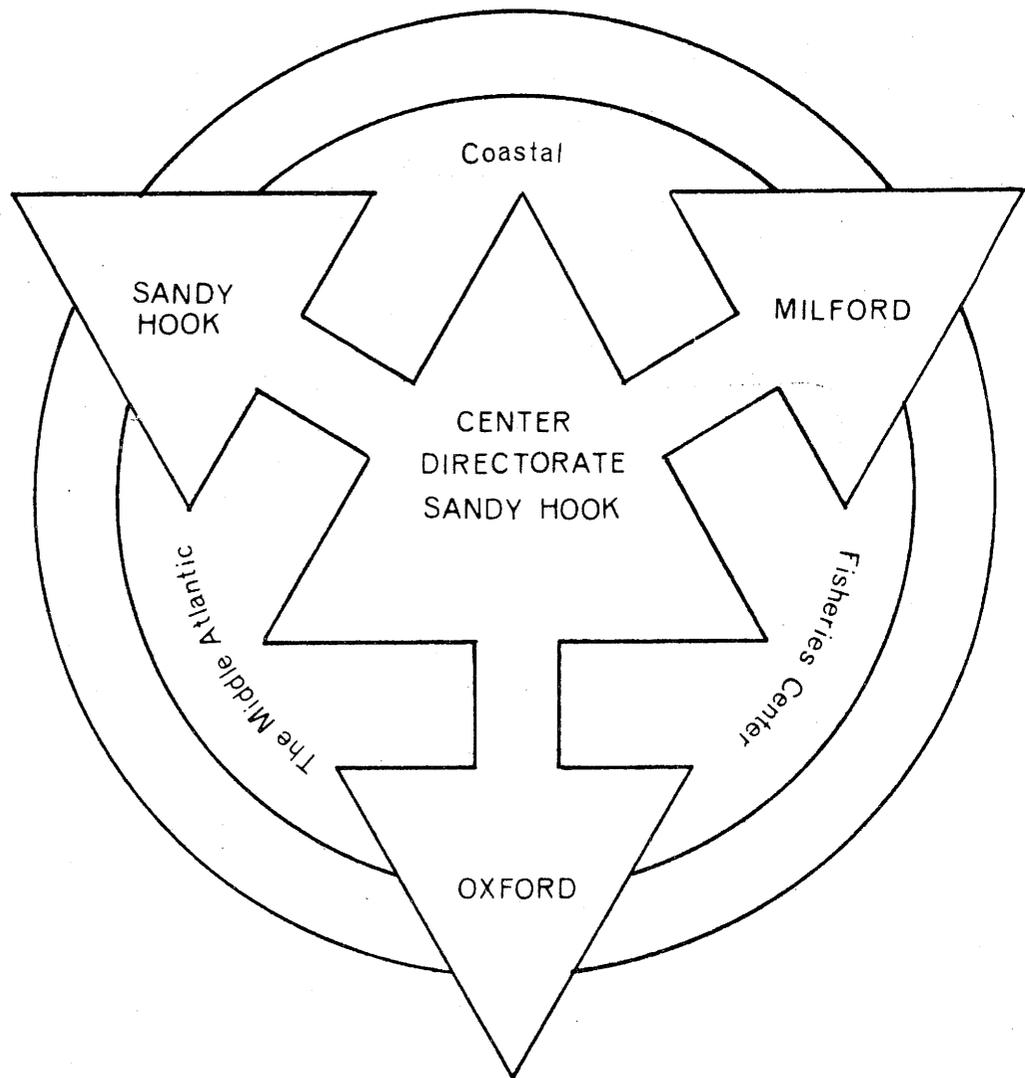


BIOLOGICAL STUDIES IN THE NEW YORK BIGHT:
A PROPOSAL BY THE MIDDLE ATLANTIC COASTAL
FISHERIES CENTER, NMFS, TO NOAA-MESA FOR
FUNDING IN FY 1976T



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region

MIDDLE ATLANTIC COASTAL FISHERIES CENTER



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I. Introduction

This proposal describes research to be carried out by the Middle Atlantic Coastal Fisheries Center during FY 1976T, the interval between the end of FY 1976 on June 30, 1976 and the beginning of FY 1977 on October 1, 1976. The proposed work is both a logical continuation of past studies and an appropriate introduction to proposed FY 1977 studies which will be described in another document.

The major emphasis in the descriptions which follow reflects instructions from the MESA Project Office to the effect that funding is available for studies in mutagenesis, abnormalities in fish and shellfish, carbon/oxygen/nitrogen cycling, benthic macroinvertebrate distribution and abundance, groundfish distribution and abundance in relation to pollution, and contaminants in organisms (in cooperation with the Southeast Utilization Research Center - SURC).

Because the proposed cooperative research with SURC will be completed in slightly more than one year, both FY 1976T and FY 1977 phases are included; the other proposals are for FY 1976T research only. Allocation of funds to individual studies (tasks) is listed in the final section of this proposal.

Task No. 1 Mutagenesis

The first year of research on mutagenesis in fish eggs of the New York Bight has had two objectives: 1) To develop methods that can be used routinely to amass large quantities of data quickly and efficiently; and 2) To examine neuston samples collected in May 1974 during the MESA cruise of the R/V Westward.

The first objective has been accomplished. We have prepared large quantities of material for examination and we have developed a uniform system of scoring cytogenetic abnormalities so that a computer can be used to assist with the analysis. Over 5,000 slides of mackerel embryos have been prepared, over one-quarter of which have been examined. In addition, the finding was made that cytogenetic aberrations can be studied in embryos that have been preserved a long time. This finding creates interesting possibilities of comparing the prevalence of present-day aberrations with that of the past.

Progress has been made toward meeting the second objective. As described in the June 1976 Trimester Report (MACFC Informal Report No. 116), cytogenetic abnormalities were much more prevalent in the Apex of the New York Bight than outside the Apex in mackerel embryos sampled during the Westward cruise. We propose to continue working on Westward cruise material until statistically convincing results have been achieved. We will then be in a position to prepare a short article for Science and probably longer articles as well.

Research Plan

1. Compile sufficient data on Westward cruise material to permit statistical testing of the significance of results.
2. Make slides of new material including fish embryos sampled about ten years ago by biologists at the Sandy Hook Laboratory as well as samples taken last May throughout the Bight.
3. Work on an article for Science summarizing work to date.

Task No. 2 Abnormalities in Fish and Shellfish

Over the past several years, we have found significantly higher prevalence of "fin rot" disease in fish caught in the Apex of the New York Bight than in fish from outside of the Apex as well as higher prevalence of the disease in fish from Raritan/Sandy Hook Bay compared with fish caught in Great Bay, a relatively unpolluted bay several miles south of Sandy Hook. Prevalence has varied seasonally and probably annually, with seasonal highs in spring, summer and fall. We propose to continue measuring prevalence in the 1976T period because summer and early fall were periods of high prevalence in past years. We propose also, to continue the experimental exposure of winter flounder in cages at the sewage dump site and at a control site several miles from the dump site.

Because "black gill" disease of crustaceans follows an annual cycle that is related to temperature and molting, we propose to continue our field and laboratory observations of infected animals. Black gill results from an accumulation of fouling organisms and fine particulate materials on and between the gills of crabs and lobsters. The density of accumulations gradually increases until respiratory efficiency is probably seriously impaired. Relief comes at molting when the fouled gill surfaces are replaced by clean ones. We have consistently found high prevalence of black gill in crustaceans of the Apex.

Fin rot will be studied by trawling for diseased fish at least once a month in the Apex and in Raritan/Sandy Hook Bay, and by exposing winter flounder at least monthly in traps placed within the sewage sludge dumping area and at a control area off the south shore of Long Island. The tissues from selected diseased fish will be fixed for histopathological examination. Data will be entered in the ADP system following procedures that are now routine.

Field sampling for crustaceans with black gill will consist of a comprehensive series of otter trawl samples that emphasize, but is by no means confined to, the Apex and Sandy Hook/Raritan Bay. Several hundred animals will be examined and a smaller but representative number will be examined histopathologically to identify the microorganisms and materials which cause blackening and fouling of the gills. The data will be organized in a manner suitable for computer input, and at least "first cut" analysis of the data will be made.

In summary, specific activities proposed for the FY 1976T period are:

1. Continued monthly monitoring of the seasonal and annual prevalence of fin rot in flatfish of the Apex and Raritan/Sandy Hook Bay.
2. Continued monthly exposure of winter flounder in cages at the sludge dump site and in a control area.
3. Continued input of data into the ADP system.
4. Continued investigation of the prevalence, causes, and pathological implication of black gill in crustaceans of the entire New York Bight with emphasis on the Apex and Raritan/Sandy Hook Bay.

Task No. 3 Carbon/Oxygen/Nitrogen Cycling

The proposed research is designed to provide clearer understanding of the cycling of carbon, oxygen, and nitrogen than exists at present, based on a 17-day cruise in August-September from the Hudson Estuary to the Outer New York Bight and on participation in the Sludge Tracking Acoustical Experiment (STAX) of early July.

The August-September cruise has two sets of objectives. The first is to determine effects of heavy metals on the transfer rates of energy and carbon (seabed oxygen consumption and heterotrophic uptake) for organisms at or near the base of the food web for demersal fish. To determine the inter-relationships between the rates at which organic material (including organic waste) is taken up (incorporated) and decomposed by these organisms, and the numbers and kinds of organisms (microbial) responsible for these activities. To monitor the distribution and magnitude of oxidation (decomposition) of organic matter (including dredge spoils and sewage sludge) by the seabed in the apex and to compare the rates found with previous summers (see Special Symposium Volume of Limnology and Oceanography, Fall 1976).

The second set is to examine integrated water column for primary productivity, heavy metal concentrations, total bacterial counts, oxygen consumption by the seabed and water above, zooplankton biomass and identification, and nutrient regeneration from the benthos along a series of gradient transects from the Lower Hudson Estuary to the Outer New York Bight. To determine extent and magnitude of influence of the New York Metropolitan area on biological components and activities (particularly those near the base of the food web for pelagic and demersal fisheries) of the affected estuary and adjacent continental shelf, particularly with reference to the recent fish kills.

In the Sludge Tracking Acoustical Experiment (STAX) of early July, we will measure oxygen uptake of whole water at various depths, fractionate the suspended particulate materials to relate particle size to oxygen demand, and we will measure primary productivity, chlorophyll, bacterial abundance, and the disappearance of organic nitrogen and phosphorus. A report on our participation in the experiment will be written for MESA. The report will include graphs.

Task No. 4 Benthic Macroinvertebrate Distribution and Abundance

The proposed research consists almost entirely of analyses of existing data to demonstrate the effects of ocean dumping on benthic macroinvertebrates of the New York Bight, and to develop principles of sampling validity that should be universally applicable in benthic studies. We propose also to sort and identify a limited number of samples collected in March 1974 to provide replicates of winter samples to compare with replicated samples from August 1973.

Dr. Rozett's factor analysis has produced evidence of several natural associations of species that were sampled during the five quarterly cruises. We propose to compile basic life-history information on the major species involved so as to develop biological rationale needed to interpret the data.

A computer program for cluster analysis assembled by Dr. Don Boesch of the Virginia Institute of Marine Science has been tested and revised at MACFC. We propose to employ the Canberra metric dissimilarity coefficient coupled with flexible clustering using both single-sample and available replicate-sample data. The program contains several alternate methods of analysis.

The question of the number of replicate grabs to take at a station is being approached in two ways. Dr. Saila has already published findings based on examination of the "historical data" (Sandy Hook Laboratory study for the Corps of Engineers, 1968-71), and he will continue to study the question using data of the RECON cruise of June 1973. RECON cruise data consist of the results of taking 19 or 20 grabs at seven representative stations in and near the dump sites. At MACFC, using RECON cruise data, families of curves will be generated that indicate with 95% probability the similarity of samples made up of 1, 2, 3, 4, 5, and 6 grabs. This work is based on the idea that two composite samples that are each made up of organisms from 6 grabs -- all taken at the same station -- are measurably more alike than two composite samples that are each made up of organisms from 1 grab, and that a measurable series lies between the two extremes. The curves will indicate the relative quality of results that a project manager or principle investigator can expect by taking 1, 2, 3, 4, 5, or 6 grabs per station. Seven families of curves will be generated, one for each of the 20-grab series of samples taken at seven stations on the RECON cruise. The curves will be accompanied by lists of species that were sampled with 95% probability at the 1, 2, 3, 4, 5, and 6-grab levels of sampling intensity.

Task No. 5 Groundfish Distribution and Abundance
In Relation to Pollution

Since the autumn of 1972, MACFC has conducted groundfish assessment surveys in shelf and estuarine waters of the mid-Atlantic Bight. Because of MESA's need for detailed distributional information concerning finfish resources, additional stations were occupied in and near the MESA Apex. Although these data have proven to be valuable sources of finfish information, they do not show statistically acceptable distributions within the MESA Apex. This includes comparisons between high and low carbon areas. Therefore, we suggest the three-phased study outlined below.

Progress on all three phases will be made during FY 1976T; however, we can realistically anticipate that activity will focus on phase III. Preparing for the cruise, conducting it, and analyzing results will consume the major share of time and funding (station map attached). Time not required for activities related to the cruise will be devoted to phases I and II. Phase I will include analysis of data from an August surf clam cruise (station map attached).

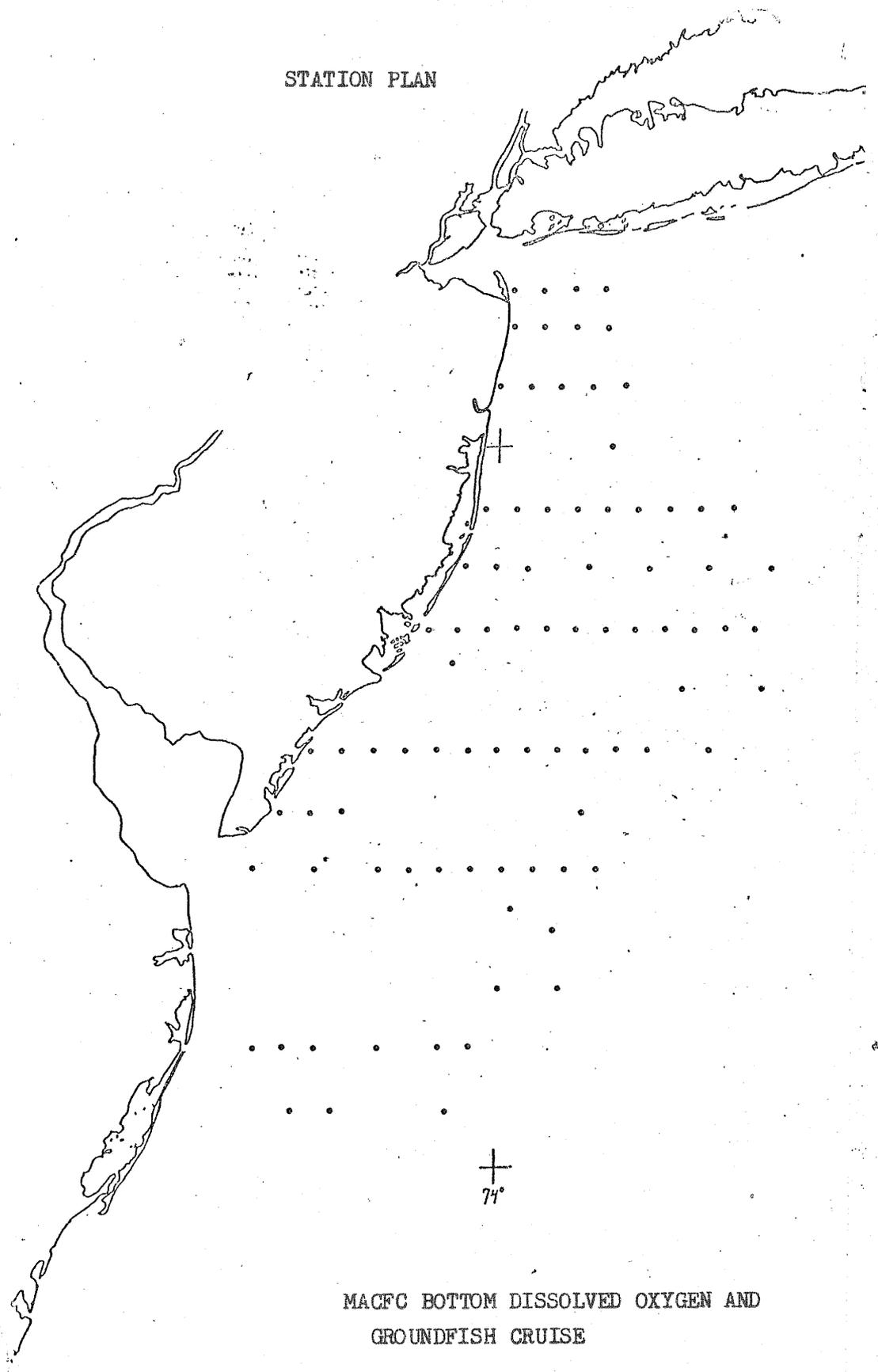
I. A detailed compilation of fishes and selected invertebrates occurring in the MESA Apex as well as in areas immediately south and east. Included would be the results from 22 cruises representing over 350 trawl hauls. We would also show relative biomass estimates on a seasonal basis for selected species.

II. A detailed comparison of finfish distribution in the Apex with all available environmental variables, i.e., heavy metals, oxygen levels, benthic fauna, etc.

III. A short-term study designed to demonstrate distributional patterns in selected areas of the MESA Apex. The work would be based on a 10-12 day cruise in August in the Apex. During the cruise, bottom oxygen levels would be measured in several high and low carbon areas. We would make high intensity replicate trawls of short duration (standard duration trawls cover too large an area) to obtain a valid small area sample.

Even if overall we find it impossible to demonstrate avoidance of high carbon areas, we should find it possible to correlate levels of dissolved oxygen with the catch of fish. We feel that this information alone will be of considerable scientific value because field experiments of this nature have rarely been conducted; documentation of the distribution of marine finfish in relation to dissolved oxygen is almost nonexistent.

STATION PLAN



MACFC BOTTOM DISSOLVED OXYGEN AND
GROUND FISH CRUISE

6-17 AUGUST 1976

SANDY HOOK

STATION PLAN

MINASQUAN

PT. PLEASANT

BAY HEAD

BARNEGT INLET

SHIP BOTTOM

BEACH HAVEN

LITTLE EGG INLET

ATLANTIC CITY

GREAT EGG INLET

CAPE MAY

37°30'

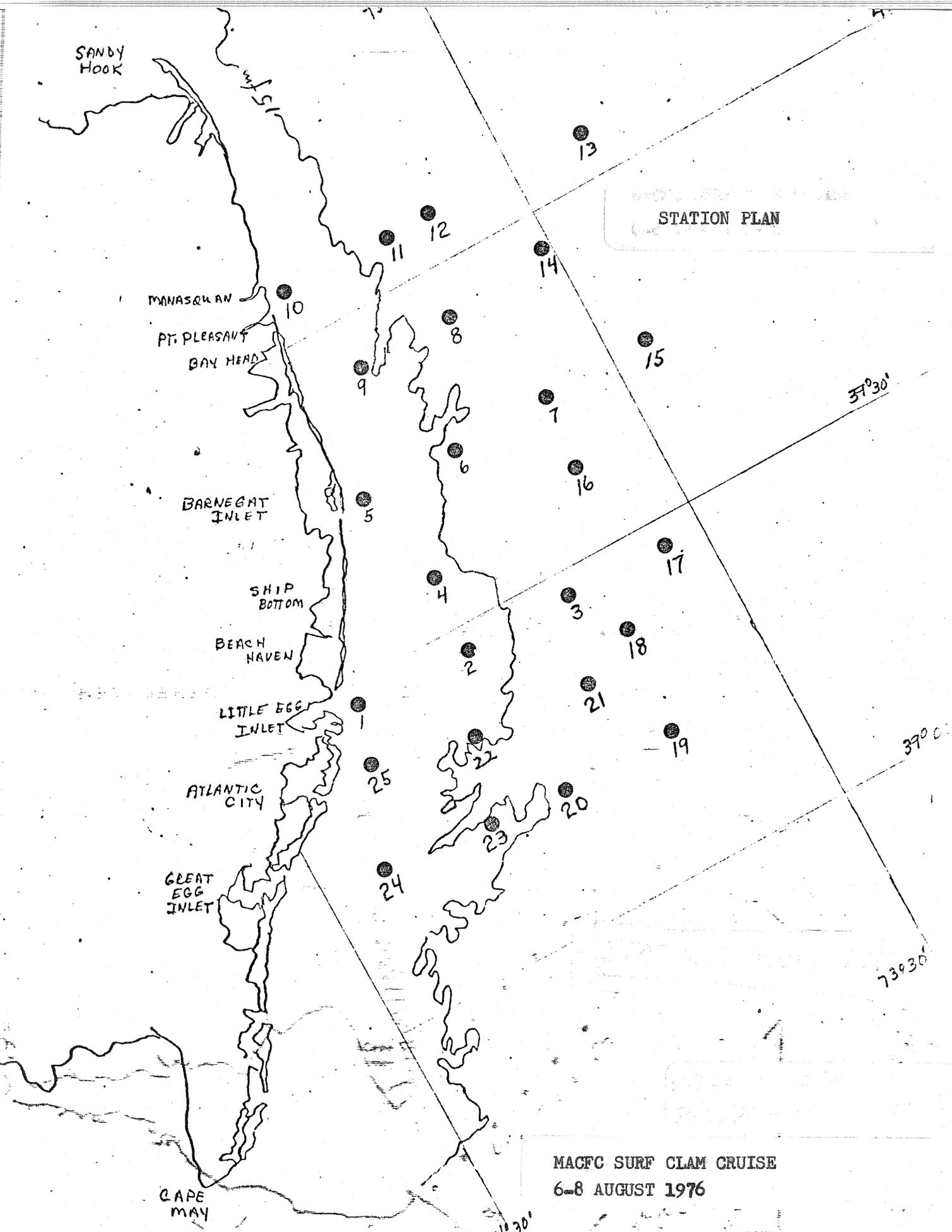
37°00'

73°30'

MACFC SURF CLAM CRUISE

6-8 AUGUST 1976

74°30'
(8)



Task No. 6 Contaminants in Organisms
(In Cooperation With
the Southeast Utilization Research Center)

The National Marine Fisheries Service, through its Southeast Utilization Research Center (SURC) and its Middle Atlantic Coastal Fisheries Center (MACFC) has carried out an extensive analytical program concerned with heavy metal contaminants in fish and shellfish; SURC studies emphasized the public health hazard aspects of the studies while MACFC was concerned with the effects upon the resource per se. The two bodies of data, consolidated and interpreted as to socio-economic and biological implications, will form a valuable adjunct to the MESA-generated data bank, will contribute to an understanding of the transport of metals through the food web and will make possible comparisons between the metals body burden of fish and shellfish of the New York Bight and those of the same or similar species elsewhere.

The Southeast Utilization Research Center (SURC) has carried out an extensive nation-wide analytical program concerned with heavy metal contaminants in fish and shellfish. Much of this work is approaching completion. Additionally, the Middle Atlantic Coastal Fisheries Center (MACFC) has carried out heavy metal analyses of selected fish and shellfish species from the Middle Atlantic Bight.

As part of the baseline information for the New York Bight, there would appear to be significant benefits derived from an early assemblage of data, together with an interpretation of the significance of the findings in the New York Bight. Since the data were gathered for other purposes, and cover a broad geographic area, some additional support would be required to carry out the specific manipulations and interpretations required, but not for actual analyses of samples -- which have been completed. Our joint proposal emphasizes use of existing but largely unassembled data, to be assembled and interpreted in the following sequence (assuming a funding date of July 1976).

- (1) Preparation by SURC of data report on some 15 heavy metals in fish and shellfish sampled in the New York Bight and adjacent waters. An estimated 470 samples from the New York Bight are available, with additional data from contiguous areas.

Completion Date: October, 1976.

- (2) Preparation by MACFC of a data report on some 8 heavy metals in fish and shellfish sampled in the New York Bight and adjacent waters. Additionally, we possess a large quantity of data, taken under controlled conditions, on the physiological effects (acute, static; and sub-acute, flow-through, long-term) of metals (plus salinities and temperatures) upon marine organisms. These physiological effects data will also be included in the MACFC data reports. An estimated 500 samples are available.

Completion Date: November, 1976.

(3) Joint preparation of a combined interpretive report utilizing data from (1) and (2) as well as other data either published or in press, discussing differences in levels (if any) among species, among species groups with different habitat or food preferences, among fish of different size groups, in geographic areas within and adjacent to the Bight. A study will be made of the reproducibility of our metals analyses by two different systems: (a) Atomic Absorption Spectrometry and by Neutron Activation Analysis, and (b) by replication of samples (up to 200 samples per station).

Estimated Completion Date: March, 1976.

(4) Master tapes in MESA/NODC formats, corresponding to data from (1) and (2) to be provided for archiving purposes. This work is logically the first or baseline phase of a longer-term study of the reasons for any observed differences in contaminant levels in fish and shellfish of the Bight and adjacent waters. The longer-term study would examine trophic levels and the cycling of contaminants through such trophic levels in the New York Bight and adjacent waters. Such studies will be initiated, on a reconnaissance basis, during MACFC's Operation "Spike" (Special Program In Key Environments) during August, 1976.

The four work products, outlined above, involve the preparation and submission of (1) two data reports, (2) one interpretive narrative report, and (3) two master tapes. The MACFC data report will include metals concentrations in shellfish taken from 240 stations covering the Middle Atlantic Bight from Block Island to Cape Hatteras and from the shoreline to the forty-fathom line. These shellfish data will serve three purposes: (1) to document "baseline" metals concentrations for relatively long-lived non-motile "indicator" organisms over a vast expanse of the coastal waters of the Atlantic Ocean, (2) permit comparisons as to relative quantities of metals in the shellfish of the New York Bight/New York Bight Apex and in the remainder of the Middle Atlantic Bight, (3) permit an evaluation of the degree of health hazard implicit in the consumption of shellfish taken in any of the offshore waters of the two Bights. These data, such as LC_{50} values for up to 11 metals for embryos, larvae and adults of oysters and hard clams, and the effects of metals upon osmoregulation, oxygen consumption, respiration rates, gross pathology, etc., of marine organisms will be used in the interpretive report.

BUDGET

<u>SURC</u>	<u>FY'76T</u>	<u>FY'77 (6 mos.)</u>
Personal Services Chemist, GS-13	\$1.0K	\$5.1K
ADP	2.0	8.0
Miscellaneous Support	<u>2.0</u>	<u>6.9</u>
TOTAL	\$5.0K	\$20.0K
<u>MACFC</u>		
Personal Services Fishery Biologist, GS-15 Chemist, GS-12	\$1.1K	\$6.6K
ADP	2.0	6.3
Miscellaneous Support	<u>1.9</u>	<u>7.1</u>
TOTAL	\$5.0K	\$20.0K

III. Budget Allocation

It is our understanding that MESA funds transferred to MACFC for use in FY 1976T are to be allocated to specific tasks as shown below:

Mutagenesis (Dr. Longwell)	\$ 37K
Abnormalities in fish and shellfish (Drs. Murchelano and Sawyer).	24K
Carbon/Oxygen/Nitrogen Cycling (Dr. Thomas)	20K
Benthic Macroinvertebrate Distribution and Abundance (Drs. Pearce and McNulty)	12K
Groundfish distribution and abundance in relation to pollution (Dr. Merrill)	10K
Contaminants in organisms (in cooperation with the Southeast Utilization Research Center) (Dr. Pearce)	5K