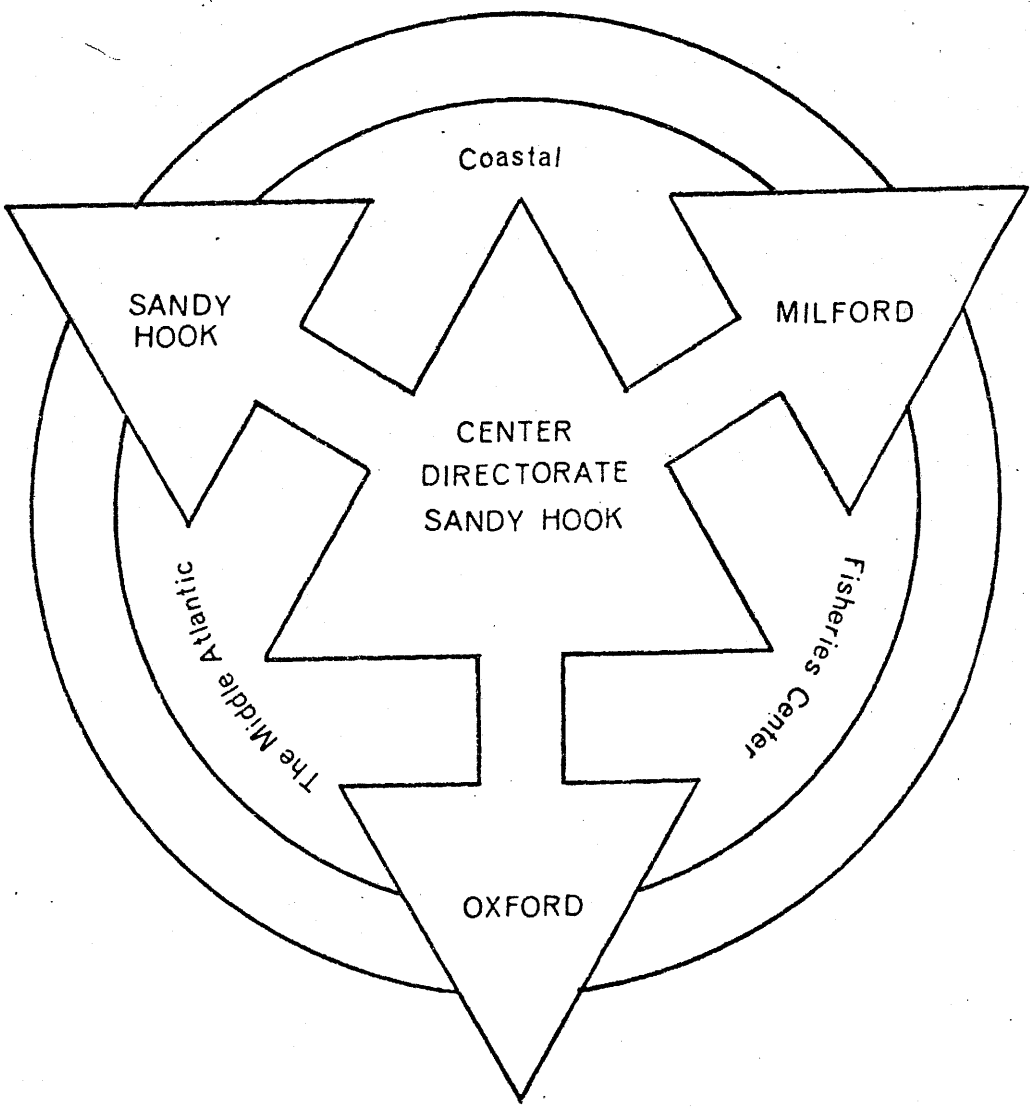
PRELIMINARY PROPOSAL
BLM - OCS GEORGES BANK STUDIES

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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PRELIMINARY PROPOSAL

GEORGES BANK BLM/OCS STUDY
Selected Biological Studies of the Georges Bank Area

Middle Atlantic Coastal Fisheries Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
Highlands, New Jersey 07732

TABLE OF CONTENTS

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SELECTED BIOLOGICAL STUDIES OF THE GEORGES BANK AREA

I. Introduction

Our national recognition of the extremely adverse socio-economic impacts of the recently developed but increasing constraints upon our supplies of inexpensive liquid fossil fuels has generated an enormous pressure to develop alternative energy sources or to develop to the utmost all domestic sources of liquid fossil fuels. This latter effort has led to a greatly increased interest in the development and utilization of offshore oil resources. Among such resources are those thought to exist beneath the oceanic waters of Georges Bank. This area, organized and managed by the Federal Government's Bureau of Land Management (BLM) is being offered to entrepreneurs, on a lease basis, for development. An ancillary and continuing responsibility developing upon BLM is that of protecting the quality of the oceanic waters, and habitat, the health of the indigenous living marine resources and aesthetic appeal of the contingent shoreline. A prerequisite for such protective activities is the attainment of pre-drilling baselines as to the present quality of the marine environment and of the indigenous marine resources. The Middle Atlantic Coastal Fisheries Center, NOAA, is, by virtue of its history of resource-and habitat-oriented research, uniquely fitted for participation in the necessary research.

II. Structure of Proposal

The proposal, involving several disciplines and structured around the particular competence of this Center is arranged in a series of three tasks:

(1) Pathological baselines in living resources of Georges Bank;
(2) Genetic (mutagenic) baselines in living resources of Georges Bank;
(3) Physiological effects of petroleum components on living resources.

It should be clearly understood that this is a preliminary proposal. Additional details will be supplied as needed.

III. Budget Summary

	FY/76	FY/77	FY/78
1. Pathological Baselines	$171.5	146.0	34.6
2. Mutagenesis	250.0	290.0	320.0
3. Physiological Effects	497.5	494.2	539.9
Totals	$919.0	$930.2	$894.5

EXPANDED WORK STATEMENT
GEORGES BANK BLM/OCS STUDY
Middle Atlantic Coastal Fisheries Center

PATHOLOGICAL BASELINES IN LIVING RESOURCES OF GEORGES BANK

A. INTRODUCTION

As petroleum exploration, drilling and production occur on the continental shelf, it is vitally important to have some means of detecting environmental changes (or "impacts") be they deleterious or beneficial. Among the most sensitive indices of deleterious environmental changes are abnormalities and disease among the biota. However, before changes can be evaluated, baseline information of conditions and the well-being of the resources prior to the new impacts must be at hand. Few diseases are known and few, if any, comprehensive surveys have been recorded for diseases of marine life of the outer continental shelf.

A major function of the Pathobiology Investigations of the Middle Atlantic Coastal Fisheries Center concerns the study, definition, and diagnosis of diseases of marine and estuarine fish and shellfish.

To establish adequate pathological baselines for fish and shellfish of Georges Bank, a study in two concurrent phases needs to be conducted.

PHASE I

The Middle Atlantic Coastal Fisheries Center will conduct a systematic and comprehensive survey of disease, abnormalities, and parasitemias now prevalent in the fish and shellfish of Georges Bank, and will continue such surveys during the first 3 years of drilling and recovery of fossil fuels which may be found in the target area.

PHASE II (concurrent)

The Middle Atlantic Coastal Fisheries Center will initiate a bibliographic search, compilation and documentation of diseases and abnormalities of animals that inhabit or migrate through the area of study. This information will be entered into the National Registry of Marine Pathology, maintained by the Center, to serve as a central reference collection for clinical, illustrative, and published material related to diseases of marine and estuarine vertebrate and invertebrate fishes.

While several institutions may have miscellaneous accessions related to pathology in marine animals, no central systematic repository or reference collection committed to this end exists, except the National Registry recently established by the Middle Atlantic Coastal Fisheries Center. The Registry can be of great utility in assessing any future deleterious effects of industrial activities on Georges Bank.

B. PROPOSED RESEARCH

PHASE I - Pathology Surveys

Emphasis will be placed on economically important species which, because of their numeric abundance in the study area, may be used to provide meaningful baseline information. The species of fish selected for examination are haddock, cod, hakes, scallops, lobsters, herring, flounders, and pollock.

All fish and shellfish selected are present in the study area throughout the year and can be sampled with an otter trawl or scallop dredge. Ten fish of each of the selected species (size determined from variance in catch) from each trawl station in the designated study areas will be obtained quarterly (spring, summer, fall, winter). Necropsies will be conducted on shipboard and tissues fixed in appropriate fixatives (10% seawater formalin, Davidsons, Bouins). Fish tissues to be examined are liver, epidermis (including underlying muscle), gill, gonad, olfactory epithelium and intestinal mucosa. Lobster tissues to be examined are hepatopancreas, gonad, antennal gland, and gill. All constituent tissues of the sea scallop can be examined by removing a diagonal section of tissue through the visceral mass. Subsequent to adequate fixation all tissues will be blocked in paraffin, sectioned at 6 um, and stained with hematoxylin and eosin. If required, special stains will be employed. A minimum of two slides will be prepared from each tissue block.

Employing this essentially observational approach, the normal histology and presence of microscopic parasites will be determined. Although the intent of these examinations is to establish histologic norms for the species selected, any apparent histopathology from infectious or non-infectious agents will be described. Photographic documentation of gross and microscopic observations and systematic cataloguing of tissue blocks and prepared slides will provide a valuable reference collection of normal histology. When deemed appropriate, histochemical techniques and electron microscopy will be utilized to augment light microscopic observations.

PHASE II - Historical Records of Diseases and Abnormalities

Several sources of information will be consulted and utilized for extraction, programming, and making entries into the Center's ADP system. These sources will include: 1) libraries of the Middle Atlantic Coastal Fisheries Center (Oxford, Sandy Hook, Milford); 2) National Library of Medicine; 3) Woods Hole Marine Biological Laboratory Library; 4) University Libraries of Johns Hopkins School of Medicine and School of Hygiene and Public Health, Georgetown; American, and George Washington Universities; 5) Federal and State Libraries, such as University of Maryland, Schools of Medicine, Pharmacy, Dentistry; Department of Interior, Library of Congress, Department of Agriculture; 6) Registries, such as those maintained by the Smithsonian Institution, Tumor Registry of Lower Animals, the Armed Forces Institute of Pathology, American Type Culture Collection, Department of Agriculture Animal Parasitological Laboratory; 7) additional information will be solicited from Federal and State marine research laboratories, fishery centers, etc., engaged in work related to parasitologic, microbiologic, and chemical and pollution effects on marine organisms, particularly on species that inhabit the area of concern.

Appropriate information will be extracted and entered onto computer cards using the Middle Atlantic Coastal Fisheries Center's ADP SELGEM automatic data processing system. The acquisition of references and other pertinent source materials (slides, blocks, photographs, etc.) and the extraction of information and its entry into the ADP system will be done on a daily basis for at least 1½ years beginning immediately on award of the Interagency Agreement, and continuing into Phase II thereon as pertinent information is available. Ultimately, this system will be integrated with the National Oceanographic Data Center and its subsidiary components ENDEX and OASIS for correlation and retrieval of information.

C. WORK PRODUCTS

1) A record of disease (infectious and non-infectious) and parasitemias affecting indigenous fishand shellfish of Georges Bank, as derived from historical reviews and surveys.

2) Descriptions of normal and abnormal cytology of selected species of fish and shellfish from Georges Bank.

D. BUDGET SUMMARY

Cost Item	FY'76	FY'77	FY'78
Direct labor	70.0	62.0	14.3
Supplies, Material, Travel	25.0	17.0	2.0
(Federal Contract) ADP Services	11.5	7.0	4.5
Support	65.0	60.0	13.8
Totals	171.5	146.0	34.6

EXPANDED WORK STATEMENT
GEORGES BANK BLM/OCS STUDY
Middle Atlantic Coastal Fisheries Center

MUTAGENIC EFFECTS OF PETROLEUM HYDROCARBONS ON MARINE FISH

A. INTRODUCTION

Some of the common marine contaminants, including certain petroleum components, are proved chemical mutagens. Through physiological and structural changes of the chromosomes with consequent disorderly distribution of the gene material in developing eggs, mutagens adversely affect zygote viability and embryo development. Fish eggs developing in polluted areas, will have their chromosomes and mitoses exposed during genetically sensitive and genetically critical stages of the second half of meiosis, fertilization, cleavage and embryo divisions to whatever such mutagenic contaminants have already been depositied in their cytoplasm and yolk. They will, in addition, be exposed to whatever contaminants or particular combinations of contaminants can enter through their egg membranes. Without many gross signs of damage through their action on the chromosomes and mitotic apparatus of developing eggs such mutagenic pollutants could affect the success of a commercial fish year class just as can adverse natural conditions.

Recent work at the Milford laboratory of the Middle Atlantic Coastal Fisheries Center has shown that silver and cadmium have chromosome breaking and general radiomimetic effects on the chromosomes and cell division apparatus of the oyster. This was true with both chronic and acute exposures. Damage was still detectable at doses well below those which fail to have a lethal effect on the first-stage larvae. Though only limited work has been done, it appears, on the basis of radiation research, that fish eggs are several orders more genetically sensitive than are eggs of invertebrates. Eggs of fish probably approach mammalian eggs in such sensitivity. Dominant lethal mutations induced in naked, unprotected pelagic fish eggs completing critical early cleavage divisions in a polluted environment could affect any spawning season's recruitment into the fisheries. Rarely should such eggs survive through the larval stages. Semi-dominant lethals could reduce vigor of the adult. Dominant lethal mutations are known to be accompanied by gross chromosome aberrations. Radiation and chemicals which break chromosomes very often induce a whole series of less specific effects on the chromosome apparatus of the dividing cells which lead to

genetic disarray at the cellular level. In turn, simple cyto-toxic chemicals can cause disorderly distribution (and breakage too) of chromosomes, with genetic imbalance - often lethal - the result. It is difficult to suppose that such genetic aberrations would not reduce recruitment into the fisheries or produce an adverse effect on the vitality of individuals, resulting in greater mortality due to predation.

Working with fish eggs from a recent cruise, procedures have been elaborated for studying the chromosomes and mitoses of fish embryos and early stage larvae from neuston and bongo net samples. Limited analysis of stations in the New York Bight has shown that cyto-genetic abnormalities, similar to those that can be experimentally induced by recognized mutagens, do occur in eggs collected in the New York Bight. Furthermore, they occur at a very significant level. There is station variation. The full significance of this work to the fisheries, and its meaning in terms of the state of the marine environment can be determined only by further work. It seems that never before have the chromosomes and division apparatus been observed in blastodiscs of fish eggs directly out of the neuston. The Russian radio-ecologist Polikarpov has expounded on the importance of studies on the hypo-neuston. However, his group, the only other one engaged in mutation studies on fish eggs, has used only experimentally spawned radionuclide-treated eggs.

It would be important to establish the present baseline condition of mutagenic rates in developing fish eggs and larvae from Georges Bank. This information could serve as an important criterion of extent of environmental impact of petroleum hydrocarbons that might result from exploration and production. The proposed research is a logical extension of research under way with samples from the Middle Atlantic Bight.

B. PROPOSED RESEARCH

PHASE I - Present mutagenic incidences in fish eggs and larvae from Georges Bank.

The Middle Atlantic Coastal Fisheries Center will conduct cytogenetic analyses on a series of bongo and neuston samples of eggs and larvae from Georges Bank. Baseline incidence of various categories of chromosomal aberrations will be determined for eggs and larvae of important commercial and recreational fish species.

PHASE II - Determination of mutagenic incidences in historic samples

Samples of fish eggs and larvae taken several decades ago during plankton and fish surveys of Georges Bank will be examined cytogenetically, concentrating on already identified eggs and early larvae of important commercial species. Incidences of mutagenesis in these historic samples wil be compared with present incidences as determined in Phase I of this proposal.

PHASE III - Experimental studies of effects of petroleum components on mutagenic incidences in fish eggs and larvae

In connection with physiological studies discussed elsewhere in this proposal, eggs and larvae of selected fish species from Georges Bank will be exposed experimentally to several petroleum components. Incidences of mutagenesis will be recorded and compared with control eggs and larvae. Initial efforts will concentrate on sea herring.

C. WORK PRODUCTS

1. A record of categories and incidences of chromosomal abberations in eggs and larvae of selected important commercial fish of Georges Bank.

2. A comparison of incidences of chromosomal abnormalities in historic samples with those of current samples.

3. Experimentally determined effects of petroleum components on mutagenesis in selected fish species will be determined and reported.

D. BUDGET SUMMARY

Cost Item	FY/76	FY/77	FY/78
Personal services	100.0	170.0	140.0
Supplies, Material, Travel	35.0	35.0	35.0
(Federal Contract) ADP Services	10.0	10.0	15.0
Support	105.0	125.0	150.0
Totals	250.0	240.0	320.0

EXPANDED WORK STATEMENT
GEORGES BANK BLM/OCS STUDY
Middle Atlantic Coastal Fisheries Center

PHYSIOLOGICAL EFFECTS OF PETROLEUM HYDROCARBONS ON REPRESENTATIVE LIVING MARINE ORGANISMS OF THE NORTHWEST ATLANTIC OCEAN (GEORGES BANK)

A. INTRODUCTION

As exploration, drilling and production occur on the outer continental shelf, it is vitally important that we have some means of evaluating the effects of possible environmental "impacts" upon the indigenous living marine resources. Many scientific papers attest to the vulnerability of living marine organisms to hydrocarbons; none of the papers, however, deal with the marine animals indigenous to or with the environmental conditions characteristic of the outer continental shelf. Physiological, behavioral, and pathological studies, under precisely controlled variations of hydrocarbon fractions and concentrations and of related hydrographic conditions, are necessary to evaluate the hazard to such animals of offshore exploration, drilling and oil production operations.

To establish adequate physiological, behavioral, and pathological baselines for fish and shellfish of Georges Bank, a study in two concurrent phases needs to be conducted.

B. PROPOSED RESEARCH

PHASE I - Present Levels of Hydrocarbons in the Water Column

The Middle Atlantic Coastal Fisheries Center will measure at the surface, mid-depth and immediately above the seabed, the uncharacterized existing concentrations of hydrocarbon in the water column. Samples taken will be sufficiently replicated so that, if later deemed to be necessary, molecular characterizations can be performed. The observed existing levels of uncharacterized hydrocarbons will be incorporated among the variables in the concurrent controlled studies. Samples will be taken twice yearly over an 18-month period at some 100 standard stations on Georges Bank. The findings will serve also as pre-drilling hydrocarbon baselines for the area.

PHASE II - Physiological, Behavioral, and Pathological Effects

It is proposed that existing closed-system Brett (cruising-speed respirometers) exposure equipment be utilized to observe and, subsequently, to study the effects of various concentrations of petroleum hydrocarbons and of suitable fractions thereof, on the behavior, osmoregulation, oxygen consumption, osmolality, enzyme functioning, and gross pathology of living marine organisms. The respirometers, which as closed-systems, ensure against change in composition of the petroleum hydrocarbons, can be adjusted to vary also the water velocity, temperature and salinity, thus ensuring a testing of all other important environmental variables. Stop-motion photography will be used to document behavioral changes; remote sensors will measure, in real-time, a variety of stress-related physiological reactions of the organisms. The tissues of the organisms, after completion of each experiment, will be parcelled out for related chemical, enzymological, physiological, histological and ultrastructural pathology studies.

Both acute and long-term sub-acute stress studies will be performed at five (5) hydrocarbon concentrations (one of which will be averaged baseline value as determined from the first Georges Bank cruise) and for some four (4) hydrocarbon fractions. These fractions will consist of: (1) fresh petroleum crudes, (2) fractions distilling at $\sim$ 60°F, (3) fractions distilling at $\sim$ 100°F, and (4) residues not distilling at $\sim$ 100°F. Organisms to be tested will be (if available): (1) haddock (M. aeglefinus), (2) lobster (H. americanus), and (3) herring (C. harengus harengus).

C. WORK PRODUCTS

PHASE I

1) Nine (9) three-dimensional charts of existing levels of uncharacterized hydrocarbon levels in the water column at 100 stations on the Georges Bank, (3 cruises x 3 water depths/cruise).

2) Biological Interpretation of the significance of existing levels of uncharacterized hydrocarbons.

PHASE II

1) Stop-motion photographs of behavioral changes as a function of type and duration of experiment.

2) LD_{50} and other biological and biochemical tables of stress responses on the part of experimental animals as a function of type and duration of experiment.

3) Comprehensive reports on the physiological and pathological implications of various concentrations and fractions of hydrocarbons and on synergistic effects of hydrographic variables.

D. BUDGET SUMMARY

Cost Item	FY'76	FY'77	FY'78
Personal Services	210.5	230.1	253.4
Supplies, Material, Travel	77.0	37.0	37.0
(Federal Contract) ADP Services	7.0	5.5	5.5
Support	203.0	221.6	244.0
Totals	497.5	494.2	539.9