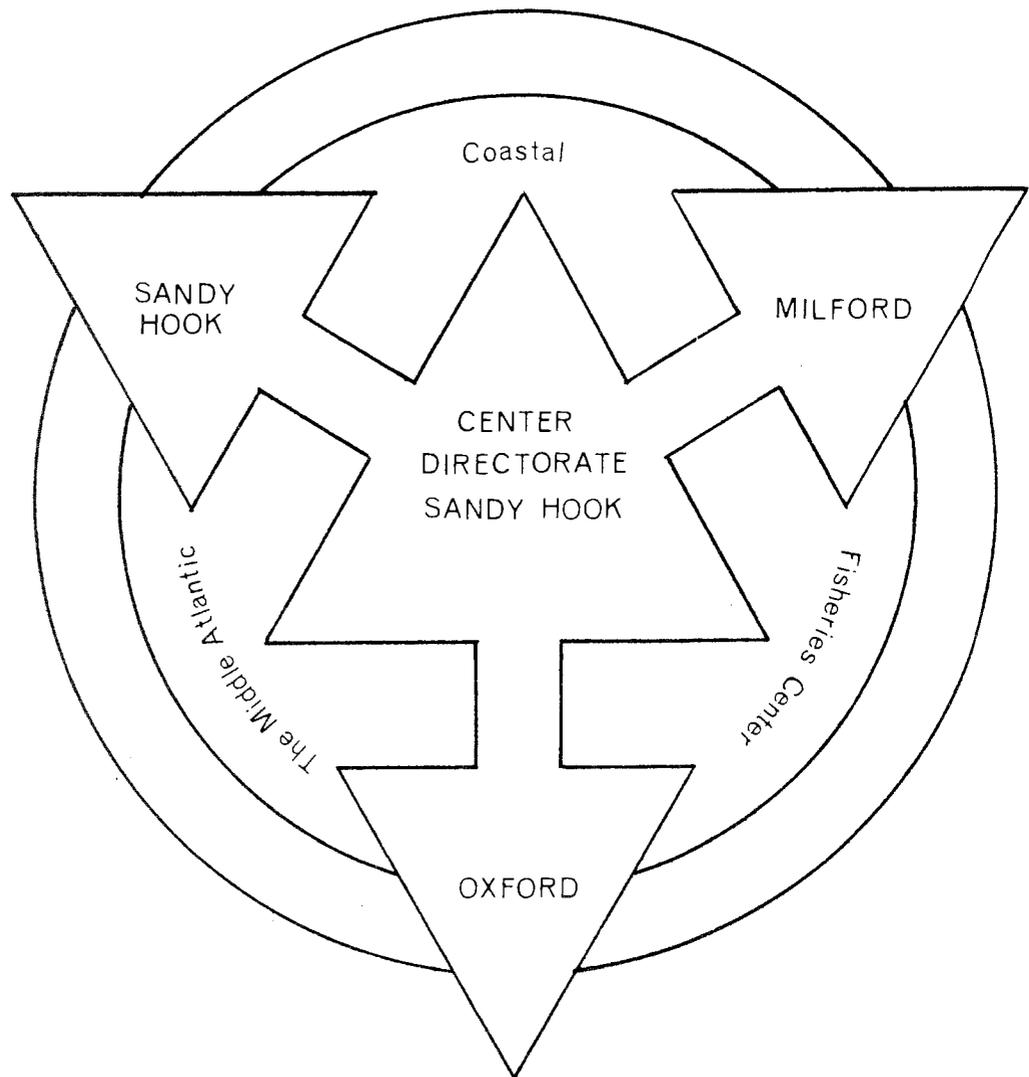


SYNOPSIS -- MIDDLE ATLANTIC COASTAL FISHERIES CENTER
OPERATING PLAN FOR BIOLOGICAL STUDIES OF THE NEW
YORK BIGHT DURING FY 1973



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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Prepared for NCAA-MESA
New York Bight Project
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I- Introduction

This synopsis is designed to make clear the ongoing New York Bight research of the Middle Atlantic Coastal Fisheries Center, and to suggest those areas which might be augmented by MESA-funded university research. It summarizes material presented in greater detail in a two-volume document titled "Biological baselines and effects of environmental changes on marine organisms" -- which is a preliminary presentation of this Center's ongoing and planned research activities in the New York Bight for the remainder of FY 1973 and for FY 1974. A more detailed longer term document will be available on July 1, 1973.

I-A. Description of the New York Bight

The New York Bight system, as we define it for biological purposes, includes the Atlantic continental shelf area from Montauk Point, N. Y. to Cape May, N. J. -- including the lower Hudson estuary, Raritan Bay, and Long Island Sound. The apex area of the Bight has received and will receive greatest attention; this is the area internal to the rectangle formed by two intersecting lines drawn along the meridians longitude 73°11'N and latitude 40°8'N. The inner reaches of the Bight are among the most degraded waters on this planet, yet such waters are still heavily used for sport fishing and some commercial fishing. Heavy industry and heavy ship traffic characterize the apex area, and the human population on its shores includes some 11 million.

I-B. Available Biological Information about the Bight

A number of independent studies of the Bight and its resources have been carried out since the 1940's. These studies have provided fragments of information useful to an overall understanding of the area as a productive system. Thus some information is available on hydrography, and on effects of ocean disposal of wastes. The most extensive work was carried out by the then Sandy Hook Marine Laboratory (now a component of this Center) from 1968 to 1972 under contract with the Corps of Engineers. A number of universities, such as CUNY and Stony Brook have carried out specialized studies, usually because of the particular interest of individual faculty members, or the availability of Corps of Engineers funding.

Much of the recent data has not reached the stages of formal publication; and many of the samples collected have not yet been completely analyzed (or even partially analyzed in some instances). These samples must constitute an immediate focus of any expanded research efforts in the Bight, as must efforts to analyze and publish information from completed studies.

The MACFC-assigned relative priorities for MESA funding of the contract research proposals listed herein are based on recognition of these needs.

I-C. Activities of Other Research Groups in the New York Bight

A great number of state, federal, industry, university, and college consortium groups are actively talking about studies in the Bight; far fewer are actively working in the Bight. Power companies are paying for usually localized studies concerned with sites for future generating stations, or concerned with problems at existing stations -- such as fish kills. The Corps of Engineers has supported, but is not now supporting, several studies, including the Sandy Hook study referred to earlier. EPA carried out an earlier study in Raritan Bay, and has reactivated some effort there. FDA carries out periodic surveys of coliform levels in water, sediments and surf clams. Stony Brook and the University of Connecticut are carrying out studies of fish resources and physical-geological oceanography respectively under Sea Grant funding.

A number of university faculty members are carrying on small scale projects, usually with minimal or no outside funding. Several of these are looking to MESA funds to expand their research.

I-D. Critical Issues in the New York Bight

The following questions, explicitly defining the types of studies necessary for resource conservation, restoration of marine environmental quality and decision-making on the New York Bight, include research areas outside the fields of expertise available to the MACFC and also areas of biological research for which available knowledge does not, at this time, permit formulation of the necessary hypotheses and related crucial experiments. Thus, we have assumed that answers

to the Question I (and sub-questions) will be developed by NOS geochemists and AOML oceanographers. The Center during fiscal '73 and '74 has underway or will initiate studies designed to supply answers to Questions II-B (and sub-questions), II-C (and sub-questions) and II-H. Questions II-D, II-E, II-F and II-G will be handled in the longer-term document now planned for submission by July 1, 1973. Question II-A (and sub-questions) will be answered largely through continuing inter-agency collaborative research and surveys with the U. S. Food and Drug Administration (surveys of the bacterial purity of shellfish-growing waters), with National Institute of Health (neoplasias and viruses in fish and shellfish) and with the Environmental Protection Agency (water quality standards, etc.). The Center will, of course, furnish logistic support to these and other MESA-cooperators to the extent possible.

1. Fate of sewage sludge and contaminated dredging spoils:

A. To answer the basic dynamic question, "are sludge and spoils beds growing, moving or static" we must:

(1) map existing sludge and spoil beds; consider three dimensions:

- a. this will require a very precise navigational system;
- b. will require intensive coring program based on sampling stations established in earlier investigations^{1/};
- c. periodically repeat mapping program to determine spatial sediments be resuspended?
- d. under what conditions will sludge and spoil contaminated sediments be resuspended?

1/ Corps Study, AOML - Adelphi Geology

- (2) make temporal physical measurements of water movements, including entrained sludge and spoils.
 - a. does sludge or spoils reach the shorelines of N. Y. and N. J. when entrained in normal currents: do these wastes move into Raritan Bay or down Hudson Shelf Valley?
 - b. are entrained wastes or deposited wastes carried ashore during unusual sea conditions such as hurricanes and major low pressure systems?
 - c. if wastes do move shoreward, what is the frequency and magnitude of wastes impinging upon coastal areas?
 - d. what is the physical condition (size, color, smell) of the wastes if and when they reach shore, i. e., are they so dispersed as not to be visually recognizable and not insulting to the aesthetics of the public?
- (3) determine if "short dumping" obfuscates efforts of sludge and spoil movement due to currents and storm waves?

B. What is the magnitude of the physical effects of wastes from other sources (Hudson River - Raritan Bay outflow and coastal sewage outfalls) relative to ocean disposed of sludge and spoils? Does any one system dominate or mask the others?

2. Effects of sewage sludges, contaminated dredging spoils and acid wastes on biological and chemical systems.

A. Public health effects:

- (1) impact on body contact recreation? swimming, SCUBA, etc.;
- (2) what are effects of consuming shellfish and finfish which habituate Bight waters? food chain contamination with toxicants or pathogens - are seafood fit to eat?

(3) aerosol effects:

- a. can salt-spray aerosols function as disease vectors?
- b. do contaminated salt sprays have an effect on people which habituate the coastal zone?

B. Effects on living marine resources:

- (1) document unequivocally the effects of ocean disposal on marine fishes, shellfish and forage or food chain organisms; emphasize those species which are commercially valuable or of ecological significance.
 - a. based on maps and other data collected during previous investigations and on new field studies, determine the effects of our disposal of spoils, sludges, and acid wastes on benthic and demersal macrofaunal, meiofaunal, microfaunal diversity, abundance and distribution.
 - c. what is the value of the extant indigenous communities versus the communities which would replace them if disposal activities are ceased or increased?
 - d. what are the short and long range effects of disposal activities on migratory finfish and shellfish or larvae which may move across the resulting sludge spoils beds or through contaminated water columns?
 - 1) what is the fate of pathogenic microorganisms associated with sludges and spoils?
 - 2) do they survive to infect fish and shellfish?
 - 3) do migrating finfish and shellfish function as vectors to carry disease to other, as yet uncontaminated, areas?
 - 4) which of the pathogenic microorganisms have the potential for the greatest deleterious effects and can these be controlled or eliminated at their sources?

does their virulence vary seasonably and should this be considered when regulating disposal activities and managing and harvesting living resources?

- 5) what are the species and quantities of waste materials entering the New York Bight? and how do they vary seasonally?

how are they partitioned between the water column and sediment?

which are bound to organics and geological fines and therefore not directly available to certain feeding types?

which are the most deleterious in terms of both toxicity and volume?

what are the short and long term effects of these materials and living marine resources, i. e., how do they affect reproduction, growth, mortality, predisposition to disease, physiology (enzymes systems, etc.), irritability, behavior and survival of the individual or population within the circumscribed ecosystem?

what is the ultimate importance of these effects to man and his well-being?

- e. are increases in plankton blooms and "red tides" related to ocean disposal activities in the Bight.

C. Forecast beneficial and deleterious effects of continued and/or increased waste disposal activities:

- (1) based on known extent of sludge and spoils beds (see I-A.1) and considering the net input of organic wastes into a circumscribed system, and the rate of physical removal of wastes from the system (see I-A.d; and I-A.2a), measure the rate of inside decomposition to determine:

- (1) is the disposal area impacted upon able to accommodate these wastes without unacceptable damage to the ecosystem?
 - (2) if it is unable to accommodate the present level of disposal activities, at what rate are the organics accumulating and what are the resultant effects, i. e., reduced dissolved oxygen, increase in heavy metals, etc.?
 - (3) what levels of organic input can the system accommodate without deleterious effects to the circumscribed ecosystem at each season?
 - (4) if disposal activities are terminated, decreased or shifted in location, what period of time is required for the sediments to return to a homeostatic condition capable of accommodating predictable, but as yet unknown, inputs of organic matter without any intervention?
- D. If present disposal activities are continued or increased, can the deleterious effects be ameliorated? if so, how?
- E. If present disposal activities are decreased, discontinued or shifted in location can the rate of recovery be hastened by man's intervention? if so, how?
- F. Should alternative disposal sites exist which could be utilized with less deleterious effects on coastal ecosystems?
- G. Should consideration be given to locating or expediting activities which would disrupt contaminated bottom sediments or sludge beds?

If bottom sediments within the disposal areas are removed or covered or built upon, what could be the effects on the water column, its physical characteristics, and associated or entrained organisms?

- H. What is the offshore extent of the effects of present ocean disposal activities in the Bight?

II-A. Objectives and Approaches

The overall objective of MACFC New York Bight research is to develop information which will enable assessment and prediction of the impact of man-induced environmental changes on marine ecosystems and on the living marine resources of the New York Bight. This information is to be of immediate value to user groups and environmental managers. General approaches include:

1. describe and map the present levels of principal pollutants and pathogens in water, sediments, and living organisms;
2. determine and map present distribution and abundance of resource and food chain organisms; and determine rates of change in populations by analysis of existing historical data, as well as data obtained by ongoing and planned surveys;
3. determine by controlled laboratory experiments the effects of pollutants at several concentrations on living resources, at many stages in their life histories, and during various exposure times;
4. determine whether the circumscribed ecosystem is less than, is fully, or is more than fully saturated with organic wastes (i. e., community respiration is strongly aerobic, weakly aerobic or anaerobic in nature).
5. compile and compare all findings to develop correlations between incidence of environmental change and abundance and distribution of any or all living marine resources;
6. determine feasibility of (a) alternate dump sites, (b) accelerated rehabilitation of damaged marine environments, and (c) effects of continued or increased ocean dumping.

II-B. Field and Experimental Work Program: Ongoing or to be initiated

This synopsis recognizes that the basic bioecological information necessary to formulate research efforts designed to answer several of the questions listed in II-A, is not now available. In all probability, when submitted as part of the long-term MESA/MACFC program (July 1, 1973), the research efforts responsive to the cited questions will consist of several optional hypotheses, each of which will be tested on a pilot scale for feasibility and usefulness. This submission will also contain formal "milestones" and other instruments for evaluation of progress during fiscal '74 and beyond.

The following is a synopsis of how ongoing MESA-related MACFC research (when appropriately extended by MESA funding) can be utilized to answer questions 2.B, 2.C, and 2.H, and of our present thinking as to the questions 2.D, 2.E, 2.F and 2.G:

Question #	Comments	Needs	Funds (in \$1,000's)
2. B	Ongoing MACFC research programs (if extended by MESA funds as proposed, will supply answers to all II-B sub-questions except:		
2. B. 1c	Still under study. Will submit proposal for fiscal '74.		
2. B. 1d(6a)	Previous attempts to obtain such detailed information have failed. Will continue collaborative efforts with EPA, Corps of Engineers and state authorities.		
2. B. 1d(6c)	Field studies data being collected is pertinent but application to this specific sub-question must await information from NOS geochemists.		
2. B. 1d(6d)	Field and laboratory data being collected is pertinent to toxicity but volume question must be resolved as in 2B. 1d(6a) above.		
		Vessel time: '73	\$ 50.0
		Contracts: '73	162.0
		Equipment: '73	96.7
2. C	Ongoing MACFC research programs designed to answer all 2. C sub-questions except 2. C. 4.		
2. C. 4	The answer to this important question must await inception of proposed '74 community respiration (redox) studies and specific microbiological field studies		
		Equipment: '73	51.7
2. D.	This question is still under study. Will require information on present redox climate of dumping areas as well as investigation of feasibility of enforcement of a highly selective system of wastes acceptable for marine disposal.		

Question #	Comments	Needs	Funds (in \$1,000's)
2. E.	Question of man-accelerated rehabilitation of no-longer-used marine dump sites has had much study here. Long-term research document (to be submitted on July 1, 1973) will contain proposal for rehabilitation through use of strategically placed artificial reefs.		
2. F.	Alternative dump sites. Current thinking is that (1) off-shelf dumping would quickly overload the marine environment, (2) alternate "onshore" sites fraught with socio-economic, political and biological problems, and (3) planned enrichment-type dumping is probably prohibitively expensive. This item is under study in cooperation with EPA. Will report on outcome.		
2. G.	Current field studies will yield answers (chemical, microbiological and biological) as to offshore extent of effects of present ocean disposal system.		

The above summation with respect to needs for MESA-funding assistance is designed through contract research to (1) expand our ability to sort, identify and enumerate all harvested marine organisms as rapidly as is feasible, (2) extend the capacity of chemists to handle rapidly the large and growing analytical workload, (3) improve our statistical and historic data files on the living marine resources of the Bight, (4) provide comprehensive information on sediments (charts and composition) for mapping purposes, (5) extend our in-house capability to analyze indicator-species, and (6) provide support to our in-house microbiological staff. It is anticipated that our July long-term research program will provide for a significant increase in contract research. We propose, therefore, that the requested '73 equipment purchase funds be made available to facilitate initiation of new and necessary in-house field-oriented studies in '74, thereby releasing these funds for contractual or other use in fiscal '74.

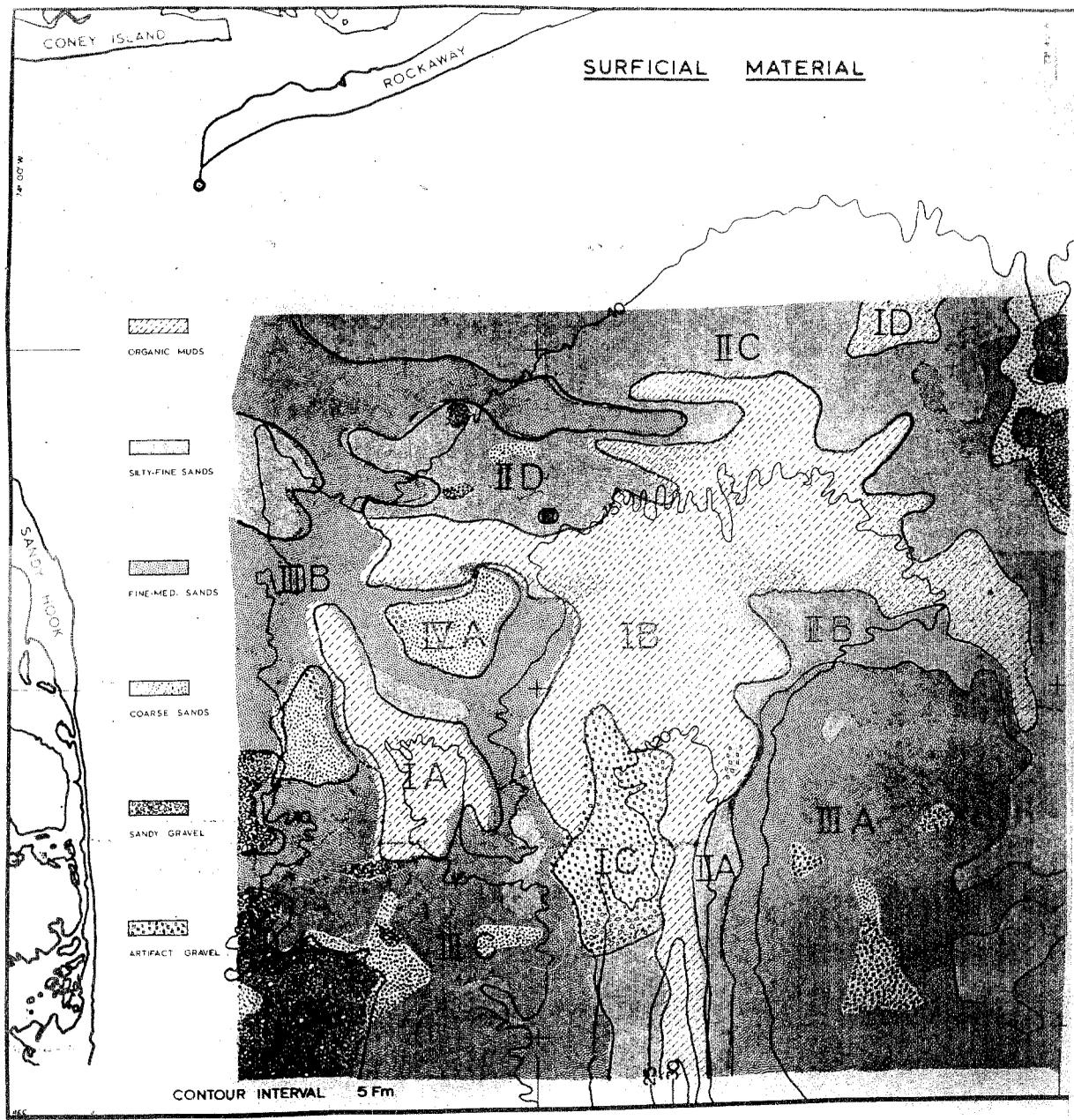
II-C. Statistical Design and Levels of Statistical Analysis

Detailed discussions and workshops, involving numerous marine ecologists and biometricians, have resulted in the conclusion that no sampling program can be established to ensure statistically valid results unless the area to be studied has previously been sampled to determine sample variance for each subarea. Since numerous samples from the Bight already exist from previous Sandy Hook studies, these are being examined to determine sample variance. Some subareas are not well represented and special sampling will be undertaken in FY 1973 to determine sample variance for these areas. Data from existing and acquired samples will be used to develop sampling strata for determining the placement and number of samples to be taken for statistically valid results (Figure 1).

Resource assessment work on finfish by the Middle Atlantic Coastal Fisheries Center involves trawl surveys at stations based on a stratified random sampling scheme, considering depth strata and geographic area encompassed by each stratum. A similar random stratified plan will be used in station selection for benthic organisms, utilizing already determined geologic strata (Figure 1) weighted by area encompassed by each stratum. Stations will be sampled quarterly, with 5 replicates per station (this number is based on preliminary analysis of station data and review of published literature on comparable studies).

The general plan, then, is to (1) determine sample variability at selected stations, (2) determine sample variability within geologic zones, (3) establish sampling stations within each geologic zone, (4) sample quarterly, (5) analyze samples for seasonal and geographic changes in abundance and distribution of benthic species, (6) examine for correlations with sediment types and other indicators of degree of environmental degradation (heavy metals, coliforms, etc.).

The data should lend themselves readily to computerized statistical analyses for validity, relationships, and correlations.



II-D. SPECIFIC IN-HOUSE MACFC PROGRAM RELATED TO THE NEW YORK BIGHT

To make the ongoing research of MACFC which is concerned with the New York Bight as clear as possible, we have subdivided the description into three categories:

- Category 1. To be completed by July 1, with data available.
- Category 2. To be started or continued in FY 1973 but no prospect of completion by July 1, 1973.
- Category 3. To be started after July 1, 1973.

It should be perfectly clear that this description concerns work to be done with existing base funding and staff, insofar as we can predict these at present. We have already been informed of recent actions -- withdrawal of funds, reduction in travel, tight ceiling control, lay-up of the Delaware II -- all of which make even the immediate future decidedly uncertain. It should be clear too that our basic mission concerns the living marine resources, and the environment which supports them.

II-D. Category 1 -- To be completed by July 1

Environmental microbiological studies during the remainder of FY 1973 will emphasize characterization of bacterial flora of Long Island Sound, and will result in a final report to the New England River Basins Commission on July 1, 1973.

Analysis of heavy metals in sediments and nutrients in the water column of Long Island Sound will also be completed and available by July 1, 1973. These data will also be available as symap presentations. Fin rot disease study of the New York Bight area will be directed to surveillance of prevalence as well as identification of the bacterial isolates obtained. Results of previous work should be published in the July issue of the Transactions of the American Fisheries Society. An attempt will be made to verify if fin rot disease is restricted primarily to the heavily polluted marine waters of Raritan Bay and the inshore areas of the Bight. Abnormalities in crustacea have been observed, and may be related to increasing pollution levels. Two manuscripts have been completed and submitted for review -- one on abnormalities in crabs and lobsters, and one on small forage crustacea.

Several manuscripts dealing with acute toxicity of a number of heavy metals on oyster embryos will be available by July 1, 1973. Several specific studies of effects of cadmium will also be in manuscript stages by July 1, 1973. A manuscript on genetic effects on oyster embryos produced by several heavy metals will also be available by July 1, 1973.

II-D. Category 2 -- To be started or continued in FY 1973, but no prospect of completion by July 1, 1973

Sampling program with the Smith Mc-Intyre grab for benthic infauna will be initiated in FY 1973. Samples will be collected at stations positioned within a stratified sampling scheme (See Figure 1). During the remainder of FY '73 we will concentrate our sampling in the apex of the Bight, i.e., in and around the dredging spoils, sewage sludge and industrial waste disposal areas, and within the upper reaches of the Hudson Shelf Valley. This sampling will augment that carried out in the Bight since 1968.

Samples of benthic macrofauna will be processed and analyzed as rapidly as existing personnel limits will permit. The processing of the samples (which will begin in FY 1973 and extend into FY 1975) will result in species lists, species distribution maps, diversity indices, biomass estimates, comparative data from impacted and non-impacted areas, community phenomena associated with different impact areas, and specimens for heavy metals, pesticides and PCB analyses.

At each benthic station, sediment cores (10-15 cm in length) will also be taken for eventual analysis for heavy metals, pesticides, PCB's, organic content, redox potential, and grain size distribution.

Surveillance and determination of nutritive requirements of phytoplankters involved in red tide problems of the New York Bight will continue. In addition, red tide blooms occurring in the New York Bight will be monitored for toxicity.

Research is now being conducted by NMFS-MACFC at sewage sludge disposal sites off New York Harbor and dredge spoil disposal sites in the New York Bight and Long Island Sound. We have found high levels of contaminants in sediments at these sites. Assays are being made by the Environmental Microbiology and Chemistry Investigation, MACFC, for contaminants in whole organisms and in specific organs or tissues. Identical materials are also being examined for pathogens and pathological conditions that might be associated with or result from contaminants. Exposure to chronic levels of specific toxic heavy metals have resulted in detectable tissue damage.

Physiology: MACFC research in FY 1973 is designed to determine changes in osmoregulation of rock crabs, Cancer irroratus, and green crabs, Carcinus maenas, when exposed to heavy metals (copper and cadmium), and changes in oxygen consumption rates of gill tissues from these organisms after exposure. This work will be continued, possibly including other metals, and will also assess changes in the osmoregulation of the cunner, Tautogolabrus adspersus.

Enzymology. In FY 1973 selected tissues of target animals (crustaceans, finfish, and shellfish) are being examined, and normal patterns, both enzymographic and spectrokinetic, have been established for selected enzymes. In vitro and in vivo work with the pollutant metals, to determine their direct effect upon enzyme reactivities, will be initiated.

Immunology. In FY 1973 immunological study concerns antibody response in a finfish, the cunner, Tautogolabrus adspersus, exposed to cadmium, and projected work will include several other heavy metals.

Histopathology. In FY 1973 histopathological examination of organs and tissues from selected invertebrate marine organisms from relatively uncontaminated areas of the New York Bight will be used to establish "normal" or baseline morphology and physiology. Animals can then be challenged with known toxic agents to determine sites or localization of pathology, types and severity of host response, micropathogen development, mechanisms of disease resistance, and disruption of tissue and cellular integrity. Also in FY 1973 tissues from fish exposed experimentally to cadmium will be examined for histopathology.

II-D. Category 3 -- To be started after July 1, 1973

An investigation of seabed oxygen consumption will be made to measure and map the present rates of in situ decomposition of organic wastes occurring as a result of biological and non-biological processes. From this, and additional information concerning the extent of organic wastes in the Bight and the rates of input and export by physical means, the following can be determined: 1) the rate at which organic wastes are accumulating or disappearing in certain areas; 2) the quantity of organic input the various areas of the New York Bight can accommodate without deleterious effects to the living marine resources; and 3) the time required for the sediments to return to a homeostatic condition capable of accommodating predictable, but as yet unknown, quantities of organic matter. It is essential that baselines of decomposition rates be mapped to monitor the spread of pollutants in the future and to provide policy makers with usable information on quantities of organic matter that delineated areas of the Bight could accommodate temporarily without deleterious effects.

Inshore surf clam surveys, begun on the New Jersey coast in 1972, will be extended along the south coast of Long Island and the Delmarva coast in 1973, in cooperation with the various states. As with the New Jersey survey, these surf clam surveys will include Smith-McIntyre grab sampling stations for sediments and benthos.

Hydraulic and scallop dredge tows of five minute duration will be made in areas bounded by Smith-McIntyre sampling sites. An odometer attached to the dredge will measure the distance traveled and surface area sampled. The resulting samples will be sorted for benthic macrofauna and used to develop semi-quantitative data for the larger and rarer organisms not sampled by the Smith-McIntyre quantitative grab.

Demersal finfish will be collected by use of an otter trawl. Fifteen and thirty-minute tows with a standard 30/60 trawl will be made monthly at 20 selected stations located in sampling strata within the Bight, principally in the strata inside the disposal areas but also at control station. Fish will be identified, measured, weighed, and examined for gross pathology on board ship. Selected species (particularly winter flounder, Pseudopleuronectes americanus; yellowtail flounder, Limanda ferruginea; silver hake, Merluccius bilinearis; red hake, Urophycis chuss; white perch, Morone americanus; and striped bass, Morone saxatilis) will be saved for stomach content analysis and pollutant content.

Collections of the larger malacostracan Crustacea will be made in conjunction with the otter trawl collections. A one-half meter and one-meter epibenthic sled fitted with a #0 mesh net will be mounted on the sweep of the otter trawl. The samples will be split and one-half frozen for contaminant analysis and one-half preserved for faunal enumeration and identification in the laboratory. The samples will be used for species distribution, community structure and relationships, relationship of animals present to fish stomach content, biomass estimates, food chain pathways, contaminant levels and incidence of disease. The schedule will be the same as the finfish program and the collections made simultaneously.

Zooplankton collections will be made simultaneously with the finfish and malacostracan collections made with an otter trawl. "Bongo" nets fitted with #2 and #10 mesh net will be hauled obliquely during the otter trawl tow. The plankton samples will be split, with half frozen for contaminant analysis and half preserved for species enumeration.

Investigations of the Hudson Shelf Valley will be instituted in FY 1974. The basic sampling program will be similar to the apex surveys in and around the disposal areas, except that sampling will be much less intensive in the offshore regions of the Canyon. Benthic sampling will be on a grid pattern in these areas. This sampling system was selected on the basis of inadequacies of a previous survey and in consideration of the finite limits of MESA funds, manpower, and time. It is felt that the grid can give gross changes in communities never before established in the New York Bight and in the Hudson Shelf Valley in particular.

A more intensive survey to determine the levels of heavy metals; hydrocarbons, including petrochemicals and chlorinated hydrocarbons; and radionuclides in marine organisms and the surrounding environment will be undertaken in New York Bight, Long Island Sound, and ancillary embayments. In addition to the small number of selected target species currently being examined, the MESA contaminants survey must establish contaminant levels throughout the entire food web, i.e., the microflora and fauna, attached algae, benthic organisms, primary consumers, and carnivores at higher trophic levels, as well as in water and sediments of the area.

The initial phase of the survey will include the analysis of tissues and sediments collected in Long Island Sound, the New York Bight, and Raritan Bay during the second half of FY '73. These materials were collected during cruises initiated by the NMFS-MACFC.

Physiological Experiments beginning in FY 1974 will determine changes in osmoregulation of other marine organisms. Experiments with stressed animals will be expanded to include polarographic measurements of large animals as well as an expansion of present microrespirometry techniques. Respiration rates of crabs, fish, and mollusks will be determined in vivo during exposure to heavy metals.

In FY 1974, Enzymological work will concentrate upon in vivo studies, beginning with acute exposure of the target animals to a range of concentrations of selected heavy metals and progressing to a study of synergistic effects of several metals. The main objects of scrutiny in FY 1974 will be the polymorphic enzymes, whose enzymographic profiles may alter as the animal adapts to its changing environment.

In FY 1974, immune responses in fish will be examined in the presence of other heavy metals (copper, mercury) and, if possible, two chlorinated hydrocarbons (one pesticide and one PCB).

In FY 1974, tissues from fish exposed experimentally to metals other than cadmium will be examined histopathologically and a study of tumors and other lesions which may be associated with high pollutant levels will be initiated.

II-E. POTENTIAL CONTRACT RESEARCH INPUT

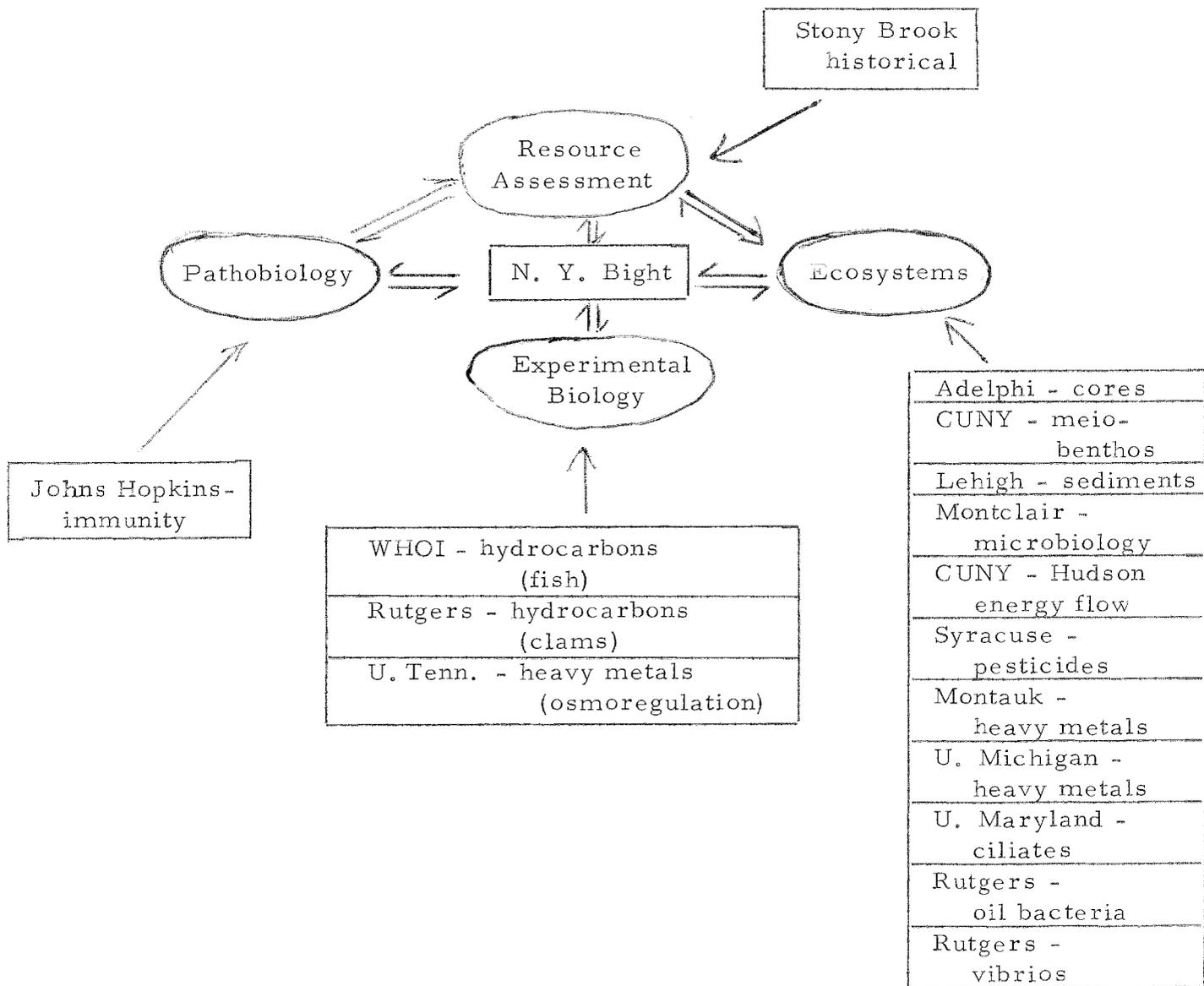
Early in FY 1973 research contract proposals were received from a number of university and other groups. The objective was to materially augment in-house research on the New York Bight by the Middle Atlantic Coastal Fisheries Center. The proposals received are listed on the following pages. They do not necessarily indicate all of the areas where contract support would be desirable, and we might not wish to fund all those that are listed. Areas where augmentation of our work is essential are: (1) Resource assessment, so that we may have a better understanding of the changes in fish and shellfish populations in the Bight during the past century, and so that we may be better able to predict future changes; (2) Chemical studies, particularly heavy metals, pesticides, and PCB's; Our in-house staff is too small to cover important aspects of the work adequately; (3) Sediment analysis, especially definition of sediment types and relation to faunal populations; (4) Meiofaunal studies, aimed particularly at biomass estimates and use of particular species as indicators of environmental degradation.

At present our in-house staffing in physiology and microbiology would indicate low priority for contracts in these areas.

Contracts which we would suggest for early implementation, because of direct relevance to ongoing work, or because they will make use of samples already collected include:

Stony Brook -- History of New York Bight Fisheries
CUNY -- meiobenthos
Adelphi and/or Lehigh -- sediments and cores.

POTENTIAL CONTRACT SUPPORT FOR
 MACFC IN-HOUSE RESEARCH
 IN THE NEW YORK BIGHT



Possible contract input to ongoing work of MACFC with MESA funds

1. Contract with J. L. McHugh of Stony Brook University for analysis of fisheries of the New York Bight.
2. Coring study with AOML, Adelphi University or Alpine Geophysical -- long cores for 3-dimensional mapping of sediments, and short cores for determinations of redox (in cooperation with Sandy Hook staff).
3. Studies by Dr. Tietjen, City University of New York, on meiobenthos from apex samples collected by Sandy Hook staff.
4. Studies by Dr. Parks, Lehigh University, on sediment types from apex samples collected by Sandy Hook staff. This would be alternative to #1.
5. Studies by Dr. Kodischek, Montclair State College, on genetic transfer from pollutant bacteria to marine microbial flora -- following up her very promising findings from contract research funded by FY 1972 contract with this Center.
6. Studies by WHOI on effects of hydrocarbons, including PCB's, on fish.
7. Studies by Dr. Sather, Rutgers University on effects of crude oil on the clam.
8. A study by Dr. Bang of Johns Hopkins University on effects of temperature on internal defenses of commercial mollusks.
9. A study by Dr. Malone, City University of New York on productivity and energy flow in the lower Hudson estuary.
10. A study by Dr. Sikka of Syracuse University on the fate of pesticides in the New York Bight.
11. A study by Dr. Alexander of the New York Ocean Science Laboratory on the distribution of heavy metals in fish and shellfish.
12. A continuing study by the University of Michigan of heavy metals in fish and shellfish. Continuation of Phoenix analytical contract for heavy metals.

13. A study by Dr. Vaughan of the University of Tennessee on the effects of heavy metals on salinity adaptation of anadromous fish.
14. A study by Dr. Small of the University of Maryland on use of ciliates as indicators of environmental degradation.
15. A study by Dr. Atlas of Rutgers University on oil degrading bacteria in the New York Bight.
16. A study by Dr. Litchfield of Rutgers University on the role of marine vibrios in contaminated areas of the New York Bight.

II-F. What MACFC could do with additional funding

1. Purchase RADUS system or equivalent for precision navigation and location of sampling stations -- or as an alternative develop a system of buoys at key stations.
2. Accelerate workup of benthic samples from apex area by supporting ongoing Northeastern work study group now concentrating on Long Island Sound samples.
3. Support contract for sorting benthic and other samples with Monmouth College -- with work to be done at the Sandy Hook Laboratory.
4. Support development of ADP format for all MESA biological data.
5. Purchase equipment for early implementation of redox work on sediment cores.
6. Support development of water treatment system for long-term chronic exposure work at Milford.
7. Support vessel costs and charter costs.
8. Support service contracts for contaminant chemical analysis of fish and shellfish, sediments, and water.

Figure 1. Distribution map of sediment types in the New York Bight

The strata designated by Roman numerals are based on sediment types defined by A. Cok (Adelphi U.) and D. Swift (NOAA-ACML). Where discontinuous, the strata subsets are indicated by a letter. Benthic fauna data collected at previously sampled stations within these strata are being analyzed to determine faunal homogeneity. Additional samples, usually in replicates of five, will be collected at stations within the strata to confirm homogeneity. Random stations within strata will be resampled quarterly during FY 73-74 to assess seasonal change and variations resulting from pollutant-induced stress. Ambrose Light indicated by ☉

Compiled by Dr. A. Cok, Adelphi University, and D. Swift, AOML, Miami, unpubl.

