, with appropriate data summaries. All Atlantic herring samples from 1981 cruises were similarly processed and completed. Samples from the 1981 silver hake fall survey were aged and summarized, and work was begun on samples from the 1981 red hake fall survey. On 9 and 10 February, a conference was held with Joe Hunt, a Canadian fish aging expert, concerning Atlantic mackerel aging problems.

Kris Andrade aged for the first time the second quarter 1980 commercial redfish samples. Kris checked Doris Jimenez's aging of fourth quarter 1981 commercial pollock samples (556 fish), checked age sheets and summaries, and sent the coded sheets to the Woods Hole Laboratory Automatic Data Processing (ADP) Unit. Kris also aged, processed on sheets, and summarized pollock samples from Delaware II Cruise No. DE 81-06 and R/V Albatross IV Cruise No. AL 81-13 (152 fish). Data were then sent to the ADP Unit.

Vi Gifford aged for the first time the first quarter 1981 commercial redfish samples (~200 fish). She tentatively aged 300 sea scallop shells from Albatross IV Cruise No. AL ~~80-06~~. Vi also instructed Blanche White in aging techniques for haddock.

Blanche White processed 1125 sea scallop shells, sectioned 272 otoliths, and logged incoming samples from Delaware II Cruise No. DE 82-01. Blanche and Vi aged 224 haddock samples from Delaware II Cruise No. DE 81-06 for the first time.

For the first 3 wk of January, John Ropes and three volunteer students from Fairfield University worked on preparations of ocean quahog shells for identifying growth marks. John prepared preliminary reports on the development of a method to obtain sections from 40-62 mm surf clams from rearing experiments at the Milford Laboratory, and on a procedure for logging and storing ocean quahog shells collected during resource assessment surveys.

Gary Shepherd, a graduate cooperative education employee from Rutgers University, worked with Ambrose Jearld on analysis of surf clam data from University of Maryland Eastern Shore (UMES) samples off the Delmarva Peninsula. Gary measured and back-calculated chondrophore sections for 10 UMES surf clam samples. Gary is testing an analysis designed to compare growth rates between samples. He entered cruise data and length at age for 385 samples and edited the data set. Gary also assisted in training Jacob Richardson, a cooperative education employee from Savannah (Georgia) State College, in the use of the computer. Gary went on the last leg of the winter bottom trawl survey cruise.

### Fishery Assessment Investigation and Senior Assessment Scientists

Mike Sissenwine expanded the NEFC's static energy budget for Georges Bank to include young (preexploitable) fish. These young fish are the primary prey of silver hake. The analysis indicated that predation mortality on young fish is very high and that year-class strength may be established during the post-larval stage, not the larval stage, as had usually been assumed.

Vaughn Anthony supervised the printing and distribution of the "1980 Status of the Stocks" document.

Emory Anderson sailed from Boston aboard the Admiral Arciszewski with Bob Rak for the first leg of the Atlantic mackerel survey (21 January-3 February). Virtually the remainder of his time during January-February has been devoted to handling day-to-day activities of two Polish vessels and/or discussing plans, activities, problems etc., of this work with Woods Hole Laboratory and Center staff. He has also had telephone interviews with Richard Holmes, reporter for the Cape Cod Times newspaper, and Jon Laitin, a field editor for National Fisherman, regarding the joint U.S.-Polish Atlantic mackerel survey.

Steve Clark initiated work on haddock assessment with Ralph Mayo and Wendy Silvia. He completed the U.S. contribution to the International Council for the Exploration of the Sea's Shellfish Committee Administrative Report for 1981 with Mike Castagna of the Virginia Institute of Marine Science and Judith Brownlow of the Woods Hole Laboratory.

Fred Serchuk continued preparation of 1982 sea scallop assessment analyses (with Bob Rak) and updated analyses of Atlantic cod and American plaice survey data to include 1981 NEFC and State of Massachusetts bottom trawl surveys (with Bob Rak and Judy Penttila). He completed an analysis of Delaware II and Albatross IV gear comparison experiments with respect to Atlantic cod catches in paired tows by both vessels. Both numbers and weight were analyzed. Two-way analyses of variance using a randomized completed block design indicated that the Delaware II caught significant ( $P < 0.01$ ) more cod (numbers and weight) than the Albatross IV. A total of 43 tows were performed on Georges Bank and in Southern New England during the gear comparison experiments (2-13 November 1981). He initiated (with Judy Penttila) research on Atlantic cod growth on Georges Bank and in the Gulf of Maine during 1970-81 through analysis of research vessel bottom trawl survey data. He also summarized Atlantic cod and sea scallop commercial sampling data (size-frequency samples) for 1960-81 to review past sampling performance and formulated 1982 sampling requirements for

both species based on projected 1982 landings and distribution of landings by port. Shell height-meat weight relationships were computed (with Bob Rak) from data collected from the Gulf of Maine during the January cruise on the Delaware II (N. DE 82-01). Fred also reviewed the final fishery management plan for Atlantic scallops and provided comments to the Northeast Regional Office's Plan Review Team Leader and provided the Regional Office with written prognosis of expected sea scallop recruitment patterns in U.S. Northwest Atlantic fisheries during 1982.

Fred Serchuk provided a considerable amount of data and information to scientific and technical constituents. Specifically he provided: (1) Arthur Gaines of the Marine Biological Laboratory in Woods Hole with background on management techniques used in managing surf clam populations (18 January); (2) Linda Barris, a Shellfish Warden from Hull, Massachusetts, with information on possible management strategies applicable for surf clam management of Hull's inshore surf clam resources (19 January); (3) Dan Schick, a fishery biologist with the Maine Department of Marine Resources, with Gulf of Maine sea scallop shell height-meat weight relationships (20 January); (4) James Costakes of the New Bedford Seafood Producers Association with information on recent events in the South Atlantic calico scallop fishery (20 January); (5) Ken Mallory of the New England Aquarium with assessment data on Atlantic cod abundance and fecundity (28 January); (6) Mike Foley of the Foley Fish Company in New Bedford, Massachusetts, with a report on a profile of the calico scallop fishery (29 January); (7) Ginette Robert, a sea scallop biologist with Fisheries and Oceans Canada, with U.S. research vessel sea scallop survey data (8 February); (8) James Costakes with a summary of NEFC data on ovary weight-mean weight relationships for sea scallops (19 February); (9) Richard Langton, Research Director of the Maine Bureau of Marine Science, with a summary of NEFC data on ovary weight-meat weight relationships for sea scallops (18 February); (10) Dan Reifsnnyder of the NMFS Central Office with information on recent developments in the George Bank sea scallop fishery (19 February); (11) J. J. Maquire, a cod biologist with Fisheries and Oceans Canada, with NEFC bottom trawl data on Atlantic cod catches in all spring and autumn surveys (22 February); (12) Bent Magelberg of the Gloucester Corporation in Lynn, Massachusetts, with calico scallop information (24 February); and (13) New England Development Foundation, Quality Enhancement Project personnel with calico scallop data (26 February).

Mike Fogarty prepared American lobster and preliminary Atlantic herring assessments.

Anne Lange participated with Joan Palmer on a joint Japan, U.S., Canada squid cruise for larval and spawning adult shortfin squid (Illex illecebrosus) in the slope and Gulf Stream waters from north of Cape Hatteras to the Scotian Shelf. She prepared for the Regional Office a summary of data which could be obtained during proposed squid joint venture and responded to a request regarding squid catch per unit of effort for the Financial Services Branch of the Regional Office.

Ralph Mayo redrafted the paper on trawl escapement and discard, and completed a second draft of the scup assessment paper. He converted from the Sigma 7 to the VAX computer the stock prediction program and the catch percentage program. He also prepared graphics for a presentation at the American Fisheries Society's Northeast Division meeting.

Bill Overholtz continued work on describing recent multispecies research ideas. He participated in the joint U.S.-Poland Atlantic mackerel research cruise aboard the Admiral Arciszewski. He, with Ralph Mayo and Karen Johnson, converted John Ropes' multispecies cohort analysis program to the VAX computer. He also continued preliminary work on updating the yellowtail flounder assessment.

Joan Palmer participated as a member of the scientific party on a squid survey aboard the Japanese R/V Kaiyo Maru.

Judy Penttala calculated stratified mean number of fish caught per tow at age for Atlantic cod from the 1981 fall bottom trawl survey of the Georges Bank and Gulf of Maine areas. She summarized the number of commercial cod samples for each statistical area by market category and the number of American plaice age samples collected on survey cruises by cruise and area. She also summarized catch and effort data for sea scallops by year and month to determine seasonality of catches. She began reviewing available information on cod growth and updated summaries of age data and calculated mean lengths at age by four different methods for a sample set of data to see which method gives the best results. Gordon Waring participated in the joint U.S.-Poland cruise aboard the Admiral Arciszewski.

### Publications

SISSEWINE, M. P. An overview of some methods of fish stock assessment. Fisheries 6(6):31-35;1981. (P)

SISSEWINE, M. P.; KIRKLEY, J. E. Fishery management techniques: practical aspects and limitations. Mar. Pol. 1982 Jan.:43-57. (P)

### Reports

ELESCHER, D. D. Research vessel cruises 1948-1981. Woods Hole Lab. Ref. Doc. No. 82-02; 1982.

ELESCHER, D. D. Fish identification in the western North Atlantic: a bibliography. Woods Hole Lab. Ref. Doc. No. 82-04;1982.

### MANNED UNDERSEA RESEARCH AND TECHNOLOGY PROGRAM

No report received. The March-April report will be included in the May-June issue.

### MARINE ECOSYSTEMS DIVISION

#### Ichthyoplankton Investigation

Our winter MARMAP I (Marine Resources Monitoring, Assessment, and Prediction Program) survey ended on 24 March off North Carolina. Weather improved during the survey, allowing us to complete 138, or 84%, of the 165 MARMAP stations. We observed an increase in abundance of sand lance larvae in the Middle Atlantic subarea, but it does not appear from preliminary observations that their overall abundance will approach observed levels of the past several years. Catches off Southern New England, where the larval population has been centered since 1976, were sharply reduced.

By the end of April, we were completing the final leg of the early spring MARMAP survey. The NOAA R/V Delaware II was working in the western part of the Gulf of Maine. The ichthyoplankton survey group was represented by Myron Silverman and Don McMillan. They reported fish eggs and larvae were scarce, with some gadid larvae observed in samples taken at stations around the periphery of the Gulf. As this

survey draws to a close, preparations are underway for our next survey which begins in mid-May. With the cruise limited to 23 days, we must count on good weather to complete three of the four MARMAP analytical subareas.

Myron Silverman completed a first draft of a manuscript describing the distribution and abundance of silver hake larvae collected on MARMAP surveys between 1975 and 1980. Wally Smith worked with Patty Schaeffer to round up available information on fish eggs and larvae collected in the vicinity of the 106-mile Dumpsite. Together they have managed to corral information from 16 cruises that collectively sampled slope waters around the dumpsite during 10 mo of the year. In addition to working on site-characterization reports for offshore dumpsites, Wally provided EPA personnel in Philadelphia with several papers describing seasonal patterns of distribution and abundance of fish eggs and larvae in the Middle Atlantic Bight. This information was sought in relation to oil exploration along the outer edge of the continental shelf. Representatives of Dames & Moore, Inc., visited the Sandy Hook Laboratory to discuss the distribution of marine organisms on Georges Bank. We gave them papers dealing with the distribution of eggs and larvae of Atlantic cod, haddock, yellow flounder, butterfish, sand lance, Atlantic mackerel, and Atlantic herring.

Mike Fahay received comments from nine of the twelve reviewers that criticized his guide to the identification of larval fishes. He spent most of the month of April incorporating the necessary revisions and plans to submit the guide for publication by mid-May. The guide has taken several years to pull together. It is an exhaustive compilation of both published and unpublished accounts of the description of young fishes and includes information on more than 290 taxa.

We have acquired some additional space adjacent to our ichthyoplankton laboratory which will be used to house our expanding collection of eggs, larvae, and juvenile fishes taken on MARMAP surveys between Cape Hatteras and Nova Scotia. Shelving will be installed within the next 2 mo and we hope to have our collections in order by year's end. Mike Fahay has assumed responsibility for overseeing necessary renovations, archiving our samples, and meeting requests for study collections.

## Larval Fish Dynamics Investigation

### Experimental Studies

Studies of larval sand lance growth and development were continued and data analyses begun. Larval feeding experiments showed direct linear relationships between plankton density, growth rate, and larval RNA-DNA ratio. Significant growth and survival were observed at the lowest plankton density tested (200 plankters per liter). Initial estimates of larval sand lance growth rates were 0.046, 0.058, and 0.12 mm/day at 2°, 4°, 7°, and 10°C, respectively. Schooling behavior was first observed when sand lance reached 2.0 - 2.5 cm.

Adult yellowtail flounder were brought into the lab and spawned at temperatures between 5° and 6°C without hormone injection. In addition to our in-house studies, preserved specimens and live larvae are being supplied to the Woods Hole Oceanographic Institution for predation studies, to EPA for toxicological studies, to Sandy Hook Laboratory for studies of otolith daily growth increments, and to the University of Rhode Island's Graduate School of Oceanography for electrophoretic studies of stock identification.

Biochemical analysis of striped bass samples from our joint study with U.S. Fish and Wildlife Service's Columbia National Fisheries Research Laboratory was completed. Results from this study are being synthesized for presentation at the Striped Bass Symposium scheduled for the American Fisheries Society's annual meeting.

next fall. Studies of the effects of different types of preservation on the stability of larval nucleic acid content are in progress. Data entry and editing were completed for zooplankton samples from Soviet R/V Evrika Cruise No. 80-01. Data analysis is in progress.

Geoff Laurence participated in NOAA R/V Albatross IV Cruise No. AL 82-04, and studied the entrainment of larval fishes by warm-core rings.

### Population Processes

George Bolz and Greg Lough completed revisions on the ichthyoplankton manuscript based on collections under the auspices of the International Commission for the Northwest Atlantic Fisheries (ICNAF) and submitted it for publication. This report constitutes a major summary of the ICNAF larval Atlantic herring data base and confirms the clockwise circulation pattern on Georges Bank. George prepared a number of Atlantic cod and haddock otoliths for scanning electron microscopy analysis of daily growth increments, and he is in the process of writing a first-draft paper on larval Atlantic cod and haddock growth based on the otolith work. Greg Lough spent much of April on assignments relating to the U.S./Canada boundary issue: two reports were prepared by Greg Lough and George Bolz. Dave Potter and Greg Lough completed a revision of a manuscript on the vertical distribution of larval Atlantic herring and their prey based on a series of MOCNESS (multiple opening-closing net and environmental sensing system) hauls from a 1977 experiment on Nantucket Shoals. Peak larval feeding occurred from noon through sunset, and more than 50% of their prey items were the copepods Pseudocalanus sp. and Centropages typicus. Dave also entered larval catch data on computer from MOCNESS hauls made on Albatross IV Cruises No. AL 78-02, AL 78-13, AL 78-14, and AL 78-15, as well as assisting Cabell Davis with final computer plotting routines for his Ph.D. thesis.

Roz Cohen turned in a second draft of the zooplankton data report (based on 1974-76 collections with 0.333-mm-meshed nets under the auspices of ICNAF) for final typing, and did preliminary work on stage separation of Centropages spp. and gut analysis on specimens. Most of her time was spent in selecting a population project model suitable for copepods with continuous cohorts, overlapping generations, and classified by stage instead of age.

Peter Donnelly and Philip LeBlanc completed the sorting, identification, and measurement of all ichthyoplankton from Albatross IV Cruise No. AL 81-05 sampled by 1-m MOCNESS and bongo nets. In early April, they traveled to the Sandy Hook Laboratory to confirm the identification of larvae and juvenile fish with Tom McKenney. Some rare tropical species were found on the southeast part of Georges Bank in May 1981, evidently transported there by the impingement of Warm-Core Eddy No. 81-C.

Hal Merry and Dave Potter have been making extensive preparations for the upcoming warm-core ring and larval dynamics cruises. Dave participated on the initial warm-core ring cruise (Albatross IV Cruise No. AL 82-04) during 19 April-4 May as a MOCNESS operator.

### Fishery Oceanography Investigation

During March, the Fishery Oceanography Investigation concentrated on three activities: moving, a MARMAP I survey, and preparations for the first warm-core ring cruise in April. As part of the rearrangement of offices in the main building of the Woods Hole Laboratory, Steve Ramp, Art Allen, Dan Patanjo, Tom Laughton, and Catherine Jewell moved from the third to the first floor. Tom Laughton, Dan Patanjo, and Dana Densmore made hydrographic observations on the second leg of the MARMAP survey on Albatross IV Cruise No. AL 82-02. Catherine Jewell replaced Tom on the third leg for her first time at sea.

Preparations for the first warm-core ring cruise concentrated on instrument and mooring hardware. Gil Dering prepared and checked the vector-averaging current meters to be deployed, while Tom Laughton coordinated efforts to refurbish the guard buoys to be used. Steve Ramp completed the mooring design calculations. Schlitz and David Mountain met with H. C. Boyar and LCDR Frank Arbusto to review ship requirements for the cruise.

Four abstracts were submitted to the spring meeting of the American Geophysical Union to be held in Philadelphia during 31 May-4 June. A special session of the meeting is dedicated to Georges Bank and two of the abstracts are for invited talks at the session.

During April, the Investigation concentrated on two activities: the first warm-core ring cruise and contributions to the preparations for the U.S.-Canada boundary dispute. The cruise took place from 19 April to 4 May. Entrainment features at rings 82-A and 82-B were surveyed using CTD (conductivity, temperature, depth), MOCNESS, and bongo nets. In addition, current-meter moorings were deployed along and across the shelf near the beginning of the entrainment feature of ring 82-B.

### Apex Predators Investigation

In March, we received information regarding 10 tag returns, including 6 from blue sharks and 1 each from the following species: tiger, sandbar, longfin mako, and shortfin mako. One of the blue sharks recaptured was at liberty for 22 mo. Another blue shark traveled from Montauk, New York, to Trinidad in 7 mo. (2310 mi). A NMFS observer tagged the longfin mako, which was recaptured by a Japanese longline fisherman 510 mi east of the tagging site after being at liberty for 10 mo. The tiger shark was at liberty for 8 mo during which time it traveled 315 mi from Charlotte Harbor, Florida, to Cayo Caimon, Cuba.

In April, information on 15 recaptures was received including: 4 blue sharks, 2 night sharks, 2 blacktip sharks, and 1 each for a tiger, nurse, sandbar, and shortfin mako shark, and an amberjack. Two of the blue sharks provided the longest distances traveled of all April recaptures. One traveled from off Block Island, Rhode Island, to the Azores, a transatlantic journey of 2357 mi in 954 days (31 mo). The other long distance blue was tagged off Montauk and was recaptured east of French Guiana on the northeast coast of South America, a distance of 2178 mi covered in 593 days (19 mo). The remaining blue sharks traveled from North Carolina to Georgia and from off Block Island to Florida. Both night sharks were tagged off Ft. Lauderdale, Florida; they traveled approximately 300 mi in opposite directions to Key West, Florida, and Brunswick, Georgia, respectively. The tiger sharks provided the third longest distance traveled--1556 mi, from North Carolina to Trinidad in 458 days (15 mo). Both the mako and the sandbar were at liberty for approximately 6 mo and traveled from Block Island to North Carolina (523 mi) and from Shinnecock, New York, to North Carolina (350 mi), respectively. The remaining recaptures of blacktip and nurse sharks showed very localized movements.

Two research reports, "Age and Growth of the Shortfin Mako" and "Age and Growth of the Sandbar Shark" are nearing completion. Much time was spent reworking these manuscripts in light of comments made by participants in the International Workshop of Age Determination in Pelagic Fishes where both papers were given in Miami, Florida, during February. Wes Pratt and Jack Casey each reviewed four papers from this workshop for its published proceedings. Wes also reviewed a manuscript for the Fishery Bulletin.

Alan Lintala began histological preparation of vertebrae from 50 tag-recaptured blue sharks for an age-and-growth project with Wes Pratt and Jack Casey.

Our annual summary newsletter, The Shark Tagger, was completed during the first week of April and was mailed to our 2500 cooperating sports fishermen.

In April, Chuck Stillwell and Nancy Kohler prepared a research proposal in preparation for a cooperative food habits study to be conducted at the New England Aquarium in Boston. Attempts will be made to measure food consumption using different feeding regimes and total intestinal evacuation rates of sandbar sharks.

Nancy Kohler continued to search for available ADP programs to develop an in-house library of working programs relating to age-and-growth analysis in fishes. A few of the programs have been applied to the shortfin mako shark age-and-growth study being conducted by Wes Pratt.

### Plankton Ecology Investigation

Jack Green provided assistance and advice in March on zooplankton distribution to Gary Carter and Ralph Owen of the University of Rhode Island's (URI) Cetacean and Turtle Assessment Program (CETAP).

During the month of April, Jack Green and Joe Kane participated in the warm-core ring cruise (Albatross IV Cruise No. AL 82-04) along with Geoff Laurence from the Narragansett Laboratory. Significant numbers of shelf zooplankton were taken in entrained water with the MOCNESS. Samples showed a clear demarcation of the fauna as the MOCNESS tow profile crossed from warmer slope water to cold entrained shelf water.

Joe Kane has completed his first draft of a report on larval haddock and Atlantic cod feeding from experiments on the Soviet Eureka Cruise No. 80-02. Jack Green has been analyzing pump data from this same cruise. Jack has also been working with the Dames & Moore, Inc., representative along with Donna Busch on the Soviet data. Work continues on the Henry Bigelow data with Jack Green and Paul Fofonoff, working on means of comparing this large data collection from 1929 to 1932 to the MARMAP data for the same geographical area.

In March, Carolyn Griswold reviewed and prepared comments on NOAA's Pollution Program Plan. She prepared a bibliography on gelatinous zooplankton which should aid in the identification process by the Polish Plankton Sorting and Identification Center. She talked to several people about the ongoing siphonophore problem to fisheries in the Gulf of Maine and prepared a memo which went out as a "Red Flag" report. From 20 to 26 March, she participated in a bottom trawl ichthyoplankton cruise on the Delaware II.

Carolyn provided Fred Fairchild of CETAP with information on squid abundance and distribution.

### Biostatistics

The months of March and April saw trenching and installation of polyvinyl chloride conduit. Optical cable was run through the conduit and a multiplexer in the Biostatistics trailer now provides a 24-hr link to EPA's computer. Optical cable was also installed to link the Apex Predators Investigation and Atlantic Environmental Group to the multiplexer. Biostatistics and the System Support Group are linked to the multiplexer via metallic cable.

Much time was spent providing data printouts and data-base searches for Dames & Moore, Inc.

The MARMAP Ecosystem Data Base User's Group (MEDBUG) was formed. Serving as a communication medium, MEDBUG held its first meeting on 2 April 1982.

Tom Plichta worked with Jim Sargent of the Woods Hole Laboratory to generate taped copies of data.

The System Support Group made modifications to the General Reformatting System to: (1) allow two optional haul-factor calculations, and (2) resolve problems encountered in older master files.

Julien Goulet drafted a report on ichthyoplankton dominance in the U.S.-Canada boundary region. There were very interesting differences in the number of taxa, total abundances, percentage of overlap of species compositions, etc.

### Image Analysis

Ray Maurer attended a meeting of the User's Group Executive Board for the new EPA/NMFS DEC network. User needs, including training and terminals, were discussed and prioritized. Ray Maurer provided advice on zooplankton identification to Gary Carter of CETAP. He met with Alex Poularikas and Costes Katsinis of URI on 23 April to review the status of hardware acquisition for the automated plankton processing system. The following components have been delivered and interfaced: Cohu camera, color coder for gray-scale analysis, color monitor, frame grabber, A/D converter, Eclipse computer, and one microcomputer. The remaining five microcomputers are awaiting preparation of printed circuit boards. Mark Berman of URI and Ray will work with the engineers through the summer, perfecting image formation and algorithms for classifications. Mark will provide the necessary software to transfer data to the computer, to perform statistical analysis, and to format output.

On 27 April, Ray and Mark met with John Pijanowski of NOAA's Office of Ocean Technology and Engineering Services (OTES) to discuss development of the plankton processing system. After a tour of the OTES engineering lab and an explanation of how the newest NOAA reorganization would affect OTES, details of system development were discussed. Topics included space requirements, sample preprocessing, system "front-end," and data analysis.

Ray provided information on Atlantic herring and Atlantic mackerel interactions to Dr. Constantin Maxim of the Institutul Roman de Cercetari Marine (Romania). Information on the automated plankton processing system was provided to Dr. Tony Kos of Dalhousie University. Also, a package of silhouette photography was prepared for John Pijanowski. On 28 April, Ray Maurer and Arlene Longwell outlined a study to determine the feasibility of processing sperm samples with the image analysis system.

### Ecosystem Dynamics Investigation

Mike Pennington continued his assessment of the variability of the MARMAP surveys. He also began studying the effects of the uncertainty associated with the input parameters of the model GEORGE on the outputs.

Ed Cohen worked on getting initial conditions for the model for the sensitivity analysis. He also worked on an invited paper (with Dave Mountain) on "Biological Implications of Georges Bank Physical Oceanography" for the annual meeting of the American Geophysical Union.

Ray Bowman prepared a master plan for future studies to be undertaken by the feeding ecology project. He also finalized a sampling protocol designed to satisfy many of the future work objectives to be accomplished. Ray completed a paper entitled, "Evaluation of the Results of Analyses of the Stomach Contents of Silver Hake (Merluccius bilinearis) Aboard Ship and in the Laboratory Ashore." Data presented in the paper suggest that examination of fish stomach contents at sea

a viable method for obtaining fish feeding information on many species of fish caught over a broad geographic range. Summarization of data obtained from examining stomach contents at sea and in the lab showed there was little advantage to preserving large numbers of stomachs at sea for subsequent examination ashore.

Bill Michaels began summarizing food data on 17 fish species for yearly food comparisons (1973-76). Bill continued coding logsheets for the 1977-80 data base and prepared supplies for upcoming bottom trawl surveys.

Wendell Hahm finished a research document describing the model GEORGE. This document describes the assumptions made in the model and also serves as a user's manual. He also finished a manuscript describing the feeding relationships of fish on Georges Bank. This manuscript is coauthored by Dr. Richard Langton at the Maine Department of Marine Resources' Boothbay Harbor Laboratory.

The beginning of March for Roger Theroux, Charlie Wheeler, Tom Morris, and Wendell Hahm was devoted to moving.

Roger spent the remainder of March in meetings, conferences, and data retrieval from the benthos data base as a result of these meetings. Also, work began on outlining graphics needs for the "Bottom Animals" chapter of a book on Georges Bank for which Roger is a chapter editor.

Charlie Wheeler completed a report on green crabs for the 3-yr study, 1979-81. He also finished a report summarizing temperature and weather observations for 20 yr of data. It includes a comparison with a similar record compiled at Boothbay Harbor, Maine.

John Hauser completed the recovery of files lost from conversion to a VAX disc. He also wrote a program for Roz Cohen to calculate eigenvectors and eigenvalues.

Tom Morris made distribution charts for witch flounder and American plaice in preparation for publication on comparative flounder mouth morphology. He also continued literature review of feeding ecology publications and began entering references on a VAX terminal.

### Publications

ALLEN, A.; SCHLITZ, R. Wind-driven currents on the northern side of Georges Bank. 1982 May 31-June 4; American Geophysical Union Spring Meeting.

(Abstract.) (S)

BOLZ, G. R.; LOUGH, R. G. Retention of ichthyoplankton in the Georges Bank region during the autumn-winter seasons 1971-1977. (MARMAP Contrib. No. MED/NEC 82-25;1982. 17 p.) J. Northw. Atl. Fish. Sci. (S)

BUCKLEY, L. J. Effect of temperature on growth and biochemical composition of larval winter flounder, Pseudopleuronectes americanus. Mar. Ecol.--Prog. Ser. (A)

CASEY, J.; PRATT, H. W.; STILLWELL, C. The shark tagger. Annual summary newsletter; 1981. (P)

DAVIS, C. S. Processes controlling zooplankton abundance on Georges Bank. Woods Hole, Mass.: Boston University Marine Program;1982. Ph.D. Thesis.

FAIRBANKS, R.; BAKER, T.; MOUNTAIN, D.; KALIBAS, G. Georges Bank circulation:  $H_2^{18}O$ --salinity tracer. 1982 May 31-June 4; American Geophysical Union Spring Meeting. (Abstract.) (S)

- KENDALL, A. W., Jr.; NAPLIN, N. A. Diel-depth distribution of summer ichthyoplankton in the Middle Atlantic Bight. Fish. Bull. 79(4):705-726;1981. (P)
- MOUNTAIN, D.; COHEN, E. Biological implications of the Georges Bank physical oceanography. (Invited.) 1982 May 31-June 4; American Geophysical Union Spring Meeting. (Abstract.) (S)
- RAMP, S.; SCHLITZ, R.; WRIGHT, W. R. The influence of Northeast Channel flow on the general circulation of the Gulf of Maine-Georges Bank region. (Invited.) 1982 May 31-June 4; American Geophysical Union Spring Meeting. (Abstract.) (S)
- SMITH, W. Sand lance abundant; Atlantic herring larvae disappear. Coast. Oceanogr. Climatol. News 4(2):21;1982. (P)
- STILLWELL, C.; KOHLER, N. Food, feeding habits and estimates of daily ration of the shortfin mako (Isurus oxyrinchus) in the Northwest Atlantic. Can. J. Fish. Aquat. Sci. 39:407-414;1982. (P)

#### Reports

- GRISWOLD, C. The role of gelatinous zooplankton in a fisheries ecosystem. (MARMAP Contrib. No. MED/NEFC 82-52) Narragansett Lab. Ref. No. 82-20;1982.
- GRISWOLD, C.; PREZIOSO, J. Larval and juvenile cephalopod distribution 1980-81. MARMAP Contrib. No. MED/NEFC 82-20;1982.
- LOUGH, R. G. Georges Bank as a unique offshore breeding area for larval fish and their zooplankton food organisms. MARMAP Contrib. No. MED/NEFC 82-59; 1982. 25 p.
- McKENNEY, T. A checklist of some fishes taken with neuston and bongo nets in the vicinity of Deepwater Dumpsite 106. Sandy Hook Lab. Rep. No. 82-06;1982.
- POTTER, D. C.; LOUGH, R. G. Vertical distribution of herring larvae (Clupea harengus L.) on Nantucket Shoals, November 1977, collected by MOCNESS aboard Anton Dohrn 77-03. MARMAP Contrib. No. MED/NEFC 82-115;1982.

#### RESOURCE UTILIZATION DIVISION

##### Processing and Preservation Investigation

###### Frozen Fish

The study to determine the shelf life of frozen U.S. Grade A haddock held in the new Vendo freezer-dispenser is continuing. After 10 mo of frozen storage, the product was found to be Grade A by a USDC inspector and fair to good (6.2) by the Gloucester Laboratory taste-test panel.

The study to determine the storage stability of U.S. Grade A frozen fish fillets at +20°, 0°, and -20°F is continuing. The sensory evaluations by the Laboratory taste panel showed that the frozen samples (starting with Grade A frozen fish stored at -20°F for 10 mo) were rated from borderline to good. These samples were

rated by a USDC inspector as below Grade A except for the flounder. The samples stored at 0°F were scored as borderline to fair by the sensory panel. The USDC inspector rated the ocean perch and flounder as Grade A and the remaining samples as below Grade A. All the samples stored at +20°F for 4 mo were scored below borderline (5.0) and were rated below Grade A. Since all the species were rated below borderline, this storage study will be discontinued. The results show that frozen fish stored at +20°F have a shelf life of less than 4 mo. A temperature of +20°F or above is not uncommon in the supermarket freezer, thereby causing the quality of frozen fish to be lowered very quickly.

The second draft of the report on the frozen fish quality program was rewritten and submitted to the program leader.

A proposal submitted to the New York Sea Grant Institute was reviewed by Joe Mendelsohn.

#### Ozone Preservation

One experiment designed to determine the preservative effect of ozone on squid was completed. Fresh longfin squid were held in ozonized flake ice, ozonized block ice, ozonized saltwater ice, and chilled seawater through which ozone was continuously bubbled. These samples were compared, both raw and cooked, to squid held frozen, iced, and in chilled seawater.

The longest shelf life achieved was 12 days for squid held in ozonized flake ice, followed by 10 days for iced squid. The remaining samples averaged 6-8 days of acceptable shelf life.

#### Sorbate Preservation

One experiment on the preservative effect of potassium sorbate storage (0.5% sorbate in chilled seawater for 2 days) on 3-day-held Atlantic cod was completed. Shelf life of the whole dressed fish, as well as their fillets, was extended from 9 to 17% over conventional iced controls by the treatment.

#### Blue Crab Pasteurization

Organoleptic testing is continuing on blue crab meat pasteurized in O<sub>2</sub>-impermeable and O<sub>2</sub>-permeable plastic pouches. After 6 mo of refrigerated storage, both samples are comparable to commercially pasteurized canned controls.

#### Engineering

An equipment list and cost estimate for the NEFC's R/V Gloria Michelle heating system were prepared and submitted to the Center along with a proposal for completing the system. A subsequent meeting was held with Al Blott to coordinate installation with vessel activity. Purchase orders for equipment and plans of work procedure will be submitted to Al. The work will probably be scheduled in several phases so as not to tie up the vessel for an extended period.

The crab squeezer is being made serviceable.

Conceptual drawings and preliminary design for a heat pump to be installed in the Gloucester Laboratory were completed.

Initial draft of a paper, "Temperature Monitoring of Commercial Freezer and Product," is essentially done except for temperature charts.

The new frozen fish display case design is progressing. We are awaiting some information on the use of plastic or nylon components to be used in the conveying system. The possible use of such material could improve the overall design to facilitate maintenance, eliminate many lubrication points, and improve aesthetic appeal.

A leak in the main circulation pump for the pool water in the marine product development irradiator (MPDI) necessitated its removal and replacement. An examination of the old pump did not show any wear where expected, i.e., all seals were good. It is suspected that vibration over a period of time loosened the housing bolts slightly, causing a minor leak. This pump is now on standby.

A (U.S.) Nuclear Regulatory Commission (NRC) inspector visited the MPDI and approved it for operation, thanks to the newly installed door safety switch interlock. It was suggested and an application was made by the NRC inspector to add Tom Connors' name to the MPDI license.

The solar project has passed its final design review, and all problems have been resolved. The request for transfer of funds has been completed so the bid packages may be prepared and construction can proceed as soon as possible.

Bob Van Twuyver gave assistance to inspection in building a new product thawing tank.

Modifications to the refrigeration cooling tower electrical system were completed.

The compressor to room #4 will be replaced with a new one. This compressor operated for more than 84 000 hr.

Renovations to freezer #6 are continuing again and are expected to be complete by late June.

#### Resource Chemistry -- Nutritional Analyses

A new Carbowax 20M fused silica capillary column has been installed and is operating poorly. The backlog of samples is staggering. Bob Van Twuyver fixed a massive leak in the capillary system and, hopefully, it will be fully operational soon.

Kate Wiggin spent 2 wk on a bottom trawl survey.

A new processing and storage experiment involving the sterilizing of red crabs started in March. Cholesterol and fatty acid composition will be monitored over time. A pilot experiment in 1981 indicated elevated levels of cholesterol over time, but the sample size was not statistically sound.

Dr. Chong Lee of the University of Rhode Island and members of our nutrition lab are planning a joint experiment to assess changes in certain measurable components of fish during repeated freeze-thaw cycles. Commencement date is dependent on the status of the capillary-column gas chromatography.

The Gloria Michelle kindly supplied us with sea urchins. Fatty acids have been extracted from their roe to be used as a standard for nonmethylene-interrupted diunsaturated fatty acids.

#### Manuscripts

Two manuscripts have been completed and are in review: (1) Krzynowek, J.; Wiggin, K.; and Donahue, P.--"Sterol and Fatty Acid Content in 3 Groups of Surf Clams (Spisula solidissima): Wild Clams (60 and 120 mm size) and Cultured Clams (60 mm size)"; and (2) Krzynowek, J.; Wiggin, K.--"Comparison of Two Methods for the Analysis of Fatty Acids."

## Product Safety Investigation

### Florisil Standardization

Lauric acid was employed to standardize the latest stock of Florisil. It was calculated that a charge of 23.8 g was needed for each polychlorinated biphenyl (PCB) sample.

### Multiresidue Procedure Evaluation

A mixture of Aroclors, p,p'-DDE, and p,p'-DDT was used to check the elution and separators of p,p'-DDT from PCB's.

### PCB Intercalibration Exercise

New standards of Aroclors 1221, 1232, 1242, 1016, 1248, 1254, and 1260 were made up at a concentration of 1 ppm. A calibration standard of 4,4'-dibromooctafluoro-biphenyl was prepared at a concentration of 0.1 ppm. An EPA neat solution was chromatographed and the PCB content calculated according to the Webb-McCall method before proceeding with the extraction of PCB's from three EPA sediment samples. The neat solution contained a mixture of Aroclors 1016 and 1254 and a total PCB content of 45 ppm. Three sediment samples, a blank, and three spiked samples were analyzed using the Soxhlet extraction procedure. All of these samples were extracted in duplicate.

One wet sediment sample was extracted for PCB's, with ultrasonic homogenization in duplicate utilizing a Branson Model 350 cell disruptor sonifier, and analyzed. The data are in the process of being calculated by the Webb-McCall technique. A report will be submitted shortly to EPA's EMSL-Cincinnati Office.

### PAH Workup

Twenty remaining samples of targeted finfish and shellfish collected from the New York Bight region and Long Island Sound were worked up and analyzed for polynuclear aromatic hydrocarbons (PAH's). Ultraviolet and fluorescent chromatograms have been analyzed and interpreted. The data will be submitted shortly.

### PAH Screening

Bond elut disposable extraction columns of  $^{18}\text{C}$  for rapid extraction with accompanying apparatus were acquired from Analytichem International. Attempts are being made to develop a fast, efficient, and economical way of preparing many samples for instrumental analysis.

### Vassilaros et al. Procedure Evaluation

The analytical chemistry of PAH's can provide an important part of the answer to the biomagnification question, but it must be improved by new technology and modification of existing procedures to the point where unambiguous, detailed, and reproducible data can be obtained on a routine basis. Considering that the heterocyclic fractions are at least as biologically active as the PAH, it is clearly desirable to utilize a method which will provide quantitative and qualitative data on the sulfur and nitrogen heterocycles in marine biota. We are presently evaluating the procedure of Vassilaros et al. along these lines and also for a more comprehensive hydrocarbon analysis.

## Manuscripts

The manuscript, "Determination of Polynuclear Aromatic Hydrocarbons in the New York Bight Area," has been reviewed by the Journal of Environmental Science and Technology. The manuscript is in the process of being revised along the lines of the reviewers' comments.

## Product Standards and Specifications Investigation

Revised drafts of "Proposed U.S. General Standards for Grades of Fresh or Frozen Fish Steaks" and "Proposed U.S. General Standards for Grades of Shrimp" are being reviewed by the NMFS Central Office. They will be published as "Notices of Proposed Rulemakings" in the Federal Register. A revised "Draft Inspectors Instructions for Grading Fresh or Frozen Fish Steaks" has been prepared to accompany the proposed rulemaking. A proposed "Draft Instructions for Grading Fresh or Frozen Shrimp" is being prepared.

A revised draft of a "Proposed U.S. General Standards for Grades of Frozen Fish Portions and Fish Sticks" is now being typed. The revision is based on several valued comments which have hopefully been resolved. The commentators like the structure and organization of this document, but there is disagreement between some of them on certain specific details. We plan to subject this document to another round of comments before approaching the Federal Register.

Two final reports from the U.S. Army's research and development laboratories in Natick, Massachusetts, (from a contract with NMFS) have been published. The first report is titled, "Consumer and Instrumental Edibility Measures for Grouping of Fish Species." The second report describes application of these edibility measures to species from the families Lutjanidae and Scorpaenidae. We expect to receive copies for general distribution in the near future.

We are helping scientists from the Natick Laboratories and the University of Massachusetts to prepare a "Protocol for Sensory and Instrumental Testing of the Edibility Characteristics of Fin Fish." This document is intended to standardize sensory and instrumental edibility measures and reporting of data among the several laboratories (nationally and internationally) which are interested in comparing edibility characteristics of species from their area with species from other areas.

Gloucester Laboratory Technical Note No. 18, "Methods for Determination of Fish Flesh Content in Seafood Products, Breaded or Batter," was prepared. Copies are available to interested persons.

An initial draft of a "Proposed U.S. Standards for Grades of Frozen Lobsters" is now being reviewed. It is based on a Codex-recommended international standard.

Several drafts of a revised "Commercial Item Description for Canned Salmon" (simplified purchase document) were prepared, and a finalized draft was sent to the NMFS Central Office. User-agencies comments were the basis for revisions.

A market research and analysis report on fresh and frozen fish fillets has been prepared and sent to the NMFS Central Office.

U.S. Department of Defense comments on the "Commercial Item Description for Canned Tuna" have been resolved and a proposed revision of this document has been sent to the NMFS Central Office.

A market research and analysis report on fish sticks and portions was completed.

John Ryan and Perry Lane participated in a meeting of the State of Connecticut Advisory Committee on Food Standards at their Veterans Hospital and Home. A short illustrated talk was given and a buffet luncheon served consisting of nontraditional fishery products including breaded squid (both Atlantic and Pacific species), con-

salad, dogfish steaks, fried hake, and mock lobster (goosefish). Everyone present seemed to enjoy the repast.

An initial draft of a proposed "Commercial Item Description for Whole and Dressed Fish" was completed for typing.

The Association of Official Analytical Chemists (AOAC) has designated Dr. Frederick J. King to be its national representative at the 15th Session of the Codex Committee for Fish and Fishery Products at Bergen, Norway.

In the recently published proceedings of Third National Technical Seminar on Mechanical Recovery and Utilization of Fish Flesh, held in Raleigh, North Carolina, during 1-3 December 1980, Dr. Frederick J. King has been acknowledged as one of the seven people who helped to organize this seminar. The editor of this publication is Mr. Roy E. Martin of the National Fisheries Institute in Washington, D.C.

### Product Quality Investigation

We welcome on board Lee Bickerstaff as a part-time employee who will be responsible for sensory evaluation, and also Rebecca Marsden, a Manchester, (Massachusetts) High School senior, who is participating in the school's SCORE Program (Student Choice of Relevant Experience). Rebecca will be working with Ron Lundstrom on species identification with isoelectric focusing.

The time-temperature-tolerance study with red hake fillet blocks was completed after a 120-wk storage period. The results of this study were incorporated into a manuscript and submitted for publication.

The Product Quality Investigation participated in an experiment, use of ozone to extend refrigerated shelf life of squid, initiated by Dr. Walter Blogoslawski. Betty Tuhkunen conducted total plate counts, Elinor Ravesi monitored extractable protein nitrogen, and Ron Lundstrom monitored volatile amines.

A preliminary experiment was initiated to test the effect of proteolytic enzyme on stabilizing the texture of frozen red hake. About 2 yr ago, we conducted an experiment with minced silver hake to evaluate the effect of Addi-Fro 71, an enzymatic hydrolysate of pigskin collagen, which is used as a texture stabilizing additive in the production of minced Atlantic cod balls. We detected a softening of texture in the minced hake, which was later attributed to incomplete heat inactivation of the proteolytic enzyme added during manufacture of the Addi-Fro 71. It is hoped to duplicate this effect by inducing controlled proteolysis to offset the textural toughening resulting from formaldehyde production during frozen storage of red hake.

The maximum dose of 100 Krad being proposed by the FDA for an approved radiation process for seafoods is only expected to extend refrigerated storage life by about 1 wk. An experiment was initiated to determine whether this shelf life extension could be further increased by a combination of 100 Krad irradiation and some other process treatment. The treatments under investigation include vacuum packing, air packing, CO<sub>2</sub> atmosphere, and potassium sorbate. Duplicate experiments are in progress with 1-day and 4-day postmortem Atlantic cod.

Ron Lundstrom completed identification of 30 frozen fish fillets for the FDA's Boston District Office. Using the AOAC official method based on polyacrylamide gel isoelectric focusing, all 30 samples were identified as Greenland halibut (Reinhardtius hippoglossoides).

Joe Licciardello participated in a critical review of 57 proposals for funding under the Saltonstall-Kennedy Act, submitted to the Northeast Regional Office. Joe also reviewed a manuscript for the Journal of Food Quality.

## NMFS/URI Cooperative Fisheries Engineering Unit

The scale model of the Isaacs-Kidd midwater trawl net build by John Kenney was tested in the tow tank. The information obtained from direct observation, recorded on videotape, will be used in John's hydrodynamic study of the net.

G. Charousset, a fisheries student, arrived from France to participate in cooperative work on a juvenile fish sampler for a few months.

The first round of two inclining tests was conducted by the University of Rhode Island Ocean Engineering Department on the Gloria Michelle. These tests are part of an ongoing fishing vessel safety and stability study.

The preliminary hardware design of the vessel instrumentation system or "Microlog" is complete and work continues on developing the initial software. Installation of sensors will commence at vessel haulout later this summer.

The Gloria Michelle cruises during this reporting period are summarized in the table below.

Cruise No.	Purpose	Area
GM 82-03	Ocean Pulse benthic ecology studies	Jeffreys Ledge, Gulf of Maine
GM 82-04	Sea scallop collection	Rhode Island Sound
GM 82-05	Trawl warp tension meter tests	Rhode Island Sound
GM 82-06	Ulcerous red hake collection	New York Bight

Rigging out the Gloria Michelle for the Massachusetts inshore survey is on schedule and a lab space is being outfitted below deck.

Al Blott and Vern Nulk have met on two occasions with personnel from the Massachusetts Division of Marine Fisheries on their use of the Gloria Michelle for the Massachusetts inshore survey.

### Technical Assistance

Information and technical assistance were provided in the following areas: brining of fish fillets; types of meat-bone separators; instrumental measurement of fish quality; dogfish surimi; Venezuelan seafood resources; definitions of prepared fish; manufacturers of meat-bone separators; importation of minced fish; regulations on breaded fish products; composition of horseshoe crabs; seafood processing technology; fish parasites; volume of seafood sales in New England; submission of seafoods to government; marketing of fish in West Africa; microbial standards and nutritional labeling; vacuum-packaging and flexible packaging materials; glucose-oxidase treatment of fish; botulism in seafoods; handling fresh and frozen fish; scombroid fish poisoning; bluefish utilization; preservation of fresh fish; method for salmonella in fish; fish identification by isoelectric focusing; sarcoplasmic proteins; differentiation of red snapper and dolphin; lobster trap escape vents; timed-release mechanisms for lobster traps; salting of fish; processing of dogfish; smoking of fish; minced fish products; transportation of lobsters; heavy metal contamination of fish; refrigeration systems; pumps for brine cooling tanks.

sea urchins; imported crab meat; amount of salt in haddock; nutritional elements of fish; sodium-restricted diets; composition of lobster meat; scientific names of fish; nematodes in fish; effect of gamma rays on indole; and use of chlorine dioxide as a sanitizer agent.

### Publications

- KELLEHER, S. D.; BUCK, E. M.; HULTIN, H. O.; PARKIN, K. L.; LICCIARDELLO, J. J.; DAMON, R. A. Chemical and physical changes in red hake blocks during frozen storage. *J. Food Sci.* 47:65-70;1982. (P)
- KING, F. J. Procedure for cooking seafood products. *J. Assoc. Off. Anal. Chem.* (S)
- KING, F. J. U.S. grading standards and labeling of minced fish blocks. Martin, R.E. Proceedings of the Third National Technical Seminar on Mechanical Recovery and Utilization of Fish Flesh;1980 December 1-3; Raleigh, N.C. 1982:492-519. Available from: National Fisheries Institute, Washington, D.C. (P)
- LICCIARDELLO, J. J.; RAVESI, E. M.; LUNDSTROM, R. C.; WILHELM, K. A.; CORREIA, F. F.; ALLSUP, M. B. Time-temperature tolerance and physical-chemical quality tests for frozen red hake. *J. Food Qual.* (A)
- LUNDSTROM, R. C.; CORREIA, F. F.; WILHELM, K. A. Enzymatic dimethylamine and formaldehyde production in minced American plaice and blackback flounder mixed with a red hake TMAO-ase active fraction. *J. Food Sci.* (A)

### Reports

- KAPSALIS, J. G.; CARDELLO, A.; SEGARS, R.; PRESS, P.; MERRITT, C., Jr.; ROBERTSON, D. JARBOE, J.; MALLER, O.; SAWYER, F.; JOHNSON, E.; PELEG, M.; FAGERSON, I.; KING, F. J. Consumer and instrumental edibility measures for grouping of fish species. Final report. Natick, Mass.: U.S. Army, Natick Laboratories;1982; Customer Order 01-8-M01-6320. Copies not yet available for general distribution. Dr. Kapsalis has a limited number.
- KAPSALIS, J. G.; CARDELLO, A.; SEGARS, R.; PRESS, P.; MERRITT, C., Jr.; ROBERTSON, D. JARBOE, J.; MALLER, O.; SAWYER, F.; JOHNSON, E.; PELEG, M.; FAGERSON, I.; KING, F. J. Consumer and instrumental edibility measures for grouping of fish species from the families Lutjanidae and Scorpaenidae. Final report. Natick, Mass.: U.S. Army, Natick Laboratories;1982; Customer Order 01-8-M01-6320. Copies not yet available for general distribution. Dr. Kapsalis has a limited number.

### DIVISION OF ENVIRONMENTAL ASSESSMENT

#### Behavior of Marine Fishes and Invertebrates Investigation

As part of our ongoing study of the life habits and ecological requirements of red hake, experiments are being conducted to examine size and/or age-specific differences in the hake's ability to detect and mitigate the effects of anoxic conditions. In preliminary experiments, adult red hake exhibited detection behavior similar to that observed previously in juveniles. However, as oxygen concentrations approach

lethal levels, the adults tend to remain on or near the bottom as compared to the upward movement exhibited by the juveniles. Additional experiments are in progress to examine further the significance of these behavioral differences.

### Biological Oceanography of Stressed Ecosystems Investigation

Phytoplankton sampling bottles were provided for the warm-core ring cruise during 19 April - 4 May 1982 for determining phytoplankton assemblages in and across the shelf/slope front and in and around shelf waters advected by warm-core rings. Cooperative work with Dr. Harold G. Marshall of Old Dominion University on publication of data on seasonal and geographical distribution of phytoplankton assemblages for the shelf waters off the northeastern U.S. continued.

Cooperative work continued with the New Jersey Department of Environmental Protection concerning the potential presence and distribution of Gonyaulax tamarina in state waters. To increase the sensitivity of algal bioassays, the nutrient additions were lowered to about 2% of former concentrations. This made nutrient spikes more commensurate with levels in the seawater. Previously, the assay has best reflected gross differences in ambient nutrient concentrations. It is expected that the assay now will be more responsive to the smaller variations in levels of ambient nutrients. Assays of 16 samples are presently being counted.

A paper, "The Effects of Trace Metals on Growth of a Phytoflagellate, Olisthodiscus luteus, Which Blooms in Lower New York Bay," has been accepted for publication in the fall issue of the Bulletin of the New Jersey Academy of Science.

A data report of the seabed oxygen consumption and nutrient regeneration rates obtained from the Southeast Bering Sea was completed and forwarded to the University of Alaska in Fairbanks and the Brookhaven National Laboratory in Upton, New York, for inclusion in the "Processes and Resources of the Bering Sea Shelf" final report.

Strip-chart data of oxygen consumption rates obtained from sediment cores with various concentrations of cadmium were reduced, and statistical analysis of data is in the process of being completed.

Bill Phoel was invited by the NOAA Diving Office to participate in an experiment into the possible acclimation of divers to nitrogen narcosis using saturation diving techniques at the Duke University Medical Center's hyperbolic chamber complex.

Work on the Superflux technical report is proceeding. Proofing and drafting of figures are in the final stages.

As part of the Coastal Habitat Assessment, Research, and Monitoring Program (CHARM), Jim Thomas and Craig Robertson attended workshops on: (1) the National Wetland Inventory Classification System at the U.S. Fish and Wildlife Service's offices in Newton, Massachusetts; and (2) aerial photography and ancillary information acquisition for CHARM at the University of Massachusetts at Amherst. A completed wetlands vegetation map of the Hackensack, New Jersey, meadowlands was submitted to the University of Massachusetts as a test site for the New Jersey area by Craig Robertson. Surveys of the remaining test sites will be conducted during May and June 1982. Jim Thomas also traveled to Miami to assist in the processing of remote-sensing imagery of the Gulf of Maine, Georges Bank, and Scotian Shelf area.

### Coastal Ecosystems Investigation

#### Benthic Community Structure

We completed a draft report based on our annual monitoring of contaminant levels and effects in the New York benthos. Studies included: sediment types; metals

sediments and demersal biota (with the Environmental Chemistry Investigation); polychlorinated biphenyls and polynuclear aromatic hydrocarbons in biota (with Don Gadbois at the Gloucester Laboratory), sediments, benthic microbes (Jack Graikoski at the Milford Laboratory), and macrofauna; gill fouling in Atlantic rock crabs (Tom Sawyer at the Oxford Laboratory); and viruses in sediments and Atlantic rock crabs (Sagar Goyal at the Baylor School of Medicine). The report describes distributions of sediments, contaminants, and fauna for most of the Bight (with emphasis on the apex). Muddy sediments in the apex and upper Hudson shelf valley had highest contaminant levels. Contaminants in biota (American lobster, Atlantic rock crab, sea scallop, red hake, winter flounder, and windowpane) generally followed no clear patterns, however. Where comparisons could be made with early 1970's data (for organic carbon, heavy metals, and coliform bacteria), we did not detect any major temporal trends. Macrofaunal variables also revealed no distinct changes over time, with one exception: abundances of several species found in an "enriched" zone around the dumpsites indicated that that zone may have expanded between 1973 and 1980.

Bob Reid worked on distilling results of all Northeast Monitoring Program (NEMP) benthic macrofauna studies for inclusion in the overall NEMP report on the health of northeastern marine waters for 1981. Ann Frame and Steve Fromm continued confirming species identification and preparing benthic data sets for computer entry and analysis.

Clyde MacKenzie and Dave Radosh made preparations for this summer's diving studies of factors limiting surf clam populations in the New York Bight. Experiments have been designed to test effects of sediment grain size and contaminant loads on setting and growth of spat. Uptake of contaminants and their effects on reproduction and larval survival in waters of relatively high versus low contamination will also be examined in conjunction with the Milford Laboratory.

Russ Terranova participated in the NEMP survey on Albatross IV Cruise No. AL 82-03. He collected several specimens of an amphipod, Reposynius epistomus, which we plan to use in running bioassays on sediments from a number of contaminated areas in the Northeast. The bioassays will be done cooperatively with Rick Swartz of the EPA in Newport, Oregon (who initially developed them), and with a Russian scientist, Dr. Burdin, who plans to visit the Sandy Hook Laboratory this summer. The amphipods can be used to run many replicate samples simply and inexpensively. This test may augment and/or replace the more elaborate and expensive sediment bioassays used under present EPA-U.S. Army Corps of Engineers guidelines. Data on Long Island Sound sediments and benthos were sent to the EPA's Narragansett, Rhode Island, facility to aid in prediction of sewage outfall effects in the Sound.

Similar data were also provided on request to our Northeast Regional Office and to Joan McGarry, who teaches physical sciences at Queens College. We gave information on the benthos of the New Jersey-Delaware outer continental shelf to EPA, Region III, for use in determining whether to delete any tracts from a new lease offering in that area.

#### Benthic Energetics

During this period, Frank Steimle continued working on the benthic production chapter of the Georges Bank book being prepared by NEFC and Woods Hole Oceanographic Institution (WHOI) personnel. On 17 March, he attended a meeting at WHOI to present an outline of how he was approaching the preparation of this chapter. Considerable time was also spent on developing performance plans and implementing performance appraisals.

Jan Ward completed the entering of the initial set of life history data (on 59 species) into our automatic data processing file, and began literature reviews

for data on the second group of species for which we will develop life history summaries. Jan also began working up the remaining benthic samples from a 1976 survey of the 65-mile alternate dumpsite to support our site characterization effort there.

On 22 March, Russ Terranova was reappointed as laboratory technician and immediately intercalibrated and serviced our calorimetry equipment. He participated on the spring Ocean Pulse Program (OPP) cruise, collecting amphipods for various people and initiating a cooperative fish feeding habits study. This cooperative effort, with the Marine Ecosystems Division's Benthic Dynamics Investigation, will develop a data base to examine further prey selectivity as well as energy and possible contaminant flows in demersal food webs. Russ also completed caloric analysis of a second lot of ocean quahogs as part of our cooperative study with the Resource Assessment Division on clam energetics, growth, and condition.

Dot Jeffress completed establishing the biomass data file for 1973 New York Bight apex benthic data. She also began to develop samples from the 1976 Long Island Sound shore survey, beginning with those stations near the 65-mile alternate dumpsite.

Frank Steimle supplied data on the caloric content of several species of fish to Dr. Allen Poole of the Marine Biological Laboratory - Boston University Marine Program in Woods Hole, Massachusetts, to assist his development of an energy budget for osprey.

On 29 March, Frank Steimle met with a representative of Dames & Moore, Inc., and gave them data and references to support the U.S.-Canada maritime boundary issue. On 30 March, Frank was invited to and attended a meeting in Trenton, New Jersey, being convened by the New Jersey Department of Environmental Protection's Division of Marine Fisheries and Bureau of Solid Waste Management, to discuss the feasibility of a large-scale artificial reef program in New Jersey using discarded tires. At the meeting he made a slide show presentation on federal research and experience in the area.

Jan Ward provided life history and habitat requirement summaries for several species of fiddler crabs (Uca spp.) to Dr. Cynthia Bishop of Stanford University, to be used as background information for sound transmission studies in Uca.

#### Ocean Pulse and Northeast Monitoring Programs Coordination

Drafts were prepared of sections of the 1981 NEMP annual report dealing with sediment quality. Frank Steimle helped plan the OPP cruise of 30 March-9 April; participated in vessel scheduling and cooperative vessel use meetings; reviewed EPA's environmental impact statement for Deepwater Dumpsite 106 and the Philadelphia Dumpsite to assist in developing site characterizations; coordinated OPP participation in this summer's sea scallop assessment survey, where four berths will be available to collect samples and measurements for the OPP; and he assisted in planning and coordinating EPA's Mussel Watch experiment in the New York Bight apex this summer.

#### Ocean Pulse and Northeast Monitoring Programs Activities

This spring, we completed planning and organizing the March-April biological effects monitoring survey aboard the Alabtruss IV. Although operations were curtailed due to blizzard conditions, most of the nearshore and midshelf stations were completed. In addition to our routine sampling efforts, 197 fish were sampled as part of a feeding ecology project.

In April, the first rough draft of the 1981 NEMP annual report was compiled and distributed for comments. The NEMP management team has reviewed the comments and begun preparation of the second draft.

Representatives of physiology-biochemistry, pathology, and immunology investigations met at the Sandy Hook Laboratory in April to develop a general sampling strategy for OPP personnel participating on the summer sea scallop survey and the fall bottom trawl survey cruises. These cruises provide us a great opportunity to increase our sampling effort in these areas.

### Environmental Statistics Investigation

The results of a statistical analysis to determine associations of seven selected heavy-metal body burdens among 14 commercially important shellfish and finfish in the New York Bight demonstrated the trace-metal load patterns. Using canonical analysis, each shellfish (surf clam, ocean quahog, sea scallop, Atlantic rock crab, and longfin squid) formed a cluster of its own distinctively separated from others with respect to metal burdens. However, all finfish (bluefish, Atlantic cod, silver and red hake, ocean pout, winter flounder, dogfish, and shark) except butterfish were so closely clustered together that their metal load patterns are not clearly distinguishable. Nevertheless, the species concentrations were separated from each other. The butterfish cluster was located between shellfish and finfish groups. A draft manuscript is being completed on the analysis and results.

The methodology for interpretation of synergistic and antagonistic effects on environmental data and physiological phenomena has been developed, e.g., enzyme concentrations with heavy-metal body burdens. The manuscript, "Investigations of the Development of Artificial Reef Assemblages," by S. Chang and J. B. Pearce was submitted to the Marine Fisheries Review.

Ongoing statistical consulting for various investigations in NEMP continued, particularly on: the silver and copper exposure study of Crepidula, heavy-metal data analysis, hard-clam sampling design problems, and the Long Island benthic community study.

G. H. Kim reviewed a paper for the Mathematical Review and S. Chang reviewed a paper for the Fishery Bulletin.

### Environmental Chemistry Investigation

During this period, members from this Investigation participated in three NEFC surveys, the spring MARMAP (Marine Resources Monitoring, Assessment, and Prediction Program) survey (Albatross IV Cruise No. AL 82-02), a warm-core ring survey (Albatross IV Cruise No. AL 82-04), and the OPP survey (Albatross IV Cruise No. AL 82-03). Cynthia Muchant and Dave Burdick measured chlorophyll-a in 2714 samples collected at 145 stations occupied during the AL 82-02 survey. Jim Nickels and Tom Finneran measured integral daily primary production at 36 stations. Al Matte trained two volunteers from Darien (Connecticut) High School who filtered and preserved approximately 800 samples for nutrient analysis.

During the OPP survey (AL 82-03), Tom Finneran was responsible for measurement of primary production at 10 stations, and Cynthia Muchant measured chlorophyll-a throughout the water column at 23 stations. Vincent Zdanowicz collected sediments for trace-metal analysis from 23 sites and collected approximately 200 tissue samples for heavy-metal analyses.

Jay O'Reilly and Dave Burdick measured the distribution of chlorophyll-a in shelf water entrained by a warm-core ring during the AL 82-04 survey. Rings 82A and 82B were surveyed. In addition to samples collected throughout the water column (1400 analyses), a continuous trace of in-vivo fluorescence was made using seawater from the ship's pumping system. High readings on the continuous fluorometer were seen at the interfaces of shelf and slope water. Members of the Fishery Oceanography Investigation and Atlantic Environmental Group assisted this investigation by sampling the full array of nutrients at 770 depths. These samples will be very helpful in characterizing the effect of rings on the vertical and horizontal distribution of inorganic nutrients, as well as filling in major blanks in our baselines on nutrients in slope water which is not extensively sampled during MARMAP and OPP surveys.

Ruth Waldhauer and Ingrid Desvouses completed the analysis of 1048 seawater samples for ammonium-nitrogen and 908 for nitrite, nitrate, silicate, and phosphate. Data from Albatross IV Cruise No. AL 80-07 and Delaware II Cruise No. DE 80-05 were submitted to the Automatic Data Processing Unit for keypunching. The Chlorophyll Subtask under Chris Zetlin's supervision spent the entire month of April computerizing, proofing, and graphing data in response to the Center's request for information concerning biomass distribution on and around Georges Bank. After all data were proofed, contoured depictions of surface pigment data (mg-chlorophyll-a/m<sup>3</sup> and mg-phaeophytin-a/m<sup>3</sup>) and percentage nanoplankton data (percentage of the total chlorophyll-a contributed by the nanoplankton size fraction) from February 1980 through March 1982 were generated and examined to determine the presence or absence of gradients between Georges Bank and surrounding areas. Recurring gradients were found in both total pigment and percentage nanoplankton data. This indicates that the bathymetry and resulting hydrography are important factors which govern the distribution, abundance, and production of phytoplankton in this area. A report was developed and provided to key Center personnel who are synthesizing an overall report which addresses the U.S.-Canada maritime boundary issue: "Gradients in Surface Phytoplankton Biomass On and Around Georges Bank," by Evans-Zetlin, O'Reilly, and Matte, NEMP Report No. II-82-A-0005, issued May 1982.

### Physiological Effects of Pollutant Stress Investigation

#### Physioecology

A time-dose response test exposing adult blue mussels, subadult surf clams, and subadult bay scallops to copper at 0, 2, 10, and 20 µg/l has been terminated after 6 mo. Modality data are now being analyzed. Twenty mussels were sampled at each concentration for chemical uptake. Subadult scallops and surf clams were not sampled as only the controls had significant numbers alive after 6 mo; only a few remained at 2 µg/l and none at 10 and 20 µg/l.

Adult blue mussels held in ambient seawater in a diluter system continue to be sampled biweekly for copper analysis.

A cooperative study with Dr. Peddrick Weiss of the New Jersey Medical School was begun this reporting period. He is interested in metal uptake and detoxification in marine animals and will use mummichogs as the test species. Fish are being exposed to either copper (CuSO<sub>4</sub>·5H<sub>2</sub>O), mercury (HgCl<sub>2</sub>), or a combination of copper and mercury. All diluters are exposing the fish at 0, 5, 25, and 50 µg/l of the respective metals.

Three diluters were calibrated and the metals were turned on for Biochemistry or Physiology. One diluter is exposing sea scallops to cadmium (CdCl<sub>2</sub>·2-1/2 H<sub>2</sub>O).

at 0 and 10  $\mu\text{g/l}$ . A second diluter is exposing winter flounder to copper ( $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ) at 0, 10, and 20  $\mu\text{g/l}$ . The last diluter is exposing windowpane and sea scallops at 0 and 20  $\mu\text{g/l}$  of copper ( $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ).

Adult blue mussels were spawned and an embryo experiment was set up.

We participated in the OPP survey on Albatross IV Cruise No. AL 82-03 from 30 March to 9 April.

### Physiology

We completed the first phase of a long-term cadmium exposure study using sea scallops. We obtained blood from 16 animals exposed to 10 ppb of cadmium for 3 wk, as well as from 16 control animals. The plasma is frozen awaiting testing. At the same time, respiratory measurements were made on gill tissues taken from these scallops. No respiratory changes due to cadmium were noted.

Analysis of fish and shellfish plasma samples from the OPP/NEMP winter survey on Albatross IV Cruise No. AL 82-01 was completed this reporting period. We also participated in the spring OPP/NEMP survey on Albatross IV Cruise No. AL 82-03. A trial run was made using osmotic fragility tests on flounder blood from several stations where anemic fish have been found in the past. The results were inconclusive and it appears that the test is so time-consuming that it will be impractical for general shipboard use. Other tests for anemia will be pursued.

We also planned for and participated in a cruise with Oxford Laboratory personnel aboard the Center's R/V Gloria Michelle in the New York Bight to develop a joint protocol for OPP blood work. Yellowtail flounder blood samples were taken and various tests will be made to evaluate anemia in New York Bight flounder.

### Biochemistry

In the past two months, Biochemistry participated in the spring OPP/NEMP survey taking flounder kidney as well as the usual sea scallop adductor muscle and kidney. We will test whether erythrocyte G6PDH in teleost kidney (which is largely hematopoietic tissue) can be related to cellular or osmotic fragility, because of its function in maintaining glutathione in the reduced state essential to membrane integrity. If so, this assay, which is less time-consuming than the various cellular fragility tests reported in the Physiology Section, could become a useful predictive tool in monitoring finfish for potential or existing hemolytic anemia.

Kidneys from 106 yellowtail, winter, and windowpane flounder were so analyzed in the first 2 wk following cruise termination, with the exception of a few samples from each of the six flounder-producing stations. These samples will remain archived at  $-80^\circ\text{C}$  for 3 mo or more to determine whether there is any detectable loss of G6PDH stability with time of frozen storage. Enzyme activity in heme tissues is notoriously labile under the usual conditions of frozen storage ( $-15^\circ$  to  $-30^\circ\text{C}$ ), but we have no such data as yet for  $-80^\circ\text{C}$ .

Kidneys from yellowtail flounder were collected during an ad-hoc Gloria Michelle cruise to the New York Bight. The kidney G6PDH activity will be compared with the bilirubin and hematocrit tests performed on blood samples (both heart puncture and caudal vein specimens) collected from the same fish, using analogous data from yellowtail flounder sampled during the recent OPP/NEMP survey on Albatross IV Cruise No. AL 82-03, as preliminary baselines. The normal seasonal ranges for flounder G6PDH have yet to be established.

Biochemical analyses were completed on sea scallop adductor muscle samples from the OPP/NEMP survey on Albatross IV Cruise No. AL 81-10 (September) and from the monthly collections from off the New Jersey coast, September through December. Analyses of scallop kidneys from the monthly New Jersey collections were also completed through December. No monthly sampling was done in either January or May.

Two experimental exposures were set up using sea scallops and heavy metals. The animals were collected by the Gloria Michelle just east of Block Island and arrived at the lab on the same day in very good condition. The first exposure is to 10 ppb of cadmium as the chloride, and the second is to copper as the sulfate; sampling for each is at 3-wk intervals and will continue into late June or early July at which time we anticipate that temperature stress will be superimposed on the lethal metal stress. The first sampling has been completed.

### Anaerobic Bacteriology

A major activity for this reporting period was the preparation and participation in the 10-day OPP/NEMP survey on Albatross IV Cruise No. AL 82-05. During the cruise 29 stations were sampled for bottom sediments, 15 for top and bottom waters, and 15 animals (three species) were obtained for examination of Clostridium perfringens and the Vibrio group. Fecal coliforms were obtained in sediments from three of the impacted stations. A preliminary evaluation of medium for isolating anaerobic vibrios and other vibrio types was also done.

A preliminary examination of the resulting data was characteristic for early spring sampling -- low counts for presumptive vibrios except at the inshore impact stations. C. perfringens counts were more stable. Fecal coliforms were demonstrated in sediments off Delaware Bay, the Philadelphia dumpsite, the New York Bight sewer disposal area, and off Massachusetts and New Hampshire. We also observed higher C. perfringens counts at Station 53 in the "anoxia area." Further sampling is necessary in this area.

Except for a few isolates from sea scallops, vibrios were absent in the animals examined (American plaice, Atlantic cod, and sea scallops). C. perfringens was present in low numbers in the animals, although studies are not yet complete.

Work is continuing on the identification of bacterial isolates obtained from the samples of the above cruise and Delaware II Cruise No. DE 81-07.

### Chemistry

A significant part of our work involves monitoring the metal exposure systems to ensure that proper metal concentrations are being achieved in these systems. The analytical procedures used are fairly lengthy when attempting to measure the metal concentrations in the 5-10 ppb range. We did some work this reporting period developing new procedures to measure these low levels and to save time. At first, it appeared that the new procedures would work. However, in actual day-to-day use, the procedures gave inconsistent results and, thus, will require further testing to determine whether it can be used on a routine basis.

It has been proposed that measurements of iron in fish blood or serum would be valuable as an additional parameter that could be useful for interpreting other types of measurements currently being conducted on fish blood in OPP studies. Thus, we have conducted tests on fish serum to determine the effectiveness of atomic absorption for iron analyses. We so devised a fairly simple preparation procedure that can be used, i.e., to add 0.1 ml of fish serum to 1 ml of a Sterox solution and analyze it directly by atomic absorption.

## Publications

- BEJDA, A. J.; OLLA, B. L. The behavioral response of juvenile red hake, Urophycis chuss, to decreasing levels of dissolved oxygen. Paper to be presented at 112th Annual Meeting of the American Fisheries Society. (Abstract.) (S)
- CHANG, S.; PEARCE, J. B. Investigations of the development of artificial reef assemblages. Mar. Fish. Rev. (S)
- MacKENZIE, C. L., Jr. Compatability of invertebrate populations and commercial fishing for ocean quahogs, Arctica islandica. N. Amer. J. Fish. Mgt. (S)
- OLLA, B. L.; BEJDA, A. J.; PEARSON, W. H. Effects of oiled sediment on burrowing behavior of the hard clam, Mercenaria mercenaria. Mar. Environ. Res. (S)
- PEARSON, W. H.; SUGARMAN, P. C.; WOODRUFF, D. L.; OLLA, B. L. Impairment of the chemosensory antennular flicking response in the Dungeness crab, Cancer magister, by petroleum hydrocarbons. Fish. Bull. 79:641-647;1981. (P)
- STEINER, W. W.; LUCZKOVICH, J. J.; OLLA, B. L. Activity, shelter usage, growth and recruitment of juvenile red hake Urophycis chuss. Mar. Ecol.-Prog. Ser. 7:125-135;1982. (P)

## Reports

- STEIMLE, F. W., Jr. A preliminary examination of the stomach contents of five species of demersal fish collected in the Christiaensen Basin, New York Bight apex 1969-1970. Sandy Hook Lab. Rep. No. SHL 82-05;1982. 12 p. (This report presents qualitative data on over 900 stomachs taken from fish trawled in the vicinity of the sewage sludge dumpsite.)

## AQUACULTURE DIVISION

### Aquacultural Genetics Investigation

#### Breeding

Roughly 35 000 juvenile American oysters (Crassostrea virginica), the progeny of a second generation of selection for fast and slow growth rate in a bidirectional selection program, have been measured. Preliminary examination of the data on shell dimensions indicates that a positive response most likely occurred in three lines, none in a fourth line, and a negative response in the fifth line. Progeny of the first selected generation showed a positive response at 2 yr in five of seven lines, a negative one in one line, and no response in another. The second selected-generation oysters were measured at 1 yr. Data are to be appropriately analyzed, the oysters again subjected to another generation of selection, and bred during the natural spawning season this summer. Response will again be measured.

Test-crossing and evaluation of geographic hybrids of the American oyster are continuing. New hybrids have been obtained between Long Island Sound oysters and wild oysters from Rhode Island, Massachusetts, and South Carolina. Two separate groups of South Carolina oysters -- a subtidal and an intertidal one -- were crossed with the Long Island Sound oysters.

## Cytological and Cytogenetic Measures of Pollution Effects

Data on chromosome mutation in the blood and hematopoietic tissues of adult windowpane, Atlantic cod, and larval red hake are being examined statistically. The relationship of variation in mutation rate to the following is being sought: sex, age-size, season, water mass, and sample site. Minimum sample sizes essential to detecting doubling of this mutation frequency are to be calculated. In cod, fish with outlying mutation frequencies are observed to fall in the category of oldest, largest fish sampled. This might be attributable to increased body burdens of contaminants with age. Blood and hematopoietic tissues of rather large numbers of Atlantic mackerel were sampled from the same school of fish over time as they enter coastal waters on their annual spawning migration. Any increased mutation associated with time in coastal waters should be measurable. Analyses to date reveal overall somewhat greater mutation frequencies than in the blood of other fish species previously examined.

A dose-response experiment on Fundulus, which measures micronuclei in immature erythrocytes of the kidney, has been completed -- the fish have been sacrificed, but the material has not yet been fully studied. A similar experiment is underway to measure the efficacy in fish of the sperm abnormality test for gene mutation.

An extensive review of the literature and considerable exploratory work have established that we can reliably measure the number and condition of the germ-line primordial cells in larval fish. This measurement occurs in cytological preparations of partially dissected larvae without histological section. The use of gills in fish is being examined as a source of material for measurement of chromosome mutations in field studies.

Chromosome methods for the meiotic apparatus of the prefertilized fish eggs, precleavage fertilized eggs, and for the mitotic cells of the yolk-sac membrane are described in conjunction with our earlier studies, are being further developed.

In addition to the approximately 300 Atlantic mackerel sampled for the micronucleus test aboard the Polish R/V Admiral Arciszewski, tissues from about 100 fish were sampled for the sister-chromatid exchange test. Also, whole fish were preserved for analytical chemical analyses of heavy-metal and toxic hydrocarbon levels. A. Herbert, J. Hughes, and D. Perry of this program participated in this expedition.

## Aspects of Nutritional Requirements of Mollusks Investigation

### Oyster Feeding

Since December 1981, we have maintained three groups of American oysters (with initial mean live weights of 0.65, 1.51, and 2.46 gm per animal) in our experimental rearing chamber system with continuously flowing seawater filtered to 1  $\mu$ m, sterilized with ultraviolet light, and heated to 26°C. Oysters were fed a daily diet of mixed algal species of high nutritional value. Weekly observations and size determinations revealed an average mortality of 1.2% per week and no growth after 17 wk. During weeks 18 and 19, sudden and rapid growth increases were observed in all groups of oysters. Mean growth of all oysters in 2 wk was 5.3% and mortality was reduced.

Seasonal variation in growth of oysters in the rearing chamber system has been observed for the past 2 yr, during which experiments started in the spring or summer yielded more rapid growth than those conducted during the winter months. However, this is the first time that groups of oysters have been kept in chambers continuously from winter through spring so that the onset of improved growth could be observed. This phenomenon does not seem to result simply from an increase in temperature -- seawater entering rearing chambers was carefully monitored and remained at 26°C ±

throughout the experimental period. We investigated the possibility that supersaturation of the seawater with oxygen during heating was occurring. Winkler oxygen determinations indicated that there was no such supersaturation, even during the coldest weeks when seawater was less than 0°C before heating.

We have postulated that the increased growth of oysters observed during the spring and summer in our system may result from nutritional input or behavioral stimulus by dissolved organic material in Milford Harbor water. It is interesting to note that the spring diatom bloom did not coincide with the oyster growth, whereas the experimental oysters began to grow immediately following the spawning of barnacles, which produces extremely dense populations in local waters. Samples of seawater from the system have been stored at -80°C for later analysis.

### Algal Growth

Cultures of Dinialiella euchlora and Phaeodactylum tricornutum, with tolerances to 6.1 ppm of cadmium and 47.3 ppm of copper, respectively, have been maintained in these concentrations for over 3 yr. To investigate persistence of metal tolerance, resistant cells were washed, grown in medium without excess metal, and returned to previously tolerated Cd or Cu concentrations. Results showed that tolerance of P. tricornutum was lost in the absence of excess metal. In contrast, D. euchlora retained some resistance to 61.3 ppm of Cd after subculture in medium without Cd. With both species, growth of metal-tolerant strains in absence of excess metal was not reduced, indicating no development of requirements for high metal concentrations. These studies have shown that responses of phytoplankters to metal pollutants can be affected by duration and continuity of exposure and suggest that both selection of tolerant individuals in the population and induction of metabolic reactions play a part on the behavior of algal populations in polluted waters.

### Semicontinuous Algal Cultures

Juvenile algal foods and larval algal foods were harvested from culture carboys in volumes of 3089 liters and 2954 liters, respectively. The harvest was distributed to the various Investigations as follows: Spawning and Rearing of Mollusks, 2435 liters; Aquacultural Genetics, 2457 liters; Physiological Effects of Pollutant Stress 551 liters; and Diseases of Larval Mollusks, 126 liters.

### Spawning and Rearing of Mollusks Investigation

Gametogenic activity was monitored in groups of young surf clams (Spisula solidissima) maintained in flowing seawater at different temperatures. Prior to the experiment, all clams increased significantly in body weight during the midwinter diatom bloom. Initially, the gonads of these clams were flaccid. Experimental groups were acclimated to 10°, 15°, and 20°C. One group was held at ambient seawater temperature of 5°C. Viable gametes were detected after 1 wk in clams in all treatments at elevated temperatures. After 1 wk, the gonads had doubled in volume due to the rapid development of ova and sperm. These results, in addition to those from two previous experiments, indicate the potential for rapid gametogenic development in surf clams if nutritional requirements are met. Under poor nutritional situations, somatic growth may occur at the expense of reproductive development.

We have begun to spawn and raise bay scallops (Argopecten irradians) to meet our experimental requirements for scallop seed this year. These tests will include a study of the effects of depth on growth and adductor yield, an experiment to determine optimal site requirements, and an extensive overwintering study.

Considerable effort has also been put into experiments with the hard clam (Mercenaria mercenaria). We are currently investigating the relative merit of using small clams in upwelling columns and raceways. Upwelling systems are used extensively in Europe, but appear to require considerably more water flow than raceways to achieve comparable growth in shellfish.

We provided bay scallop spawning stock to the People's Republic of China through Professor C. Y. Wu, who hand-carried them to Dr. C. K. Tseng of the Institute of Oceanology, Academia Sinica, in Tsingtao.

## PATHOBIOLOGY DIVISION

### Comparative Invertebrate Pathology Investigation

Examination of specimens collected on two Ocean Pulse Program (OPP) surveys (Delaware II Cruise No. DE 81-07 in November 1981, and Albatross IV Cruise No. AL 82-01 in January-February 1982) was completed. A total of 3221 amphipods were identified and examined for gross lesions, and 1119 of these were examined histologically. Patterns of parasitism were much as in previous samples except that prevalence of microsporidians was unexpectedly high in "old" ovigerous females and in postovigerous females of Ampelisca agassizi collected at OPP Station No. 23 (Georges Bank oil lease area) during the January-February survey. Reasons for this may never be apparent because no collections were made at Station No. 23 on the preceding cruise (November 1981) or on the succeeding one (March-April 1982).

Identification and gross examination of amphipods collected on Albatross IV Cruise No. AL 82-03 (March-April 1982) have been completed and material prepared for histological processing. A total of 1998 amphipods were involved.

With the aid of Fred Kern, the Oxford Laboratory's computer coordinator, an outline and data file on the amphipods and their major pathological conditions were devised and entered into the R 1022 system. Pertinent data from the eight cruises for which all information has been gathered, have now been entered into the R 1022 system and all have been edited. The cruises include Albatross IV Cruises No. AL 80-07, AL 80-09, AL 81-07, AL 81-10, and AL 82-01, Delaware II Cruises No. DE 80-07 and DE 80-09, and Kelez Cruise No. KE 81-04.

During April, Austin Farley participated in a 3-wk (fifth leg) Atlantic macrobenthic pathology survey aboard the Polish R/V Admiral Arciszewski. Gross observations were made; blood smears and tissue samples were fixed for future examination for parasites and disease. He also participated in a 1-day field trip to New Jersey where samples of mussels were collected from sites in Raritan, Sandy Hook, and Great Bays.

Automatic data processing files were established for sample, individual, and intraindividual pathology data for coastal mollusks. Gross and microscopic pathology and parasite data from eight samples, consisting of 50 animals each, have thus far been entered into the computer. These data consist of over 300 records of individuals and over 1000 pathology records, and, presently, space and time information on 50 samples collected from sites from Maine to Virginia. Sample data consist of year, latitude, longitude, OPP station number, month, site code, and histo code. Specimen data contain histo code, specimen number, species, length, condition, color, sex, and gametogenesis stage. Pathology data consist of histo code, specimen number, organ, pathology category, and intensity. All systems can be mapped to one another into histo code, specimen number and/or cruise code, year, month, or OPP station. Data now can be easily retrieved for statistical comparisons.

As a result of increased OPP and fish parasite/pathology surveys as well as a Center task force on a pathology and parasite study of Atlantic mackerel with Polish colleagues, a large number of specimens were processed by the histology lab. Approximately 1500 specimens were received and over 3000 slides were stained for microscopic examination during the reporting period.

### Fish Pathology Investigation

Investigation personnel have spent considerable time at sea during the past 2 mo. John Ziskowski participated in the spring bottom trawl survey from 30 March to 23 April. Ann Charles of the Marine Biological Laboratory at Woods Hole has been on board the Delaware II since 27 April making observations on fish health, preparing blood smears, and excising tissues for lab examination. Sharon MacLean participated in a 3-wk cruise on the Admiral Arciszewski. During the conduct of the cruise, Ms. MacLean prepared blood smears, kidney imprints, and excised visceral lesions from Atlantic mackerel as part of a multilaboratory study to determine if hemoparasites are responsible for fluctuations in mackerel abundance.

Livers and spleens excised from apparently normal Atlantic cod, haddock, and yellowtail flounder were sectioned and examined for microscopic lesions. None of the fish had any apparent gross lesions. The tissues were collected on the fall 1981 bottom trawl survey by Survey Unit personnel of the Resource Surveys Investigation. Of the 102 fish sampled, 55 were yellowtail flounder, 30 were cod, and 17 were haddock. Microscopic lesions were noted in 10 (9.8%) of the fish. Four cod had splenic granulomata of unknown etiology (probably microsporidian induced). Four cod had distinctive microsporidian-induced granulomata in liver and spleen. One cod and one yellowtail flounder had myxosporidian trophozoites in hepatic bile ducts and one haddock had a granuloma of unknown etiology in the splenic capsule. None of the lesions appeared capable of compromising the health of the host. Disease surveillance activities on bottom trawl surveys are based on the presence of grossly recognizable lesions. At this time it does not appear necessary to examine tissues with no obvious gross lesions.

Experiments are in progress to determine the pathogenicity of the virus isolated from southern flounder. Postmetamorphosed summer flounder supplied by the Narragansett Laboratory were exposed to the virus by immersion. During the conduct of the experiment, an equal number of control and experimental fish died. These fish have not yet been cultured for virus. A second experiment using young-of-the-year southern flounder which were injected with the virus is in progress.

The "Big Mack" attack has been successfully initiated. Several hundred blood smears and tissue samples were collected aboard the Admiral Arciszewski. Mackerel have also been successfully sampled inshore near Ocean City, Maryland, and Point Pleasant, New Jersey. The protozoan hemoparasite Haematractidium is present in some of the fish examined; however, there are remarkably few ectoparasites on the fish.

Blood smears are being readied for shipment to the Polish Plankton Sorting and Identification Center at Szczecin where they will be examined for hemoparasites. Tentative arrangements have been made for obtaining mackerel from inshore waters in the Northeast.

Erythrocytes from yellowtail flounder with a possible anemic disease have been studied with light and electron microscopy. The nuclei of anemic fish frequently have an abnormal shape and appear pyknotic or karyorrhectic. Additionally, some of the erythrocytes appear to contain inclusions which resemble those found in piscine erythrocytic necrosis disease. Ultrastructure studies thus far, however, have failed to reveal any biological agent that may be responsible for this condition.

Blood smears, whole blood, and other tissue samples have been received from Atlantic mackerel collected on the Admiral Arciszewski. The blood smears have been stained and electron microscopic examination reveals that a number of the fish were infected by a "piroplasm" (MacLean 1980). Hopefully, electron microscopic studies of this organism will provide useful taxonomic data which can be used to determine the potential pathogenicity and life cycle of the parasite.

All members of the Fish Pathology Investigation spent considerable effort during this reporting period searching the literature on parasites of fishes found on Georges Bank.

#### Diseases of Larval Mollusks Investigation

Testing of modified basal media for use with the Minitek miniaturized bacterial differentiation system was completed. After some supplemental tests to classify more accurately the 65 bacterial isolates used in the study, the work will be developed into a manuscript for publication. It appears that at least 18 of the 31 biochemical tests can be used to identify marine bacteria more rapidly, although about half of these must be used with qualifications because of insufficient sensitivity. All reactions appear to be usable in recognizing a bacterium that has been previously defined by the Minitek system; however, these reactions may not correspond to reactions listed in the literature that are based on standard tube reactions.

Two abstracts and a related draft for a book chapter were prepared during the reporting period. Tables and figures were prepared or reanalyzed for completed work on in-vitro handling of molluscan blood cells; an abstract on the effects of centrifugation on molluscan cells was prepared and submitted for a colloquium on invertebrate pathology. The draft of a chapter on the etiology, pathogenesis, diagnosis, and treatment of fish disease caused by Pasteurella piscicida, and a related abstract were prepared for a working discussion at an international symposium, Antigenic Fish Pathogens, which will be held at Talloires, France, during 9-12 May 1982 and sponsored by the Fondation Marcel Merieux.

Work was started on enzyme-linked immunoassays which will be useful in identifying bacterial disease agents and in detecting the presence of specific antibacterial antibodies in fish sera.

Colonies growing on the last set of plates from the yearlong bacteriological study of Long Island Sound have been isolated and identified. Data from the daily samplings are being compiled and analyzed. The data will be compared with that collected from the previous year. During the first year, ambient raw seawater was sampled; this year's samples were of raw seawater at 26°C.

One more experiment is needed to complete the study conducted to determine whether activated carbon-filtered seawater enhances survival and growth of American oyster larvae. Thus far, the data suggest that survival, although improved, is not significantly different ( $P < 0.05$ ) when carbon filtration is used. Setting also took about the same length of time in the two types of seawater.

An earlier study showed that an exotoxin produced by a Vibrio sp. was not lethal to oyster larvae in the presence of neomycin sulfate. The sulfate was thought to be chelating the exotoxin. Studies conducted using either  $MgSO_4$  or  $NaSO_4$  failed to produce similar results. This suggests that the sulfate is not the reacting material. A study is underway to determine whether the toxin can be detoxified using streptomycin sulfate.

On 22 February, bacterial sampling was done on American oyster shells dredged from the Stratford and New Haven, Connecticut, sites. A total of 32 isolates were selected from the cruise plates (17 from New Haven and 15 from Stratford). These

isolates were identified to genus and are as follows: New Haven isolates consisted of 12 Vibrio sp., 3 Achromobacter sp., and 2 unidentified species, while those from the Stratford site consisted of 11 Vibrio sp., 1 Achromobacter sp., 1 Flavobacterium sp., and 2 unidentified species. Biochemical tests are being conducted to learn genus of these unknown strains.

On 17 February, 16 isolates from the 17 November 1981 Stratford cruise were tested for pathogenicity; six isolates appeared to be pathogenic to oyster embryos. These will be tested again in future challenges. On 23 February, 20 New Haven isolates were tested and none appeared to be pathogenic.

Also during this reporting period, five other larval challenge tests were conducted. On 9 March, 15 isolates from the 22 February Stratford cruise were tested and nine isolates appeared to cause larval mortality. Other challenges were conducted on 23 March, 30 March, 13 April, and 20 April. Pathogenicity data have not yet been analyzed.

As part of a special assignment at the Gloucester Laboratory during March, Dr. Blogoslawski conducted a food preservation experiment on longfin squid using ozonized flaked ice. After storage of squid for varying periods, samples were plated periodically and bacterial counts were made. The data were plotted and it appears that ozonized flaked ice prolonged squid shelf life for an extra 2 days. Graphics were made from this data and will be used at the Northeast Shellfish Sanitation Association meeting in Davisville, Rhode Island.

On 4 November 1981, a California hatchery isolate (CA 10) was sent to Dr. Rita Colwell at the University of Maryland. Since then, DNA base pairing work has been done and it has now been positively identified as a Vibrio sp. Two different forms of CA 10 have been returned to determine whether they are pathogenic. As of now they have been tested in one oyster larval challenge and have caused 98% mortality. They have been challenged again, but the data have not been analyzed yet. Extensive biochemical testing will be conducted to determine which of the two isolates has the same biochemical results as the original CA 10.

A good deal of the month of April was spent on artwork, writing, and revising two manuscripts being reviewed for publication.

As recently as 19 April, another Stratford-New Haven sampling cruise was completed. Oyster shells were collected and plated. Isolates will be taken and they will be tested for pathogenicity.

#### Microbial Ecology and Parasitology Investigation

Monitoring studies on "black gill" condition in the Atlantic rock crab (Cancer irroratus) collected in Sandy Hook Bay, New Jersey, showed that only 1/241 specimens had gill blackening; clean gills were noted in 219/241 (91%). Results from 1982 surveys agreed with previous data which showed that molting activity by adult specimens caught in nearshore waters is responsible for the high incidence of clean gills during January-April of each year. Histological examinations showed that fouling microorganisms and microscopic debris also were minimal. Ongoing studies with Richard Greig at the Milford Laboratory have suggested that two heavy metals--copper and cadmium--decrease in concentration in gills but not in digestive glands subsequent to molt. Previous data, now in press, showed that most of the specimens of C. irroratus with less than 15 ppm of copper in the gills were newly molted softshell or papershell crabs. This observation was tested in February by analyzing for copper in 30 newly molted papershells. Mr. Greig's findings showed that copper ranged from 3.0 to 14.1 ppm in gills and from 2.3 to 116.7 ppm in digestive glands. Cadmium ranged from 0.3 to 1.51 ppm in gills and from 0.22 to 6.8 ppm in the glands. Other

workers have demonstrated that an enzyme system is present in the digestive glands which selectively binds both copper and cadmium, accounting in part for the high levels occurring in this organ. Silver, in contrast, is not enzyme bound and was found at approximately the same concentration in both organs--0.02-3.9 ppm versus 0.09-3.2 ppm. Preliminary histological studies on the same specimens used for metal analyses have not shown any evidence of an association between metal levels and microscopic pathology or gill color. Several investigators have demonstrated an association of heavy metals and cellular damage at the electron microscopic level, but we have not conducted similar studies on wild-caught crustaceans.

Mr. Jay Lewis participated in the March-April Albatross IV cruise to sample crabs and fish from the Gulf of Maine to the Philadelphia sewage disposal site. Among 76 C. irroratus examined, 64 had clean gills, 11 had discolored gills, and 1 had less than 50% blackening. Molting activity by nearshore ocean crabs was recorded at one station near New Jersey (#53) where 12/14 specimens were papershells. Data obtained from Station #53 clearly demonstrated that molting activity in specimens from bays and the ocean has a marked effect on the incidence of "black gill" during January-May. Polychaete worms were noted in 13/76 (17%) of the crabs collected. Most were found externally between gills, but several were present in the body cavity. All specimens were taken to the Division of Worms, Smithsonian Institution where Dr. Kristian Fauchald tentatively identified them as belonging to the family Iphitimidae (Fauchald 1970). A new species, Iphitime holobranchiata (Pilger 1971) was described from C. antennarius, but members of the family have not been reported from C. irroratus. The worms are being studied by Dr. Fauchald who will determine whether or not they represent a new species.

#### Publications

- BLOGOSLAWSKI, W. J. Ozonized ice as a preservative. Ozonews 10:9;1982. (P)
- BROWN, C. The role of carbon filtration in culturing the American oyster, Crassostrea virginica. (Abstract.) J. Shellfish Res. (S)
- JOHNSON, P. T. Crustacean viruses. (Abstract.) Paper to be presented at mtg. of Soc. Invertebr. Pathol. (S)
- JOHNSON, P. T. Patterns of parasitism in species of benthic amphipods. (Abstract.) IIIrd Int. Colloq. Invertebr. Pathol., XVth Annu. Meet. (S)
- MacLEAN, S. A. The Chesapeake ray. Underwater Nat. 13:31-33;1981. (P)
- NERAD, T. A.; DAGGETT, P.-M.; SAWYER, T. K. Pathogenic Acanthamoeba species from polluted marine sediments. (Abstract.) J. Protozool. (S)
- ROBOHM, R. A. In vitro handling of molluscan hemocytes: control of cell loss from centrifugation effects. (Abstract.) IIIrd Int. Colloq. Invertebr. Pathol., XVth Annu. Meet. (S)
- ROBOHM, R. A. Pasteurella piscicida. (Abstract.) Int. Symp. Antig. Fish Pathog.
- ROSENFELD, A. The Chesapeake oyster. Underwater Nat. 13:34-38;1981. (P)

SAWYER, T. K.; GHITTINO, P. Proliferative kidney disease in rainbow trout from Italian hatcheries. (Abstract.) East. Fish Health Worksh. (S)

SAWYER, T. K.; LEWIS, E. J.; GALASSO, M. E. Amoebae (Amoebida: Acanthamoebidae) from offshore marine sediments near Puerto Rico. (Abstract.) J. Protozool. (S)

SAWYER, T. K.; LEWIS, E. J.; GALASSO, M. E.; ADAMS, W. N.; GAINES, J.; LEAR, D. W.; O'MALLEY, M. L. Distribution of potentially pathogenic protozoans (Amoebida: Acanthamoebidae) in seabottom sediments. (Abstract.) Paper to be presented at mtg of Atl. Estuar. Res. Soc. (S)

#### NATIONAL SYSTEMATICS LABORATORY

##### Systematics of Fishes

Progress was made on revision of the Spanish mackerels, genus Scomberomorus: the osteology section of the manuscript was completed. Corrections were made and the format was improved for computer-generated tables of morphometric and meristic data for all the species of Spanish mackerels. A key to the scombrids was drafted for the UN Food and Agriculture Organization's World Catalogue of Scombridae manuscript. A draft manuscript on the needlefish genus Potamorhaphis was revised.

##### Systematics of Crustaceans

Research continued on the "rock shrimps" (genus Sicyonia) occurring in the American Pacific: descriptions were completed of S. ingentis (ridgeback prawn), a member of the genus commercially fished in U.S. waters, and S. disdorsalis (camarón conchiduro), a species taken in large quantities in Mexican coastal waters. The morphology of these shrimps has been treated in detail, their phylogenetic relations appraised, and their geographic and bathymetric distributions presented. Illustration of entire animals and certain organs have been prepared.

Completed was the part of a manuscript dealing with nomenclature, taxonomy, description, and distribution of the blue crab (Callinectes sapidus) that will go into a jointly authored species synopsis.

Preparation continued on a trilogy of papers on the systematic status of the "forms" of the mud crab Panopeus herbstii prominent in the oyster community of the eastern and southern U.S. The study is in part a collaboration with Robert Reames, formerly with the Dauphin Island (Alabama) Sea Laboratory, and with J. Bolling Sullivan and associates of the Duke University Marine Laboratory in Beaufort, North Carolina.

Preparation continued on a revision of the mud shrimps of the eastern Pacific. All specimens in the U.S. National Museum have now been identified. There are five recognized species and a set of undescribed ones.

Preparation began on a revision of Chace and Dumont's (1949) "Spiny Lobsters -- Identification, World Distribution, and U.S. Trade" that appeared in Commercial Fisheries Review, Vol. 11, No. 5, and has long been out of date and out of print.

Preparation began on a paper on morphology of feeding structures in the deep-sea hydrothermal crab Bythograea thermydron from the Galapagos Rift in collaboration with J. R. Factor and C. L. Van Dover of Cornell University.

## Scientific Services

Identifications were made of illustrations of shrimps from off Bahrain, submitted by Dr. B. G. Ivanov of the Soviet Union's All-Union Research Institute Marine Fisheries and Oceanography. A collection of shrimps from Puerto Rico was studied at the request of Dr. Ray Bauer of the Universidad de Puerto Rico. Shrimps from Carrie Bow Cay, Belize, were identified for the Smithsonian Institution's Crustacean Department. Shrimps from Panama were identified for Vernon Rix of the NMFS Northeast Inspection Office in Gloucester, Massachusetts. Mud shrimp from San Francisco Bay were identified for Dr. F. N. Nichols of the U.S. Geological Survey, Pacific - Arctic Branch of Marine Geology in Menlo Park, California. Identified was an Australian halfbeak for Dr. K. Rhode of the University of New England in Australia.

Loans of billfish skeletons were made for the Smithsonian Institution to Duke University. Exchanges of gadiform and percid fishes were made to: the American Museum of Natural History; Cornell University; the Academy of Natural Sciences, Philadelphia; the Field Museum of Natural History, Chicago; the Illinois Natural History Survey, Urbana; Tulane University; the University of Michigan Museum of Zoology; the California Academy of Sciences, San Francisco; and the Florida State Museum, Gainesville.

Research proposals were reviewed for the Biological Research Resources Program at the National Science Foundation and for the U.S. Aid for International Development Program.

Manuscripts were reviewed for the Fishery Bulletin, NOAA Technical Report NMFS Special Scientific Report-Fisheries, Gulf Coast Research Reports, the Journal of Crustacean Biology, and for a colleague at the NMFS Honolulu Laboratory.

## Publications

COHEN, D. M. The deepsea fish genus Enchelybrotula (Ophidiidae): description of new species, notes on distribution, and osteology. *Bull. Mar. Sci.* 32(1): 99-111;1982. (P)

COLLETTE, B. B. Review: Synopses of biological data on eight species of scombridae. Bayliff, W. H. ed. *Copeia* 1982(1):242;1982. (P)

WILLIAMS, A. B. Shrimps, lobsters, and crabs of the Atlantic coast of the United States, Maine to Florida. Smithsonian Institution. (A)

WILLIAMS, A. B.; CHACE, F. A., Jr. A new caridean shrimp of the family Bresiliidae from thermal vents of the Galapagos Rift. *J. Crustac. Biol.* 2(1):136-147; 1982. (P)

## ATLANTIC ENVIRONMENTAL GROUP

### Ocean Monitoring and Climatology Task

The Atlantic Environmental Group and the EPA facility at Narragansett, Rhode Island, have established an agreement with the National Earth Satellite Service in Suitland, Maryland, to receive digital sea-surface temperature composites from the Geostationary Orbiting Environmental Satellite (GOES). This agreement provides for the EPA facility to receive the composites on a daily basis.



The satellite, designated Goes East, is in orbit circling the earth's equator at the same rate at which the earth rotates. In this fashion, the satellite appears to remain stationary above the earth's surface at roughly 75°W longitude.

The digital composites are derived from the thermal infrared channel (10.5 - 12.6  $\mu\text{m}$ ) of the Visible Infrared Spin Scan Radiometer and have a spatial resolution of  $\approx 7$  km. To access the digital composites, a direct-dial telephone link is established between the NOAA computer in Suitland, Maryland, and the EPA computer in Narragansett. Once communication has been established, the data are transmitted via phone lines to a disk drive at the EPA facility. From there it is copied onto a magnetic tape, where it remains on file, and to a line printer where a "hard copy" is displayed for future analysis. Although the composites do not show absolute temperatures, the relative temperature information they provide is helpful in determining the position of various features such as the shelf/slope front, the Gulf Stream, and warm/cold-core rings. See figure on former page. The computer center at the University of Rhode Island's Graduate School of Oceanography, with help from the computer facility at the EPA, is developing a program to contour these composites, but at this time, nothing conclusive has been discussed.

The cooperative Ship of Opportunity Program obtained 13 expendable bathythermograph (XBT) transects and three continuous plankton recorder (CPR) transects in March and April: three XBT and one CPR transect in the Gulf of Maine, three XBT transects off Southern New England, four XBT and two CPR transects across the shelf and slope off New York, and three XBT transects across the Gulf of Mexico.

The announcements of eddy conditions shown on pages 48 and 49 for the Georges Bank-Middle Atlantic Bight area were sent to the Commander of the Atlantic Area for the U.S. Coast Guard, for publication in the April and May 1982 issues of the Atlantic Notice to Fishermen.

#### Publications

- ARMSTRONG, R. S. Variation in the shelf water front position in 1981 from Georges Bank to Cape Romain. *Ann. Biol.* 38. (S)
- CRIST, R. W.; CHAMBERLIN, J. L. Bottom temperatures on the continental shelf and slope south of New England during 1981. *Ann. Biol.* 38. (S)
- CRIST, R. W.; CHAMBERLIN, J. L. Bottom temperatures on the continental shelf and slope south of New England during 1980. *Ann. Biol.* 37. (A)
- FITZGERALD, J. L.; CHAMBERLIN, J. L. Anticyclonic warm core Gulf Stream eddies off the northeastern United States during 1981. *Ann. Biol.* 38. (S)
- FITZGERALD, J. L.; CHAMBERLIN, J. L. Anticyclonic warm core Gulf Stream eddies off the northeastern United States during 1980. *Ann. Biol.* 37. (A)
- GUNN, J.; WATTS, D. R. On the currents and water masses north of the Antilles/Bahamas arc. *J. Mar. Res.* 40(1):1-18;1982. (P)
- HESS, J. Rapid cooling on western Georges Bank. *Coast. Oceanogr. Climatol. News* 4(2):1-2;1982. (P)
- HILLAND, J. E. Variation in the shelf water front position in 1980 from Georges Bank to Cape Romain. *Ann. Biol.* 37. (A)

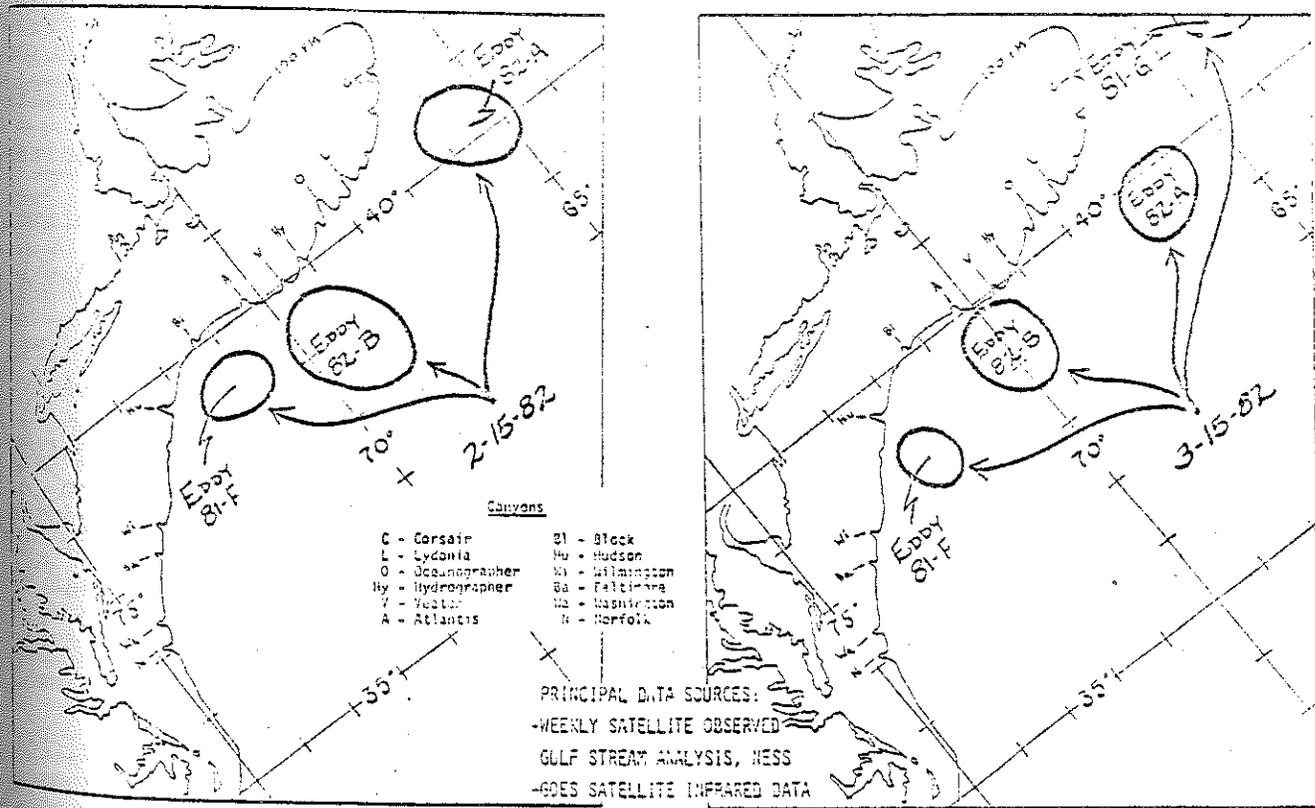
GULF STREAM EDDY LOCATIONS

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

Eddy 81-F travelled southwest about 104 km (56 nm) to a center position near 38.8°N 72.2°W, south of Hudson Canyon. Eddy 82-B moved northwest about 69 km (37 nm) to a center location near 39.5°N 69.9°W, southeast of Atlantis Canyon. Eddy 82-A moved southwest about 111 km (60 nm) and is now located southeast of Lydonia Canyon at about 39.6°N 66.4°W. Eddy 81-G moved slowly west since its formation near 61°W in mid-December, and is now centered near 41.2°N 63.4°W, east of Corsair Canyon and far offshore of the 100-fm line.

During the next 30 days Eddy 81-F may move southwest to a center position east of Baltimore Canyon; Eddy 82-B may move west to a center position east of Hudson Canyon; Eddy 82-A may move west to a center position south of Oceanographer Canyon and Eddy 81-G may move southwest to a center position south of Corsair Canyon.

Fishermen are requested to report unusual conditions or catches occurring in the vicinity of these eddies to the Director, Atlantic Environmental Group, National Marine Fisheries Service, RR 7, South Ferry Road, Narragansett, Rhode Island 02882, by mail. Updates on eddy positions and general information on Gulf Stream eddies may be obtained by calling the Atlantic Environmental Group (401-789-9526).



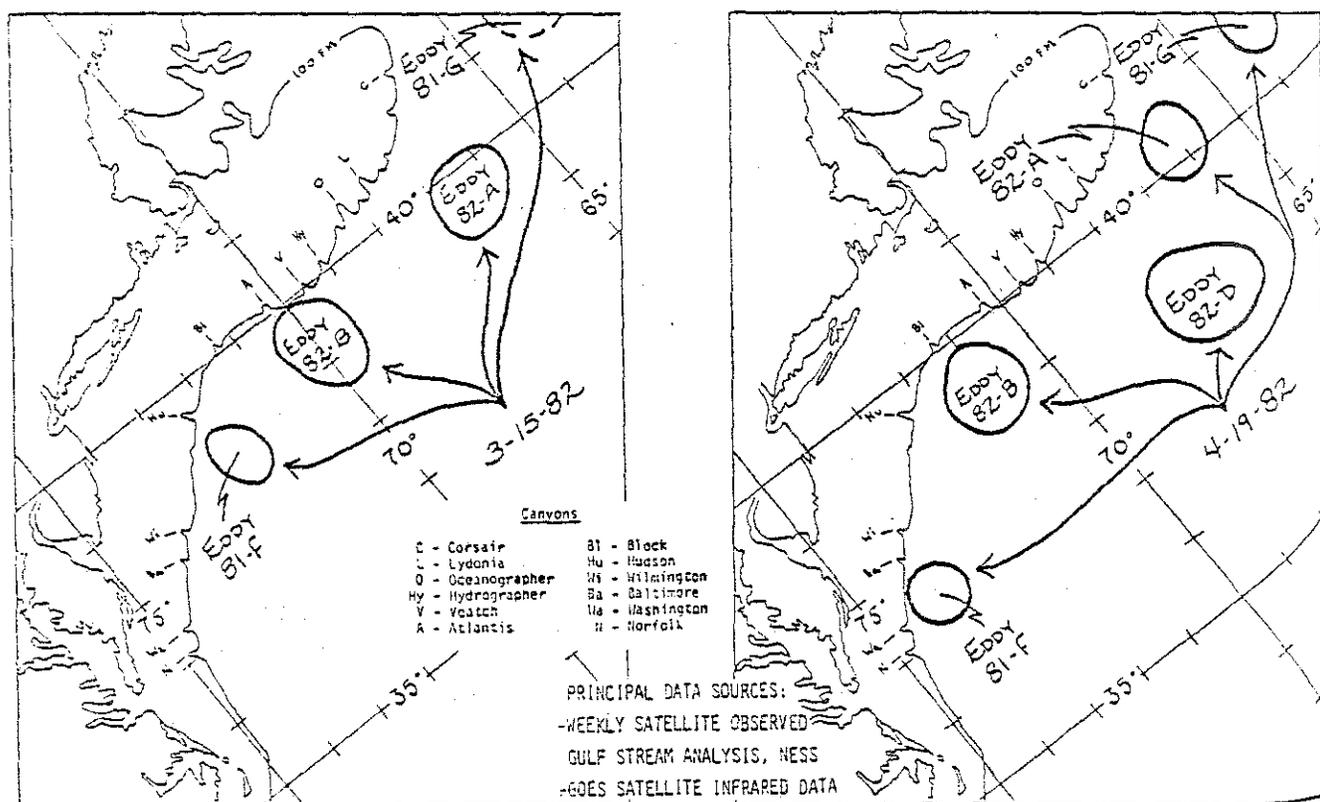
## GULF STREAM EDDY LOCATIONS

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

Eddy 81-F moved southwest about 210 km (113 nm) to a center position east of Washington Canyon, near 37.4°N 75.8°W. Eddy 82-B moved west about 115 km (61 nm) and is now located south of Block Canyon, with a center position near 39.2°N 71.1°W. Eddy 82-D formed in early April from a large Gulf Stream meander. In mid-April the eddy still contains large volumes of Gulf Stream water, and may be in the process of being overrun by the Gulf Stream. The eddy is now located south and far offshore of Lydonia Canyon, centered near 38.5°N 67.2°W. Eddy 82-A was pushed about 68 km (37 nm) to the northeast by the Gulf Stream meander which produced Eddy 82-D. Eddy 82-A now occupies a center position south of Corsair Canyon, near 40.3°N 66.1°W. Eddy 81-G moved southwest about 60 km (32 nm) to a center position near 41.0°N 63.8°W, east and far offshore of Corsair Canyon.

During the next 30 days Eddy 81-F may travel southwest and become resorbed by the Gulf Stream east of Cape Hatteras; Eddy 82-B may move southwest to a center position south of Hudson Canyon. Eddy 82-D may be resorbed by the Gulf Stream, or it may move north and west to a center position south of Hydrographer Canyon. 82-A may move west to a center position south of Lydonia Canyon; Eddy 81-G may move west to a location closer to Corsair Canyon.

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



HUGHES, M. M.; COOK, S. K. Water column thermal structure across the shelf and slope southeast of Sandy Hook, New Jersey, in 1981. Ann. Biol. 38. (S)

HUGHES, M. M.; COOK, S. K. Water column thermal structure across the shelf and slope southeast of Sandy Hook, New Jersey, in 1980. Ann. Biol. 37. (A)

HUGHES, M. M. Thermocline erosion in the Middle Atlantic Bight outer continental shelf - fall 1981. Coast. Oceanogr. Climatol. News 4(2):16;1982. (P)

INGHAM, M. C. Weather conditions and trends in the Maine-Virginia coastal and offshore area during 1970-79. Northw. Atl. Fish. Org., Sci. Stud. (S)

INGHAM, M. C.; McLAIN, D. R. Sea-surface temperatures in the northwestern Atlantic in 1980. Ann. Biol. 37. (A)

JOSSI, J. W.; SMITH, D. E.; WHITE, G. A. Continuous plankton records: the sampling program of the U.S. National Marine Fisheries Service. Ann. Biol. 38. (S)

McLAIN, D. R.; INGHAM, M. C. Sea-surface temperatures in the northwestern Atlantic in 1981. Ann. Biol. 38. (S)

#### TRAVEL, MEETINGS, AND PRESENTATIONS

##### Resource Assessment Division

During 3-7 January, Brad Brown attended an American Association for the Advancement of Science meeting.

On 6 January, Emory Anderson attended a Mid-Atlantic Fishery Management Council Scientific and Statistical Committee meeting in Philadelphia.

On 11 January, Emory Anderson attended a pre-council meeting briefing for Regional Directors at the Northeast Regional Office in Gloucester, Massachusetts.

During 12-14 January, Vaughn Anthony, Mike Sissenwine, Mike Fogarty, and Gordon Waring attended a workshop on Atlantic herring tagging in Quebec City, Canada.

On 13 January, Steve Clark attended an Atlantic States Marine Fisheries Commission's Northern Shrimp Technical Committee meeting in Greenland, New Hampshire.

On 13 and 14 January, Emory Anderson attended a Mid-Atlantic Fishery Management Council meeting in Philadelphia.

On 19 January, Emory Anderson attended a meeting in Boston with Captain and officers of the Polish ship, Admiral Arciszewski, together with Tom Azarovitz, Bill Overholtz, and Gordon Waring, to discuss the upcoming Atlantic mackerel survey.

On 20 January, Mike Sissenwine attended a New England Fishery Management Council Scientific and Statistical Committee meeting in Saugus, Massachusetts.

On 25 January, Fred Serchuk attended a Sea Scallop Review Team meeting at the Northeast Regional Office in Gloucester, Massachusetts.

On 27 January, Fred Serchuk presented a talk on NEFC stock assessment activities in the Northwest Atlantic to a group of seafood industry representatives at the Foley Fish Company in New Bedford, Massachusetts.

On 23 January, Steve Clark attended an Atlantic States Marine Fisheries Commission's Northern Shrimp Technical Committee meeting in Woods Hole.

On 26 January, Brad Brown met with Roger Mann of the Woods Hole Oceanographic Institution, Marv Grosslein, and Dick Hennemuth regarding a proposed workshop on commercial offshore mollusks.

During February, Brad Brown and John Boreman attended the Atlantic States Marine Fisheries Commission meeting on shads and river herrings.

On 2 and 3 February, Brad Brown attended the Mid-Atlantic Fishery Management Council's Scientific and Statistical Committee meeting along with S. Wilk and D. Christensen to present material relative to the NEFC statistics program in the Mid-Atlantic area.

Gordon Waring attended a seminar on fish parasites on 12 February.

On 18 February, Mike Fogarty and Vaughn Anthony attended an Atlantic Herring Oversight Committee meeting in Saugus, Massachusetts.

On 10 February, Vaughn Anthony gave a presentation at the Foley Fish Company in New Bedford, Massachusetts.

On 20 February, Vaughn Anthony gave a presentation at the Massachusetts Fishermen's Forum in Bourne. On 20 and 21 February, Chuck Byrne attended the Forum.

On 23 and 24 February, Vaughn Anthony attended a sampling workshop in Ottawa, Canada.

On 24 February, Emory Anderson attended a meeting in Boston with Captain and scientists of the Polish ship Kanaryjka, together with Paul Jones and Dennis Hanst to discuss the Atlantic mackerel survey.

#### Marine Ecosystems Division

During 1-5 March, Mike Fahay, Geoff Laurence, and Larry Buckley attended the Sixth Annual Larval Fish Conference, sponsored by American Fisheries Society and held at Solomons, Maryland.

On 6 March, Wes Pratt gave a lecture on the edible resources of Narragansett Bay at a symposium at the Wheeler School in Providence.

On 10 March, Ken Sherman traveled to Washington, D.C., to attend a meeting on the U.S.-Canada maritime boundary issue.

On 15 March, Roger Theroux met with representatives of Dames & Moore, Inc., and with Marv Grosslein, Eugene Heyerdahl, Anne Lange, and Robert Pawlowski of the Woods Hole Laboratory, regarding data bases for use by the U.S. State Department on the U.S.-Canada maritime boundary issue.

On 15 March, Roger Theroux received an invitation from John Lindsay to lecture at a graduate seminar at the University of New Hampshire.

On 15 March, Ray Bowman met with Tom Leschine of the Woods Hole Oceanographic Institution to discuss progress on a joint-authorship paper dealing with outer continental shelf oil drilling and its potential impact on Georges Bank and Southern New England marine life. Tom Morris and Ray have completed a working outline of the paper.

On 16 and 17 March, Ken Sherman attended a meeting in Washington, D.C., of scientific advisors to the U.S. State Department on the Antarctic Convention.

On 17 March, Ray Bowman met with scientists composing a book on the current knowledge of the Georges Bank ecosystem and gave a brief presentation of food data available within the Northeast Fisheries Center.

On 18, 23, and 30 March, Greg Lough and members of the Population Processes attended warm-core ring seminars at the Woods Hole Oceanographic Institution.

On 19 March, Roger Theroux met with J. F. Grassle of the Woods Hole Oceanographic Institution, and with Marv Grosslein and Ray Bowman of the Woods Hole Laboratory, regarding benthic and food habits concurrent sampling on Bureau of Land Management spring cruises.

On 24 March, Roger Theroux, Ron Schlitz, Dave Mountain, and Greg Lough met with Tom Scanland of Dames & Moore, Inc., regarding choice of data to provide to that for the U.S.-Canada maritime boundary issue.

During 29-31 March, Ken Sherman, Robert Marak, and Wally Smith met at the Narragansett Laboratory with Dr. Leonard Ejsymont, Director of the Plankton Sorting and Identification Center in Szczecin, Dr. Andrzej Ropelewski of the Morski Instytut Rybacki in Gdynia, and Ms. Hanna Fidelus-Ferlus of the Plankton Sorting and Identification Center, for the eighth annual meeting of the Advisory Board.

On 30 March, Dave Potter and Hal Merry traveled to Markline Corp. in Boston to check out the new HP-87 computer and peripherals.

On 1 April, Ken Sherman attended a meeting in Washington, D.C., of the Polar Research Board of the National Academy of Science.

On 13 April, the following presentations were given at the 39th Northeast Fish and Wildlife Conference held at Cherry Hill, New Jersey: (1) Stillwell, C.--"Food and Feeding Ecology of the Broadbill Swordfish (Xiphias gladius) in the Western North Atlantic"; (2) Bowman, R.--"The Food of Silver Hake"; and (3) Sherman, K.--"Perturbations in the Structure of Fisheries Ecosystems in the North Atlantic."

On 13 April, Carolyn Griswold met with Dr. Robert Edwards, Charles Ehler, and Reed Bohne [the latter two with the NOAA Office of Resource Coordination and Assessment (ORCA)], Bruce Higgins (OCS Coordinator for the Northeast Regional Office), and other NEFC personnel to discuss the role of ORCA and the Regional Action Plan in the U.S.-Canada maritime boundary issue. Carolyn was appointed the NOAA representative on a subcommittee of the Bureau of Land Management's Mid/North Atlantic Regional Technical Working Group. The subcommittee met in New York City on 16 April to discuss the Bureau's Environmental Studies Program and to make suggestions for the direction of the Program in 1984.

On 20 April, Ken Sherman traveled to Washington, D.C., for a meeting with the U.S. State Department to discuss Dames & Moore, Inc., and the U.S.-Canada maritime boundary issue.

During 27-30 April, Ken Sherman traveled to Los Angeles, California, for a meeting with Dames & Moore, Inc., regarding the U.S.-Canada maritime boundary issue.

On 29 and 30 April, Hal Merry and Peter Donnelly flew to Meriden, Connecticut, to pick up a multichannel analyzer from Canberra Corp., and worked with their engineer to integrate it with a HIAC particle-size analyzer.

Wes Pratt delivered an evening lecture on underwater photography at the University of Rhode Island's Graduate School of Oceanography, and gave an illustrated talk on North Atlantic fishes as part of a public lecture series at the Roger Williams Museum in Providence, Rhode Island.

#### Resource Utilization Division

Ron Lundstrom spent a day at the New England Enzyme Center at Tufts Medical School with Dr. Philip Shich to discuss and observe monoclonal antibody techniques used there.

Ron Lundstrom attended the Seventh Annual AOAC Spring Workshop held in New Orleans and presented the paper, "Identification of Seafood Products by Isoelectric Focusing."

Al Blott attended a Scottish seining seminar in Portland, Maine.

#### Division of Environmental Assessment

Frank Steimle and Bob Reid attended a Northeast Monitoring Program meeting at the Sandy Hook Laboratory on 2 March to begin drafting a report on monitoring findings for 1981.

J. Graikoski attended an American Society of Microbiology meeting in Atlanta, Georgia, during 7-12 March, and gave a poster presentation on Vibrio species in the western Atlantic Ocean.

On Wednesday, 17 March, Dr. Pearce participated in the Washington, D.C., meeting of the Northeast Monitoring Program. Reviewers represented the NOAA Office of Marine Pollution Assessment, the National Ocean Survey, NMFS, and the program managers for NEMP.

On 17 March, Frank Steimle attended a meeting at the Woods Hole Oceanographic Institution (WHOI) to discuss progress on the benthic productivity chapter of a new NEFC/WHOI book on Georges Bank.

Bob Reid attended a meeting of the New York Citizens Advisory Committee on Water Pollution and representatives of their Congressmen on 23 March in New York.

F. Thurberg served as a member of the Sea Grant Site Review Team at the Woods Hole Oceanographic Institution during 23-25 March.

On Thursday, 25 March, Dr. Pearce participated in an interagency steering committee meeting for the cooperative/coordinated work ongoing between the NEFC and the EPA's Environmental Research Laboratory in Narragansett, Rhode Island. The general outline for the site-characterization updates for the 106-mile and Philadelphia Bay sites was reviewed and approved. Presentations were also given on the water management units being developed by the NEFC.

Dr. John Pearce, Dr. Tony Calabrese, Frank Steimle, and Bob Reid participated in a NOAA-sponsored workshop on Meaningful Measures of Pollution Effects or Impacts held in Pensacola, Florida, during 25-29 March. Bob presented a poster paper on "Defining Unreasonable Degradation of Benthos."

During 26-28 March, Frank Steimle, Dorothy Jeffress, Dave Radosh, Steve Frame, Ann Frame, and Bob Reid attended the annual meeting of East Coast Benthic Ecologists at Harvard University.

During 27 March-2 April, Dr. Pearce participated in the meetings of the International Council for the Exploration of the Sea's Advisory Council on Marine Pollution. Topics of particular interest included the continued development of regional assessments and site-characterizations, use of at-sea incineration techniques, monitoring for marine contaminants and biological effects, and atmospheric inputs of contaminants.

On 17 April, Dr. Pearce gave a presentation at the Toxic Wastes Symposium, cosponsored by the New Jersey State Colleges and the Hoffman LaRoche Pharmaceutical Company. He discussed the Center program in environmental monitoring for toxic substances.

Dr. John Pearce, Bob Reid, and Frank Steimle attended a NEMP management meeting on 20 April in Philadelphia. They discussed finalizing the second annual NEMP report.

Dr. Pearce participated in the Georges Bank Conference held on Nantucket Island. The Conference was concerned with possible effects of oil exploration and development on Georges Bank. Dr. Pearce presented two papers: (1) "A Review of Benthic Communities on Georges Bank," and (2) "Possible Effects of Petroleum on the Biota of Marine Ecosystems."

Allen Bejda, Anne Studholme, Carol Roe, and Joseph Luczkovich attended the Northeast Fish and Wildlife Conference in Cherry Hill, New Jersey.

On 17 March, Jay O'Reilly presented a seminar to the staff of EPA's facility in Narragansett, Rhode Island, which dealt with the spatial and seasonal distribution of chlorophyll, nutrients, and phytoplankton production in the Northwest Atlantic shelf ecosystem.

Vincent Zdanowicz attended the Eastern Analytical Symposium in Atlantic City, New Jersey, in March.

Andrew Draxler attended a meeting of the chemistry subgroup of the Georges Bank book on 12 April, at the Woods Hole Oceanographic Institution, and presented an analysis of the annual nutrient cycles in three areas on Georges Bank.

S. Chang gave a talk on "Nuts and Bolts of Fisheries Management" at a graduate seminar at the State University of New York at Stony Brook on 21 April.

A talk on "Total Plankton Respiration in the Chesapeake Bay Plume" was presented at the spring meeting of the Atlantic Estuarine Research Society in Baltimore, Maryland, by Craig N. Robertson.

### Aquaculture Division

Ed Rhodes presented a paper entitled, "Suspension Culture Grow-out of the Bay Scallop (Argopecten irradians)," at the annual meeting of the World Mariculture Society in Charleston, South Carolina, during 28 February-4 March.

Ed Rhodes attended the Massachusetts Shellfish Officers Association meeting in Danvers, Massachusetts, during 17-19 March.

Ed Rhodes and Ron Goldberg visited a number of shellfish facilities in Maine and presented talks at the New England Aquaculture Convention in Portland, Maine, during 25-27 March.

A. Longwell participated in the First International Conference on Aquaculture Genetics, held during 29 March-2 April in Galway, Ireland, and in the second meeting of the ICES Working Group on Genetics, held during the same time.

Gary Wikfors attended the Northeast Algal Symposium in Woods Hole on 1 and 2 May, and presented a poster session entitled, "Persistence of Metal Tolerance in Two Microalgal Species." The information included in the poster described continuing investigations on the nature of mechanisms by which phytoplankters adapt to detrimental concentrations of heavy metal ions using strains of algae that have developed tolerances to metals in lab culture.

### Pathobiology Division

Dr. Rosenfield participated in the Maryland Sea Grant Advisory Committee meeting in Annapolis on 5 March.

Dr. Murchelano attended Northeast Monitoring Program meetings at the Sandy Hook Laboratory on 9 March and 13 April.

Mr. Newman visited the U.S. Fish and Wildlife Service's National Fish Health Research Center at Leetown, West Virginia, on 12 March to conduct studies on virus isolated from southern flounder.

Dr. Robohm attended a training workshop on hybridomas and monoclonal antibodies sponsored by GENCOM Associates on 13 and 14 March in Bethesda, Maryland.

Dr. Rosenfield attended the Maryland Sea Grant Citizens Advisory Board meeting in Annapolis on 16 March.

Mrs. Smith and Ms. Roe attended the Fourth Annual Region II Symposium of National Society for Histotechnologists during 18-20 March at Williamsburg, Virginia.

Mr. Newman conferred with Polish scientists at the Narragansett Laboratory during 28 March-1 April.

Dr. Rosenfield attended the People's Republic of China Working Group meeting in Washington, D.C., on 31 March.

On 2 April, Dr. Blogoslawski visited with Kenelm W. Coons in Boston where they discussed fishery technology.

Dr. Rosenfield participated in ICES Working Group Meeting on Diseases and Pathology of Marine Animals in Ijmuiden, The Netherlands, during 19-23 April.

On 22 and 23 April, Dr. Blogoslowski attended the Northeast Shellfish Sanitation Association meeting in Davisville, Rhode Island, and presented a progress report for the Pathobiology Division.

Dr. Rosenfield held discussions from 26 to 30 April in Vigo and La Coruna, Spain, with representatives of the Spanish Institute of Oceanography regarding cooperative oceanographic and fisheries research under the United States-Spain Treaty of Friendship.

#### National Systematics Laboratory

Dr. Bruce Collette visited the Department of Marine Science of the University of South Florida during 1-3 March and presented two seminars: "Mackerels, Bonitos and Tunas: A Synthesis of Phylogenetic Speculations"; and "Ecology of Coral Reef Fishes: The Results of the Tektite Program."

Dr. Collette served as Chairman of the Priorities Workgroup of the ADP Workshop on Computer Usage in Museums, sponsored by the National Science Foundation and held in the National Museum of Natural History on 8 and 9 March.

Dr. Collette represented the American Society of Ichthyologists and Herpetologists at a consortium of Presidents of American Association for the Advancement of Science-affiliated societies at a meeting in Washington, D.C., on 15 March to discuss the research and development parts of the proposed FY 1983 federal budget.

J. Russo attended a symposium on Computers in Research at the Smithsonian Institution on 6 and 7 April.

Drs. I. Canet, B. B. Collette, and A. B. Williams participated in a Council Meeting and the Annual Meeting of the Biological Society of Washington on 14 April.

#### Atlantic Environmental Group

Mert Ingham and Steve Cook traveled to Washington, D.C., and Silver Springs, Maryland, to confer with National Weather Service/Ocean Survey personnel about AEG Ship of Opportunity Program. They departed on 28 February and returned on 3 March.

On 23 and 24 March, Mert Ingham went to the State University of New York at Stony Brook, to participate in a meeting of the EPA/NMFS/OMPA Steering Committee on Ocean Dumping Research.

The NASA office at Greenbelt, Maryland, was visited by Peter Celone on 31 March to 2 April for training on the High Resolution Picture Transmission System.

Reed Armstrong attended a Northeast Monitoring Program meeting on water-column monitoring activities, held at the Sandy Hook Laboratory on 1 and 2 April.

#### VISITORS

##### Resource Assessment Division

On 5 January, Fred Serchuk met in Woods Hole with Arnie Howe of the Massachusetts Division of Marine Fisheries to discuss results from the 1981 spring State of Massachusetts inshore bottom trawl survey.

On 18 January, Fred Serchuk met with Dan Fried, NMFS port agent in Louisiana concerning assessment research activities in Woods Hole.

### Marine Ecosystems Division

On 10 March, Marty Newman and Sharon MacLean of the Oxford Laboratory, and Art Kendall of the Northwest and Alaska Fisheries Center's Seattle Laboratory, met with Robert Marak and Jerry Prezioso at the Narragansett Laboratory for a preliminary meeting of the U.S. participants of the U.S./Poland Advisory Board for the Plankton Sorting and Identification Center at Szczecin, Poland.

On 20 April, Snoore Tilseth of the Institute of Marine Research's Directorate of Fisheries in Bergen, Norway, visited with Greg Lough to discuss larval Atlantic cod and haddock sampling strategy using MOCNESS and an in-situ HIAC particle-size analyzer; he also visited with George Bolz regarding larval Atlantic cod otoliths.

### Resource Utilization Division

On 9 March, Mr. Ronald Segars of the U.S. Army's Natick (Massachusetts) Laboratories, and Dr. Ernest Johnson of the University of Massachusetts, visited to discuss instrumental measurement of the texture of fish.

On 25 March, Dr. Armand Cardello of the Natick Laboratories, and Dr. Miles Sawyer of the University of Massachusetts Department of Food Science, visited to discuss a draft protocol for measuring the edibility characteristics of fish.

On 26 March, Dr. Chung Lee of the University of Rhode Island's Department of Food Science, visited to discuss his research on shellfish analogues.

CDR Charles Molyneaux, with the NMFS Central Office, spent a few days with us to familiarize himself with fishing vessels, gear, and operations.

Barbara Rasco of the University of Massachusetts Marine Station spent 3 days at the Gloucester Laboratory running preparative scale isoelectric focusing experiments.

### Aquaculture Division

Visitors to the Division's operations at the Milford Laboratory included: the Cambridge Energy Group from Cambridge, Massachusetts; Linc Murray of Blue-Gold Sea-farms in Rhode Island; Hugh Rule of the Stamford (Connecticut) Public Schools; John Lindsay of the University of New Hampshire's Department of Vocational Education; Michael Corbett from New Haven, Connecticut; and Jim Quinn from Narragansett, Rhode Island.

### Pathobiology Division

Visitors to the Oxford Laboratory during the reporting period were: Dr. Robert Kifer of the NMFS Northeast Regional Office in Gloucester, Massachusetts; Ms. Anne George and 15 students from Western High School in Baltimore, Maryland; Ms. Sara Otto, Ms. Ann Marie Fields, and Mr Howard King of the Maryland Department of Natural Resources in Annapolis; Dr. Jeffry Bier of the Food and Drug Administration in Washington, D.C.; Ms. Krista Lecato of the University of Delaware in Lewes; Dr. Ian Morris and Dr. Michael Kemp of the University of Maryland's Center for Environmental & Estuarine Studies in Cambridge; Mr. Robert Palmatier of Zeiss, Inc., in Falls Church, Virginia; and Dr. David Flemer of the EPA in Annapolis, Maryland.

## National Systematics Laboratory

Dr. Collette was visited by: Dr. John Randall of the Bishop Museum in Honolulu to discuss Red Sea Fishes, Dr. James Tyler of the National Science Foundation who worked on the osteology of the louvar at the National Systematics Laboratory, Dr. Steven Ross of the University of Southern Mississippi to use the library.

Visitors to the Crustacean Section of the Laboratory included: Dr. Marea Hatziolos of the Department of Biological Sciences at Yale University, Ms. Sylvana Campbello of George Washington University, Dr. Thomas J. Lawson of East Carolina University in Greenville, Mr. John Clamp of the North Carolina State Museum in Raleigh, Dr. J. R. Schubel of the State University of New York at Stony Brook, Mr. Jerome Williams of the U.S. Naval Academy at Annapolis, and Dr. Richard Bailey of Northeastern University in Boston, Massachusetts.

## UNIVERSITY AFFAIRS

### Resource Assessment Division

Fred Serchuk served as coordinator for the NEFC-Smith College January 1982 Intern Program. Ms. Kerry Flynn, an undergraduate from Smith College, participated in this program during 5-22 January in the Division.

Fred Serchuk met with John Trautman and Sabine Rowa, student volunteers from Fairfield (Connecticut) University to discuss general assessment activities and opportunities during their January tenure in the Division.

Fred Serchuk participated as Adjunct Professor in the Dissertation Committee meeting of a Ph.D. candidate within the Department of Forestry and Wildlife Management (Fisheries) at the University of Massachusetts, Amherst, on 2 February, and participated as a Dissertation Committee member in the project review of Ph.D. research activities of a doctoral candidate at the Marine Resources Center of the State University of New York at Stony Brook on 11 February.

Fred Serchuk met with Saul Saila and staff members from the University of Rhode Island Graduate School of Oceanography on 17 February in Woods Hole to discuss fisheries stock identification research.

Fred Serchuk spoke on 20 January with Dave Rockland of the University of Delaware concerning surf clam growth rates.

Vaughn Anthony met with a professor from the University of Connecticut. Vaughn and Brad Brown met with Dave Conover from the State University of New York regarding potential cooperative work.

Steve Clark met at Woods Hole on 17 February with Dr. Saul Saila and Dr. Dun-Lung Chen (Shantung College of Oceanography in the People's Republic of China) and with other Division staff to review NEFC assessment research.

Mike Sissenwine gave a lecture on uncertainty in fisheries science at the University of Rhode Island on 23 February.

Gordon Waring discussed aging of spiny dogfish with Marta Nummach of the Virginia Institute of Marine Science and Peter Woodhead of the State University of New York.

### Marine Ecosystems Division

On 8 March, Greg Lough met with Dr. Jennifer Purcell of the Woods Hole Oceanographic Institution (WHOI) to discuss a proposed Sea Grant-funded study of predation of fish larvae by gelatinous zooplankton.

On 17 March, Roger Theroux presented a 10-min overview of benthic data to be incorporated in the "Bottom Animals" chapter (to be edited by Roger) in the Zoogeography Section of the Georges Bank book at an editorial review meeting of benthic contributors convened by book editor Richard Backus of WHOI. Presentations were also made by the following people: Ray Bowman of NEFC, Bob Butman of U.S. Geological Survey, W. Grant of WHOI, J. F. Grassle of WHOI, Marv Grosslein of NEFC, Tom Leschine of WHOI, A. Michael of Taxon, Inc., T. Novitsky of Associates of Cape Cod, S. Peterson of WHOI, R. Price of WHOI, L. Smith of Haverford College, Frank Steimle of NEFC, J. Teal of WHOI, Joseph Uzzmann of NEFC, and William Overholtz of NEFC.

#### Aquaculture Division

Ed Rhodes and Ron Goldberg discussed shellfish research with faculty from Rutgers University and University of Maine.

Ed Rhodes discussed a possible thesis problem with bay scallop reproduction with Ms. Valerie Hall of the Boston University Marine Program.

Ron Goldberg led a tour of the Milford Laboratory for a group of students from South Central Connecticut Community College in New Haven.

Ed Rhodes discussed with State University of New York faculty a thesis proposal from a student at the State University of New York at Stony Brook.

#### Pathobiology Division

On 4 March, Dr. Rita Colwell was sent three oyster larval pathogens--710, 807, and LIOF 4--for DNA base ratio analysis; nothing has been reported to date.

Dr. Sawyer attended the dedication of the Marine Sciences Building at Hampton Institute in Hampton, Virginia, on 27 March.

Dr. Carolyn Brown sent a culture of a pigment-producing pseudomonad to Dr. Nancy Geber of Rutgers University for comparing the pigment with one earlier extracted from Alteromonas rubra.

Dr. Rosenfield convened a workshop on Oxford Laboratory/University of Maryland cooperative research planning on 16 April.

On 16 April, Rev. Elder, S. J., from Fairfield University visited with Dr. Blogoslawski and discussed progress in their joint research on chemical identification of paralytic shellfish poison in shellfish samples.

On 18 April, Dr. Blogoslawski gave a lecture entitled "The Diving Marine Scientist" to the 6th Annual Dive to Adventure Exposition, held at the State University of New York at Purchase.

Ms. Lisa Petti submitted her Master's Thesis proposal, "Relationship Between Shell Associated Pathogens and Interference of Crassostrea virginica Set," to the Chairman of the Biology Department at Southern Connecticut State College, Dr. H. W. Stevenson.

#### Atlantic Environmental Group

Mert Ingham visited the Virginia Institute of Marine Science on 8 and 9 April to confer with personnel on research contracts.

## PUBLIC AFFAIRS

### Resource Assessment Division

Emory Anderson had a televised interview with Ann Conway of WLNE-TV, Providence, Rhode Island, concerning the upcoming Atlantic mackerel survey aboard Polish vessel. He was interviewed both in Woods Hole and in Boston aboard ship, as well as being interviewed by Ann aboard ship upon arrival at Woods Hole (2 February).

### Marine Ecosystems Division

On 23 March, Robert Marak gave a talk to the South Kingstown (Rhode Island) Women's Club regarding the Antarctic.

### Division of Environmental Assessment

J. Graikoski served as a judge at the Connecticut State Science Fair.

### Pathobiology Division

Dr. Rosenfield presented a lecture on Center and Pathobiology Division research to the Eastern Shore Citizens Group on 18 March.

On 23 April, Bruce Fellman, a staff writer for Science 82, visited the Mill Laboratory and obtained background information on diseases from Drs. Robohm and Brown for an article on the American oyster for the fall 1982 issue.

## PERSONNEL

### Resource Assessment Division

Eileen Klopfer returned to school at the end of January. Her fine efforts will be missed.

Judy Penttila was assigned to the Fishery Assessment Investigation to work with Fred Serchuk on ongoing assessment activities.

Mike Fogarty began taking a course in population biology and fisheries research at the University of Rhode Island.

### Marine Ecosystems Division

On 24, 26, and 29 March, Ray Bowman, Bill Michaels, and Tom Morris attended an introductory course on the use of the VAX terminals.

Roz Cohen completed an informal introductory computer user's class on the Woods Hole Oceanographic Institution's new VAX system.

Cabell Davis successfully defended his Ph.D. Thesis through the Boston University Marine Program on 12 April.

Dave Dillman's appointment expired at the end of April, and Christine Phillips resigned her position as a personnel assistant.

### Pathobiology Division

Dr. Blogoslawski was appointed as Acting Laboratory Director at the Gloucester Laboratory from 28 February to 2 April; he also participated as Chief of the Resource Utilization Division.

Mr. Peter Pendoley completed his temporary assignment at the Milford Laboratory

### National Systematics Laboratory

Dr. Collette was appointed as Director of the National Systematics Laboratory.

### EEO ACTIVITIES

#### Resource Assessment Division

Steve Clark attended Woods Hole Laboratory EEO Committee regular meetings on 5 January and 2 February (the latter with Louise Dery and Sherry Sass).

Sherry Sass and Louise Dery attended a Career Day on 13 January.

On 14 January, Steve Clark and Fred Serchuk attended a Woods Hole Laboratory EEO Executive Subcommittee meeting in Woods Hole.

On 18 January, Fred Serchuk attended a Federal Women's Program (FWP) workshop in Woods Hole on career counseling.

On 27 January, Brad Brown and Sherry Sass attended a Center FWP meeting at the Milford Laboratory.

Louise Dery and Sherry Sass attended an FWP meeting on 10 February.

On 11 February, Gordon Waring attended an EEO film.

On 16 February, Brad Brown and Dick Hennemuth met with Dr. Shirley Malcolm to discuss general aspects of interacting with her office for opportunities in science within the American Association for the Advancement of Science.

On 17 February, Brad Brown met with Ms. Beth Schuarzman of the U.S. Geological Survey (USGS) to discuss the USGS program for development of career opportunities for minorities.

Sherry Sass attended an FWP meeting on 18 February.

On 25 February, Steve Clark attended Black History Month seminars at the Woods Hole Oceanographic Institution's Clark Laboratory.

Dennis Hansford, Carl Harrison, and Andy Thoms assisted in organizing and conducting activities celebrating Afro-American History Month.

#### Marine Ecosystems Division

The EEO Committee at the Narragansett Laboratory met in both March and April. Discussions centered around our proposed summer apprenticeship program in conjunction with the EPA. A memo was sent out to investigation chiefs explaining the program in brief and requesting replies from interested groups. Kathy McArthur and Jim Taormina of the Northeast Regional Office visited the Laboratory in March and conducted a seminar on personnel-related matters which was well attended and received.

#### Pathobiology Division

Dr. Carolyn Brown attended the Center EEO meeting on 2 March at the Milford Laboratory.

Dr. Carolyn Brown met on 6 April with the Woods Hole Laboratory FWP cochairpers to discuss their activities and concerns.