NORTHEAST FISHERIES CENTER

NEWSLETTER

JULY-AUGUST 1982

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"NORTHEAST FISHERIES CENTER NEWSLETTER"

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PRE-OIL DRILLING BENCHMARKS OF OCEAN-FLOOR FAUNA, HABITATS, AND CONTAMINANT LOADS ON GEORGES BANK AND IN ITS SUBMARINE CANYONS

by

Dr. Richard A. Cooper, Chief
Manned Undersea Research and Technology Program

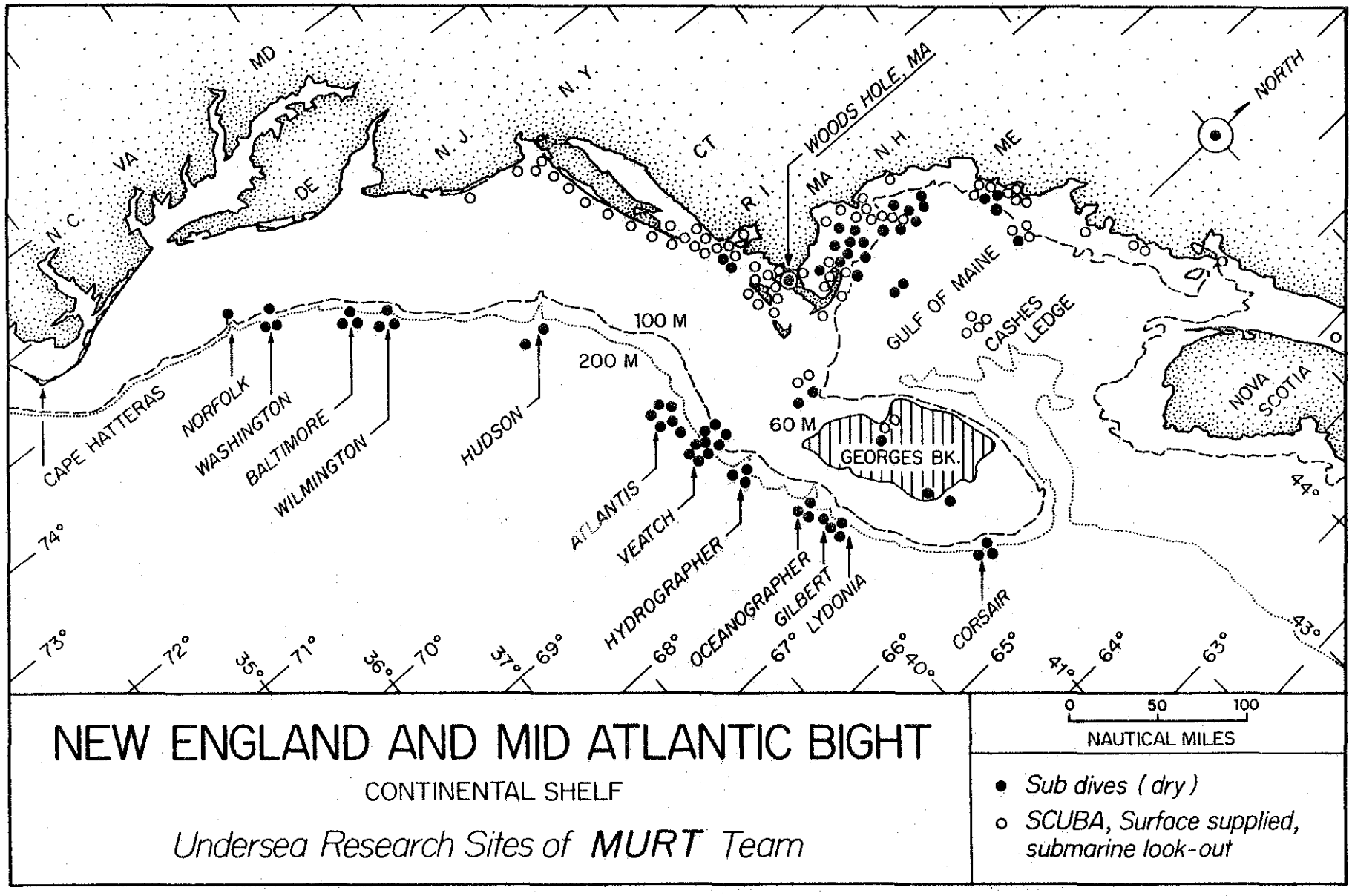
INTRODUCTION

For the past 10 years, the Manned Undersea Research and Technology Program (MURT) has studied, in-situ, the megabenthic fauna (large, bottom-dwelling animals) of the outer continental shelf and upper continental slope from Cape Hatteras to the American-Canadian boundary. These studies focus on: (1) species abundance, habitat preference, and behavior; (2) community structure; and (3) variations in the above two items from year to year. These studies also measure the effectiveness and calibrate the operation of conventional research survey and commercial catch gear (lobster trap, otter trawl, clam dredge, camera sled, etc.), and document their impact on the ocean floor and its fauna. Most of these studies have taken place on Georges Bank and in or around the Georges Bank and Middle Atlantic Bight submarine canyons (Corsair, Lydonia, Gilbert, Oceanographer, Hydrographer, Veatch, Atlantis, Block, Hudson, Baltimore, Washington, and Norfolk; Figure 1).

In response to scheduled (beginning in summer 1981) exploratory drilling for oil and natural gas on south-central Georges Bank (Lease Sale Area 42; Figure 2), and expected exploratory drilling along the continental slope south and west of Georges Bank (Lease Sale Area 52; Figure 2), and based upon our 10-year background of biological and geological studies on Georges Bank and "downstream" (Veatch, Hydrographer, Oceanographer, Gilbert, and Lydonia Canyons) from Area 42, MURT began a pre-drilling (benchmark) definition and monitoring investigation to identify impact, or lack of impact, on the living resources of the ocean floor and their habitats. We began field investigations in the summer of 1980 as part of NOAA's Northeast Monitoring Program (NEMP). The following sections of this article summarize our findings so far on: (1) the biology and geology of the Georges Bank submarine canyons, (2) benchmarks (species abundance, community structure, and annual variations thereof) of megabenthhic fauna and their habitats, (3) benchmarks of body and habitat burdens of contaminants, (4) current regimes and geological features, and (5) the uniqueness and productivity of submarine canyon heads. We also list selected publications and reports pertinent to this investigation.

Integral to these studies is the development of shallow- and deep-diving techniques, including the use of sophisticated, externally-operated camera systems, sampling devices, and environmental sensors. Over the past 12 years, MURT has operated with 10 different research submersibles and related support systems, with diving capabilities of 250-4,000 m (840-13,000 ft) and crew complements of two to four diver-scientists.

Also important to these studies is the cooperation of guest fishermen and scientists, the latter coming from academia, state agencies, and other federal agencies [U.S. Geological Survey (USGS), etc.]. These collaborators provide expertise complementary to that of the MURT team.


NEW ENGLAND AND MID ATLANTIC BIGHT
CONTINENTAL SHELF
Undersea Research Sites of MURT Team
0 50 100
NAUTICAL MILES
Sub dives (dry)
SCUBA, Surface supplied, submarine look-out
NORTH
N.C.
VA
MD
DE
N.J.
N.Y.
CT
R.I.
MA
N.H.
ME
WOODS HOLE, MA
GULF OF MAINE
CASHES LEDGE
NOVA SCOTIA
GEORGES BK.
100 M
200 M
60 M
CAPE HATTERAS
NORFOLK
WASHINGTON
BALTIMORE
WILMINGTON
HUDSON
ATLANTIS
VEATCH
HYDROGRAPHER
OCEANOGRAPHER
GILBERT
LYDONIA
CORSAIR
74°
73°
72°
35°
71°
36°
70°
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69°
68°
67°
66°
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65°
41°
64°
63°
44°
43°

Figure 1.

Figure 1.

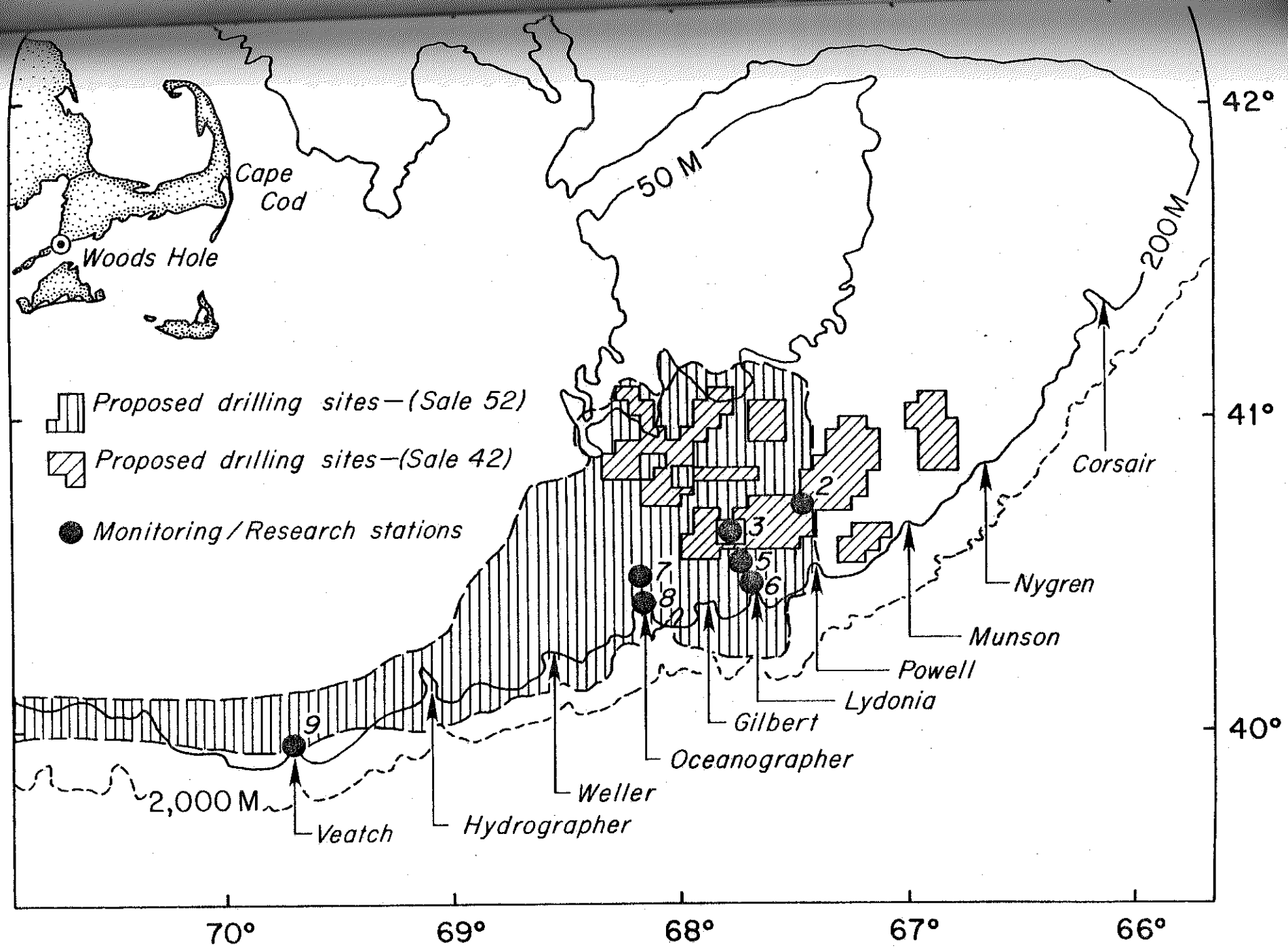

Figure 2.

For example, the surface geology and sedimentary features of the ocean floor (studied by USGS scientists) and the current regime directly influence the species and abundance of fauna inhabiting a given area.

BIOLOGY AND GEOLOGY OF SUBMARINE CANYONS

Our studies of the Georges Bank submarine canyons show that these large geological features are unique ecosystems, largely because of their unique habitats. The species abundance and community structure of the megabenthic and epibenthic (bottom-associated) fauna are closely related to the surface geology and sedimentary features of the canyon walls and axes, which in turn are related to the bottom gradient and currents. These sedimentary features and surface geology produce five habitat types covering the full range of ocean-floor environments occupied by megabenthic fauna:

I. Flat, featureless or mildly featured, mud/silt/clay substrate with less than 5% overlay of gravel;

II. Level or gradually sloping mud/silt/clay substrate with more than a 5% overlay of gravel/rock/cobble;

III. Level to steeply sloping (50°) sand/clay substrate with an overlying boulder field;

IV. Gradually (3°) to precipitously (70°) sloping exposed clay substrate with biologically eroded excavations of various shapes and sizes, which we call a "Pueblo Village" (Figure 3); and

V. Featured sand dunes with overlying sand ripples.

We hypothesize that submarine canyons function as refugia for many bottom-oriented species, where there is little, if any, impact from active fishing gear. Both species diversity and abundance are greater in canyons than in noncanyon areas at comparable depths. Canyons also function as important nursery grounds for a wide variety of bottom-oriented species such as shrimps, *Cancer* spp. crabs, American lobster, white hake, cusk, ocean pout, conger eel, tilefish, blackbelly rosefish, etc., and provide three-dimensional shelter, rarely occurring in noncanyon areas of the outer shelf and slope, for the adults of some 20 species. The highly significant animal-habitat associations observed within the canyons were considered in designing our site-specific (with regard to exploratory and production drilling) monitoring studies as discussed below.

BENCHMARKS OF MEGABENTHIC FAUNA AND THEIR HABITATS

Quantitative and qualitative benchmarks of species abundance and community structure, as well as measures of variation from year to year, are needed before any conclusions can be drawn on impacts due to drilling activity. Accordingly, MURT began defining such benchmarks in July 1980 at two stations on Georges Bank and two stations in Lydonia Canyon (Figure 2) thought to be potential reservoirs for bottom-carried sediments and entrained contaminants. In July 1981, we established two additional stations in Oceanographer Canyon (Figure 2), and revisited the stations set

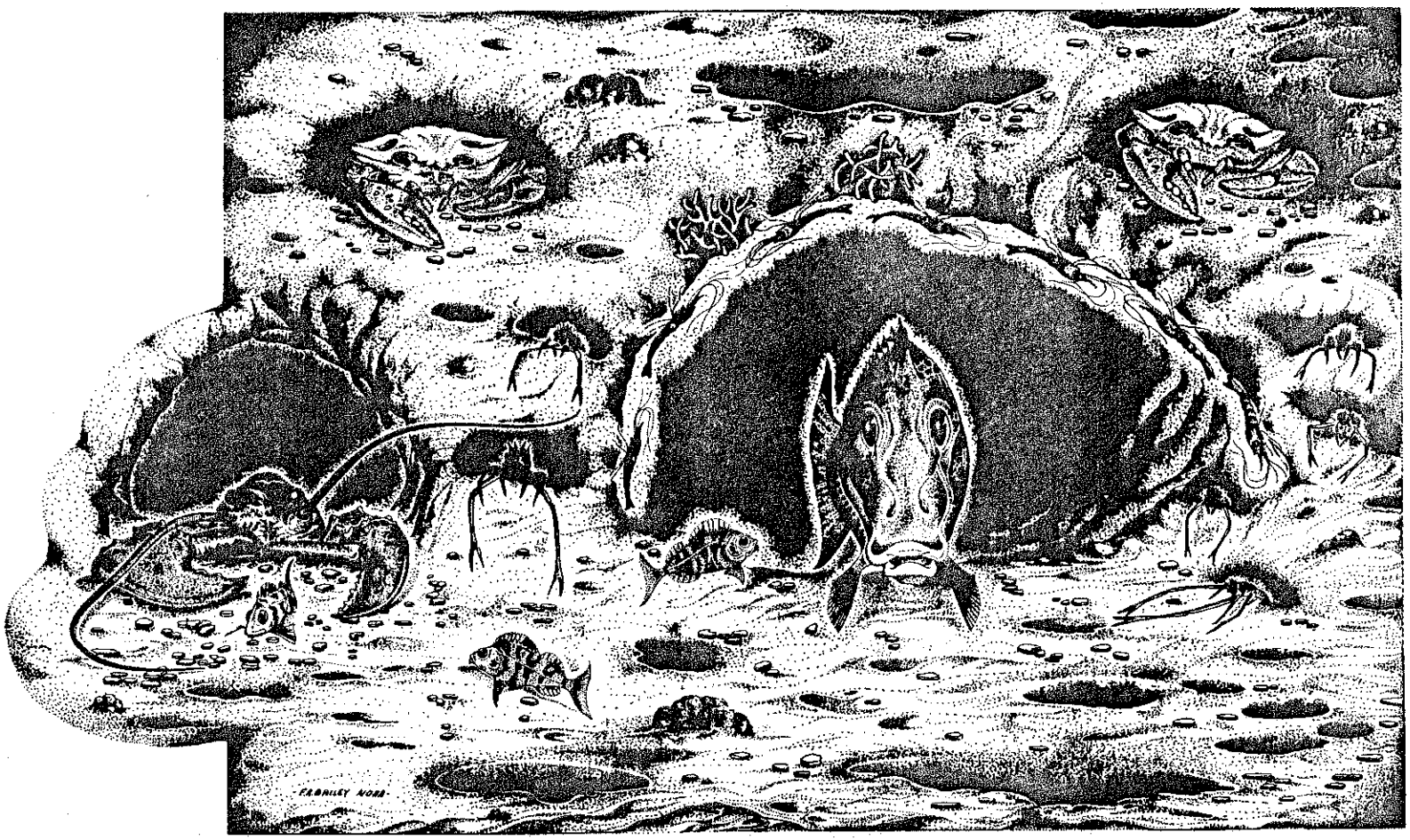

Figure 3. Galatheid crabs, Cancer spp. crabs, cleaner shrimp, American lobster, blackbelly rosefish, and tilefish as actually observed in "Pueblo Village" habitat at 200 m in Veatch Canyon.

up in 1980. In July 1982, we established a seventh station in Veatch Canyon and revisited each of the six previously established stations. Each station is a site-specific location marked with a 37-kHz pinger embedded in a pyramid-shaped cement block.

We collect benchmark data at each station primarily by using manned research submersibles (*Alvin* and *Johnson-Sea-Link*). Four photographic transects (north, south, east, and west of the pinger) are run at each station with the submersible cruising 600 yd along the bottom. This combination of precise navigation and site revisitation permits assessment of the megabenthic fauna and their habitats over the same ocean-floor areas year after year. Using two externally mounted (forward and aft) Benthos cameras, we take from 1,500 to 2,600 color pictures (high-speed Ektachrome 35-mm film), representing between 10,000 and 18,000 m^2 of ocean floor of each monitoring station. Each photographic frame encompasses 7.0 m^2 of ocean floor. We read all films on a 15X film reader and analyze the faunal abundance data by habitat type. We also collect benchmark data by: (1) making direct observations and recording them on audio tapes; and (2) sampling surface sediments and selected biota (anemones, sea scallops, and American lobsters) in-situ by using an externally mounted, hydraulically operated arm on the submersible, as well as traps and hook/line gear operated from the surface.

Figures 4 and 5 show the mean abundance [number per hectare (10,000 m^2)] of megabenthic fauna assessed at Stations 2 (Georges Bank) and 3 (head of Lydonia Canyon) in July 1980 and 1981. We have just completed reading and analyzing data from the July 1982 films; these data will give us our third consecutive year of abundance estimates at site-specific locations, and a first estimate of natural variation. We estimate that 5-7 years of species abundance and community structure data will produce a reasonable benchmark; production drilling activity, if warranted, would not begin until the late 1980's (Lease Sale Area 42) and 1990's (Area 52).

Of the 30 or more megabenthic species that inhabit Georges Bank and its canyons to depths of 350 m, 10 are likely candidates for long-term monitoring as "key indicator" species reflecting possible impact from drilling activity within Lease Sale Areas 42 and 52. The criteria for key indicator species designation are: (1) endemic to study area, (2) specific habitat-type association, (3) relatively long (4-5 years or more) life span, (4) relatively high population level, (5) population level not subject to large fluctuations through year-class input, and (6) individuals easily counted from photographs. For any species that meets five of these criteria, we designate it as a key indicator species, such as the burrowing (mud) anemone, rock anemone, starfishes (several species), sea scallop, *Cancer* spp. crabs (two species), American lobster, ocean pout, white hake, tilefish, and blackbelly rosefish. The population levels of these species appear to be relatively constant from 1980 to 1981, with no evidence of significant population shifts, habitat changes, behavioral anomalies, etc. Our observations and preliminary data analysis for 1982 support the above.

As expected, habitat types (I, II, III, IV, and V) and animal shelter characteristics (density and shape of excavations, burrow stability relative to erosion or deposition, distribution of "Pueblo Village" areas and boulder fields, etc.) have remained relatively constant over three consecutive summers. There has been no apparent degradation of ocean-floor habitat as a result of exploratory drilling (eight holes drilled to date). We have made several dives in the immediate vicinity of drilling

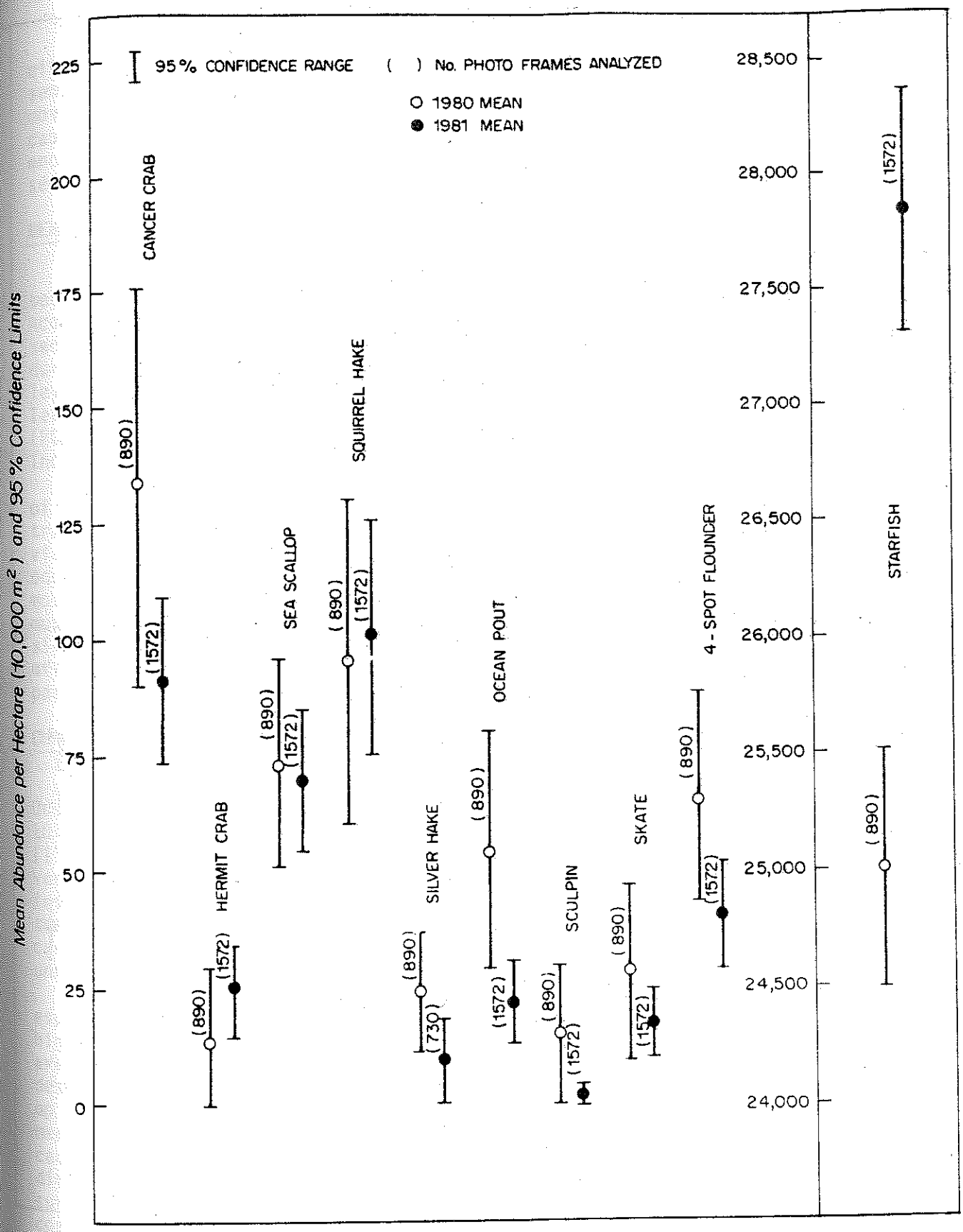

Figure 4. 1980 and 1981 estimates of megabenthic fauna density at Station III (Georges Bank).

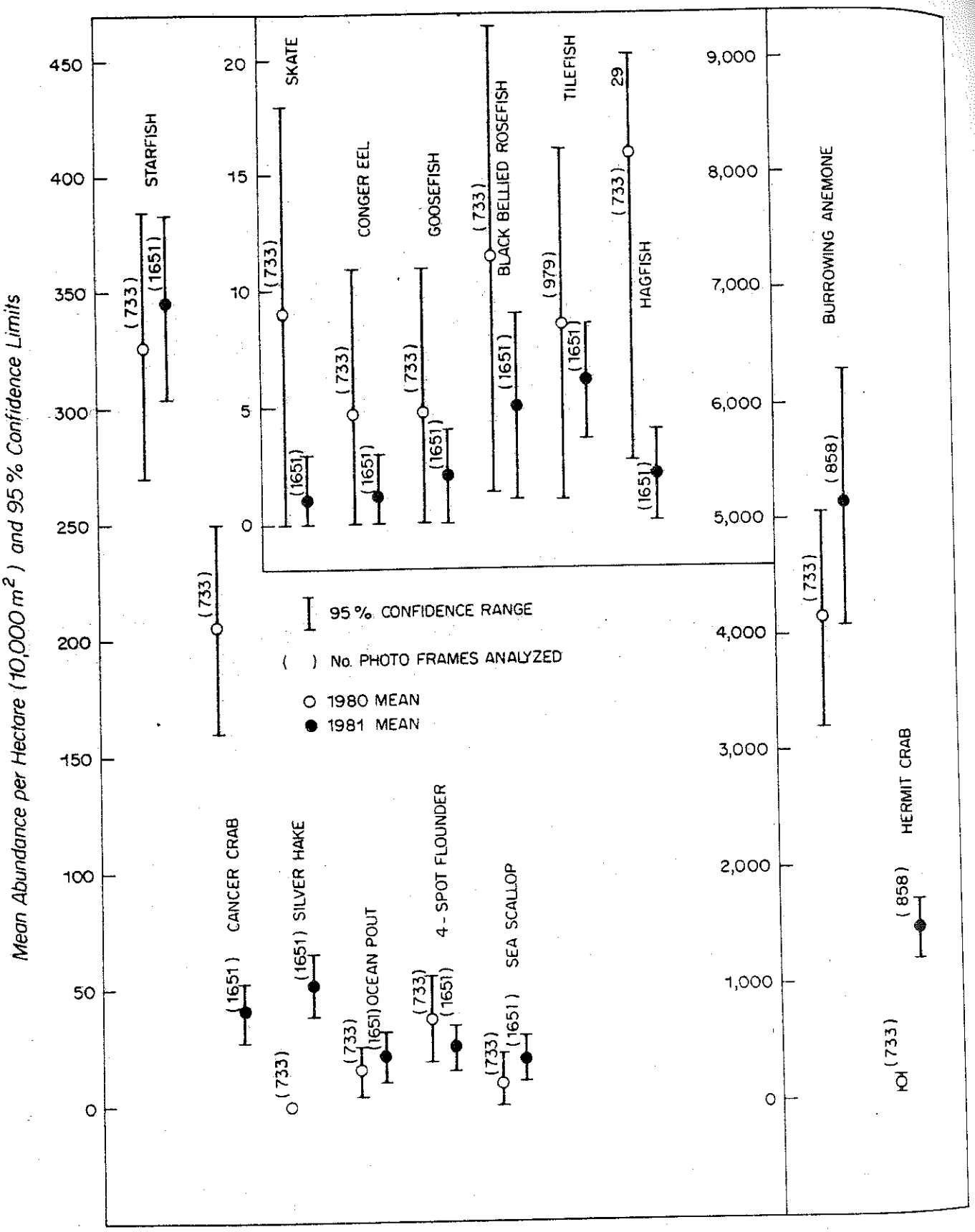

Figure 5. 1980 and 1981 estimates of megabenthic fauna density at Station V (Lydonia Canyon).

sites, both two weeks and two years after drilling ceased and the semisubmersible drilling rig left the site. In both instances, the only obvious signs of drilling activity were the manmade objects (anchors, cable, helmets, sieve screens, tools, etc.) lying on the ocean floor, encompassing an area of approximately 2,500 m^2. We saw no craters or sediment mounds.

BENCHMARKS OF BODY AND HABITAT BURDENS OF CONTAMINANTS

Surface sediments and megabenthic fauna, including infauna (within the sediments), reflect the input of contaminants to the environment. Accordingly, MURT scientists have collected many samples of surface sediments, sea scallops, *Cancer* spp. crabs, American lobster, and tilefish during the summers of 1980, 1981, and 1982 to define preproduction drilling levels of certain trace metals (barium, cadmium, copper, chromium, mercury, lead, and zinc), petrogenic hydrocarbons, and polychlorinated biphenyls (PCB's). Cambridge Analytical Associates and the Energy Resources Company, Inc., perform the analyses under contract.

Through July 1982, all sediment and faunal samples appear to be free of PCB's; petrogenic hydrocarbons are either nondetectable or occur in trace (<0.01 ug/g dry weight) amounts. Barium, cadmium (except for scallop viscera and crab and lobster hepatopancreas), chromium, mercury, and lead occurred in very low levels. Copper and zinc were relatively high in crab muscle and hepatopancreas, in scallop muscle and viscera, in lobster muscle, eggs, and hepatopancreas, and in bottom sediments. The significance of these high values of copper and zinc is unknown, although offshore lobsters have been known to be high in copper for at least the past 15-20 years.

CURRENT REGIMES AND GEOLOGICAL FEATURES

The extensive observations made by NMFS and USGS in Lydonia and Oceanographer Canyons (canyon walls, axes, and tributaries) over the past 10 years, including our submersible dives in 1982, strongly suggest that: (1) the canyon heads are erosional areas swept by strong currents of highly variable direction, (2) the deeper portions of the canyons are repositories (sinks) for bottom-carried sediments and entrained contaminants, and (3) the "lifetime" or longevity of a given particulate in the heads of the canyons may be very short or long depending on the "flush time," which is unknown.

The strong and highly variable currents in the canyon heads, especially those in Oceanographer Canyon's axis, have created large (3-4 m high) sand dunes, waves, and ripples, whose orientations and sharp crests are further evidence of the current regime (mostly internal waves) described above. These currents may be most swift (observed and measured up to 3.0 knots) in the main axis, but are also significant (observed and measured up to 1.0 knots) along the canyon walls, flowing in either a down-canyon (south), up-canyon (north), or cross-canyon (east and west) direction. This current regime strongly suggests a continuous reworking of surface sediments and redistribution of them and their potential load of contaminants within the upper (shorter) portion of the canyons. These results complement those of the USGS's extensive current studies in the Georges Bank submarine canyons, and directly bear on the potential impact of drilling and production activity, whether it occurs on the shoals of

Georges Bank (Lease Sale Area 42) or on the deep slope (Lease Sale Area 52).

UNIQUENESS AND PRODUCTIVITY OF SUBMARINE CANYON HEADS

The heads of the Georges Bank submarine canyons are now recognized as geologically unique (surficial features providing abundant "prime" habitats) and biologically productive and important (nursery grounds for many valuable species--American lobster, tilefish, white hake, etc.). Past and present deliberations between the New England States and the U.S. Department of the Interior concerning which Georges Bank and canyon areas are available for drilling were and are based primarily on: (1) technical capabilities of deepwater drilling, and (2) recognition of the canyon heads as "sensitive and productive" lobster and fish habitats. The New England States successfully requested the removal of 12 tracts from Lease Sale 42, and are requesting the removal of 41 canyon head ("lobster sensitive") tracts from Lease Sale 52, scheduled for March 1983. These deliberations are based primarily on the results of the cooperative studies between NMFS/MURT and USGS in the Georges Bank submarine canyons over the past 10 years, and specifically the NEMP site-specific monitoring studies begun in 1980.

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Valentine, P.C., J.R. Uzmann, and R.A. Cooper. 1980. Geologic and biologic observations in Oceanographer Canyon--descriptions of dives aboard the research submersibles ALVIN (1967, 1978) and NEKTON GAMMA (1974). U.S. Geol. Surv. Open-file Rep. 80-76:1-34.

Valentine, P.C., J.R. Uzmann, and R.A. Cooper. 1980. Geology and biology of Oceanographer Submarine Canyon. Mar. Geol. 38:283-312.

CENTER DIRECTORATE

No report received.

RESOURCE ASSESSMENT DIVISION

No report received.

MANNED UNDERSEA RESEARCH AND TECHNOLOGY PROGRAM

No report received.

MARINE ECOSYSTEM INVESTIGATION

Ichthyoplankton Investigation

We collected 300 ichthyoplankton samples during the important July-August time period by piggybacking on the annual sea scallop and surf clam-ocean quahog surveys. The two surveys provided us with coverage over depths less than 120 m in the Middle Atlantic, Southern New England, and Georges Bank subareas, as well as the western part of the Gulf of Maine. The ichthyoplankton community in the Middle Atlantic subarea was diverse and included larvae of hakes (*Urophycis*), silver hake, butterfish, black sea bass, tautog, searobins, Gulf Stream flounder, and smallmouth flounder. Silver hake larvae were numerically dominant off Southern New England and over the western part of Georges Bank. However, zooplankton volumes were light and fish eggs and larvae scarce on the eastern half of the Bank. Redfish larvae dominated catches in the Gulf of Maine. Our next survey begins in mid-September when we will piggyback with Resource Assessment Division personnel on the autumn bottom trawl survey.

We have received winter 1982 survey results from the Polish Plankton Sorting and Identification Center. Actual catches of sand lance larvae confirm our preliminary shipboard observations made during the survey. Although young sand lance continued to dominate numerically the winter ichthyoplankton community, their numbers declined from winter 1981 levels. In the Gulf of Maine, catches were off 16%, on Georges Bank 43%, and off Southern New England, where the larval population has been centered since 1977, the standing crop of larvae dropped 64%. Only in the Middle Atlantic subarea (New Jersey to Cape Hatteras) did they show an increase (11%) over 1981 levels.

Don McMillan and Wally Smith recently completed an analysis of the distribution and abundance of Atlantic herring larvae during the autumn-winter spawning season of 1981-82. From late September through early November, or the time period that encompasses the height of the spawning season, larvae occurred only around the periphery of the Gulf of Maine. Their center of abundance was situated in the Massachusetts Bay area. None were taken on Georges Bank and around Nantucket Shoals where peak larval production occurred during the 1960's and early 1970's. By the end of November, larvae occurred along the western edge of the Gulf of Maine and around Nantucket Shoals, but, except for the western extreme, not on Georges Bank. We failed to collect any herring larvae during the winter survey in February-March, thus the 1981-82 spawning season marked the second consecutive year that spawning was essentially nonexistent on

Georges Bank. Our MARMAP (Marine Resources Monitoring, Assessment, and Prediction Program) surveys of fish eggs and larvae during autumn 1981 through spring 1982 further indicate that numbers of Atlantic cod and haddock larvae on Georges Bank were at the lowest observed levels in the past 8 yr, and might prove to be the lowest recorded by NEFC biologists since the early 1950's. We will seek further information on the status of the 1981-82 year class of cod and haddock during the autumn bottom trawl survey which begins in September.

Larval Fish Dynamics Investigation

Experimental Studies

We completed a first draft of a manuscript describing a general model for the relation between temperature, larval RNA-DNA ratio, and growth rate in fish. The model is based on lab studies with seven species, including Atlantic cod, haddock, summer flounder, winter flounder, sand lance, Atlantic herring, and striped bass. Variations in temperature and RNA-DNA ratio explained most of the variability observed in growth. The manuscript also describes results from our field studies of cod, haddock, and sand lance.

Work with larval nucleotides was continued. We can separate most of the common nucleotides with high-performance liquid chromatography. Preliminary work indicated that upon stress or prolonged storage, the adenosine nucleotides (i.e., ATP, ADP, and AMP) decrease in concentration while the inosine nucleotide IMP increases.

Two manuscripts describing the lab spawning of sand lance and their development and growth at several temperatures and feeding levels are in preparation. Analysis of data from the joint NMFS-U.S. Fish and Wildlife Service study of the effects of contminants on striped bass viability, describing the egg, larval, and juvenile stages, was continued. Preparations are being made for presentation of results from this study at the American Fisheries Society meeting at the end of September. A manuscript on larval fish trophodynamics has been prepared for presentation to Fish Ecology III at the University of Miami.

Population Processes

Final revisions were made on a paper by Roz Cohen and Greg Lough on the prey field of larval Atlantic herring; it was returned for publication. George Bolz continued working on the larval Atlantic cod and haddock growth manuscript, and Peter Donnelly has been preparing a manuscript on the results of the use of the HIAC particle counter for the determination of fine-scale particulate/phyto-zooplankton distributions from samples collected on the larval dynamics studies on *Albatross IV* Cruises No. AL 81-03, AL 81-05, and AL 82-05. Dave Potter has been doing extensive computer programming and plotting of HIAC particle-size distributions and larval herring data from the 1978 larval herring patch study. Phil LeBlanc completed the sorting, identification, and length measurements of ichthyoplankton from bongo net hauls on *Albatross IV* Cruise No. AL 81-05, and is in the process of enumerating zooplankton from the MOCNESS (multiple opening-closing net and environmental sensing system) samples on *Albatross IV* Cruise No. AL 82-05.

George Bolz, Phil LeBlanc, and Peter Donnelly participated on the warm-core-ring study on *Albatross IV* Cruise No. AL 82-09 during 9-20 August, and were responsible for the MOCNESS operations. Dave Potter and Hal Merry also helped with cruise preparations. Hal has worked on the general servicing and repair of the two MOCNESS units and has set up the MOCNESS-Aiken fluorometer for calibration purposes.

Apex Predators Investigation

Project personnel sampled four major shark tournaments in New York, Rhode Island, and Massachusetts during July and August. At Montauk, New York, 83 sharks were landed at two tournaments. Sportsfishermen landed 25 sharks at a new tournament at Snug Harbor, Rhode Island, and 69 sharks at the 3rd Annual Hyannis (Massachusetts) Shark Tournament.

Nancy Kohler examined 61 shark stomachs from eight species for food studies. Samples obtained at tournaments this summer included vertebrae for age studies and reproductive tissues from tagged blue and mako sharks, as well as from untagged white, common thresher, sandbar, dusky, and scalloped hammerhead sharks. These tissues were run through the initial stages of processing by Christine Carrigan, Alan Lintala's replacement. Alan, who worked with us as a University of Rhode Island undergraduate, is now studying for his Ph.D. at West Virginia University.

In August, Chuck Stillwell and Nancy Kohler conducted blue shark tracking experiments aboard the R/V *Geronimo* in the area south of Martha's Vineyard. The purpose of the cruise was to derive values for digestion and stomach evacuation rates in blue sharks under natural conditions, using tethered floats that allowed retrieval of sharks containing known amounts of food. Results from four trackings were inconclusive with respect to digestion data because the sharks pulled free before they could be retrieved. However, two of the sharks tracked for 25 and 26 hr demonstrated movements of 18 and 34 mi at an average swimming rate of 0.75 mph. This agrees well with sonic telemetry experiments conducted previously by Dr. Frank Carey of the Woods Hole Oceanographic Institution (WHOI), and with the average daily rates computed from our tag-and-recapture data.

Chuck Stillwell and Nancy Kohler continued work on two manuscripts related to food and feeding behavior of blue sharks and swordfish in the Northwest Atlantic. Wes Pratt and Jack Casey continued work on two age-and-growth manuscripts.

Length-weight data from sharks collected over the summer were keyed into the computer by our summer trainee, Paul Francis. He was responsible for running programs to verify and edit the data prior to adding it to the length-weight data base.

Nancy Kohler and Fred Lerch continued work on adapting Gompertz, von Bertalanffy, and ELEPHAN I programs for use on mako and sandbar sharks age-growth and length-frequency data. Several mapping programs were completed by Fred Lerch in concert with Bob Payne of the EPA, using the EPA computer. All of the Apex Predators Investigation data and programs have been transferred to the new EPA system.

John Hoey completed the first draft of "A Comparison of Species Composition and Catch Rates from Pelagic Longline Fisheries in the Western North Atlantic," and submitted it for in-house review.

In August, Dr. Frank Carey of WHOI completed a 12-day swordfish sonic tracking cruise aboard the Center's R/V *Gloria Michelle*. Inclement weather

hampered operations at the start of the cruise, but a sonic tag was implanted in a 250-lb swordfish on the northeast peak of Georges Bank and followed for 2 days. The swordfish traveled 100 mi to the offings of Corsair Canyon at an average speed of 3 knots. The fish remained near the surface on the first day, then swam near the bottom in depths of 250 m on the following day. On the second day, the fish breached several times in the late afternoon and remained near the surface at night. Aggregations of fish or squid visible on the echosounder suggested the swordfish may have been feeding during part of the time. A new tracking system developed for this cruise worked well and additional experiments are planned for next year.

During July and August, 38 tags were returned from 10 species of sharks and 2 tags were returned from swordfish. These recaptures included two blue sharks that traveled from Montauk, New York: one to the Madeira Islands (2,300 mi in 2 yr) and another to the Cape Verde Islands (3,000 mi in 3 yr). Other returns came from a bigeye thresher shark that traveled from North Carolina to the Sargasso Sea (1,000 mi in 3 yr), a mako that traveled from Oregon Inlet to the West Indies (1,650 mi in 5 yr), and a sandbar shark that traveled from Long Island to Panama City (1,200 mi in 3 yr). The most dramatic return came from a sandbar shark that was tagged off Virginia and was recaptured off Veracruz, Mexico, after 17.5 yr at liberty. This is the longest time at liberty we have had for any tagged shark. We were fortunate to obtain information on this recovery through Dr. Bill Fox of the Southeast Fisheries Center who obtained the information at a conference in Mexico. The address on the tag was worn away, but the number was still legible.

Fishery Oceanography Investigation

During July-August, the Fishery Oceanography Investigation accomplished the third warm-core ring cruise of the year. The target of the cruise was the entrainment feature associated with the Ring No. 81-G which was located south of Georges Bank. First, an array of current-meter moorings was deployed along the outer edge of the Bank near the entrainment, then a brief survey of the feature was done, and finally observations by conductivity-temperature-depth (CTD) and MOCNESS were made around drogues deployed across the mouth of the entrainment. The preliminary results indicate that the ring was not actively entraining water from the shelf and that the shelf water that had been previously entrained contained only small amounts of shelf plankton.

Preparations are underway for the fourth ring cruise in September. That cruise will recover the moorings deployed in August. It will mark the first time that *Delaware II* has been used for mooring and CTD work.

The Investigation has received a UNIFAX recorder which will receive copies of satellite images from GOES (Geostationary Orbiting Environmental Satellite) and polar orbiter satellites. These are the same images received by AEG. When our machine is fully operational, the Investigation will maintain a file of images received for use by Division and other Center investigators.

In August, Tom Laughton resigned from the group to pursue graduate work in physical oceanography at Oregon State University. We will miss Tom's wide ranging ability and wish him the best in his new adventure.

Plankton Ecology Investigation

Jack Green worked with Ken Sherman and Julien Goulet on an ICES paper based on 5 yr of zooplankton sampling on Georges Bank. Analysis of the data for the paper revealed 2 yr of exceptional biomass on Georges Bank, 1977 and 1979. Jack and Cabell Davis have since been looking at the possible biological and physical conditions during those 2 yr to determine the causes and species compositions of the high biomass. Analysis of plankton-pump data for 1980 and 1981 continued through August. Jack has been working with Ralph Owen and Jerry Scott of the University of Rhode Island's Cetacean and Turtle Assessment Program on the apparent correlation between concentrations of right whales and large numbers of *Calanus finmarchicus* in the Great South Channel.

Joe Kane has been working on a manuscript on the feeding of larval fishes from 1980 sampling. Jerry Prezioso trained Archimedes Merriweather in plankton taxonomy. Sorting of a limited number of samples from *Albatross IV* Cruise No. AL 79-03 was completed during the training of Archimedes and Pat Michalik, both summer appointees. Measurement of krill samples from the First International BIOMASS Experiment in the Antarctic (FIBEX) was completed using image processing. The FIBEX work is currently in the data-reduction stage. A shipment of zooplankton samples from *Delaware II* Cruises No. DE 82-02 and 82-03, and *Albatross IV* Cruises No. AL 82-06 and AL 78-01, was sent to the Polish Plankton Sorting and Identification Center in August.

During July, Carolyn Griswold reviewed the draft environmental impact statement for OCS Sale #76, and prepared comments for Jack Pearce for inclusion with other Center comments. As coordinator for the Marine Ecosystems Division site-characterizatioin report, she met with Jack Pearce in Woods Hole on 29 July and contacted Division representatives regarding their inputs. On 14 July, she hosted Tommy Purwaka, an Indonesian graduate student attending the University of Washington, and discussed MARMAP and its integration with other Center programs. She also attended a seminar by John S. Gray on "Commonness and Rarity in Marine Benthic Communities: Some Consequences for Pollution Studies." On 15 July, she attended a seminar entitled, "Use of Airborne Remote Sensing Data To Study Biological Processes in the Ocean," given by Janet Campbell of the NASA Langley Research Center. Much of August was spent making plans for the charter of the R/V *Challenge* for a 5-day cruise at the end of September. On 10 August, she spent a day on the R/V *Sea Hawk* collecting water samples and doing plankton tows for ctenophores. She responded to a request from Paul Perra of Battelle Memorial Institute in Duxbury, Massachusetts, for information regarding MARMAP plankton sampling protocol, and sent him the newly revised draft of the MARMAP manual. She provided Jack Pearce with several items of interest from the Marine Ecosystems Division for the *Habitat Protection Newsletter*.

On 19 August, Carolyn attended a meeting of the Georges Bank Biological Task Force and prepared a memo for distribution on the results of that meeting.

Carolyn prepared a report characterizing *Nanomia cara* population origins and distributions in the Gulf of Maine as a *Narragansett Laboratory Reference Document*, and *MARMAP Contribution Report*.

On 31 August, Carolyn Griswold attended a meeting of the Mid/North Atlantic Technical Working Group Subcommittee in Boston, Massachusetts, where the Subcommittee's recommendations for the Bureau of Land

Management's Fiscal Year 1984 studies program were reviewed and necessary changes and additions were made.

Donna Busch coordinated the Biostatistics Unit while Julien Goulet was on leave, provided primary productivity and phytoplankton species information for a deepwater dumpsite report, and reviewed manuscripts, ICES papers, and laboratory reference documents for the Laboratory Director. She also issued a news release concerning the signing of the solar energy system contract at the Narragansett Laboratory, arranged for a course on "Why Japanese Management Works" to be presented at the Narragansett Laboratory, attended a meeting with Ken Sherman, Jack Green, and Tom Plichta to plan a zooplankton section for the deepwater dumpsite report, and surveyed fluorometers at the Woods Hole Laboratory and made recommendations to the Division Chief regarding requirements for monitoring surface chlorophyll continuously on MARMAP surveys.

Image Analysis

During July and August, final contracts were issued for completion of the automated plankton processing system prototype being cooperatively developed by the Narragansett Laboratory, the NOAA Office of Technology and Engineering Services, and the University of Rhode Island. Applied Science Technology, Inc., located in Arlington, Virginia, will develop a programmable translation stage for viewing both preserved plankton and silhouette photographs. The storage and associated hardware and software will be integrated with the rest of the system and a system console will be designed and constructed. Strauss Photo-Optical, Inc., located in Washington, D.C., will provide a system of high-resolution optics required for image scanning, and a suite of silhouette cameras for shipboard or lab application utilizing motorized transports.

Costas Katsinis of the University of Rhode Island's Engineering Department, who is developing the computer hardware, software, and algorithms for the digital analysis, completed testing the Motorola 68,000 microprocessor boards and began teaching Mark Berman of the University of Rhode Island's Oceanography Department about the machine and microprocessor-based languages used in the system. Mark has been working with the system throughout the summer in an effort to provide continuity after Costas returns to Greece.

Dr. Takeo Ishii of the University of Tokyo's Institute of Oceanology visited the Narragansett Laboratory from 27 August to 3 September. Dr. Ishii is heading up a five-man team investigating the feasibility of applying image analysis to taxonomic classification of biological subjects ranging from bacteria to krill. One day was spent reviewing his progress which has had limited success in classification of different species of diatoms of the genus *Ceratium*.

On 30 August, Ray Maurer gave Dr. Ishii a demonstration of counting and sizing plankton with the small Bausch and Lomb system. On 1 September, Costas Katsinis presented a demonstration of the new automated plankton processing system. Although our approaches to the problems are similar, both deriving digital information from a video image, Dr. Ishii stressed his research is limited to demonstrating feasibility. Dr. Ishii's visit is the first in a series of exchanges expected with the international fisheries community which have been sparked by interest in our system's development.

Biostatistics

On 12 July, Julien Goulet met with Ken Sherman, Ray Maurer, and Jack Green of the Center, with Perry Jeffries and Mark Berman of the University of Rhode Island, and with representatives of the NOAA Office of Technology and Engineering Services. A review of the next-generation image analysis system was presented, and technical details were discussed.

Julien Goulet spent some time on hunting down bottom topography data. A digitized data tape, interpolated to 2' of longitude and latitute, has been requested from the National Geophysical Data Center in Boulder, Colorado.

Except for leave time, Julien Goulet spent most of the months of July and August on problems of the Element Dictionary and the Data Base Structure needed to implement the MARMAP Ecosystem Data Base on EPA's PDP11 computer.

The Narragansett Laboratory received seven new CRT terminals, two of them with graphics capabilities. We also received modems and connecting cables. The terminals and modems are being distributed, and rental terminals will be turned in. The Narragansett Laboratory also received an NBI word processing system. As soon as it is properly installed, training of the secretarial staff will be provided by NBI.

The Biostatistics staff, Tom Plichta, Ronna Lupovitz, Glenn Gioseffi, and Greg Skomal, spent a large fraction of time generating dominance statistics, plots, and median statistics for several scientists in the Division, including Ken Sherman. This work included extracting data from the MARMAP Information System, quality controlling the data, and processing the extracted data through the Statistical Analysis System in order to obtain the desired results.

Julien Goulet visited the Woods Hole Laboratory on 4 August to meet with Jack Suomala of the Charles Stark Draper Laboratories, Inc., of Cambridge, Massachusetts, and others for a presentation of capabilities on image and data analysis.

On 4 August, Julien Goulet met with Kay Paine and reviewed the status of documentation concerning the MARMAP Ecosystem Data Base.

On 6 August, Julien Goulet met with Bob Payne of the EPA and reviewed the potential budget for next fiscal year's support of automatic data processing.

Ecosystems Dynamics Investigation

Ed Cohen and Wendell Hahm made preliminary runs of the model GEORGE with initial conditions based on Center data. The model appears to be stable and they are making additional runs to investigate the effects of selective fishing on target and nontarget species.

Mike Pennington continued to research techniques for determining the sources of variability in plankton surveys.

Ray Bowman, Tom Morris, and Bill Michaels prepared for and participated on *Gloria Michelle* Cruise No. 82-11, a fish feeding study from 9 to 15 August. The primary objective of the cruise was to determine the size, type, and quantity of food consumed by selected species of fish inhabiting continental shelf waters in the vicinity of certain Bureau of Land Management sampling sites located south of Martha's Vineyard and on southern Georges Bank. Ray Bowman served as Chief Scientist on the cruise.

Ray spent a large part of his time during July and August formulating new data processing methods and a computer format for entering 1981 and subsequent fish feeding information into the computer data bank. The data to be entered include quantitative, qualitative, and fish-prey-length information.

Tom Morris worked during July and August principally on completing papers on the feeding and mouth morphology of marine fishes.

Bill Michaels completed preliminary analyses of the data compiled for a paper entitled, "Food of Seventeen Species of Northwest Atlantic Fishes: Part II; Examination by Year and Listing of Prey Species." He presently is preparing a draft of the manuscript. Bill's time was also used gathering supplies for various cruises and coding 1979-80 logsheets.

As part of the lobster larval study, Charlie Wheeler made five sampling trips in Buzzards Bay during July. After a cold June, water temperatures were close to normal and the numbers of late stage larvae in early July were comparable with those of previous years.

Roger Theroux devoted most of the July-August period to preparation of a data base of benthic data, to a preliminary analysis of the data, and preparation of graphics for the "Bottom Animals" chapter of the forthcoming joint Center/WHOI book on Georges Bank.

Roger's bivalve manuscript is currently being typeset. It is scheduled for completion at the end of September.

John Hauser completed the benthic cluster-analysis program, and applied it to Georges Bank using various data inputs. John also wrote programs to reformat data files for compatibility with DATATRIEVE, for use with the food habits data base.

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RESOURCE UTILIZATION DIVISION

Product Quality Investigation

In the previous bimonthly report, we reported that the iced shelf life of Atlantic cod fillets irradiated with 100 Krad, the maximum permissible level currently under proposal by FDA, could be significantly extended if the fish are treated with a potassium sorbate dip prior to irradiation. A study just completed has indicated that the iced storage life of sorbate-treated cod fillets, whether irradiated with 100 Krad or not, were comparable. Therefore, there appears to be no advantage to irradiating sorbate-treated cod fillets with a 100-Krad dose for the purpose of shelf-life extension.

Potential panelists for the "edibility study" were trained and screened for ability to discern the four basic tastes, and also for sensory acuity to threshold levels of taste stimuli. Panelists are currently being trained to evaluate texture of fish on the scale developed at the U.S. Army's Natick (Massachusetts) Laboratories. Armand Cardello and Miles Sawyer of the Natick Laboratories recently visited the Gloucester Laboratory and participated in a panel training session and were satisfied with the progress made.

In conjunction with the New Bedford fish quality study, the Resource Utilization Division conducted sensory analysis for the New England Fishery Development Foundation on ice-stored samples of Atlantic cod and flounder fillets which had been either boxed at sea or stored in pens. The results are being analyzed by analysis of variance to determine whether there was any significant difference in iced shelf life due to method of storage on board ship.

After 14 wk of storage at 0°F, red hake fillet blocks which had been vacuum-packaged in either polyethylene, nylon-surlyn, or a retort-pouch laminate, and blocks which were in nonevacuated polyethylene, were rated as slightly tougher than control samples held at -80°F. Sensory evaluation, Instron measurements, and chemical quality indexes such as dimethylamine and formaldehyde content show that of the treated samples, those packaged in the retort-pouch laminate are toughening at a rate greater than the other treatments.

The minced red hake study described in the last report is now into its fourth month of storage at 0°F. Sensory evaluation and Instron measurements indicate that while the control sample has become objectionably tough, the proteolytic-enzyme-treated samples have not. One sample containing a highly active bacterial protease has remained mushy during the study. Dimethylamine and formaldehyde content of the treated samples are similar to those of the control sample.

A new storage study was initiated to test the effects of oxidizing and reducing substances on dimethylamine and formaldehyde production in minced red hake blocks stored at +20° F.

Ron Lundstrom completed identification of 17 unknown fish samples using the polyacrylamide gel isoelectric focusing technique. These identifications were done for the Arizona Attorney General's Financial Fraud Division.

Product Safety Investigation

Analysis of Targeted Finfish and Shellfish Samples for PCB's

Workup of flesh samples collected from the New York Bight region has been completed, preparatory to analysis for polychlorinated biphenyls (PCB's). The samples consisted of fourspot flounders, windowpane flounders, and winter flounders. The florisil extracts from the above flesh samples of flounders have been analyzed by gas-liquid chromatography utilizing a ^{63}Ni electron-capture detector.

Livers were excised from all of the flounder samples. Composites were made from five individual livers and homogenized. A subsample was worked up in accordance with the Association of Official Analytical Chemist's multiresidue procedure, including a final silica gel step. The extracts will be analyzed by gas-liquid chromatography.

Evaluation of Analytical Procedures for PAH's

The following procedures were evaluated for the analysis of polynuclear aromatic hydrocarbons (PAH's) in fish tissues: J&W Soxhlet extraction with carbon dioxide at 900 psi, Dunn's procedure, and Grimmer's procedure. Five experiments were run by the Grimmer procedure, giving very high yields for Atlantic cod spiked with known PAH's and clean extracts. Solvents and chemicals were ordered for an extensive method verification. Two experiments were run by the Dunn procedure. The florisil deactivation step was modified to improve yields on benzo-a-pyrene and benzo-g,h,i-perylene. Yields were improved substantially, but large interferences of cholesterol were found in the final extracts. Three experiments utilizing the J&W soxhlet extractor were run. Results indicated that the extraction of PAH's by this technique was nil.

ICES Intercomparison Exercise

Six standards from the ICES kit were prepared and analyzed by gas-liquid chromatography for PCB's and chlorinated hydrocarbons.

Entry of PCB and PAH Data Into a Data Bank

All of the PAH data from samples of the New York Bight and Casco Bay regions were entered into a Decasystem 10 computer. Analysis of variance for the 16 PAH concentrations was then performed by site and species. All of the PCB data are currently being entered into the system. A PCB file has been configured and PCB data are now being entered.

GC-MS Analysis of Targeted Extracts for PAH's

The current technique to analyze fish for PAH's by gas chromatography-mass spectrometry (GC-MS) is now an in-house one. Before any extract can be analyzed by GC-MS, it is necessary to do additional silica gel cleanup to remove cholesterol. Without this additional cleanup, a great deal of nonsaponible lipid is injected into the capillary column, overloading the capacity of the column.

Installation of a Backup Cooling System

A backup cooling system for the GC-MS is reaching completion. The final task is the installation of an electrical outlet by a licensed electrician. The system includes solenoid valves which shift the flow of water from a circulating unit to a tap supply in the event of power loss. An electrical unit was also devised to signal the loss of power so that routine maintenance on the mass spectrometer may be performed.

Product Standards and Specifications Investigation

A proposed draft "U.S. Standards for Grades of Frozen Lobster" and a preamble have been sent to the NMFS Central Office for publication in the *Federal Register*. These documents are intended to facilitate procurements by federal agencies and others.

A proposed draft "U.S. Standards for Grades of Fresh or Frozen Headless Dressed North American Freshwater Catfish" and products made therefrom have been reviewed and commented on.

A proposed draft "U.S. Standards for Grades of Fresh or Frozen Fish Steaks" and a preamble for publication in the *Federal Register* are in the Central Office.

A revised proposed draft "U.S. Standards for Grades of Frozen Fish Portions and Fish Sticks" is being reviewed by interested persons in NMFS and in commercial organizations.

An initial draft of a revision of the "U.S. Standards for Grades of Frozen Fish Blocks" has been outlined.

Several comments have been received on both the "Interim Standards for Fresh and Frozen Shrimp" and the instructions for grading fresh and frozen shrimp. These will be resolved before final publication of the standard and instructions.

A market research and analysis report on fresh and frozen fillets was transmitted from the Central Office to USDA. A recommendation was made to replace the federal specification for fish--chilled-and-frozen--with three commercial item descriptions for whole and dressed fish, fillets, and steaks.

NMFS/URI Cooperative Fisheries Engineering Unit

Gilles Charousset, a student at the Ecole Nationale Superieure Agronomique in Rennes, France, has been working with us on a project to model the Isaacs-Kidd midwater trawl and test its flow patterns in the University of Rhode Island's (URI) Ocean Engineering Department tow tank. A one-third scale model has been constructed and is being tested.

Work continues on choosing a shrimp survey trawl for the Gulf of Maine in cooperation with the Northern Shrimp Technical Committee. A candidate trawl has been picked and will be purchased soon.

Dr. Recksiek of the URI Fisheries and Marine Technology Department is working on entering the Yankee 36 trawl model and prototype data into the URI computer to enable us to compare the model results with those of the full-scale version.

Progress continues on the "Microlog" vessel instrumentation system. All the required hardware have been fabricated and purchased to establish communication between the three system microprocessors. All the software for data acquisition, transmission, and interpretation have been prototyped and testing has begun. Sensor installation will be conducted when the *Gloria Michelle* is hauled out.

Al Blott reviewed two research proposals, one for the National Science Foundation and one for URI. He also reviewed a paper concerning a new mathematical technique for determining webbing tapers for net making.

The second automatic squid jigging machine is on loan to a Weymouth, Massachusetts, fisherman for demonstration purposes.

During the emergency haulout of the *Gloria Michelle*, hull measurements were taken with a laser theodolite by URI Ocean Engineering Department personnel. These measurements are for the ongoing fishing vessel safety and stability study.

Gloria Michelle cruises during the reporting period are shown in the following table.

Cruise No.	Title	Duration	Area
GM 82-10	Seabird Collection	4 days	East of Chatham, Massachusetts
GM 82-11	Fish Feeding Study and Sand Lance Collection	7 days	Georges Bank and Stellwagen Bank
GM 82-12	Swordfish Tracking	12 days	Georges Bank

Modifications continue on the *Gloria Michelle* with the below-deck lab space being enlarged and a new companionway and steps installed for better access to the lab. In addition, the main and auxilliary exhausts have been insulated in the engineroom.

Processing and Preservation Investigation

Frozen Fish

Hunter L color measurements of the changes in color of the raw U.S. Grade A frozen haddock, Atlantic cod, and pollock stored at +20°, 0°, and -20° F were tabulated. An examination of the plotted raw data shows no distinct trend in the white-to-black (L value), green-to-red (a value), or blue-to-yellow (b value) color measurements. Regression curves will be calculated and drawn to confirm the results. One of the main problems in measuring the color of the fish samples is their lack of color uniformity and cracks in the sample.

Weight and Length Changes in Cod During Iced Storage

A second and third experiment to determine if there are any weight or length changes in gutted Atlantic cod stored in boxes covered with ice were completed. The cod varied in weight from 2 lb 2 oz to 9 lb 4 oz, but most fish weighed between 2-1/2 and 3-1/2 lb. Their length was between 18-3/16 and 30-1/8 inches, but most measured between 19 and 23 inches.

From an analysis of variance, there is a nonsignificant difference between the weight and length changes of individual cod over the 11-day iced storage period. The fish lost an average of 1.4% of their total weight after 11 days of storage. In contrast to the weight loss, the cod increased 0.73% in length after 11 days iced storage.

Fish Bleeding

Bleeding of fish is primarily done to enhance the visual quality of the fillets because little or no blood would be present when the fish are cut.

This preliminary study was conducted on flounder. Unlike most fish caught, flounder are not gutted when landed on a vessel. The size and shape of this fish allow it to be iced down quickly. As soon as the fish are landed on shore, they are usually processed.

For this study, live flounder were procured and put into our own tanks. When sampled for bleeding, eight fish were taken from the tanks for bleeding. Four fish were bled at the caudal peduncle and four in the gill/head area. In each case, we made certain that the dorsal aorta or its continuation was severed to promote bleeding.

The following table lists the bleeding point of the fish and the weights noted after bleeding after various time intervals.

Fish		Weight(gm)			
No.	Cut	Initial	15 min	4 days	6 days
1	Tail	627	624-3	646+22	643+19-3
2	Tail	483	479-4	501+22	497+18-4
3	Tail	308	303-5	323+20	319+15-5
4	Tail	700	686-14	717+31	708+22-9
5	Head	455	442-13	467+25	466+24-1
6	Head	546	529-17	549+20	548+19-1
7	Head	613	586-27	613+27	608+22-5
8	Head	542	529-13	549+20	547+18-2
9	None			301	305
10	None			484	474

The first 15 min after cutting showed the greatest weight loss, presumably due to bleeding. Those fish cut at the tail showed less weight loss (3-14 gm) than those cut at the head/gill region (13-27 gm).

After storage on ice to note if further bleeding occurred, a significant gain in weight of the fish was noted in all cases ranging from 20 to 31 gm after 4 days. There was no evidence of further bleeding. The weight gain must be attributed to moisture pickup from the ice. After 6 days on ice, a small loss in weight was noted (1-9 gm).

After the sixth day of storage, we decided to conduct a raw fillet evaluation, followed by a taste test. The following table shows the average results of both tests conducted on the treated fish.

Test	Score		
	Tail bleeding	Head bleeding	Control
Raw fillet	7.5	7.8	7.4
Taste	7.0	7.4	7.0

All results were adjudged good. No significance can be attributed to either head or tail bleeding on the appearance of the raw fillet, nor can any significance be attributed organoleptically to the cooked fillets from bleeding.

Apart from the empirical observations noted, certain conditions existed that bear mentioning.

We noted that the blood of the flounder did not flow freely after a few minutes, seeming to coagulate. This possibly prevented further bleeding. Also, since the treated fish were well iced during storage, we are not sure if they passed through rigor nor not. Presumably they did, but no change in blood condition occurred.

A new study to determine the U.S. Grade A frozen stability of fish held in ice for various times is being planned. This experiment will begin as soon as the details are worked out.

New Interest in Minced Fish

From the number of inquiries on our past work with minced fish, it appears that there is new interest in preparing minced fish products. To confirm this, our Bibun meat-bone separator has been loaned out to a fish processor to prepare new minced fish products.

Sorbate Preservation

Two experiments on the preservative effects of potassium sorbate (KS) on dressed Atlantic cod were completed. For these experiments, dressed cod held in ice for 5 days were immersed in chilled seawater (CSW) containing 0.5% KS for 2 days, and then placed in ice. This procedure simulated in-plant conditions where the fish are held over a weekend in CSW + KS rather than in ice. Control fish from the same lot were held in ice only and in CSW containing no KS. The fish were organoleptically examined to determine the acceptable shelf life of the whole fish, the raw fillets cut from them, and the cooked fillets.

The results indicate that immersion of 5-day-old fish in KS was not effective in extending the shelf life of the whole fish or of the fillets cut from them.

A bacteriological study shows that dipping fresh cod fillets in 2.5% and 5.0% KS does not appreciably lower total aerobic plate counts when compared to nondipped controls over a 14-day holding period. Trimethylamine (TMA) assays done on these samples, however, showed that the production of TMA was considerably slowed in the dipped fillets.

These results are preliminary; retesting awaits certain samples for reproducibility of results. In addition, a second batch of dipped and nondipped fillets are being analyzed for bacteriological and TMA production data.

Blue Crab

Organoleptic testing has been completed on blue crab meat pasteurized in oxygen-permeable and oxygen impermeable plastic pouches for up to 9 mo. The organoleptic data are being statistically analyzed.

Experiments are continuing on the production of an organoleptically acceptable, sterilized canned blue crab meat pack.

Resource Chemistry--Nutritional Analyses

We received a block of crab meat for speciation from the NMFS Southeast Inspection Office in St. Petersburg, Florida. Kate Wiggin ran the samples by the agarose gel isoelectric focusing method which she has modified for cooked proteins.

In collaboration with the Marine Biology Laboratory at Woods Hole, Massachusetts, we are characterizing the Codakia clam by its sterol and fatty acid content. We have had to pull in the Massachusetts Institute of Technology (MIT) for mass-spectral assistance in the identification of the fatty acids, since this clam appears to be totally different in makeup from clams indigenous to this area. Samples are being cleaned up by thin-layer chromatography before they are sent to MIT.

The freeze/thaw experiment we are running in conjunction with URI was repeated due to discrepancies in the original data.

Kate Wiggin is researching procedures for the analysis of vitamins by high-performance liquid chromatography (HPLC), and Judith Krzynowek will be using HPLC for oxidative products in stored seafood.

Engineering

Purchase orders including costs, specifications, and lead time on equipment to complete the *Gloria Michelle*'s heating system were completed and submitted to Al Blott for approval and ordering. Budget restrictions and vessel scheduling are now such that it looks like October for this work, when the vessel is in the Gloucester area for a shrimp survey, or in November when vessel schedules may slow down. The total cost is within the original estimate.

The squid ring cutter has been dismantled and the Urchell cutting machine restored to its original condition. It has been checked out and is ready to loan out. A drawing of the squid ring cutter will be made for the record.

Freezer room #6 reconstruction was completed, and the room has been under test for several weeks. Its capabilities are excellent. Cooling curves have been developed from +50° to 0°F in 1-3/4 hr, and from 0° to -30°F in 3 to 3-1/2 hr with a capability of -40°F, and possibly as low as -50°F. A heating curve from -20° to +30°F took 3 hr. A suction accumulator has been ordered to take care of a small problem of frost coming too far back on the suction line.

Specifications were written to upgrade the Gloucester Laboratory's plumbing, and new hot- and cold-water mains have been installed.

Specifications were written to upgrade the Gloucester Laboratory's electrical systems. Wiring in the compressor room to upgrade this section is complete. Specifications were also written to renew the old roof on the main part of the Laboratory.

A review of the chart paper from the Dranetz line monitor which was on

line for a month showed unusual events took place that would affect the quality of incoming power. A surge and sag were noted when the generator came on line and when it shut down; otherwise, everything was within limits.

We are waiting for the quotation to come in from a minority bidder on the Gloucester Laboratory's solar project. If he cannot meet the budget constriction, then bid packages will be sent to other contractors.

Technical Assistance

Information and technical assistance were provided in the following areas: red hake; sand lance; composition of finfish; modified atmosphere storage; NOAA proposal review; supply authentic samples of 14 species of finfish; train student in isoelectric focusing technique; 20.5 and 22.6 fatty acids; crab sample; review proposed refrigeration manual; myofibrillar proteins; shrimp statistics; pH studies; definitions of fish terms; scientific names of spiny lobsters; discoloration in canned clams; test for fresh fish; freshwater shrimp; grade standards; quality program; fish parasites; lobster tomalley; identify thresher shark; filleting; luminescent lobster flesh; mariculture; and species of salmons.

Publications

Lundstrom, R., F. Correia, and K. Wilhelm. Dimethylamine production in fresh red hake (*Urophycis chuss*): the effect of packaging material, oxygen permeability, and cellular damage. J. Food Biochem. (A)

ENVIRONMENTAL ASSESSMENT DIVISION

Behavior of Marine Fishes and Invertebrates Investigation

As part of our continuing effort to assess the impact of petroleum hydrocarbons on marine communities, we have initiated a series of long-term experiments, conducted in cooperation with Battelle Pacific Northwest Laboratories, to study the influence that weathering has on the sublethal effects of oil-contaminated sediment on sand worms. Although these experiments are still in progress, it appears that avoidance behavior diminishes and the potential for recovery increases as a function of the weathering period.

Environmental Statistics Investigation

A methodology for interpretation of synergistic and antagonistic effects using environmental variables and physiological responses has been developed. The effects of heavy metals are examined with the ranges from the interaction between metals singly or combined with levels of enzyme responses. We did not predict the effects of multiple contaminants upon enzyme-level changes in nature. Nevertheless, the statistical treatment and interpretation on this problem are investigated. The data samples of sea scallop digestive mass were collected from Fippennies Ledge in the Gulf of Maine (Station 17) and a deep valley of the Gulf of Maine (Station 16). These two stations are a part of an Ocean Pulse Program survey on *Albatross IV* Cruise No. AL 80-09, as dated 7 September 1980.

We cannot draw any conclusions from this exploratory analysis on

enzyme-level differences and metal loads in scallop tissue. However, the methodology which we employed in the study could bring a deeper insight for determining a relationship between biochemical, physiological, and ecological responses/phenomena and multiple environmental factors. The lab experiments traditionally tend to be concerned with relationship within *controlled* environmental factors (e.g., bioassays); nonetheless, our inquiry searches for relationships in the *uncontrolled* and *unconstrained* environmental variables.

In results, the interrelationship between heavy metals indicates that the synergistic and antagonistic effects could be tied with the general characteristics of periodic cycles of atomic arrangements within the periodic table for the elements. Silver & copper and cadmium & zinc always have positive correlations regardless of the presence of other sets of metals. The correlation for the in-between two groups leads to negative values. In fact, silver and copper are in the same periodic cycle as are cadmium and zinc.

In comparison of Stations 16 and 17, we cannot draw any judgment as to contaminated or positive environments. However, the correlations for the enzyme measurements in the presence of metal contributions could be interrelated with the measurements of glycogen level, and with the ratio of PK to GDH values. Consistently low values of glycogen levels and PK/GDH ratio at Station 16 might be the same indicator of a consistently high correlation coefficient value between PK and GDH in the presence of all combinations of metal (Ag, Cd, Cu, and Zn) contributions. A preliminary report of these analyses is being drafted.

We are exploring the possibility of differentiating four subregions of the New York Bight based on some portion of the 1980 summer environmental data. A sewage-sludge-affected region, a dredge-spoil-affected region, the periphery to dump regions, and the rest of the inner Bight, together with 12 monitoring variables (Cd, Cr, Cu, Ni, Pb, Zn, % silt, % clay, TOC, TKN, PCB, and coprostanol) are being considered. A preliminary indication from the canonical analysis is that: (1) the first canonical dimension indicates significance of the dredge-spoil region in terms of % silt, TKN, TOC, and Ni; (2) the second canonical dimension shows significance of the sewage-sludge region in terms of coprostanol, PCB, Cd, Zn, Pb, Cu, and Cr; and (3) the third canonical dimension shows the moderate significance of the peripheral region in terms of % clay and TOC. This third relation is less important because the corresponding variability is very small.

The second procedure is to make a qualitative demonstration of the contribution of each variable to the makeup of the regionwide differences. This is done by graphical comparisons of successive partitioning patterns, each of which is to be generated after each addition of new variables to the analysis. A manuscript reporting these analyses is being drafted.

Environmental Chemistry Investigation

Members of this Investigation developed baseline characterizations of nutrients and phytoplankton at the 106-mile Dumpsite and the Philadelphia Dumpsite. Additionally, three ICES papers were completed. They are listed under "Publications."

V. Zdanowicz, R. Bruno, and J. Parrota collected 688 sea scallops for heavy-metal analysis during the annual sea scallop survey on *Albatross IV* Cruise No. AL 82-06. Sixty-eight stations were sampled in the Middle

Atlantic Bight, Georges Bank, and the Gulf of Maine. This activity represents a cooperative effort by the Biochemistry and Physiology Groups at the Milford Laboratory, our Investigation at the Sandy Hook Laboratory, and the Resource Assessment Division at the Woods Hole Laboratory.

Cynthia Muchant and J. Anderson measured chlorophyll pigments during the warm-core ring survey on *Albatross IV* Cruise No. AL 82-09. Members of the Fishery Oceanography Investigation collected seawater samples for nutrient analyses which will be performed by the Environmental Chemistry Investigation. Analyses of seawater nutrients in samples collected during the July warm-core ring survey were completed. A. Draxler developed a first draft for a paper which examines and interprets nutrient data collected over Georges Bank and the Gulf of Maine.

J. O'Reilly attended a meeting held at the Narragansett Laboratory which reviewed progress on the Center's warm-core ring studies.

Biological Oceanography of Stressed Ecosystems Investigation

The Seabed Metabolism Subunit of this Investigation completed the basic statistical analyses of the effects of varying concentrations of cadmium on the rate of oxygen consumption by the sediments from three stations with varying degrees of contamination.

An ICES paper entitled, "A Comparison of the Seabed Oxygen Consumption Rates of Different Benthic Environments Along the Northeastern U.S. Continental Shelf," was completed and copies forwarded to Denmark.

A large amount of time was spent in support of the diving program at the Sandy Hook Laboratory as well as other federal agencies (EPA) and academic institutions (Rutgers University). Bob Reid and Dave Radosh participated in a comparison study of the acid-waste disposal site and a control site approximately 5 nautical miles to the NNE. By using specialized diving techniques, we observed the water column and sediments at the acid-waste site approximately 2 hr after a dump. Still photographs, video tapes, and sediment samples were obtained at both sites. A report of our findings and a presentation on the topic are planned to be presented at a seminar at the Sandy Hook Laboratory in the near future.

We were also requested by the Monmouth County (New Jersey) Prosecutors Office to supply wind and current data to determine the approximate origin of an unclaimed body found on a New Jersey beach.

Work has progressed on the technical report concerning the uptake of oxygen by the sediments of the northeast U.S. continental shelf, and on a manuscript entitled, "Utilization of Phytodetritus by Benthic Communities in the New York Bight," (with Paul Falkowski of the Brookhaven National Laboratory) which is almost completed. Bill Phoel was invited to participate in the Northeast Undersea Research Laboratory planning session at the University of Connecticut on 12 August.

Algal assay of Northeast Monitoring Program/Ocean Pulse Program water samples continued as the major work effort. Assay of a run of 36 samples was completed. Over the past several months, the concentrations of nutrient spikes had been adjusted to increase the sensitivity of the assay. The present results indicate that the N, P, etc., levels are now sufficient to provide reliable growth of the assay diatom while not being inordinately high relative to seawater ambient levels.

Over 3,000 assay culture tubes were cleaned and treated with a silicopolymer which increases chemical resistivity.

A new assay study was started to see how well the dinoflagellate,

Gonyaulax excavata, which causes paralytic shellfish poisoning (PSP) in Northeast waters, can grow in New York and New Jersey waters. This species is endemic to the Gulf of Maine, but in recent years has apparently spread southward to at least Long Island Sound waters off Rhode Island. Assuming that the species reaches New York Harbor, if *G. excavata* can flourish in extremely nutrient-rich Lower New York Bay, an intense bloom and consequent PSP problem could result. On the other hand, New York Harbor water quality, modified by contaminants including copper and lead in the highest concentrations reported for any estuary, might preclude *G. excavata* red tide.

Water samples for phytoplankton species composition were obtained on three *Albatross IV* cruises and are presently being processed.

In July 1982, Craig Robertson surveyed the Brigantine National Wildlife Refuge as a test site for the Center's Coastal Habitat Assessment, Research, and Monitoring Program. A species composition map and biological-physical data list were prepared from the survey and forwarded to Dr. Jack Finn at the University of Massachusetts for use in computer classification of wetlands. Preparations are being made to survey the Barnegat National Wildlife Refuge in September 1982.

Checking and drafting of the figures for the Superflux technical report is nearing completion, and photography and text should be completed this fall.

Surface chlorophyll *a*, total suspended matter, and temperature samples are being collected for the Coastal Zone Color Scanner calibration on the Northeast Monitoring Program's August cruise.

We continued our interaction with the Charles Stark Draper Laboratories to produce a series (March-August 1979) of enhanced sea-surface temperature and pigment images for the Gulf of Maine-Georges Bank region based on data from the Coastal Zone Color Scanner on board the Nimbus-7 satellite. These images were prepared as a poster, "Seasonal Patterns of Surface Temperature and Phytoplankton Pigments in the Georges Bank Region," for the ICES meetings during October 1982. From a visual examination of the imagery, the Gulf of Maine-Georges Bank region was divided into coherent subareas. Pigment concentration plotted against temperature for each of these subareas over time demonstrated the existence of three ecologically distinct regimes: (1) those subareas which are relatively cold in temperature and rich in pigment (Yarmouth Upwelling, Bay of Fundy, Georges Bank, and Nantucket Shoals), (2) those subareas which are relatively cold and poor (Scotian Shelf and the Gulf of Maine), and (3) those subareas relatively warm and poor (slope water). No relatively warm and rich subareas were in evidence. It is known that the colder waters, with the exception of the Scotian Shelf and Gulf of Maine, are subject to greater vertical turbulence (i.e., upwelling and/or tidal mixing) and nutrient replenishment. The persistently high pigment concentrations were associated with these turbulent waters which were less than 60 m in depth. The temporal-spatial comparisons and interrelationships made between temperature and pigment over this relatively large area enabled us to begin dissecting the overall region into functional ecological subunits of importance to fisheries and for which future predictive models can be developed.

Coastal Ecosystems Investigation

Community Structure

We received comments on our New York Bight benthic monitoring report, and spent considerable time revising and expanding the report to reflect these comments. The report should be submitted to the *NOAA Technical Memorandum NMFS-F/NEC* series by mid-September.

We have also put much effort into planning the September 1982 survey on *Delaware II* Cruise No. DE 82-06. This cruise will spend about 2 days sampling in Massachusetts and Buzzards Bays and six days in the New York Bight. Variables examined will be sediment grain sizes and concentrations of TOC, TKN, metals, PCB's, PAH's, coprostanol, bacteria, and viruses; seabed oxygen consumption; and benthic macrofauna community structure. The Bight sampling will include our standard 44 monitoring sites plus more spatially intensive work in the Christiaensen Basin, in an attempt to separate influences of the various dumpsites, Hudson-Raritan plume, and other waste sources.

A paper on 1980 benthic macrofauna patterns in the Bight was prepared for the Oceans' 82 conference in Washington, D.C., during 20-22 September. We began to identify and prioritize samples to be analyzed by the Northeast Monitoring Program for organic contaminants, and attended a meeting at the Woods Hole Laboratory on that subject. Preparations were made to run bioassays using amphipods to determine toxicities of various sediments. These tests are being developed by the EPA in Oregon to supplement or replace the present U.S. Army Corps of Engineers (COE)/EPA dredge-spoil bioassays. The tests are fairly simple and inexpensive and may be a useful addition to the Northeast Monitoring Program's suite of measurements. We also completed computerizations of the regional benthic data set through all 1980 collections, and are completing coding of the summer 1981 samples.

Seven projects are underway to ascertain the effects of environmental factors on the abundance and vitality of surf clams and associated invertebrates in New York Bight. One study is examining the effects of grain size and contaminants in sediments on settlement densities of invertebrates. The sediment sizes range from fine to coarse sands; the contaminants include: (1) those from the sewage dumpsite, (2) sewage sludge high in heavy metals, and (3) heavy metals. An objective is to determine whether some heavy metals are more toxic than others. Trays holding the sediments are being held in 10 m of water off Rockaway Beach for periods of 30 days. Another project involves surveying settlement densities and mortality rates of juvenile surf clams and other invertebrates, with emphasis on mortality caused by predation. The study, which began in July 1982, consists of collecting the invertebrates at seven stations from nearshore to the sewage dumpsite with a Smith-McIntyre grab at 3-wk intervals. Data from a smaller study in 1980 and 1981 showed that surf clam larvae set in densities as high as 2,500-5,000/m^2 in coastal zones, but as spat they are nearly all consumed by predators. Another study consists of determining the rate at which heavy metals and organic compounds accumulate in the tissues of surf clams. Clams from a clean area were transplanted during 1982 to a site in Lower New York Harbor, a highly polluted area. Samples of clams are being collected from the site and analyzed periodically. Another study consists of determining the effects of contaminants in clams on their eggs. In 1982, the Milford Laboratory

spawned a group of clams that had been held in Lower New York Harbor for 1 yr. Egg development was normal as compared with that in clams from clean water. Future studies include effects of contaminants on respiration rates of clams.

Benthic Energetics

We initiated a new research project to be conducted by Stavros Howe and Wayne Leathem of the University of Delaware that will attempt to assess the influence of New York Bight apex sewage-sludge dumping on the growth and secondary productivity of several dominant benthic invertebrate species in the area. Three stations are being monitored: in the sewage-sludge dumpsite, several miles "downstream", and a control off Fire Island. These three sites are also being used in the summer by EPA for blue mussel "scope-for-growth" studies and Rutgers University studies with crabs. Standard Ocean Pulse Program monitoring sites are congruent or very close by, so the integrated results of this work should be very interesting.

Arrangements were made to obtain additional samples of the ocean quahog and tilefish for analysis of body burdens of trace metal, PCB, and petroleum hydrocarbon contamination as part of a series of benchmark studies for valuable species in the Northeast.

Work continued on adding to our benthic invertebrates life history file and analyzing additional benthic samples from the EPA's alternate dumpsite south of Long Island to contribute adequately to site characterization of the area next spring.

We contributed advice and comments in developing a NMFS Northeast Regional Office project to study the feasibility and fishery potential of artificial reefs in Chesapeake Bay.

Further steps are being taken to integrate benthic data in National Oceanographic Data Center (NODC) files with other Center data to create an interactive Center benthic data file that will enable Center personnel to make timely retrievals and summarization of existing data. A properly formatted NODC tape of these files for the Northeast has been obtained, and plans are being developed to inventory and assess the contents of the tape file and to identify primary uses of the file. Bob Pikanowski of IOCS, Inc., is being contacted by the Center to develop the appropriate automatic data processing program package to organize and develop this file.

We prepared for and participated in the late summer Ocean Pulse Program monitoring survey. During this survey a new cooperative effort was initiated to obtain data on feeding habits of groundfish at the sites where benthic community structure monitoring was ongoing. This will provide direct data on the trophic relationships of groundfish at Ocean Pulse stations. Direct knowledge of food habits at each site can be evaluated to: (1) understand how changes in benthic community structure or production may influence the feeding habits of certain benthophagen fish, (2) provide clues on how contaminants enter groundfish species, and (3) show how the predation by groundfish may influence benthic community structure. The data collected on this survey will also be used to study feeding selectivity by other researchers.

Calorimetric analysis continued with most efforts directed toward organisms collected on the continental slope and material to support a cooperative study of shark energetics. Material was collected during the sea scallop assessment and Ocean Pulse monitoring survey to fill in the few remaining data gaps to produce an inventory of the caloric equivalence of most major groundfish prey and dominant benthic biomass components.

Work continued on the manuscript concerning refined estimates of benthic secondary production on Georges Bank for the joint Center/Woods Hole Oceanographic Institution book on the area.

Physiological Effects of Pollutant Stress Investigation

Physioecology

An experiment with adult blue mussels held in ambient seawater in a diluter system to determine seasonal changes in copper uptake was terminated. A few samples remain to be analyzed before the data can be evaluated for trends in copper uptake.

A cooperative study with Dr. Steven George of the Institute of Marine Biochemistry in Aberdeen, Scotland, was begun. Adult blue mussels were placed in a diluter system and are being exposed to silver ($AgNO_3$) at concentrations of 0, 50, and 100 ppb. Dr. George is interested in determining localization and speciation of silver in mussels by X-ray microprobe analysis.

A diluter for a 60-day heavy-metal exposure test was set up for Dr. Marvin Freadman and the Physiology Subtask. Striped bass were exposed to lead [$Pb(NO_3)_2$] at 0, 20, 100, and 200 ppb.

Another diluter was set up for American lobster exposures for the Physiology Subtask. The lobsters are being exposed to cadmium ($CdCl_2 \cdot 2\text{-}1/2H_2O$) at 0, 5, and 10 ppb of Cd for 60 days.

We participated in the second and third legs of the annual sea scallop survey on *Albatross IV* Cruise No. AL 82-08 from 12 July to 6 August, and in the Ocean Pulse Program survey on *Albatross IV* Cruise No. AL 82-10 from 23 August to 3 September.

The remainder of the reporting period was spent cleaning diluter glassware and calibrating diluters.

Physiology

Physiology participated in the last two legs of the annual sea scallop survey. A total of 759 hemolymph samples were collected from sea scallops. Measurements of sodium, potassium, calcium, and osmolality have been completed for all the samples collected on the June leg. Analyses of samples collected on the July-August legs are in progress.

Blood samples from windowpane from four Long Island Sound stations were collected during July and August. We dropped the Norwalk dumpsite as a sampling station and added the New Haven dumpsite in order to facilitate cooperative work with the EPA laboratory in Narragansett, Rhode Island.

Measurements of gill-tissue oxygen consumption of caged mussels held at three New York Bight stations were completed during July and August. In July, the mussels taken from the New York sewage dumpsite respired at a rate significantly higher than those taken from either Ambrose or the Fire Island control station.

During August, we collected blood samples from a group of striped bass subjected to a 60-day exposure to 200 ppb of lead. Analyses of plasma samples are in progress.

Exposures of sea scallops to copper and cadmium for up to 15 wk were completed in early July. Our subtask measured gill-tissue oxygen consumption and collected hemolymph samples for later analysis.

Biochemistry

During this reporting period, our subtask participated in the final two legs of the annual sea scallop survey, bringing back to the lab for later analysis 205 adductor muscle samples from a total of 17 stations, and 586 kidney specimens from a total of 49 stations; these included the collection from the first leg. Among the samples were tissues taken from some 46 different-looking scallops, almost all of them from deepwater sites in the Gulf of Maine. The abnormal animals typically had very thin shells, small muscle in proportion to shell size, and, not infrequently, gonads of what seemed to be abnormal color and texture. We also sampled scallop gonads at a Georges Bank and at a deepwater station for Dr. Ray J. Thompson of the Marine Sciences Research Laboratory at Memorial University in St. John's, Newfoundland.

Another cruise in which we are participating, currently in progress, is the Northeast Monitoring Program/Ocean Pulse Program seasonal monitoring survey over a suite of fixed stations, as compared to the random-sampling format customary during resource assessment surveys. (The scallop survey this year, however, was able to go to a few nonrandom sites in the Gulf of Maine.)

With Physiology Subtask, our Biochemistry Subtask is collaborating this summer with the EPA's Narragansett, Rhode Island, personnel in their field study of blue mussels deployed at monthly intervals at three stations in the New York Bight apex, two levels per station. The final two monthly samplings have been made, as well as samplings from animals held at those sites for the entire duration of the field study. These mussels are being examined using a number of biological monitoring techniques.

At the bench, analyses have been completed for sea scallop tissues from Ocean Pulse Program surveys on *Albatross IV* Cruise AL 82-03 and *Delaware II* Cruise No. DE 81-07, and from resource assessment surveys on *Delaware II* Cruises No. DE 81-05, DE 81-06, and DE 82-02, as well as *Albatross IV* Cruise No. AL 81-13. Data are presently being calculated and tabulated. Work has begun on tissue samples from scallops experimentally exposed to cadmium at 10 ppb for 3, 6, 9, 12, and 15 wk, and on kidney samples from the recent scallop survey.

Anaerobic Bacteriology

Speciation of bacterial isolates from samples collected on previous cruises (*Albatross IV* Cruises No. AL 82-01 and AL 82-03) were completed during this reporting period. As previously reported, the presumptive *Vibrio* spp. counts are low in winter and early spring samplings. Screening some additional 100 isolates showed no additional *Vibrio* species, confirming our low *Vibrio* counts in the samples. In contrast, *Clostridium perfringens* counts do not vary significantly between winter and summer samplings. This suggests that this bacterium is stable in the ocean environment, not proliferating under different environmental conditions. These are important criteria for a bacterial indicator of fecal pollution.

A day-sampling cruise aboard the Center's research vessel *Kyma* in the New York Bight on 29 July produced a collection of sea scallops and bottom sediments as part of the New York Bight benthic study and Ocean Pulse Program activities. The animals were examined for *C. perfringens*, *Vibrio* species, and several other bacterial pathogens.

Chemistry

A backlog of samples set aside for PCB analyses was completed this reporting period.

All Atlantic rock crab samples collected to date for an NOAA Office of Marine Pollution Assessment (OMPA) contract were analyzed for PCB's. The data are now being summarized and analyzed statistically in preparation of a report to OMPA. Preliminary examination of the data revealed that rock crabs collected from the New York Bight ocean dumpsite contained an average of 2-3 times more PCB's in their digestive glands than crabs obtained from the Philadelphia Dumpsite.

During May and June, sea scallops that had been exposed to either copper or cadmium were dissected and their tissues frozen for metals analyses. About one-third of about 200 samples collected have been analyzed. The remainder will be analyzed shortly.

Ocean Pulse Program Coordination and Management

Most of our efforts have been concentrated in editing the Northeast Monitoring Program's 1981 annual report. The current draft is complete and being typed; figures are ready. The report will be about 90 pages in length. Some time was also spent in developing final contracts for Fiscal Year 1982, and in monitoring the remaining Ocean Pulse budget.

We planned, organized, and supervised the late summer Ocean Pulse monitoring survey. The cruise was shorter than normal because of scheduling cuts, but we still managed to occupy and collect monitoring information from 47 stations between Chesapeake Bay and Maine.

We assisted in planning and organizing the New York Bight benthic survey that will occur in early September. Efforts have been made to coordinate this survey with a congruent survey by EPA's research vessel *Antelope* that wil also be collecting benthic samples in the areas at this time.

Ocean Pulse personnel successfully participated in this summer's sea scallop assessment survey. Physiological, biochemical, and contaminant-burden measurements were made on a larger sampling of scallops than are normally available in the standard multiprogram Ocean Pulse surveys. Immunological samples from yellowtail flounder were also collected. We are continuing to plan the participation of Ocean Pulse personnel in this fall's bottom trawl fish survey. Collections and measurements will be made for pathobiology, physiology, biochemistry, genetic, immunology, and tissue contaminant burdens on up to seven species of fish on the Middle Atlantic Bight and Georges Bank legs of the survey. This cooperative effort represents a major step forward in making fuller use of the focused sampling capability of these resource assessment surveys, although at this point the effort is still part of a feasibility study.

Dr. McNulty prepared two summary reports on the state of our knowledge of the benthic community likely to be impacted by additional waste disposal at Deepwater Dumpsite 106. These reports were to be integrated into a NEFC site characterization for Deepwater Dumpsite 106 as requested by EPA. Work also continues in developing statistical programs to assist Ocean Pulse researchers in undertaking a more quantitative analysis of their data.

Publications

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AQUACULTURE DIVISION

Spawning and Rearing of Mollusks Investigation

We have recorded rapid growth of hatchery-reared juvenile surf clams (*Spisula solidissima*) maintained in sand-filled cages in Long Island Sound. Growth data compare favorably to those recorded for clams reared in a land-based raceway and would enable a 50-mm-sized product after only one growing season. Cage designs employed this year have effectively excluded predators, insuring high survival. Data indicate that planting densities of 1,000 clams/m^2 yield acceptable growth rates. The possiblity of intensive culture and the wide availability of usable sea-bottom offer favorable prospects for resource enhancement.

Post-set, 3-mm surf clams have been successfully reared to 14 mm in 6 wk in Japanese pearl nets suspended in Long Island Sound. Growth was greatest at a depth of about 2 m below the surface. Moderate settlement of barnacles occurred on the clams, causing no detectable problems. Suspension culture of young hatchery-reared surf clams offers an alternative intermediate culture method to utilizing pumped seawater.

Preliminary results from a study comparing bay scallop (*Argopecten irradians*) growth in Long Island Sound with growth in land-based raceway systems are available. Scallops in a shallow (2-4 m) Long Island Sound location and in the raceways grew equally well, but scallops in deeper water (4-6 m) grew about 10% slower. These depth-related differences may be due to decreased phytoplankton availability at deeper sites, and will be further studied in a more elaborate depth study in the future.

Aspects of Nutritional Requirements of Mollusks Investigation

Oyster Feeding

We have completed a study in which three species of algae grown in reduced-nutrient-enriched seawater (X_1) were fed to juvenile American oysters (*Crassostrea virginica*). Two of these food species grown in X_1 medium produced less oyster growth than the same algae cultured in the standard enriched seawater medium (E). Whereas these algal species had nearly identical growth rates in E and X_1 media, we found that total protein per cell was lower in strains grown in the reduced-nutrient X_1. The contrast, a third algal species, demonstrated a far different response to reduced nutrients; growth was greatly inhibited. However, protein per cell was identical for cells cultured in the standard growth medium and in the reduced-nutrient medium, and there was no significant difference in the food value of these two strains for juvenile oysters. These results indicate that different species of algae may have evolved different mechanisms for adjusting to fluctuations in nutrient availability. More practically, the total production *or* the food value of algal species seem to have a strong dependence upon the chemistry of the growth medium.

Investigation into the effects of reduced nutrients upon phytoplankton growth and food value has continued with an oyster feeding study using algal strains cultured in enriched seawater medium with vitamins absent (ENV). The three algal species that we selected for this experiment grow equally well in the presence or absence of vitamins; the standard enriched seawater medium, E, contains added B_{12} and thiamin. This work is currently in progress, but preliminary results indicate that differences exist in the food values of these algae grown in either E or ENV.

Analyses of total protein are being conducted to determine if this parameter again correlates with oyster growth response.

Concurrently, the food values of the following algal species are being determined using juvenile oysters in the experimental chamber rearing system: *Dicrateria inornata*, *Pavlova gyrans*, *Carteria chunii*, and strain NOR-5-66G.

Requests for starter cultures were received from and appropriate cultures were provided to: Mr. Michael Caffrey of Fairleigh Dickinson University; Mr. Jerry Milmoe of Long Island Oyster Farms; and Mulberry Farm Bivalve Aquaculture, Inc. In addition, on very short notice we were able to provide 20 liters of high-cell density, axenic *Phaeodactylum tricornutum* culture to investigators from the EPA's Narragansett, Rhode Island,

laboratory so that the Mussel Watch Program was able to proceed on schedule.

Semicontinuous Mass Algal Cultures

We have added three new algal strains to the semicontinuous mass-culture carboy system for the purpose of conducting feeding studies. The green flagellates *Dunaliella euchlora* and *Pyramimonas grossi* and the unidentified diatom D-828 are being cultured in enriched seawater medium without vitamins (ENV) and are providing dependable food sources with daily harvests.

Stock Culture Collection

Periodic subcultures of stock strains of algae proceeded on schedule and one new strain, a species of the diatom *Melosira*, was added to the culture collection. This algae was isolated from Milford Harbor water by Mr. Joseph Twarog of our staff who provided an axenic culture by treatment with a mixture of the antibiotic Garamycin and the mold inhibitor Amphotericin B.

We have also isolated a *Prorocentrum* sp. from Long Island Sound waters this summer and are currently working toward producing an axenic culture of this dinoflagellate.

Aquacultural Genetics Investigation

A. Longwell has reviewed a considerable number of aquaculture genetics manuscripts and grant proposals. The following papers were requested by A. Longwell and J. Ryther, ICES Mariculture Committee members, and prepared for presentation at the ICES Statutory Meeting in Copenhagen, Denmark, this October: "Salmon Ranching in the Northeastern Pacific: Status and Outlook," by W. J. McNeil of Oregon Aqua-Food, Inc.; and "Potential of Genetic Engineering for Aquaculture," by R. R. Colwell of the University of Maryland.

Aquaculture Genetics of Shellfish

A protocol for growout of juvenile oysters is being established which should make possible the spawning and breeding of 6-mo-old spat, at least in some cases. Since generation internal is a limiting factor in improvement by selective breeding, this is important.

New interest in the use of induced gryogenesis in breeding has led to a reevaluation of our older experiments on parthenogenetic development in the American oyster. Plans are underway to research further the reliable induction of this phenomenon in shellfish in conjunction with use of high pressure to double the reduced chromsome number of haploid eggs.

Cytologic and Cytogenetic Tests of Mutagenecity on Fish

Experimental Studies: To establish a sound experimental basis for the field applications of the micronucleus test for chromosome mutation in adult fish and plankton-sampled larval fish, two experimental studies were conducted. The first of these was carried out on larval salmon and was reported earlier. The second, conducted on adult *Fundulus*, is now also

completed. In both cases, X-irradiation was used as the mutating agent, and a dose-response relationship was established for mutation rate as calculated by micronuclear incidences in mature and immature erythrocytes or larval blood cells. These experiments are to be reported in the literature, along with the particulars of the methodologies. Field data collected through application of this test are reported below.

Sperm-head abnormalities in mature sperm of mice have in recent years been demonstrated to be good indicators in that species of gene (not chromosome) mutation. A preliminary examination of the sperm of both marine fish and shellfish in our lab showed the mature sperm of these groups to be within a measurable size range for detection of morphological abnormalities. An experiment conducted with *Fundulus* demonstrated a characteristic dose-response curve on treatment of fish in spermatogenesis with a typical mutating agent. The background mutation rate measured this way interestingly correponds rather well to the level detected by the micronucleus test on mature erythrocytes of marine fish. Chromosome mutation as well as gene mutation probably contributes to the sperm abnormalities observed in fish.

Plans are to field-sample ripe sperm from the widely distributed silver hake from both Georges Bank and Middle Atlantic Bight coastal areas this fall on joint resource assessment-Ocean Pulse Program cruises for the first field application of this test of mutation. (Silver hake may have greater body burdens of contaminants than other ocean fish.)

The image analyzer at the Narragansett Laboratory, being used in a joint effort by us with that Laboratory, will be used to extend the sensitivity of the analysis and increase the numbers of sperm examined per fish and perhaps the number of fish that might be examined.

Field Studies: As reported earlier, statistical study of the mutation frequencies in windowpane (2-3 yr old), as tabulated by the micronucleus test, reveals significant differences in incidence for month, stations, and water mass. Flounder caught near the mouth of Hempstead Bay, Long Island, had clearly higher incidences for just about every month surveyed over a year. A followup study of 1-yr-old flounder again showed the Hempstead Bay fish to have mutation incidences about double those of flounder from near the tip of Long Island. Again the circulating blood of the Hempstead Bay fish exhibited a degree of cell fragility far less frequently encountered at the other two Long Island stations, and which made application of the test to circulating blood from these fish impossible. Mutation frequencies were also calculated in the immature erythrocytes of the hematopoietic tissue of the kidney which did not present this problem.

Flounder from the Bay area further showed quite different correlations between mutation incidences measured in the immature erythrocytes of the head kidney and mature erythrocytes in the circulating blood, than did fish at two other presumed less polluted areas also repeatedly sampled over a year. Incidences measured in the immature erythrocytes of the hematopoietic tissue would reflect, at the most, exposure and metabolism of a few-day period before fish were sampled. Incidences, as calculated from circulating blood, must integrate the same for a period of several months before the time of capture, considering the presumed longevity of mature erythrocytes in fish, 6-9 mo.

The same test used on 200 Atlantic cod yielded no significant difference according to station or water mass (Georges Bank and coastal Massachusetts) with exception of one instance near Cape Cod related to increased mutation in a number of fish sampled there with active cases of

viral erythrocytic necrosis disease. (In mammals, several viruses are known to increase mutation rates in blood-forming tissues.)

There may be a tendency for adult cod with high outlying mutation frequencies to be large, old females or small, immature males. This, as well as the presumed tendency for piscine erythrocytic necrosis-infected fish to have higher incidences, is now being examined statistically. In mammals, increased frequencies of one form of mutation (chromosome nondisjunction) are well known to be associated with age, but sensitivity to mutagens has not been shown to increase with age. Accumulated total body burdens of contaminants over time, as well as age-related differences in natural metabolism and metabolism of xenobiotics, are expected to contribute to frequency variations of mutation in fish.

The mature and immature erythrocytes of 86 adult Atlantic mackerel, caught at three locations near the edge of the continental shelf from February through March 1982 and in the Hempstead Bay areas of Long Island this June, have also been examined for mutation incidences (same test). Size-age and sex of fish from the four sample areas are similar. The fish caught in the Hempstead Bay area differed from the others in two respects. They were fully ripe and spawning at the time they were caught, and the others were still ripening. Also, unlike those sampled offshore, they had spent about 2 mo in inshore waters. Because the southern contingent of mackerel migrates to coastal waters to spawn, it was not practical to seek fish at a clean site at an equivalent stage of ripeness as those taken at Hempstead Bay. The influence of such factors is better studied in another species with different spawning-migratory studies. Mackerel from the Hempstead Bay area, like the windowpane earlier studied, have higher mutation incidences in the immature erythrocytes of their hematopoietic tissues. The mature erythrocytes of their circulating blood, as anticipated (see above), did not appreciably differ in mutation incidences from those caught earlier offshore. The mean mutation incidence in the immature erythrocytes of the fish from Long Island Sound was approximately 1.5 times that of the offshore fish. Additional samples from the same offshore areas are available for analyses of chromosome mutation and for chemical analyses of heavy metals and toxic hydrocarbons in the kidney tissues should this be deemed worthwhile. Data are to be examined statistically using the same procedures as on the flounder.

Methods Development and New Studies: In a continuing effort to apply the micronucleus test for chromosome mutation to larval and late-stage embryo of fish as collected in plankton, blood cells from the gills and heart of red hake dissected freehand are being scored for micronuclear frequencies. Younger, smaller Atlantic mackerel larvae dissected with the aid of the micromanipulator are also being examined, as are the precursor cells of the hematopoietic system in late-stage mackerel eggs.

Efforts at isolating, identifying, and suitably preparing the germ-line primordia of larval fish have been fruitful. There appears to be no methodologic hurdle to the use of reproductive primordia in practical field surveys on larval fish. A "backup" lab experiment with a known "test" mutagen is being planned. Future efforts are being made to identify particular larval periods when the germ-line primordia would be of maximal interest and of most practical use in cytogenetic tests of mutagenicity.

Seaweed collected by Dick Cooper's diving team on Georges Bank and Jeffreys Ledge has been examined to ascertain its suitability as material on which pollution-related and normal variations in chromosome mutation frequencies might be measured in field surveys should the need occur. The

chromosomes are small. However, both the growing tips of the fronds and spores provide a source of dividing chromosomes in large cells, the size of which somewhat offsets the small chromosome size. Some tests of chromosome mutagenicity should be practical provided sufficient samples can be taken at appropriate times. A single prefixation protocol is being set up for the divers which should increase the usefulness of the material for cytologic study. These protocols will be appropriately modified using locally collected samples of seaweed.

Publications

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PATHOBIOLOGY DIVISION

Comparative Invertebrate Pathology Investigation

In Ocean Pulse molluscan studies, work has continued on collection, examination, and data processing of blue mussels for pathology.

Presently, 56 sets of 50 mussels each from 18 areas of the Northwest Atlantic coast have been collected and processed for histological examination. Their latitude, longitude, year, consecutive station, fixed station, cruise number, month, site, and date data have been computerized. We presently have samples collected in the vicinity of six Ocean Pulse fixed stations. Records of 650 individual animals from the above, which include data on area, date collected, species, length, condition, sex, and gametogenesis stage, have been entered into the computer and compared to 1,890 pathologic lesions which were diagnosed in them. These comprise 58 types of pathologic lesions and approximately 20 parasites which were found to occur in the New England and Mid- Atlantic region.

Additional samples were obtained from new sites located at Quoddy Head and Portland, Maine, and Ocean City and Assateague Island, Maryland.

Histologic examination has now been completed on mussels from all major areas. Apparently, the northern areas have the most pathologic involvement, and Virginia Beach the lowest.

European oysters (*Ostrea edulis*) from three rias (bays) on the northeast coast of Spain were examined microscopically to determine the possible cause(s) of ongoing severe mortalities. Because of shipping and handling delays, all oysters showed signs of stress-induced pathology. The poor condition of the tissues may have hampered the detection of low levels of some pathogens. However, oysters from the Ria de Vigo had detectable levels of the "microcell" disease organism *Bonamia ostreae*. Thirty-two percent (32%) of the oysters from this area were diagnosed with the disease. Prevalences this high and intense have been associated with mass mortalities of oysters in other countries. This disease was not detected in oysters from the other areas sampled in Spain, but due to their poor condition, low levels of the parasite may not have been detectable.

Samples of surf clams and ocean quahogs were collected for Ocean Pulse pathology studies from the recent resource assessment clam cruise. Samples are now being processed for histological examination.

Tissues have been examined from eight premolt and early postmolt crabs involved in the Boone Creek shedding-tank mortality discussed in the last bimonthly report. Six of these crabs were either moribund or recently dead at time of dissection; two appeared fairly normal. There was degeneration in the central nervous system (CNS) of all crabs. Two of them were infected with a reolike virus (RLV); probably these animals also had rhabdolike virus (RhVA), because the latter virus occurred in all previous cases of RLV investigated with electron microscopy (EM). Except for one of the virally-infected crabs that also had a bacterial infection, microorganisms or parasites were not seen. Except for the two RLV-infected crabs, pathologies consistent with known viral diseases of blue crabs were lacking. Conceivably, the CNS degeneration seen in crabs not infected with RLV could have been due to RhVA infection. To date, this virus has only been seen (with EM) in company with one or more other viruses, and what pathologies RhVA might cause by itself are unknown. It does have a predilection for nervous tissue, and there are indications that overt infection (i.e., virus demonstrable in tissues with EM) depends upon the presence of either physical or biotic stressors. In this shedding-tank mortality, a stressor, if present, was probably physical or chemical, not biotic. Various chemicals will cause degeneration of nervous tissue, and a toxic cause of the CNS degeneration is a possibility.

Twenty-one crabs included in the *Paramoeba*-transmission series being done by David Campbell of The Johns Hopkins University have been dissected and tissues are being processed. It is anticipated that chronology of development of paramoebiasis can be followed histologically, to augment the information already obtained by Mr. Campbell.

The histology lab provided over 2,000 sections of finfish and shellfish tissues for microscopic study by resident pathologists.

Microbial Ecology and Parasitology Investigation

Microscopic examination of Atlantic rock crabs (*Cancer irroratus*) collected in May 1982 was completed and the data compared with that from a collection in September 1981. Both collections were made at the "Mudhole" near the inshore limit of the Hudson Shelf Valley near the New York Bight sewage disposal site. The "Mudhole" has been selected as a monitoring site because bottom sediments consist of black mud and silt with high levels of PCB's and other pollutants. Comparative histological findings within the two samples are as follows:

		Microbes, parasites, etc.						
Date	# crabs	Debris	Bacteria	Diatoms	Nodules	Ciliates	Amoebae	Copepods
9/81	31	29(94)*	20(67)	5(16)	13(42)	4(13)	5(16)	16(50)
5/82	45	39(87)	18(40)	6(13)	12(27)	7(16)	6(13)	7(16)

*( ) = percent incidence.

The September 1981 crabs showed an incidence of 50% for copepods compared to only 16% for May 1982. Examination of data on incidence of "black gill" showed that none of the September crabs had the condition, while 16% of the crabs collected in May 1982 had the black condition (see below):

Date	# crabs	Gill Condition				
		Clean	Discolored	<50% black	>50% black	Comment
9/81	87	67	20	0	0	None black
5/82	200	147	22	16	15	16% black

The high incidence of copepod infestation on gills in September probably was associated with absence of black sludge deposits between adjacent gill lamellae where the copepods often are situated. Also, seven newly molted females and one newly molted male were observed in the September collection, indicating that recent molting activity had an influence on the results obtained. A third collection at the "Mudhole" in September or October is planned to determine whether or not the fall season, coupled with molting activity, is associated with the absence of the black-gill condition. Historical data have shown that the incidence of 16% black gill recorded in May 1982 was preceded by an incidence of 32% in May 1981. Monitoring activities showed that a high incidence of gill blackening has remained constant in the New York Bight apex since 1973.

The first publication devoted entirely to the incidence and distribution of pathogenic and nonpathogenic amoebae at the Philadelphia-Camden disposal sites was published in the September issue of the *Journal of the Water Pollution Control Federation.* Followup studies since the cessation of sewage dumping in November 1981 have shown that the amoebae are now being recovered more frequently at stations located away from the center of the dumpsite than in the immediate vicinity of the site. New data suggest that with the cessation of dumping, water currents and natural phenomena are dispersing the amoebae into surrounding sediments where eventually they will be widely distributed in the ocean and no longer recoverable by our present sampling techniques.

Strains of amoebae that survive and grow at temperatures up to 45°C have been sent to Dr. Pierre-Marc Daggett at the American Type Culture Collection in Rockville, Maryland. Dr. Daggett and his associates infect mice with the amoebae to test for pathogenicity. All strains were isolated from environments rich in sewage-associated bacteria (New York Dumpsite, Philadelphia-Camden Dumpsite, Puerto Rico Dumpsite, and Apalachicola River, Florida). Four strains from the New York site have killed mice and are now under study to determine if they are new species. One strain from Florida did not kill mice, but amoebae grew out from pieces of brain tissue taken from mice that were sacrificed. The strain, identified as *Acanthamoeba lenticulata* by workers in France, was reported to be pathogenic when amoebae recovered from mice were passed a second time through additional mice. All of the strains sent to Dr. Daggett are examined with electrophoretic techniques to determine whether three enzyme systems possessed by the amoebae are similar to those found in type cultures. The enzyme systems (i.e., alkaline phosphatase, proprionyl esterase, and leucine aminopeptidase) produce characteristic bands on starch gel and also are being investigated in England and Belgium. We have already detected major differences in banding patterns among certain amoeba species that otherwise appear identical in their morphological features. New studies are planned to investigate the possibility that certain marine pollutants may cause mutagenic effects in the single-celled protozoans, thus altering their enzymatic characteristics.

Fish Pathology Investigation

With the continued cooperation of the Resource Assessment Division's Resource Surveys Investigation at the Woods Hole Laboratory, data were summarized on the geographic distribution and numeric prevalence of fish integumental lesions and pigmentation/skeletal anomalies. To date, 105,042 fishes have been examined from 4,733 trawl stations in the western North Atlantic. Overall disease prevalence was 0.98%. In order of decreasing numeric prevalence, the predominant lesions/anomalies noted included ambicoloration, fin rot, skeletal malformations (bent fin, cranial compression, dwarfism, lordosis, scoliosis), lymphocystis, and ulcers. Ambicoloration was most prevalent in yellowtail flounder, fin rot in winter flounder, skeletal malformations in winter flounder, lymphocystis in winter flounder, and ulcers in Atlantic cod. Ten fish species--winter flounder, yellowtail flounder, Atlantic cod, haddock, American plaice, windowpane, summer flounder, red hake, fourspot flounder, and silver hake--accounted for 89.1% of the lesions/anomalies observed. With the possible exception of fin rot and lymphocystis, the diseases noted appeared to be randomly distributed in the area surveyed. A manuscript (Despres-Patanjo et al. 1982) was prepared for the ICES 1982 Statutory Meeting to be held in Copenhagen, Denmark.

On the last spring bottom trawl survey (*Delaware II* Cruise No. DE 82-02), a program was implemented to monitor the prevalence of specific anatomic lesions in the integument and viscera of Atlantic cod, haddock, Atlantic mackerel, red hake, silver hake, winter flounder, and yellowtail flounder. Tissues were excised from 158 fish for microscopic evaluation of the gross lesion. To date, lesions from 275 fish have been evaluated histologically. The results of these studies are being collated for incorporation in a manuscript to be submitted to the *Journal of Fish Diseases*.

The examination of Giemsa-stained blood smears from Atlantic cod continues. To date, 200 of 293 smears have been examined with oil immersion. Six cod were parasitized by viral erythrocytic necrosis (VEN) and two cod contained *Hexamita* (a flagellate commonly found in the gut). The VEN-infected fish ranged from 23 to 62 cm in length. The two cod with *Hexamita* measured 32 and 34 cm. *Hexamita* is not known to be a blood parasite; its presence *may be* the result of contamination of the smear with gut contents.

To date, 507 blood smears prepared from silver hake have been examined with light microscopy. Piroplasms were found in 10 (1.9%) of the smears, hemogregarines and VEN in 5 (0.98%) of the smears, and trypanosomes in 4 (0.78%) of the smears. None of the parasites were numerically abundant.

Three hundred and fifty stained mackerel blood smears were shipped to Szczecin, Poland, for examination and quantification of parasite infections. Cursory examination of these smears prior to their shipment showed that 7.7% (27/350) had *Haematractidium scombri*. This is a much lower overall infection prevalence than previously noted; however, earlier studies showed that mackerel measuring 33-37 cm had 10% prevalence of infection (the majority of fish examined on the Polish research vessel *Admiral Arciszewski* measured from 30 to 40 cm). To provide a solid data base for comparing the prevalence of *H. scombri* in overwintering, migrating, and spawning mackerel, collections of blood smears, kidney, and spleen imprints and heads are being made of mackerel as they appear on the Northeast coast during the spring and summer months.

Blood smears from 92 haddock, collected on the spring bottom trawl survey have been examined for hemoparasites. A hemogregarine resembling *Hemogregarina aeglefinus* was found in the erythrocytes of 11 (11.9%) haddock (3 males, 7 females, and 1 unsexed) ranging in fork length from 36 to 76 cm. Three of the seven hemogregarine-infected females were coinfected with an unidentified trypanosome. Another extracellular organism, trypanoplasma, was observed in only one fish. The flagellate *Hexamita* was commonly seen in the smears and was found in 16 (17.4%) smears. *Hexamita* is known as a parasite of the gut, not of the blood, which suggests these 16 blood smears may have been contaminated by gut contents during preparation. Various intracellular structures, which may be piroplasms or unidentified stages in the development of other intracellular parasites were also commonly observed (20/92 = 21.7%). All hemoparasite infections, except three piroplasm infections, affected less than 1% of the blood cells. A summary report of hemoparasites in haddock and other gadoid fishes is planned for the near future.

The examination of blood smears from winter flounder and yellowtail flounder collected on resource assessment surveys in the Georges Bank, Gulf of Maine, and Scotian Shelf areas during the fall of 1981, winter of 1982, and spring of 1982 is nearly complete. Thus far, no significant numbers of blood-borne (intracellular or extracellular) parasites have been observed in fish of either species.

Ultrastructural studies on the piroplasm *Haematractidium scombri* in blood cells of Atlantic mackerel collected on the *Admiral Arciszewski* are complete. Based on these observations, it was possible to confirm the following: (1) the parasite is a eukaryotic organism which may reproduce within the blood cells by simple cell division; (2) the organism is identical to the one described in the fine structural studies of Johnston (1975) on mackerel from the northeast Atlantic and is, therefore, taxonomically correct; and (3) thus far only trophozoites have been observed. A short manuscript describing the morphology of the organism (light and electron microscopy) is being prepared for submission to the *Journal of Fish Diseases*.

Diseases of Larval Mollusks Investigation

Bacterial isolates made from six Long Island Sound cruises have shown that numbers of the genus *Vibrio* frequently occur on oyster shell surfaces. Oyster larval pathogens, which are also shell-associated, have been found at the Stratford, Connecticut, site while no pathogens were detected at the "control site" in New Haven Harbor. Continued experimental evidence suggests that Stratford sediment holds a bacterial flora pathogenic to newly set oyster larvae. Stratford was formerly a very productive oyster growing area which declined within the past 10 yr. One might speculate that the decline is a result of the presence of larval pathogens.

In another *Vibrio*-related problem, the Pathobiology Division assisted the Spawning and Rearing of Mollusks Investigation in a sudden mortality of cultured juvenile surf clams. The young clams first crawled to the sediment surface in 4,000-liter tanks, and then developed gas bubbles in tissues, causing most clams to float, hence the term "floating disease," as distinguished from gas bubble disease. From microbial counts of unaffected animals in other tanks, it was determined that *Vibrio* levels were two logs higher in the affected tanks. An antibiotic sensitivity test of

predominant flora revealed that chloramphenicol was most inhibitory. Upon use of 50 ppm of chloramphenicol as we recommended, the juvenile clams recovered in significant numbers over untreated controls to clearly implicate bacteria as the problem. The identity of the pathogen presently remains unknown. However, it is now possible to treat "floaters" with the antibiotic and eliminate "float" condition and induce normal animal function. Additional work on this problem will continue.

A recently completed study showed that bacterial counts and flora from seawater used in hatcheries do change when charcoal filtration is included as part of the treatment process. However, bacterial counts were less in seawater which was exposed to ultraviolet light without prior filtration through a charcoal cartridge. The difference was less than 10-fold when the sample was plated 24 hr after seawater was treated; consequently, the difference may not be significant. More gram-positive microorganisms were recovered from plates with charcoal-filtered seawater than from those with seawater not subjected to this treatment.

Isolation and characterization of microbial toxins affecting molluscan larvae continues. With electrophoresis the location containing a toxic metabolite produced by a pigmented *Pseudomonas* sp. has been found; however, further purification of the toxin must await the production and concentration of a fresh batch of filtrate.

A newly developed lytic-fluorometric method for counting cells was used to corroborate earlier work concerning the effects of centrifugation stress on oyster hemocytes. When applied to cells attached to plates in monolayers, the technique produced counts with minimal variation in less than 10% of the time needed to count cells by the conventional microscopic method. Possible variation in cell size between oysters or seasonally within oysters could have an influence on the consistency and accuracy of the new technique. Therefore, the method is being used to count cells from multiple oysters over a an extended time period in conjunction with: (1) fluorescence readings from a single lot of bovine serum albumin as a protein-standard, and (2) comparative counts from an electronic cell counter.

Sera from summer flounder in Long Island Sound were collected for subsequent analysis of antibody levels to fish pathogens and to human pathogens or waste-associated bacteria. Serum aliquots for the latter assays were sent to J. Stolen at the Sandy Hook Laboratory along with preserved red blood cells for isoagglutinin testing. Most of the sera were collected from fish captured in a nonpolluted area.

During this reporting period, additional fish anti-rabbit red-cell antibodies and rabbit anti-striped bass immunoglobulins were developed to be used in immunodiagnostic tests for bacterial pathogens.

On 30 June, Dr. Blogoslawski visited the Shinnecock Tribal Indian hatchery as a followup to an earlier problem reported in June. Water samples were taken; an algal contaminant seems to be involved.

Upon request, three bacterial slant cultures were sent to Dr. Frances Hickman at the Center for Infectious Diseases in Atlanta, Georgia.

On 14 July, Mr. Emil Usinger of Bluepoints Hatchery in West Sayville, New York, reported on *Mercenaria mercenaria* larvae in Great South Bay. A trip to Bluepoints was made on 19 July, water samples were taken, and clam challenges were completed. A report was sent to Mr. Usinger.

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NATIONAL SYSTEMATICS LABORATORY

Systematics of Fishes

Copies of the Spanish mackerel revision were sent to five ichthyologists and fishery biologists for outside review. Manuscripts on host-parasite relationships of scombrid copepods and needlefishes of the genus *Potamorrhaphis* were revised. Preparation began for manuscripts on scombroid and beloniform fishes for the Ahlstrom larval fish conference in August 1983. A paper on Spanish mackerels was prepared for presentation at the Fourth European Congress of Ichthyologists to be held in Hamburg in September 1982.

Systematics of Crustaceans

"Shrimps, Lobsters, and Crabs of the Atlantic Coast of the Eastern United States, Maine to Florida," will be released as a hardbacked book by the Smithsonian Institution Press in mid-1983; text will be composed from edited magnetic diskettes on which the manuscript was originally entered.

Preparation continued on a revision of the eastern Pacific rock shrimps (genus *Sicyonia*). A detailed description (including morphometric and meristic characters and color patterns) of *Sicyonia disedwardsi* and a discussion of its affinities with other members of the genus was completed.

A manuscript, jointly authored with Mark Millikan of the NMFS Charleston Laboratory, on synopsis of biological data on the blue crab (*Callinectes sapidus*), was revised after first and second lab reviews.

Three manuscripts on forms of the mud crab *Panopeus herbstii*, prominent in the oyster community of eastern and southern United States, were revised after outside review; the study is in part a collaboration with Robert Reames (formerly of the University of South Alabama in Mobile) and J. Bolling Sullivan and associates (Duke University Marine Laboratory in Beaufort, North Carolina). Preparation continued 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 (Cornell University and New Jersey Oyster Laboratory at Cape May, respectively). A description of a new speies of anomuran collected during recent dives of the *Alvin* to submarine thermal vents of the East Pacific Rise at 21°N was begun in collaboration with C. L. Dover. Preparation continued on a revision of Chace and Dumont's 1949 "Spiny Lobsters--Identification, World Distribution, and U.S. Trade."

Scientific Services

Identifications were made on: a collection of caridean shrimps from the Dominican Republic at the request of T. J. Costello of the Southeast Fisheries Center, palaemonid shrimps for Lawrence P. Rozas of the University of North Carolina's Department of Biology at Wilmington, lobster tails for David T. Chia of U.S. Customs laboratory in San Francisco, and 50 lots of beloniform fishes for the Museum of Comparative Zoology at Harvard University.

Information was provided on: distribution and life cycle of penaeopid shrimps from the eastern Pacific and Indo-West Pacific for Mr. Leslie Robinson of Joseph Slavin Associate (importation of fisheries products), locality data on parasitized bluefin tuna to V. Walters of the Southeast

Fisheries Center, and number of crab species on the East Coast of the U.S. for Merrill Lefler of the University of Maryland at College Park.

Assistance was provided to Ms. Susan Hitch of the EPA for the identification of larval shrimp, and to the EPA's Narrangansett Laboratory in obtaining live *Ammodytes*.

Curatorial services included loaning two lots of gadids to J. R. Dunn of the NMFS Seattle Laboratory.

Three research proposals were reviewed for Biological Research Resouces and the Systematic Biology Program at the National Science Foundation.

Manuscripts were reviewed for the *Bulletin of Marine Science* (2), *Journal of Crustacean Biology* (4), *Contributions in Marine Science* (1), *Bulletin of the Southern California Academy of Sciences* (1), and for authors at their request (2).

Publications

Collette, B. B. Needlefishes of the genus *Potamorrhaphis* (Pisces, Belonidae). Proc. Biol. Soc. Wash. (A)

Cressey, R. F., B. B. Collette, and J. L. Russo. Copepods and scombrid fishes: study in host-parasite relationships. Fish. Bull. (A)

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

ATLANTIC ENVIRONMENTAL GROUP

Ocean Monitoring and Climatology Task

The announcements of eddy conditions in the Georges Bank-Middle Atlantic Bight area, included as pages 51 and 52, were sent to the Commander of the Atlantic Area for the U.S. Coast Guard for publication in the August and September 1982 issues of the *Atlantic Notice to Fishermen*.

The cooperative Ship of Opportunity Program obtained 16 expendable bathythermograph (XBT) transects and four continuous plankton recorder (CPR) transects in July and August: four XBT and two CPR transects in the Gulf of Maine, six XBT transects off Southern New England, and four XBT and two CPR transects across the Gulf of Mexico.

Publications

Armstrong, R. S. Variation in the shelf water front position in 1981 from Georges Bank to Cape Romain. Ann. Biol. 38. (S)

Chamberlin, J. L. Application of satellite infrared data to analysis of ocean frontal movements and water mass interactions off the Northeast coast. Proceedings of the Northwest Atlantic Fisheries Organization Annual Meeting, 13-16 September 1981, Halifax, N.S. (A)

Crist, R. W., and J. L. Chamberlin. Bottom temperatures on the continental shelf and slope south of New England during 1981. Ann. Biol. 38. (S)

Fitzgerald, J. L., and J. L. Chamberlin. Anticyclonic warm core Gulf Stream eddies off the northeastern United States during 1981. Ann. Biol. 38. (S)

Fizgerald, J. L., and J. L. Chamberlin. Anticyclonic warm core Gulf Stream eddies off the northeastern United States during 1980. Ann. Biol. 37. (S)

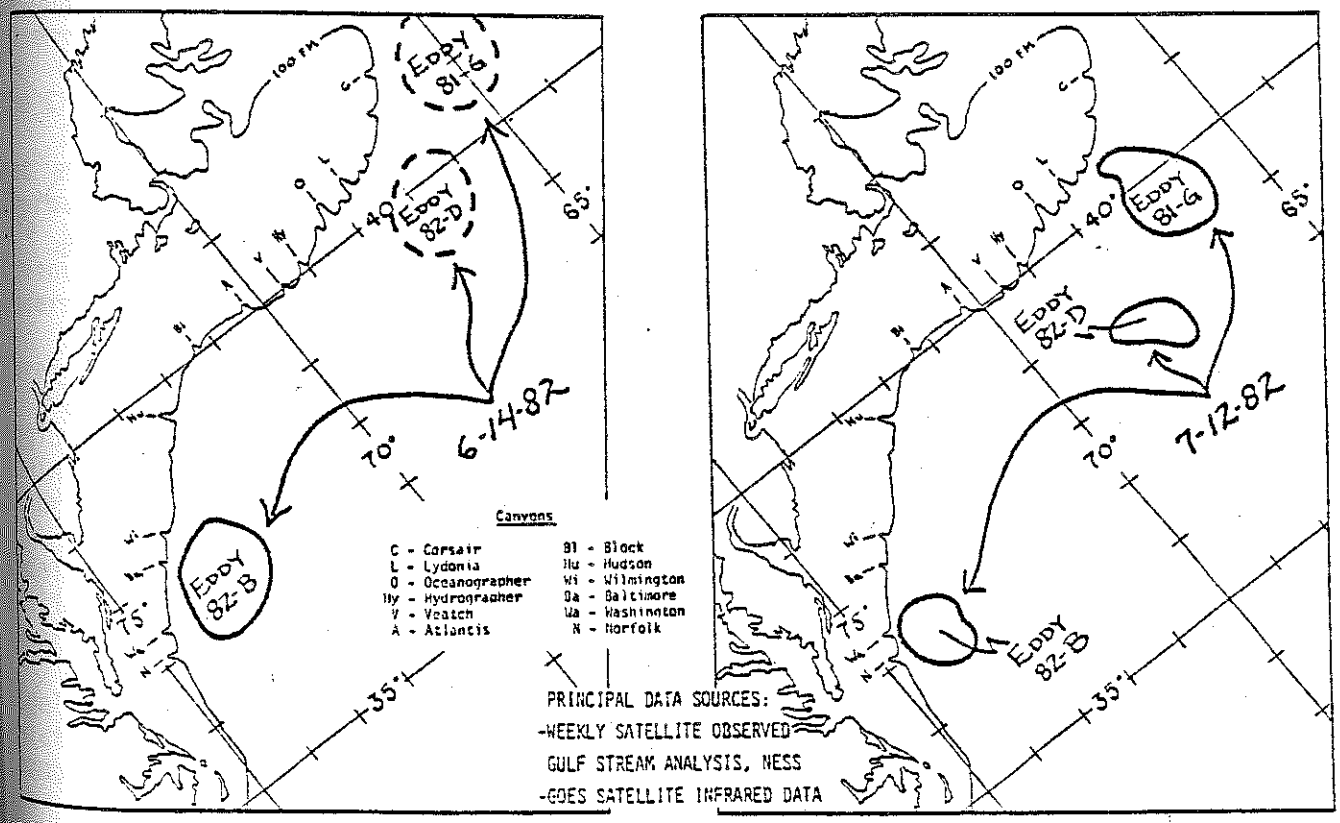
GULF STREAM EDDY LOCATIONS

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

Eddy 82-B travelled southwest about 89 km (48 nm) and is now centered near 36.9°N 73.9°W, east of Norfolk Canyon and just north of the Gulf Stream. Eddy 82-D moved southwest about 165 km (89 nm) and has a center position near 38.4°N 67.9°W. The eddy is south of Oceanographer Canyon and far offshore of the 100-fm line. Eddy 81-G moved southwest about 190 km (102 nm) and is now located southeast of Lydonia Canyon, near a center position of 39.7°N 66.4°W.

During the next 30 days Eddy 82-B will be resorbed by the Gulf Stream east of Cape Hatteras, and Eddy 81-G may move west to a position southwest of Oceanographer Canyon. Eddy 82-D may be resorbed by the Gulf Stream south of Oceanographer Canyon, or the eddy may move west and northwest to a center position south of Veatch 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).



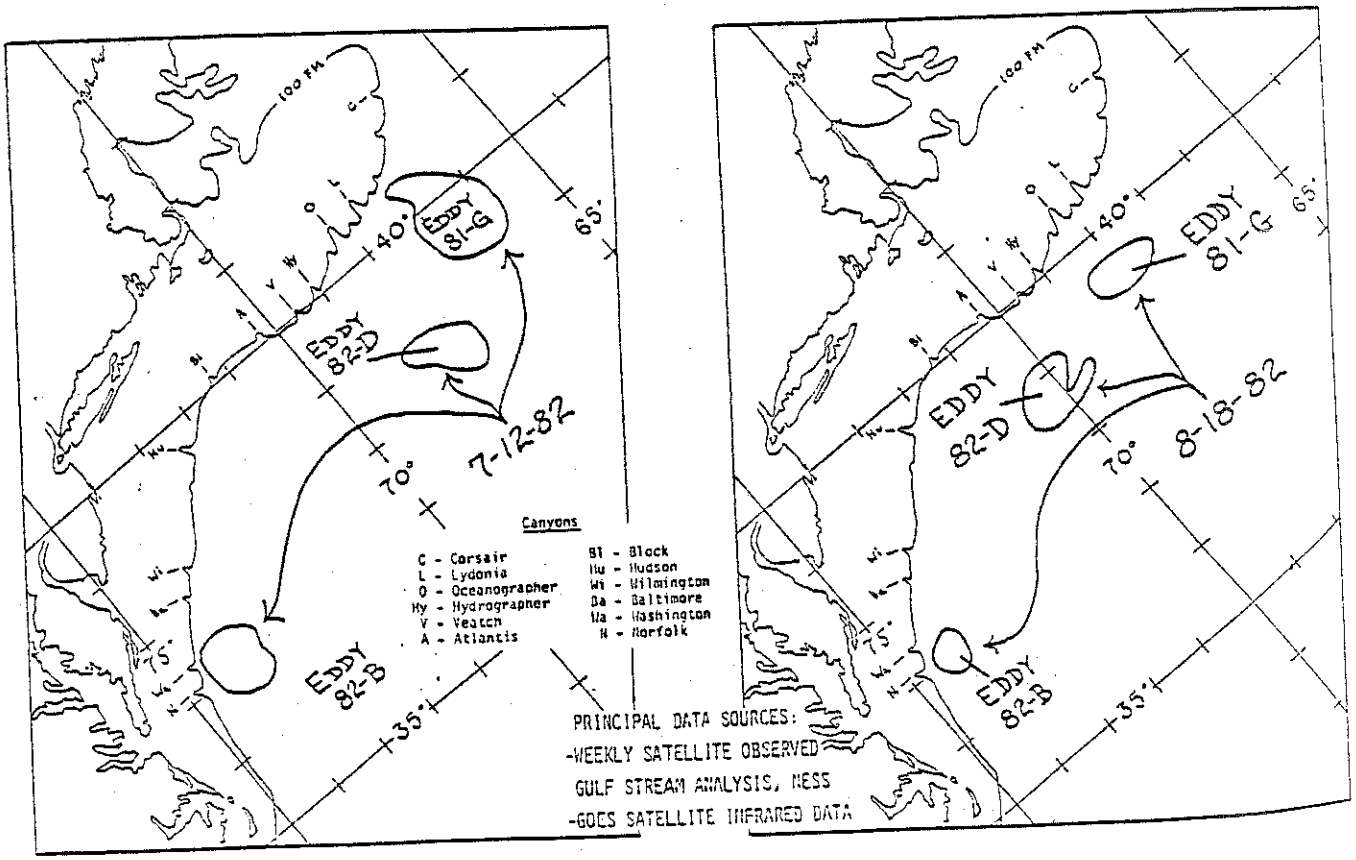
GULF STREAM EDDY LOCATIONS

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

Eddy 82-B travelled in a westerly direction 27.8 km (15 nm) while decreasing in surface area, and now appears to be a remnant eddy, centered at 37.1°N 74.2°W, east of Norfolk Canyon. Eddy 82-D moved west-northwest 195 km (105 nm), interacting with the meandering Gulf Stream along the way. Its position is centered near 38.7°N 70.1°W, between Atlantic and Veatch Canyons, but far offshore of the 100-fathom line. Eddy 81-G moved west-southwest 139 km (75 nm) and also appears to be a remnant eddy, centered at 39.4°N 67.9°W, south of Oceanographer Canyon, and just north of the Gulf Stream.

During the next thirty days, 82-D may be expected to move west-southwest to a position centered near the vicinity of Wilmington Canyon. Eddies 82-B and 81-G will be resorbed by the Gulf Stream.

Fisherman 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).



Hilland, J. E. Variation in the shelf water front position in 1980 from Georges Bank to Cape Romain. Ann. Biol. 37. (A)

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

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

Ingham, M. C. Weather conditions and trends in the Maine-Virginia coastal and offshore area during 1970-79. Proceedings of the Northwest Atlantic Fisheries Organization Annual Meeting, 13-16 September 1981, Halifax, N.S. (S)

Ingham, M. C., and D. R. McLain. Sea-surface temperatures in the northwestern Atlantic in 1980. Ann. Biol. 37. (A)

Jossi, J. W., D. E. Smith, and G. A. White. Continuous plankton records: the sampling program of the U.S. National Marine Fisheries Service. Ann. Biol. 38. (S)

McLain, D. R., and M. C. Ingham. Sea-surface temperatures in the northwestern Atlantic in 1981. Ann. Biol. 38. (S)

TRAVEL, MEETINGS, AND PRESENTATIONS

Marine Ecosystems Divisions

On 6 and 7 July, Ken Sherman traveled to the State Department in Washington, D.C., to review ecological studies pertinent to the U.S.-Canada maritime boundary issue.

On 22 and 23 July, David Mountain attended a workshop at the Bigelow Laboratory for Ocean Sciences in Boothbay Harbor, Maine, concerning future research in the Gulf of Maine.

On 23 July, Hal Merry attended the particulates measurement meeting at the Charles Stark Draper Laboratories in Cambridge, Massachusetts.

On 28 July, members of the NOAA/National Earth Satellite Service team met at the University of Rhode Island and were briefed on MARMAP by Ken Sherman.

During 2-6 August, Ray Maurer presented a poster for the Joint Oceanographic Assembly (JOA) entitled, "Technical Constraints to Understanding Very Large Marine Ecosystems."

On 3 August, Roger Theroux gave a lecture on invertebrates to new NMFS Foreign Fisheries Observers.

On 4 August, Dave Potter met at Woods Hole with the NMFS Northeast Regional Office's procurement officer, Tony Bocelle, and the Small Business Administration contractor to develop a bid for the Woods Hole Laboratory solar energy system contract.

On 5 August, Tom Halavik, Jack Green, Ray Maurer, Donna Busch, Tony Bocelle, Steve Strong, Gordon Preiss, and Louise Andsager were present at a meeting where the construction contract for the Narragansett Laboratory solar energy system project was signed.

On 5 August, Ken Sherman met with Drs. Yentch and Garside at the Bigelow Laboratory for Ocean Sciences to review the dynamics of plankton in relation to satellite imagery of the Gulf of Maine. Drs. Lockwood Chamberlin and Dave Mountain also attended.

On 9 and 10 August, Ken Sherman attended the JOA meeting at Halifax, Nova Scotia, and gave a presentation entitled, "Coherence in the

Zooplankton Component of the Marine Ecosystem Off the Northeast Coast of the United States," by K. Sherman, J. R. Green, J. R. Goulet, and P. W. Fofonoff.

On 10 August, during the JOA meeting, Ken Sherman convened a meeting of experts from the United Kingdom, Canada, South Africa, Japan, and the United States on Antarctic krill sampling problems.

On 12 August, Ken Sherman traveled to Washington, D.C., to participate in a briefing for the NOAA Administrator on the U.S.-Canada maritime boundary issue.

During August, Ed Cohen gave two lectures to the Field Marine Studies Program at Shoals Marine Laboratory.

Resource Utilization Division

Three abstracts were submitted by members of the Product Quality Investigation for papers to be presented at the Atlantic Fisheries Technological Conference: (1) "Effects of Some Process Treatments on the Iced Shelf Life of Cod Fillets Irradiated (Co-60) with 100 Krad," by J. J. Licciardello; (2) "Gas Chromatographic Determination of Dimethylamine and Trimethylamine in Seafoods," by R. C. Lundstrom; and (3) "The Effcts of Oxygen on the Enzymtic Production of Dimethylamine and Formaldehyde in Red Hake (*Urophycis chuss*)," by R. C. Lundstrom.

Joseph Licciardello and John Kaylor participated in a fresh seafood marketing seminar sponsored by the New England Marine Advisory Service.

Joseph Licciardello presented a seminar on seafood quality to a group of retail seafood store operators.

Ronald Lundstrom presented a lecture on "The Development of Analytical Methodologies for Fish and Shellfish Identification" at the annual summer conference of the New England Association of Chemistry Teachers held at Bowdoin College in Brunswick, Maine.

Fred King participated in a meeting of the New England Fisheries Institute in Gloucester, Massachusetts, on 28 August.

Perry Lane attended a monthly meeting of the New England Fisheries Steering Committee in Braintree, Massachusetts.

Perry Lane participated in a meeting of the Quality Project Oversight Committee in New Bedford, Massachusetts. This Committee monitors and assists in directing the Quality Fish Project sponsored by the New England Fisheries Development Foundation.

Pathobiology Division

Dr. Rosenfield attended the 2-wk Foreign Affairs Interdepartmental Seminar beginning 29 June at Arlington, Virginia.

Dr. Sawyer attended the Conference on Marine Science at Hampton Institute in Hampton, Virginia, on 12 and 13 July.

Dr. Sawyer attended the Society of Protozoology meeting at San Francisco State College during 1-8 August, and presented a scientific talk.

Dr. Johnson and Mr. Kern attended the Society for Invertebrate Pathology ad hoc meeting at Penn State University during 8-11 August; Dr. Johnson presented a paper on crustacean viruses in a symposium on diseass in marine invertebrates, Mr. Kern presented a poster session.

Mr. Newman attended the Wildlife Disease Association meeting in Madison, Wisconsin, during 16-20 August.

During the week of 23 August, Mr. Newman attended the Immuno-Workshops in Aspen, Colorado.

Atlantic Environmental Group

On 7 July, Steve Cook traveled to Washington, D.C., to discuss the GOES satellite data link with National Weather Service personnel, V. Zegowitz and R. Deryke.

Mert Ingham traveled to Sandy Hook Laboratory on 7 and 8 July to confer with Center scientists and review progress on the fishery climatology contract with the Virginia Institute of Marine Science.

Woody Chamberlin attended a Northeast Area Remote Sensing System meeting at Woods Hole on 9 July.

On 13 July, Mert Ingham attended a meeting of the NMFS/EPA/NOAA Office of Marine Pollution Assessment Ocean Dumping Research Committee held at Woods Hole.

Reed Armstrong attended a meeting on oceanographic conditions in Maine coastal waters which was held at Boothbay Harbor, Maine, on 5 and 6 August.

Steve Cook attended the U.S. Minerals Management Service information transfer meeting held in New Orleans, Louisiana, during 23-26 August as a guest of the Bureau of Land Management. He made a presentation on AEG's Ship of Opportunity Program in the Gulf of Mexico.

VISITORS

Marine Ecosystems Division

On 9 July, Bob Cannon of the Northeast Regional Office visited the Narragansett Laboratory to review pending contract negotiations with the University of Rhode Island.

On 14 July, Tommy Purwaka, an Indonesian graduate student attending the University of Washington, visited the Narragansett Laboratory.

On 17 August, Greg Lough accompanied Dr. Peter C. Rothlisberg of Australia's Common-wealth Scientific and Industrial Research Organization, on a tour of the Narragansett Laboratory. Dr. Rothlisberg also visited the Woods Hole Laboratory, talking with various scientists about ongoing ecosystems research.

On 17 August, Ray Maurer gave a demonstration of the image analysis system to Dr. Rothlisberg.

During the week of 30 August, Dr. Takeo Ishii of the University of Tokyo's Institute of Oceanography, visited the Narragansett Laboratory to discuss progress on the development of the automated plankton sorting system.

Ray Bowman met with Kerry MacPherson, project scientist for Carolina Power and Light Company, during August. Ray described NMFS's mission and presented Kerry with an overview of our sampling methods and ongoing projects.

Resource Utilization Division

Drs. Steven Swift, Pat Dunne, Jeff Phillips, and Bruce Wright from the U.S. Army's Natick Laboratories spent a day at the Gloucester Laboratory to familiarize themselves with the various chemical, physical, and sensory methods used to assess seafood quality.

Pathobiology Division

Visitors to the Oxford Laboratory during the reporting period were: Jean Boggio, Dave Rapp, and Scott Lamb of Old Salt Seafood Co. in Easton,

Maryland; Donna O'Brien of Bico/Zeiss in Baltimore, Maryland; Tammy and Dave Fischbach of Carteret Marine Laboratory in Carteret, New Jersey; John Kelley of the University of Alaska's Institute of Marine Science in Fairbanks; Irving Lind and broadcasters from the Voice of America in Washington, D.C.; Mark Bushnell of NOAA in Miami, Florida; Robert Sellers and Krystyna Boczon of the FDA in Washington, D.C.; Ashton Stewart of the Veterans Administration's Medical Center in Martinsburg, West Virginia; Pauline Clift of Cape Coral, Florida; James and Rebecca Tobat of Secretary, Maryland; Drs. Alicia Toranzo-Barja and Juan Barja of the Department of Microbiologia of the Universidad de Santiago in Santiago de Compostela, Spain; Donald Wickham and Naida Yolen of Sea Grant in Washington, D.C.; Dr. William Pegg and his ecology/biology class from Frostburg College in Frostburg, Maryland; Mr. Peter Jensen of the Maryland Department of Natural Resources in Annapolis; Drs. Nazmi Demir of the Turkish Embassy in Washington, D.C., and Isfir Sahin of the Turkish Department of Fisheries in Ankara.

Drs. Demir and Sahin discussed not only fishery problems, but problems related to plant and animal ecology important to the economy of Turkey.

Drs. Alicia Toranzo-Barja and Juan Barja spent 7 and 8 September at the Oxford Laboratory discussing potential U.S.-Spanish cooperative research programs in microbiology, and establishing contacts with U.S. investigators in the field of fishery disease reasearch.

National Systematics Laboratory

Dr. Collette was visited by: Dr. Labbish Chao and two graduate students from the Universidad do Rio Grande de Sul in Brazil to study South American freshwater sciaenids; Mr. Michael Goulding of the Brazilian National Institute for Animal Production in Sao Paulo to discuss needlefish taxonomy and life history; Dr. Peter Castle of Victoria University in Wellington, New Zealand, to study eels; and Dr. James C. Tyler of the National Science Foundation to study *Luvarus*. K. Able of Rutgers University in New Brunswick, New Jersey, visited the Laboratory to examine specimens of fishes, and David Wildrick of Northern Illinois University in DeKalb used the library.

Dr. Canet was visited by Dr. Joseph Jay Ewald of the University of Zulia in Venezuela to discuss present status of penaeoid shrimp taxonomy, Dr. Darryl L. Felder of the University of Southwest Louisiana to inform of a new locality record for *S. olgae*, and Dr. Anthony J. Provensano, Jr., of the Institute of Oceanography at Old Dominion University to discuss shrimp rearing in Latin America.

Dr. Williams was visited by Dr. Robert E. Knowlton of George Washington University in Washington, D.C., to discuss a manuscript on salinity tolerance in palaemonid shrimps, Dr. Robert Hessler of the Scripps Institute of Oceanography in La Jolla, California, to discuss decapod crustaceans from thermal vent areas of the rift zone in the East Pacific at 21°N, Dr. Jan R. Factor of Cornell University in Ithaca, New York, and Cindy L. Van Dover of the New Jersey Oyster Laboratory in Cape May Courthouse, to study and evaluate results of research on decapod crustaceans from thermal areas on rift zones near the Galapagos Islands and 21°N in the East Pacific, and Dr. Darryl L. Felder of the University of Southwest Louisiana, to collaborate on studies of xanthid and goneplacid crabs in the Gulf of Mexico.

Atlantic Environmental Group

Wang Jin Long of the Institute of Oceanographic Instrumentation of the National Bureau of Oceanography in Tiajin, China, visited AEG on 26 July and conferred with Steve Cook to familiarize himself with XBT gear and its use on ships of opportunity.

Vince Zegowitz of the National Weather Service in Silver Springs, Maryland, visited AEG on 28 July and conferred with Steve Cook regarding automation of XBT data logging and transmission on the M/V *Oleander*.

UNIVERSITY AFFAIRS

Marine Ecosystems Division

On 30 July, Ken Sherman met with Perry Jeffries and staff of the University of Rhode Island to review progess on the development of the automated plankton sorting system.

Resource Utilization Division

The Fisheries Engineering Investigation and URI Marine Advisory Service personnel met with Mr. Hennemuth and Mr. Stern of the NEFC concerning the Investigation's cooperative program with URI.

Al Blott discussed future gear testing projects with Cliff Goudey of the MIT Marine Advisory Service. The proposed testing would be carried out at the Navy's David Taylor Model Basin.

Monica Hallsey, a URI Ocean Engineering Department graduate student, will be a graduate assistant assigned to the Fisheries Engineering Investigation for the next school year. She will be involved with the acoustic measurement of fishing gear and models.

Aquaculture Division

On 14 July, Ron Goldberg hosted a class from Fairfield University in marine science.

On 28 July, Ed Rhodes hosted a group from Fairfield University's summer session in marshland ecology.

On 10 August, we provided shellfish larvae and shellfish seed to Wendy Wiltse and Steve Malanowsky of the University of Connecticut for use in their research.

Pathobiology Division

A modified amino-assay procedure for the chemical detection of paralytic shellfish poison in clam meats continues in cooperation with Dr. Julius Kuck of Fairfield University.

Sea Grant and NMFS are concerned about the meaningfulness and extent of cooperative research and extension services undertaken by each agency, and how integration of such activities could improve productivity. NMFS's Don Wickham, temporarily assigned to the Office of Sea Grant, and Dr. Naida Yolen of the Office of Sea Grant at the Page Building, visited the Oxford Laboratory on 9 September. Drs. Wickham and Yolen are pooling their talents, visiting laboratories, and discussing programs with investigators.

National Systematics Laboratory

Dr. Collette taught his summer graduate course in ichthyology for the 16th year at the Marine Science Institute of Northeastern University in Nahant, Massachusetts. Dr. Williams valuated professional accomplishments for a tenure review committee.

PUBLIC AFFAIRS

Aquaculture Division

On 21 August, a number of our personnel participated in the Milford Laboratory's exhibit for the Milford Oyster Festival.

On 4 August, a shark was found at a Fairfield, Connecticut, beach. The Milford Laboratory was called to see whether it could be identified.

Pathobiology Division

Dr. William Pegg and his ecology/biology class from Frostburg (Maryland) College were presented with a lecture on marine science and a tour of the Oxford Laboratory on 8 July.

The American Littoral Society held its annual picnic at the Oxford Laboratory on 1 August.

Mr. Irving Lind and several members from Voice of America visited the Oxford Laboratory on 10 August and were presented with a tour and description of Center programs and activities for later incorporation into broadcasts to foreign nations.

PERSONNEL

Marine Ecosystems Division

Alan Lintala and Michael Couturier left the Apex Predators Investigation. Alan is seeking his Ph.D. from West Virginia University. Michael is relocating to sunny, southern California to work for private industry.

Marie Carter left the Biostatistics Unit to continue working with the University of Rhode Island.

Robert Marak is now happily retired. A farewell party was given in his honor at the Larchwood Inn in Wakefield, Rhode Island, with over 40 of his colleagues and friends wishing him well in his retirement. Hopefully, he will keep in touch.

Debbie Delgado filled the vacated personnel management assistant position of Christine Philpott.

We welcome aboard Christine Carrigan, a Biological Aid, and Robert Medved, a Research Assistant, who will be working with the Apex Predators Investigation.

Robert Kenney is on board in the Biostatistics Unit as a Computer Programmer.

Five minority students--Paul Francis, Arnold Kee, Archimedes Merriweather, Lysa Suggs, and Job Williams--were selected and participated in the 1982 Minority Research Apprenticeship Program at the Narragansett Laboratory this summer. This Program is designed to give on-the-job experience to outstanding high school students, encouraging them to seek careers in the marine sciences.

Paul Francis, a 17-yr-old senior at St. Andrews High School, is the son of Mrs. Pearl Francis. He was a returning apprentice who worked with Chuck Stillwell and Nancy Kohler studying food habits of sharks and other large pelagic fish for the Apex Predators Investigation.

Arnold Kee is a 16-yr-old senior at St. Andrews High School, is the son of Mr. and Mrs. Ernest M. Kee. He worked for AEG under the supervision of Jack Jossi and Gretchen White. He was involved in data entry and manipulation of the MARMAP data base.

Archimedes Merriweather, a senior at Hope High School and the 18-yr-old son of Mrs. Mildred Merriweather, worked under the direction of Ray Maurer and Jack Green in the Plankton Ecology Investigation. He sized and identified plankton both manually and automatically with an image analysis system.

Lysa Suggs, daughter of Mrs. Brenda Suggs, is a 16-yr-old junior at Central High School. Lysa worked with Dr. Laurence Buckley and Tom Halavik in the Larval Fish Dynamics Investigation. She was involved in biochemical assay work and some field collection of larval fish.

Job Williams, a 17-yr-old senior at Jeremiah E. Burke High School in Dorchester, Massachusetts, was a returning apprentice and the group's student leader. He worked under Dr. Mert Ingham, Director of the AEG, studying changes in the Gulf Stream and other physical oceanographic processes.

The Program consisted of weekly lectures by members of the research community on their present projects, followed by question-and-answer periods. In addition, students had the opportunity to tour the University of Rhode Island Graduate School of Oceanography and R/V *Endeavor*, the EPA Environmental Research Laboratory at Narragansett, the Woods Hole Laboratory, *Delaware II*, and WHOI. The program coordinator at Narragansett was Tom Halavik. The regular Narragasnett EEO Committee did not meet during this period.

Resource Utilization Division

Lt. John T. Moakley of the Fisheries Engineering Investigation received a commendation from the NOAA Officer Personnel Board for overall excellent performance.

Tom Connors took a course at the General Services Administration's Training Center on "Basic Elements of Property Management," a 1-wk refresher to update his present knowledge of property management.

Claire Jensen has started a self-study course on "EEO and Its Place in the Federal Government."

Perry Lane, John Ryan, and Fred King participated in the "in-house" training of an expert texture panel based on the General Foods' technique.

Pathobiology Division

Ms. Joyce Bowling completed her Junior Federal Fellowship at the Milford Laboratory and left to attend veterinary school in Mississippi.

Ms. Renee Mercaldo, Junior Fellow, completed her summer assignment with the Pathobiology Division at the Milford Laboratory.

Ms. Robin Friend and Mr. David Kent terminated their summer assignments at the Oxford Laboratory on 27 August.

Ms. Marina Priesnitz completed a 3-mo summer appointment at the Milford Laboratory and has returned to her senior year at Wheaton College.

Awards were presented to several staff members at the Oxford Laboratory: William Brey--30-yr pin; Barney Brooks, Solomon James, Fred Kern, and Jane Wade--sustained superior performance; Susie Hines and Muriel McNelis--quality step increase; Jay Lewis--special act; and Tom Sawyer--27-yr in the U.S. Army Reserve and outstanding meritorious service from 1972 to 1982. Tom retired as a Lieutenant Colonel.

EEO ACTIVITIES

Marine Ecosystems Division

On 29 July, Roz Cohen and Donna Busch participated in a 2-day Federal Women's Program (FWP) workshop in the individual development plan program at the Woods Hole Laboratory.

On 5 August, Roz Cohen attended a FWP meeting at the Woods Hole Laboratory.

On 12 August, Roger Theroux attended an EEO briefing in Woods Hole by Tony Mackel of the NOAA Office of Civil Rights.

On 19 August, Debbie Delgado, Peggy Lamoureux, and Donna Busch attended an FWP luncheon in Newport, Rhode Island.

The five students that were employed in the Minority Research Apprenticeship Program are now back in school. The Narragansett Laboratory and the AEG benefited tremendously by these bright students. On 26 August, an Apprentice-Mentor Banquet ended the summer-long Program.

Donna Busch attempted to locate qualified female applicants for job vacancies in the Marine Ecosystems Division.

Resource Utilization Division

Perry Lane attended a meeting of the joint Center and Regional Office EEO Committees.

Pathobiology Division

Dr. Brown attended the Federally Employed Women's 13th National Training Program and the Women in Science and Engineering Seminar in San Antonio, Texas, during 21-24 July.