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TECHNICAL DEVELOPMENT PLANS - FY 79

Environmental Assessment of the Alaskan Continental Shelf

Gulf of Alaska

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

TECHNICAL DEVELOPMENT PLANS

GULF OF ALASKA

NORTHEAST GULF OF ALASKA
LOWER COOK INLET
KODIAK
ALEUTIAN SHELF

FISCAL YEAR 1979

COORDINATED BY
LEASE AREA COORDINATORS:

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This TDP is a document prepared for FY 79 program planning. Inclusion of a project description and funding level is not to be construed as a commitment to any project or agency. Requests for current information on program content and official funding should be addressed to the undersigned.

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OUTER CONTINENTAL SHELF ENVIRONMENTAL ASSESSMENT PROGRAM

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
BOULDER, COLORADO

CONTENTS

PREFACE

The Alaska Outer Continental Shelf Environmental Assessment Program (OCSEAP) covers nine lease areas extending from the Northeast Gulf of Alaska to the Beaufort Sea. The program thus focuses on a vast geographic area where environmental working conditions are extremely severe. Because of the harsh environment and the emphasis on open ocean research during the period from 1955 through 1968, less research has been conducted on the Alaska Outer Continental Shelf (OCS) than on any other coastal area of the United States. It was recognition of this lack of environmental data that resulted in the request by the Bureau of Land Management (BLM) that the National Oceanic and Atmospheric Administration (NOAA) institute a program to supply the information needed prior to and during exploration and development of the OCS as an energy resource.

Before the initiation of OCSEAP studies in 1974, conferences involving about 300 scientists were held to develop an understanding of the existing data, which were found to be based primarily on fragmentary studies and to lack continuity in time and space. The primary goal of the Alaska OCS environmental studies program is to provide background information for management decisions that may be necessary to protect the OCS marine environment from damage during oil and gas exploration, development and production. Therefore the program must develop meaningful data in a timely manner so that considered decisions and corrective actions can be taken before serious or irreversible impacts occur. In response to this program goal and the objectives of BLM environmental programs in all OCS areas, including Alaska, the investigations of the Alaska OCS Environmental Assessment Program must address the scientific objectives and sub-objectives listed in all Technical Development Plans (TDP's).

The research effort from FY 75 through FY 78 was implemented with broad-scale surveys known as reconnaissance studies. These reconnaissance studies have supplied the initial information to define circulation systems, contaminant trajectories, ice hazards, seafloor faults, seismic activity, and areas of sediment instability, needed for selection and design of studies addressing specific sites and environmental processes. They also provided initial data on hydrocarbon and trace metal concentrations and on biological populations, as well as locations of critical habitats and environmental processes. More intensive studies are now required to understand their vulnerability to impingement from oil and gas development. Site specific amd environmental process studies in FY 79 will develop supplemental information to fill major data gaps in nearshore processes and trophic relationships of the biological communities.

The total program for FY 79 is co-funded by the BLM, NOAA, and the U.S. Coast Guard.

	FY 79 Million $
Direct funds from BLM (Planned)	$ 17.4
Ship time furnished by NOAA (Estimated)	6.3
Ship time from USCG (Estimated)	0.5
TOTAL Direct Costs	$ 24.2

In addition, NOAA's Environmental Data Service supports some of the data management effort and the Pacific Marine Environmental Laboratory supplements the effort in some research projects conducted by that laboratory. The total program except for the logistics, management, and syntheses functions, is described in these TDPs, covering nine lease areas and general non-site-specific studies.

These funds have been distributed among lease areas in accordance with the lease schedule and known deficiences in environmental information. The planning recognizes that there will be successive sales in the same lease area, and that even after development proceeds, a study and monitoring effort will be essential.

1.0 INTRODUCTION

1.1 BACKGROUND

Expeditious development of the Outer Continental Shelf (OCS) is essential to meet the energy needs of our Nation during the remainder of this decade and throughout the next. The Alaskan OCS oil and gas deposits are potentially the largest national source of petroleum during a time of critical need. In each OCS area for which development is proposed, extensive environmental studies must be conducted before such development is allowed. If these studies show that development of specific areas will result in unacceptable environmental risks, those areas will not be leased. As manager of the Outer Continental Shelf Leasing Program, the Bureau of Land Management (BLM) of the Department of Interior (DOI) has initiated the Outer Continental Shelf Environmental Assessment Program (OCSEAP) as an essential part of its management responsibility in order to ensure that the Alaskan marine environment is not deleteriously disturbed. Study programs for the nine lease areas of Alaska and one additional general or non-site-specific studies group are planned and conducted under interagency agreement for BLM by the OCSEAP offices of the National Oceanic and Atmospheric Administration (NOAA), U. S. Department of Commerce.

There are ten annual Technical Development Plans for the Alaskan Outer Continental Shelf program, one for each of the nine lease areas and one for studies that are "non-site-specific". The essentials of these plans were developed by the interdisciplinary staff of the NOAA-OCSEAP Office, with input from the Bureau of Land Management, the State of Alaska, and a Users Panel composed of representatives from several Federal and State agencies and from private environmental groups. The planned effort herein described begins with environmental studies already underway.

In May 1974, the Bureau of Land Management requested that the National Oceanic and Atmospheric Administration initiate a program of environmental assessment in the Northeastern Gulf of Alaska in anticipation of possible oil and gas lease sales in the region early in 1976. These studies were initiated in July 1974.

In October 1974, a major expansion of the environmental assessment program was requested by BLM to encompass four additional areas of the Continental Shelf of Alaska during the FY 1975-1976 period. After an intensive planning effort, including workshops, public comment and consultations with scientists and other concerned persons, a program proposal equivalent to a plan was published. This document was entitled "Environmental Assessment of the Alaskan Continental Shelf, First 18-month Program - Gulf of Alaska, Southeastern Bering and Beaufort Seas, April 1975."

Since that document was approved, scientific efforts have been extended into the northern Bering Sea, Chukchi Sea, and Lower Cook Inlet. Many of these efforts are simply geographic extensions of the work underway in earlier areas and already subjected to wide review and comment.

A Program Development Plan, which brings into one document the planned program for all nine proposed lease areas of the Alaskan OCS including work underway and planned, was completed in December 1976. The nine areas, extending from the Northeastern Gulf of Alaska (NEGOA) in the south to the Beaufort Sea in the north, are shown in Figure 1-1 and their characteristics are briefly described in their respective TDPs.

1.2 OBJECTIVES OF THE ALASKA OCS ENVIRONMENTAL ASSESSMENT PROGRAM

The primary objective of the Alaska OCS environmental studies program is to provide background information for management decisions that may be necessary to protect the Alaskan marine environment from damage during oil and and gas exploration and development. The protection of the marine and coastal environment is a direct outgrowth of the National Environmental Policy Act of 1969. The program must develop meaningful data, in a usable form, in a timely manner, so that any required corrective actions can be taken before serious or irreversible impacts occur.

The objectives of the BLM environmental studies program for all OCS areas, including the nine Alaska areas and non-site-specific lease area studies are:

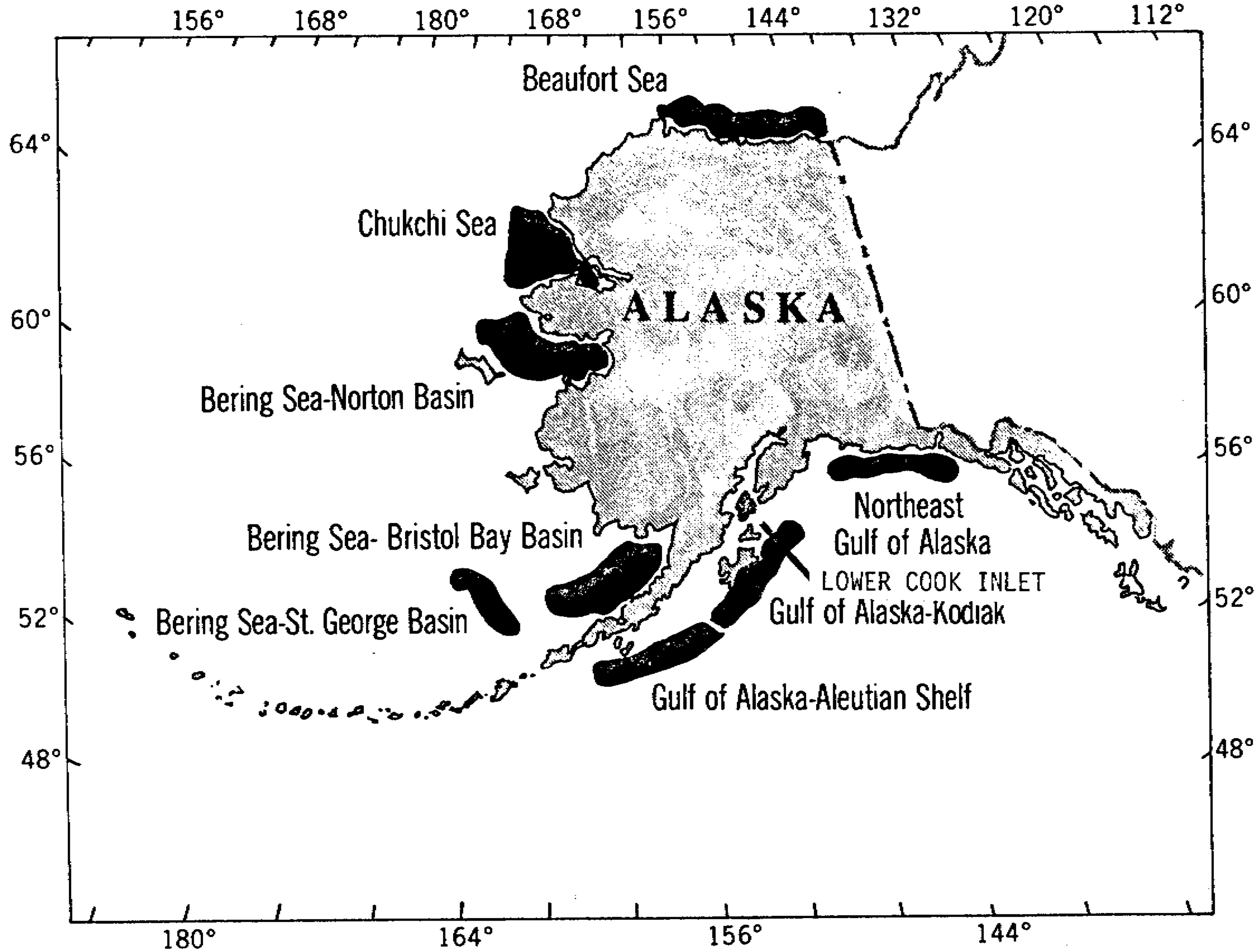

FIGURE 1-1. ALASKAN OUTER CONTINENTAL SHELF LEASE AREAS.

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1. To provide information about the OCS environment that will enable the Department of the Interior and the Bureau of Land Management to make sound management decisions regarding the development of mineral resources on the Federal OCS.
2. To acquire information that will enable BLM to identify those aspects of the environment that might be impacted by oil and gas exploration and development.
3. To establish a basis for prediction of the impact of OCS oil and gas activities on the environment.
4. To acquire impact data that may result in modification of leasing regulations, operating regulations, and OCS operating orders in order to permit more efficient resource recovery with maximum environmental protection.

In response to these program objectives, the enviro.-ental investigations of the Alaska OCS Environmental Assessment Program must address scientific objectives (henceforth referred to as Tasks) which are to determine:

A. Contaminant References - Determination of the predevelopment distribution and concentration of potential contaminants commonly associated with oil and gas development.

B. Sources - Determination of the nature and magnitude of contaminant inputs and environmental disturbances that may be assumed to accompany exploration and development on the Alaskan continental shelf.

C. Hazards - Identification and estimation of the potential hazards posed by the environment to petroleum exploration and development.

D. Transport - Determination of the ways in which contaminant discharges move through the environment and how they are altered by physical, chemical and biological processes.

E. Biological Receptors - Determination and characterization of the biological populations and ecological systems that are subject to impact from petroleum exploration and development.

F. Effects - Determination of the effects of contaminants and other insults on individuals, populations, and ecological systems.

1.3 TASKS A-F

A schematic overview of the implementation and integration process utilized in the technical approach of the program is illustrated in Figure 1-2. Information in the forms described later in Section 1.6 (End Products and Deliverables) is necessary for BLM to make their predictive assessment. These end products and information are the output of the six major tasks. To obtain these end products requires the synthesis and integration of a hierarchy of tasks, subtasks, and research units addressing those subtasks. Figure 1-2 shows the interrelationship of research units leading to assessment.

The six tasks and respective subtasks have a natural relationship to one another in the way in which they lead to assessment capability, as suggested by the curving arrow in Figure 1-2. An assessment requires a) a reference value, b) estimation of the nature and magnitude of the contaminant or insult, c) information to set design standards in order to reduce releases and insults, d) ways to calculate the path and modification of released contaminants, e) identification of the biota that will be affected by exposure downstream, and f) the effects on the biota and ecosystem from these exposures.

The six major tasks were originally derived from consideration of the information required. Research units are determined annually for

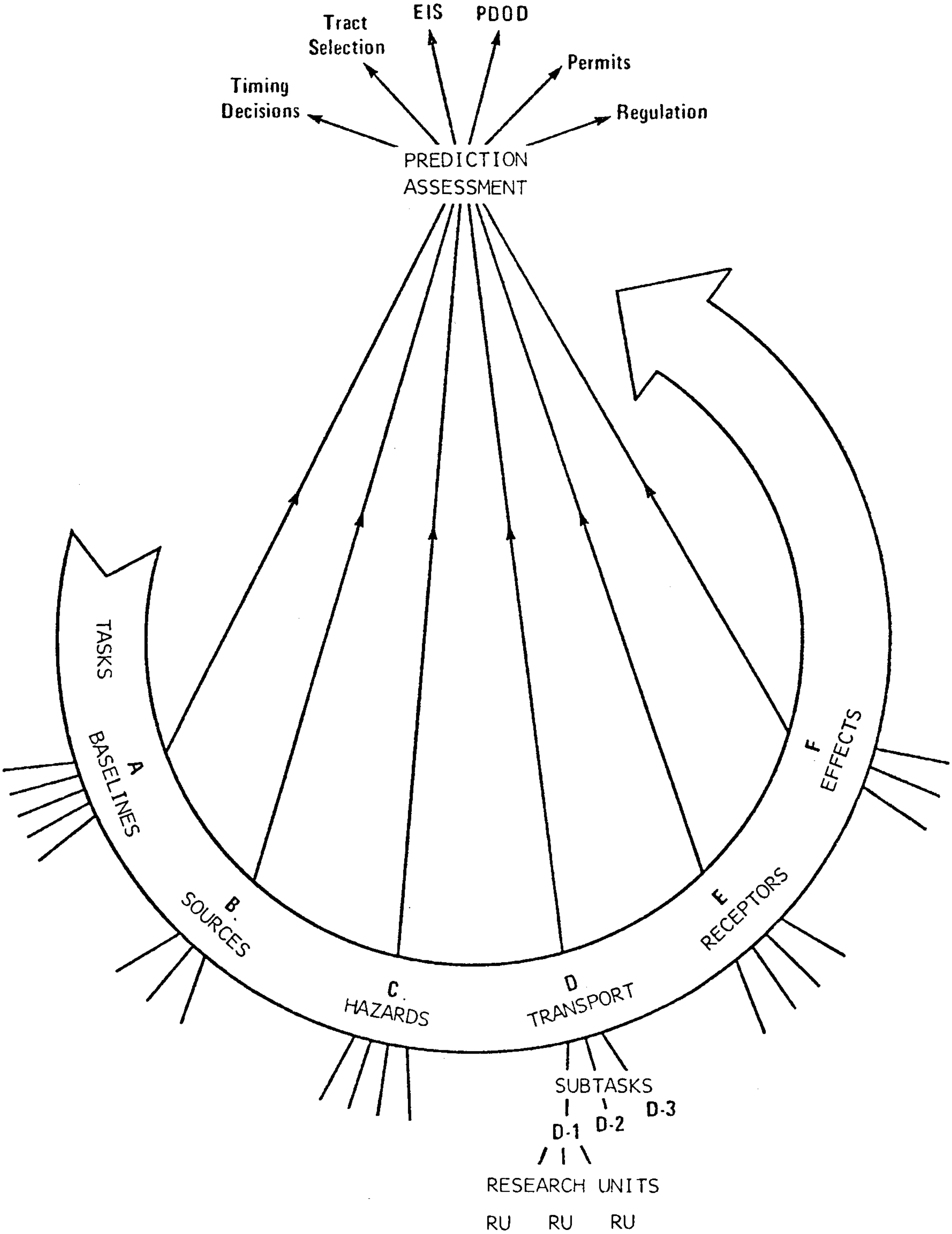


FIGURE 1-2 RELATIONSHIP BETWEEN INDIVIDUAL RESEARCH UNITS (RU) AND THE ASSESSMENT PREDICTION FUNCTION OF BLM. ALSO, THE SEQUENTIAL RELATIONSHIP AMONG THE SIX TASKS, ALL OTHER TASKS FEEDING INTO EFFECTS AND THENCE TO ASSESSMENT.

each lease area according to the special problems of the lease area and existing information. These research units are described in Section 4.0.

The prediction and assessment capability created by the six tasks is an integral part of timing decisions, tract selection process, environmental impact statements, permits, regulations and other management decisions, of the DOI. The following text amplifies the six tasks.

1.3.1 Task A (Contaminants)

The distribution of potential petroleum-related contaminants should be described before further development of petroleum resources; later changes, if any, in a contaminant's concentration or occurrence can then be detected and examined for possible correlation with concurrent ecological changes. The Alaskan research program emphasizes the high-molecular-weight petroleum hydrocarbons and trace metals in each lease area. In addition, it determines the ambient concentrations and distribution of light hydrocarbons and explores the feasibility of using C_1-C_4 concentrations as a monitoring indicator of hydrocarbon contamination. Inorganic nutrients are being measured only to the extent necessary to evaluate reconnaissance of microbial populations and planktonic primary production.

The contaminant studies are essentially complete. Future chemistry efforts will be concentrated on processes controlling contaminant distribution and modifications. Some site-specific surveys may be conducted where planned facilities are to be located.

1.3.2 Task B (Sources)

To guide the studies undertaken in succeeding phases of the Alaskan OCS program, a general understanding of the nature and magnitude of potential contaminants and environmental disturbances is required. It is necessary for program planning to obtain and continually update estimates of the location, nature, and timing of platform, pipeline, and facility development in each lease area, to estimate the quantity and physical and chemical nature of contaminants from each potential source, and to estimate the nature and amount of possible environmental disturbance likely to accompany development.

The data required in this task will be furnished to NOAA by BLM in a timely manner, or contracted for with BLM approval.

1.3.3 Task C (Hazards)

It is important to identify environmental hazards early in the decision-making process. Such information can be used by the Department of the Interior: (1) to determine which OCS areas are less environmentally hazardous than others and thus contribute to a risk/benefit analysis of areas to be leased; (2) to exclude particular tracts from leasing; and (3) to develop appropriate OCS orders, regulations, and stipulations to control the safety of energy development on the shelf. Consequently, hazard studies receive priority emphasis early in the program.

The approach is to achieve an initial broad regional understanding of the geologic, ice, and oceanographic hazards that might affect development. In subsequent studies, the level of detail will be increased with the objective of quantifying the particular risks of specific proposed actions. Geographically, the progression is (1) regional reconnaissance of the entire lease area, (2) more detailed studies of the lease area to enable tract hazard evaluations, and (3) studies related to hazards in oil transport corridors.

1.3.4 Task D (Transport)

In order to relate or "connect" the oil (or other contaminant) released from operations with the effects on the environment, an assessment must contain the trajectory, dilution, and changes in composition of the oil along the pathway. These items are treated in transport studies, which include winds, water currents, ice movement, mixing and weathering.

1.3.5 TASK E (Receptors)

A major incentive for conducting studies of biological populations is to determine which populations, communities, and ecosystems are at risk from either acute or chronic impacts. Estimates of the distribution and abundance, migration, feeding sites, and behavior of populations are among the first studies undertaken to establish potential vulnerability. At a later stage, the locations of the populations at each life-stage and activity are related to predicted paths of petroleum and incidence of disturbance to determine whether risk may exist. Further, the criteria of uniqueness, importance to the ecosystem, sensitivity, and aesthetic considerations must be examined to define a species or community fully, and to assess the significance of the effects from the potential impacts. When vulnerability is indicated, detailed site-specific studies will be undertaken to focus on processes, positions in food webs, population dynamics, sensitivity to disturbance, ability to recover from disturbances, mobility, habitat dependence, feeding dependence, and physiological characteristics. The latter involve studies of the direct effects of hydrocarbons, trace elements, and sediment characteristics on the physiology and behavior of target organisms (Task F). Also used in the design of biological studies is the information obtained in the biological baseline studies on habitat dependence and population dynamics.

1.3.6 Task F (Effects)

Knowledge of the effects of petroleum on marine organisms is an essential ingredient in the environmental assessment process. The OCSEAP will attempt to determine the deleterious effects of petroleum exposure and the threshold concentrations causing these effects. The initial studies use acute toxicity exposures in order to better define the more susceptible species and mechanisms, and thus provide input to the design of more realistic studies using chronic exposures levels. The laboratory efforts are addressed in the non-site-specific TDP.

This approach is limited, however, in that controlled laboratory conditions and real field conditions are dissimilar, and there is much uncertainty about the interaction of added stress from contaminant exposure with other biological/ecological stresses, such as those associated with reproduction, growth, and predation (including fishing pressure by man). Once the most important species of the marine ecosystem have been surveyed for lethal and sublethal effects of contaminant exposure, tests will be made for applicability of the results to a field situation through the use of controlled perturbation experiments.

The controlled perturbations studies will include not only oil spills but also noise and other disturbance experiments. These controlled studies, designed to have no lasting effects on the environment, are essential to verify the results obtained from the laboratory effects studies, and to verify the impact models obtained from the ecological process studies. Until such verification is accomplished, confidence in assessments will be low.

Of course, knowledge of effects on the individual organism provides only a part of requirements for assessing effects on the environment. Knowledge is also needed about the relationship between the individual of a species and his species population, and between the species and its environment. Impacts from oil and gas development are selective in their points of interaction ("pressure points"), and certain species and processes in the environment are more vulnerable and more important with regard to whether or not the ecosystem can tolerate the pressure. These species and processes are selected for study in "ecological process studies". The Ecological Process Studies that address these issues are classified as effects studies.

1.4 END PRODUCTS AND DELIVERABLES

The OCSEAP studies are designed and managed to provide in a timely manner products that are directly and immediately applicable to BLM needs for prediction, assessment, stipulation, and regulation. These products are identifiable both within the reports routinely submitted by investigators, and as separate volumes, operational capabilities, and items "on the shelf" but on call. Identifiable products from these studies include:

- Models
  a. For calculating oil transport on water, including vertical mixing, evaporation, weathering, biodegradation, and dispersion. This model permits the transition from an oil spill to the prediction of characteristics and concentration of oil exposing biota downstream.
  b. For changes in wind with distance from mountainous shore lines, for use in calculating oil transport on water.
  c. Of oil transport in ice-covered areas. Oil moves both in leads and with the ice when trapped beneath it. The ice movement differs from that of the water currents, so special models are needed for ice conditions.
  d. For estimating and quantifying biological damage. These models can be used in tandem with the transport models to obtain assessments.
  e. Of processes in ecosystems and the relationship between species, used for assessing and predicting impacts from released oil and recovery rates.
  f. Of the modification of permafrost by man's activities. These models make it possible to estimate the hazards of permafrost to OCS development.
  g. Of ice strength and movement, for use in letting permits and in judging industry technology.

- Maps and Charts
  a. Of sediment character and stability, potential slump areas, etc., for use in selecting tracts and in specifying further studies needed in advance of permits.

b. Of earthquake epicenters and of faults, active and inactive, for the same purposes as above.

c. Of permafrost distribution, for the same purpose as above.

d. Of location, character, and movement of sea ice.

e. Of biological parameters, including food and nutrient distribution, habitats, migratory routes, spawning areas, mortality, major colonies and hauling grounds, seasonal distributions of threatened, endangered and commercial species, and others, for the purpose of selecting sites and assessing impacts, and for design of monitoring programs.

f. Of ocean currents, for use in predicting oil transport through the use of models and for use in determining passive migration of plankton and juvenile fish through the lease area.

g. Of petroleum, toxic compounds, and metal distributions in the water column, biota, and sediments, for use as references for future assessment of effects.

h. Of possible sources of oil in the environment for use in assessing impact and designing monitoring programs.

i. Of sea floor topography.

- Statistical Probability Distributions

  a. For wave heights.

  b. For storm surges, for use in facility siting and for estimating transport of marine oil onto the land.

  c. For depth and frequency of ice gouging in prospective pipeline corridors.

  d. For wind speed, including extreme winds.

  e. Of usual climatological parameters, for use in planning operations and siting.

  f. Of atmospheric stability, for use in assessing air pollution from oil and gas development.

g. Of effects on different species from different hydrocarbons and metals associated with oil and gas development, for use in setting standards for concentrations and in regulating sources.
h. Of types and incidence of mortality and disease in biota, for later use as background information when monitoring the effects of production.
i. Of ice forces.

- Data Sources and Collations
  a. Of data that should be digitized in standard format. These data will be available for future analysis to meet BLM needs as yet unidentified.
  b. Of data that should not be digitized, but which will be kept in raw form or in smoothed form according to its nature, to meet future BLM needs.
  c. Of biological and physical specimens, for future use in verifying conclusions of investigators, for use in possible legal actions and in obtaining new chemical analyses.

- Data Summaries and Collations
  a. Collected, summarized, graphed, and plotted data, sometimes subjected to statistical analysis and smoothing, for use in DEIS, FEIS, PDOD, permitting, etc.
  b. Special data products or presentations on request to BLM, such as required input to impact assessment computer models and data syntheses reports.

- Engineering Input Data
  a. Strength, location, movement, and character of sea ice useful for judging the adequacy of the design submitted by industry and for setting stipulations.

b. Depths and frequencies of bottom gouging by sea ice for input to pipeline specifications.

c. Properties of permafrost drilling cores.

1.5 STUDY SEQUENCE, TYPICAL LEASE AREA

The sequence of study progression in the Alaskan program reflects the BLM concepts of baseline, special studies, and monitoring as three program elements. In Figure 1-3, these three elements are posed in six Tasks A-F and portrayed against the time scale for a typical lease area. Development scenarios that provide understanding of the nature and magnitude of potential contaminants and environmental disturbances, to be updated and supplied by BLM periodically under Task B, may produce modifications to the current plan of studies in any lease area.

Figure 1-3 shows the time progression of the program keyed to BLM needs. It also shows a continuing program in the lease area throughout the production phase (1) to provide information for identification and regulation of effects from the production resulting from the first sale, and (2) for assessments in advance of successive sales in the same lease area. It is recognized that the information needed for impact statements, tract selection, and permits for exploratory drilling is, in many aspects, different from that needed to regulate production activities. In general, during exploration, local effects are transient, and, unless the habitat is altered, ecosystems will return approximately to their original state after the local disturbance is removed. Therefore, in advance of leasing and exploratory drilling, BLM will require:

1. Enough information on the distribution, dynamics and interdependence of biota to be assured that the particular sites to be leased and developed are not critical habitats or do not contribute substantially to the survival of a population (such as a principal spawning ground or food source).

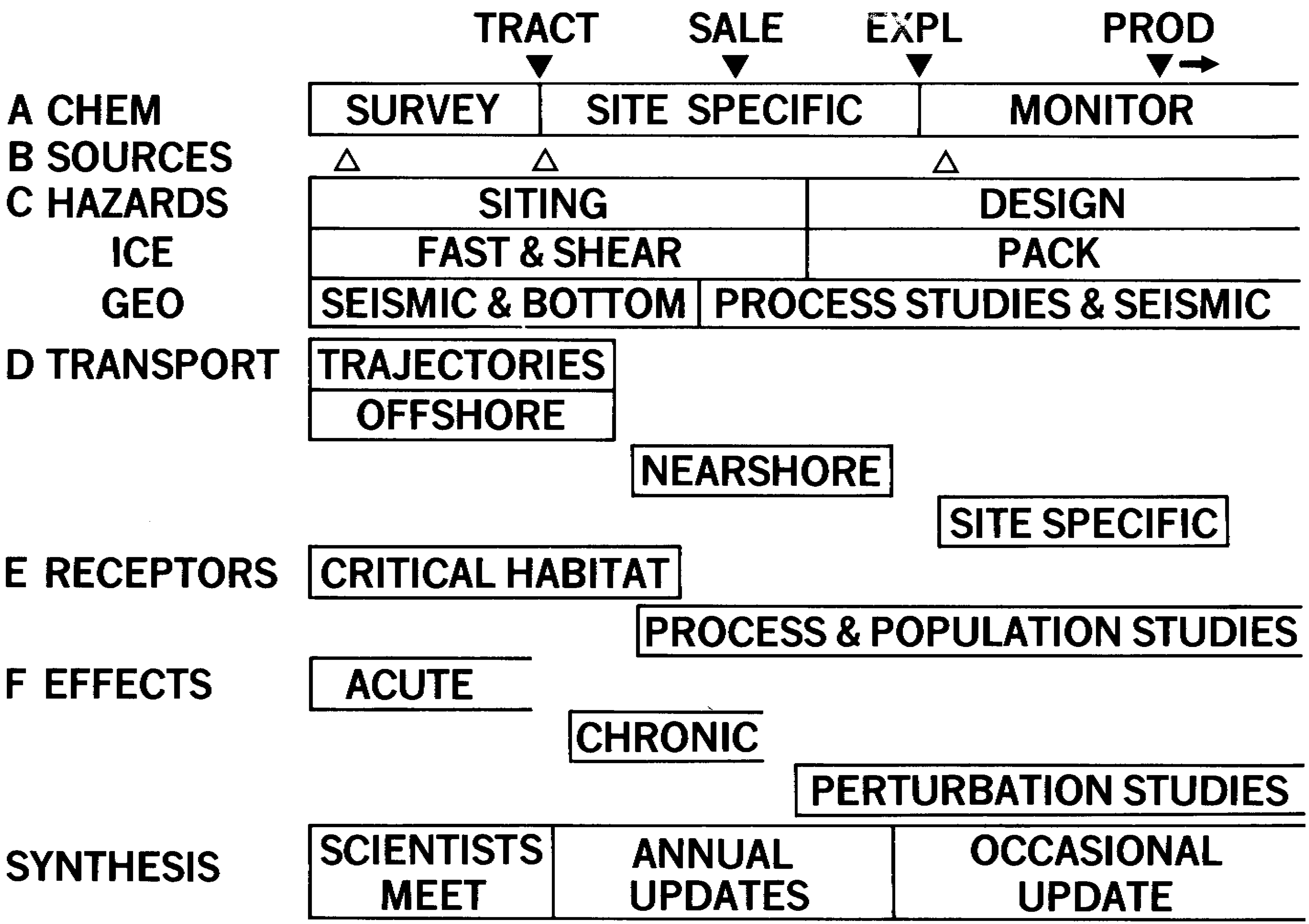

TRACT
SALE
EXPL
PROD
A CHEM
SURVEY
SITE SPECIFIC
MONITOR
B SOURCES
C HAZARDS
SITING
DESIGN
ICE
FAST & SHEAR
PACK
GEO
SEISMIC & BOTTOM
PROCESS STUDIES & SEISMIC
D TRANSPORT
TRAJECTORIES
OFFSHORE
NEARSHORE
SITE SPECIFIC
E RECEPTORS
CRITICAL HABITAT
PROCESS & POPULATION STUDIES
F EFFECTS
ACUTE
CHRONIC
PERTURBATION STUDIES
SYNTHESIS
SCIENTISTS MEET
ANNUAL UPDATES
OCCASIONAL UPDATE

FIGURE 1-3.

2. Enough information to identify geological hazards to structures so that hazardous tracts may be identified and licensing and regulatory agencies can assess the adequacy of the industry designs and plans for platform foundations, blowout preventers, etc.
3. Enough knowledge of wave, wind, and ice so that rig and platform design can be evaluated.
4. Enough knowledge of trajectory pathways so that, for hypothetical blowouts or other large spills, the hazard to specific habitats at some distance can be assessed.
5. Enough knowledge of vertical mixing, oil behavior and interaction with suspended and bottom sediments to predict the characteristics of contaminant plumes at a distance, and to predict the extent of exposure to biota throughout the water column along the trajectory.

Development and production activities present somewhat different circumstances to be evaluated. Local effects from development activities, construction and operation of pipelines and facilities, acute effects from accidents at well sites, and chronic effects from lesser environmental concentrations of oil and other contaminants over long production periods must be assessed.

Therefore, for assessments in advance of development, BLM requires the following additional information:

1. Identification of "critical" habitats between individual wells and potential gathering and loading points, as well as of habitats onshore, so that alternate routes and sites can be found, as necessary. "Critical" is a relative term and somewhat subjective as it is based upon the best scientific opinion relative to the following considerations: a) sensitivity to impact relative to other habitats; b) rate of recovery once impact is removed; and c) status as to requirements for maintaining populations of economic or esthetic species, or of rare or endangered species.

2. Storm surge and wave data in the area of shore facilities.
3. Chronic physiological and behavioral effects levels for important species possibly reached by source plumes from the production area. (Acute toxicity levels give a preliminary estimate of the maximum limits for chronic toxicities; thus acute toxicity research precedes chronic effects research.)
4. Identification of all "important" species within reach of development impact: threatened, endangered, and commercial species; those species present in the foodchain of the preceding species; those providing cover or serving other beneficial purpose; those having aesthetic value; and those playing significant roles in important ecosystems.
5. Knowledge of the ecosystem and of the population dynamics of each important species, for assessing the significant effects that changes in particular populations might have on the rest of the environment and on man.
6. Sufficient data on pre-production concentrations of oil, trace metals, and other potential pollutants in the biota and their environment so as to provide a perspective or context for viewing concentrations after production begins.
7. An understanding of source, transport and uptake, so that regulatory agencies can predict what concentrations are to be expected and develop an appropriate and economic monitoring program.

Thus, preliminary information from studies that are still incomplete may be sufficient to proceed with exploration, provided that the decision is reversible should later results from the environmental studies show the decision unwise. More complete study results with higher confidence levels are necessary for assessment of the production phase. Further assessment in advance of successive sales in the same lease area will benefit from data derived from continuing study and monitoring effort following the first sale. With successive sales, the total impact in an area will increase, and refinement of earlier gross estimates of effects will be essential.

The study sequence calls for a survey of contaminants (Task A) and biological elements (Task E) to be commenced as soon as possible. The results of the survey studies are to be used both as reference for the future and as input to design of site-specific studies and specific ecosystem studies. These specific studies are determined after information is available on the probable location of impact from oil and gas development, as obtained from the EIS, sale, and input from Task B. Also needed in the design of ecological studies is the information obtained in the biological reference studies on habitat dependence and population dynamics (Task E).

Task C on hazards is emphasized very early in each lease area since the output is critical to the choice of tracts, to stipulations on drilling and production, and to siting and design of facilities. Ice nearshore is studied first because technology still needs to be developed for oil drilling in pack ice.

In order to provide data for BLM to assess probable impacts, the program requires source term information (Task B), transport data such as winds and currents (Task D), and data on effects (Task F). Initially the transport studies are conducted offshore to provide a context and boundary conditions for the later mesoscale and inshore work. Addition of inshore work is much more difficult and calls for a different combination of size and nature of platforms. The biological program also tends toward more emphasis on the inshore areas with time, although this is not shown explicitly on the figure.

The effects studies (Task F) consist of both laboratory and field work. The initial studies use acute toxicity exposures in order to better define the more susceptible species and mechanisms and thus give input to design of more realistic studies using chronic effects level exposures. The effects field work is of two types: ecological process studies and controlled perturbation experiments.

The ecological process studies are conducted using representative lease area ecosystems. They are designed to understand the impact resulting from the insults and perturbations caused by oil and gas development (these are not complete ecosystem studies, but are tailored according to the expected insults from the development). Both the ecosystem and the insults vary within and among lease areas, so that if funding permits there will be one or more of these studies for each lease area. Figure 1-3 shows a transition from emphasis on location of critical habitats toward emphasis on understanding effects on the scale of entire lease areas.

2.0 RATIONALE FOR ALASKA EFFORT

2.1 ALASKAN OVERVIEW

2.1.1 Introduction

The Alaskan OCS region can be divided into three natural geographic areas: the Beaufort and Chukchi Seas; the Bering Sea; and the Gulf of Alaska, including Lower Cook Inlet, the Alaskan Peninsula, and the Aleutian Islands. Ice and its temporal fluctuations are the dominant feature governing environmental processes and levels of biological activity in the Beaufort and Chukchi Seas. Physical processes over the extensive shallow Bering Sea shelf are governed by a seasonal ice pack, intrusions of warm Pacific Ocean water and weak, fluctuating circulation patterns. These conditions foster high biological production and make the Bering Sea one of the world's leading fishery regions.

The dominant environmental features in the Gulf of Alaska are the high seismic activity throughout the area and the strong cyclonic oceanic circulation along the shelf break with highly variable anu weak circulation over a relatively narrow shelf. This region is characterized by a subarctic climate which leaves the waters ice-free with the exception of certain inshore waters such as Cook Inlet. This latter area is a large tidal estuary and has features which differentiate it from the remainder of the Gulf of Alaska (such as significant fresh water input, a heavy suspended sediment load, and high turbidity). Since each of these three geographic areas has different environmental mechanisms governing the ecological processes, the research emphasis varies from one to the other.

The material to follow will present the major highlights and rationale for past, present, and projected OCSEAP-sponsored research on the major tasks identified in Section 1.5. Studies are described separately within each of the three regions discussed above whenever it is felt that this will add to the clarity of the material. More detailed presentations of the status of knowledge and research priorities for specific lease areas within each of these three regions are given in Section 3.

2.1.2 Contaminants

The OCSEAP chemistry effort began in FY 75 as a program in the NEGOA lease area intended to establish pre-development light and heavy hydrocarbon and trace metal concentrations. In FY 76 the southern Bering and Beaufort Sea areas were added to the program. In FY 77 the chemistry program was further expanded to include the Lower Cook Inlet, Norton Sound and Chukchi Sea lease areas.

The initial programs in the NEGOA and southern Bering Sea involved extensive sampling along carefully designed station grids in an attempt to determine hydrocarbon and trace metal baseline concentrations. The addition of new lease areas to the program as well as large natural and analytical variability resulted in the replacement of the baseline concept with that of a reconnaissance program. This modified program emphasis, employed in the latter part of FY 76 and in FY 77, attempted to provide a broad-scale description of potential contaminant levels in the lease areas of concern. Hydrocarbon concentrations observed during the reconnaissance effort in Alaska were generally lower than in other OCS areas elsewhere and reflected the essentially undeveloped nature of the Alaskan coastal zone. Trace metal concentrations in offshore waters were about the same as open ocean mean concentrations. Concentrations in Alaskan coastal waters were not higher than in other coastal OCS areas.

During the planning for FY 78 contaminant studies, it became obvious that continuation of the reconnaissance program would not significantly improve understanding of OCS chemical problems. Therefore, in FY 78 the reconnaissance program was directed toward addressing a few large information gaps, including hydrocarbon and trace metal analyses of Beaufort Sea biota and sediment hydrocarbon analyses in the Kodiak and Norton Sound areas. A significant portion of the FY 78 chemistry program is directed toward process-oriented studies designed to give insight into the processes that control the distribution of hydrocarbons in the Alaskan OCS. Such studies yield information of predictive value and provide a framework for interpreting concentrations. Studies designed for FY 78 will provide information on diel and seasonal variability of hydrocarbon and trace metal contents of water, biota, and sediments of Lower Cook Inlet in relation to either microbial activity and high biologic productivity (Kachemak Bay) or microbial activity and exposure to petroleum production activities (Redoubt Bay). This effort will continue in FY 79.

The first chemistry program review was held in September 1977. The review committee endorsed the concept of process-oriented studies. The committee also questioned the need for continued inclusion of trace metal analysis in the program, since injection of metals from drilling materials or oil was at most a localized problem. The negative results obtained from other research projects seeking metals released from oil-impacted sediments also argued strongly for a cessation of trace metal work. Consequently, trace metal analyses will not be conducted after FY 78.

The FY 79 chemistry program is designed to provide greater understanding of the processes controlling hydrocarbon distribution and weathering. Three major projects are planned:

1. Continuation of the Lower Cook Inlet studies initiated in FY 78. These studies will give some insight into the impact of biological activity and petroleum production of hydrocarbon content of water, sediments, and biota.
2. Study of the Norton Sound hydrocarbon seep. The composition of the hydrocarbons escaping from the seep will be determined, and subsequent dispersal and weathering will be documented.
3. Small, contained oil spills will be conducted out of doors. These experiments will allow quantification of hydrocarbon weathering processes under nearly natural conditions.

The chemistry program beyond FY 79 will continue to emphasize site-specific field investigations (specific areas of exploration and production, activities, hydrocarbon sources such as seeps, spills, and chronic discharge) and field weathering and dispersal studies.

2.1.3 Hazard Assessment

Proper assessment and understanding of environmental hazards are important before and after leasing. Such information is used by the Department of the Interior to determine which OCS areas are more environmentally hazardous than others, to exclude particular tracts from leasing, and to develop appropriate OCS orders, regulations, and stipulations to control the safety of petroleum development on the shelf.

Geologic hazards to petroleum-related operations in the arctic and subarctic Alaska waters center around seismicity, surface and near-surface faulting, sediment instability, erosion and deposition, subsea permafrost, ice forces and gouging, stratigraphic hazards, and severe meteorological and oceanographic events.

Many of the hazards present in Alaskan lease areas also occur in other shelf areas of the United States. However, in Alaska these problems are unique in terms of both severity and complexity. A knowledge of the nature, frequency, and intensity of severe environmental events is essential since the greatest hazards to production-related structures and activities as well as the greatest effect on the environment will more than likely occur in conjunction with environmental extremes.

The nature of the major environmental hazards to OCS development, and consequently to OCSEAP research emphasis, differs from one OCS region to another. For example, in the Gulf of Alaska seismicity and related events present the dominant natural environmental hazards. In the Bering Sea seismicity is less important, the major risks being associated with faulting, sediment instability, and ice (the latter limited to Norton Sound). In Arctic OCS areas sea ice and sub-sea permafrost present the greatest hazards.

In the planned OCSEAP study sequence the initial approach has been to achieve a broad regional understanding of the geologic, ice, and oceanographic hazards that might affect development. In subsequent studies, the level of detail is increased with the objective of quantifying the particular risks of specific proposed actions. In terms of spatial resolution, the progression is (1) regional reconnaissance of the entire lease area, (2) more detailed studies of the lease area to enable tract hazard evaluations, and (3) studies related to hazards in oil transport corridors, and (4) topical studies of processes and causal factors to improve predictive capabilities.

Gulf of Alaska

Earthquakes and related events represent the most serious natural hazard to OCS development in any of the Gulf of Alaska lease areas. Alaska is one of the world's most seismically active regions, with most earthquakes occurring along a narrow arcuate strip extending from Prince William Sound to the western tip of the Aleutian Islands. All lease areas proposed for the Gulf of Alaska lie within this zone.

Earthquakes resulting from regional or local uplift, subsidence, or tilting may damage facilities directly and may create secondary impacts, such as tsunamis and sediment failure, which can have catastrophic consequences. In the Alaskan areas, volcanic activity such as that of Mt. Augustine in Cook Inlet, may be of particular local importance. The severity of earthquakes resulting from crustal movement is difficult to predict. The knowledge of deformational character is highly variable; seafloor fault breaks, broad crustal warping, and seismic sea waves have characteristics that commonly are unique to specific areas.

OCSEAP-sponsored seismic studies in the Gulf of Alaska, as in other Alaskan OCS areas, have consisted of two phases: (1) a historical summary of all reported Alaskan earthquake epicenters from the late 19th century to the inception of OCSEAP studies and (2) ongoing specific regional field programs to supplement the historical seismic data base by providing additional information on the locations, magnitudes and recurrence rates of all significant earthquakes and their relationship to active onshore and offshore faulting.

OCSEAP-sponsored seismic field studies in the Gulf began in FY 75 and 76 as supplements to existing studies being funded by other agencies. For example, in the NEGOA, OCSEAP is directly funding a portion of the seismograph work in an ongoing USGS study employing a land-based network of seismograph stations.

In the Western Gulf of Alaska the OCSEAP effort is a part of a combined DOE-NOAA study of the seismotectonics of the Alaska Peninsula and Aleutian chain. The OCSEAP funding has permitted the extension of the seismic network to give better coverage of the Gulf of Alaska and Bering Sea continental shelves.

The major objective of the seismic studies program is to determine a probability scale for earthquake hazards with reference to petroleum exploration and development. A requisite for accomplishing this objective is the improvement of the statistical reliability of the existing data base through continuation of present observational programs and the use of additional or improved instrumentation, such as ocean bottom seismometers (OBS) and strong-motion accelerometers. In recognition of this long-term need, OCSEAP has adopted the philosophy that seismic field studies will receive strong support in the Gulf of Alaska (including those lease areas that no longer appear on the OCS Planning Schedule) throughout the lifetime of the program.

A potential improvement in the FY 78 NEGOA program is the inclusion of several OBS units to improve resolution of centers offshore thus decreasing the observation time required to generate statistically reliable location and recurrence estimates. Unfortunately, all the seismic studies conducted to date have resulted in a predictive capability with an uncertainty that is no smaller than the expected lifetime of OCS activity. Significant reduction of this uncertainty will require the routine detection of smaller earthquakes than has been possible in the past. Even with improved earthquake detection methods, a serious information gap continues to exist insofar as actual ground motion is concerned. It is therefore anticipated that the OCSEAP-sponsored seismic effort in FY 79 and beyond will show an increased emphasis toward the use of bottom-mounted seismometers and determination of ground motion associated with major events. The latter will permit the spatial correlation of earthquake magnitude and the actual ground motions that OCS-related structures will be required to withstand.

In addition to seismic activity are natural hazards resulting from volcanism, faulting, sediment instabilities, and seismic sea waves. In the western Gulf of Alaska volcanism presents a significant environmental hazard. The Aleutian, Kodiak, and Lower Cook Inlet lease areas contain a chain of active and potentially active volcanos extending along the Alaska Peninsula. Consequently, volcanism studies have been, and will continue to be, integral parts of the seismic programs in these lease areas. These studies emphasize improved characterization of eruptive styles, ejecta composition and ranges of influence, and estimates of recurrence rates. The major objective of the volcanism program is the generation of reliable volcanic risk maps that describe the nature of the hazards associated with particular volcanos, the spatial distribution of these hazards and the probable recurrence rates. An ultimate goal is the development of a geophysical monitoring and warning system, primarily through a strengthening of the existing seismic net. As in the case of seismicity, volcanism is a dynamic phenomenon with major events occurring at large time scales. Therefore, the OCSEAP effort is again guided by the rationale that studies should be of the maximum duration practicable and that future emphasis should be placed on the utilization of additional and more sensitive instrumentation (e.g., OBS units) to improve the capability of making useful predictions with the data base realistically achievable. A shortcoming of the current seismicity/volcanism program is an inadequate level of coordination among seismicity studies performed by different institutions. During FY 78, OCSEAP and the appropriate geological investigators will devise a coordinated plan for instrument calibration and reporting, which will be reflected in the FY 79 field program.

Shallow faulting, sediment instability, and erosion/deposition constitute significant potential threats to safe OCS petroleum development. The Gulf of Alaska is tectonically complex, and numerous faults have been identified, most notably in the NEGOA and Kodiak lease areas. Fewer faults have been found in Lower Cook Inlet, and the Aleutian lease area is yet to be investigated. Some of these faults may be active, and displacements can affect man-made structures, such as drilling platforms, drill casings, and pipelines. Further hazards in the Gulf of Alaska are associated with sediment instability. High rates of sedimentation of fluvial and glacial outwash materials occur along parts of the coast (e.g., the Icy Bay and Copper River Delta regions of NEGOA), producing large unconsolidated sediment deposits. Some of these deposits have undergone extensive slumping and others have been identified as potentially unstable. Slumping may be triggered by low magnitude earthquakes resulting from fault movement.

The likelihood of sediment failure actually occurring in areas identified as potentially unstable can be evaluated only by studies of the sediment geotechnical properties. For example, slumping that has occurred in an area will result in a sediment mass that is either more stable now as a result of slumping, or less stable, depending on the amount of water incorporated, the degree of consolidation, and style of movement. Knowledge of the geotechnical properties of sediment in critical areas was identified as a major information gap at the geology program review held Jan 31-Feb 3, 1978 in Menlo Park. OCSEAP plans to initiate studies of this type beginning in FY 79.

As described earlier in the general hazards study sequence, OCSEAP shelf faulting and sedimentation studies first seek a regional description of potential hazards so that environmental risks can be minimized, either by outright avoidance or by appropriate regulation of facilities. Certain features identified as potentially troublesome during the regional reconnaissance of the lease area are selected for further detailed study. Nominally the reconnaissance phase constitutes about a two-year effort, with focused studies of special problems taking an additional two years (these time estimates are approximate and vary with the lease area size and the specific nature of the hazards identified).

OCSEAP-funded shelf faulting and sedimentation studies in the Gulf of Alaska began in FY 76 in the NEGOA, Lower Cook Inlet, and Kodiak lease areas. The NEGOA study, begun the previous year by the USGS, has produced basic information at a tract-specific level on the geologic hazards of the area, including the location of probable active faults, potentially unstable sediments and areas of erosion and deposition on the shelf. This information has had a significant influence on tract selection, stipulations and drilling regulations in NEGOA. The work is being continued in FY 79 in response to BLM's request to gather additional tract-specific hazards information to the west of Kayak Island in preparation for the second NEGOA sale currently scheduled for mid-1980.

Reconnaissance geological and geophysical surveys conducted in 1976 over the outer continental shelves of Lower Cook Inlet and Kodiak Island identified, on a regional scale, potential seafloor hazards due to faulting, slumping, erosion, deposition, and large scale bedform movement. Detailed studies of specific problems, such as large fault zones on the Kodiak Shelf, possible weak volcanic sediments in the troughs that cut the Kodiak shelf, and large-scale bedforms in Lower Cook Inlet, were begun in 1977 and will continue into FY 79, with the focus on improved mapping and age determinations on surface and near-surface faults on the Kodiak shelf and areas of sediment instability on both the Kodiak and Lower Cook Inlet shelves.

Shelf faulting and sedimentation studies have not been conducted in the Aleutian lease area. The January 1977 OCS Planning Schedule showed a December 1980 Aleutian sale date, but by August 1977 this lease area had been removed from the leasing schedule. In FY 78 the level of OCSEAP effort was low in response to the new OCS schedule. It is anticipated that a very modest research program with limited objectives will continue in the Aleutian lease area over the next few years. Only studies with long-term applicability and requiring long lead time are being conducted at this time. Hazards studies are presently restricted to OCSEAP's long-term support of seismicity/volcanism research in this region. If leasing does not occur before 1982, as is indicated on the current OCS Planning Schedule, initiation of faulting and sedimentation studies in FY 80 will still allow adequate lead time.

Extreme oceanic and meteorological events, such as high wind waves, storm surges, tsunamis, and severe storms pose hazards to offshore structures, shipping and coastal facilities. OCSEAP-sponsored studies of oceanic and meteorological hazards in the Gulf of Alaska are included in a synthesis of existing data and literature in the form of a climatic atlas of the entire Alaskan coastal region recently completed by the Arctic Environmental Information and Data Center and the National Climatic Center. This atlas summarized the present knowledge of marine and coastal climatology in the Gulf of Alaska, the Bering Sea, and the Beaufort/Chukchi Seas. Information includes statistics (means, extremes and recurrence rates) of such parameters as wind speed, wave height, and storm surges. More detailed studies of severe storm hazards are planned for FY 79 and will include prediction of types and frequencies of extreme storms and storm tracks associated with hindcasts and pack ice response.

Bering Sea

The Bering Sea contains the Bristol Bay and St. George Basin lease areas in its southern part and the Norton Sound area to the north (Figure 1-1). The June 1975 Proposed OCS Planning Schedule showed a first generation Bristol Bay sale at the end of 1977. On the January 1977 schedule Bristol Bay no longer appeared and on the most recent (August 1977) schedule St. George Basin has also been removed. As a result of the changing leasing priorities and the OCSEAP budget reductions over the last two years, the allocated FY 79 funding levels in St. George Basin and Bristol Bay are approximately 40 percent and 10 percent of their respective FY 77 values. The funding reduction in Bristol Bay is the largest of any of the Alaskan OCS areas and reflects in part the lack of a substantial geohazards program, which would normally continue to receive strong support even in the face of budget reductions and a postponed leasing schedule.

With the exception of sea ice distribution, there do not appear to be major geologic or oceanographic hazards in Bristol Bay. Seismic activity is low and no tsunamis or strong storm surges have been reported. Bottom faulting and sediment stability investigations have not been undertaken, however. Assuming that the present Proposed OCS Planning Schedule for Bristol Bay is not changed, these studies, along with ice investigations, can be initiated in FY 80 with sufficient lead time to influence decisions to be made in 1982 or beyond.

Earthquakes and faulting are potential hazards to OCS development in St. George Basin. Seismicity is being monitored coincidentally with the instrumentation from the Aleutian Islands and Alaskan Peninsula described earlier. To date, however, reliable epicenter location has not been possible, since the region contains only one monitoring station north of the Aleutian Islands. OCSEAP is currently evaluating the necessity and feasibility of additional stations. Reconnaissance level seafloor hazards studies, initiated in FY 76, have confirmed the existence of numerous faults and extensive areas of slope instability near the shelf edge. This work is not being continued in FY 79, the rationale being (1) the low leasing priority, (2) the fact that two years of reconnaissance data will have been synthesized by the end of FY 78, and (3) identified regions of seafloor instability have been located on the continental slope but not within the St. George lease area.

Norton Sound is the only Bering Sea lease area remaining on the August 1977 Proposed OCS Planning Schedule. It is also the last of all the Alaskan lease areas presently scheduled for sale (December 1981). Assuming that this schedule is maintained, the results of FY 79 and FY 80 field studies will be available in time to contribute significantly to the EIS.

Marine geological and geophysical reconnaissance surveys conducted through fiscal year 1976 have identified several potential seafloor hazards in Norton Sound, including surface and nearsurface faults, ice gouging, bottom current scour, and gas-charged sediments. Detailed studies of these phenomena were begun in FY 77 and will continue into 1979. These studies will provide critical information for determining the age of recent faulting, recurrence rates and depth of ice gouging, mobility of large bedforms, and stability of gas-charged sediments.

Complex surface processes of the Yukon-Kuskokwim delta region also pose potential hazards and environmental impact problems to onshore development that may occur there in conjunction with offshore oil and gas activity in the northern Bering Sea. These problems include rapidly shifting coastlines and stream channels, permafrost, major flooding associated with breakup, storm-surge erosion, shorefast ice, faulting, and possible volcanism. By the end of the FY 78 field season, sufficient data on such processes will have been generated to define, for the present need, the general nature and distribution of these hazards and to evaluate their implications for siting of onshore processing and transportation facilities. Efforts in FY 79 will be devoted to final data processing and preparation of reports.

Although a first generation Norton Sound sale is not currently scheduled until the end of 1981, it is possible that the recent discovery by OCSEAP investigators of a major submarine oil seep and substantial gas-charged sediments might stimulate sufficient interest that this schedule will be accelerated. In anticipation of this possibility OCSEAP is timing the geohazards studies so that information at a several-tract level of resolution will be available by the end of CY 1980.

Beaufort/Chukchi Sea

The nature of environmental hazards is quite different in the Beaufort and Chukchi Seas from any of the other Alaskan lease areas and therefore the direction and scope of OCSEAP studies there are also different. In the Beaufort and Chukchi Seas sea ice and subsea permafrost are of primary importance. These hazards are so severe that leasing has been restricted so far to a narrow coastal area in relatively safe shorefast ice.

The studies start with a general, area-wide description of these risks and hazards and end several years later (but prior to petroleum development) with specific information on the nature, location and frequency of hazards, with a high level of geographic resolution). Studies of the location and seasonal occurrence of ice hazards, mechanical properties of sea ice, ice gouging, the movement of sea ice and the properties and spatial distribution of subsea permafrost fall within the scope of OCSEAP research.

Sea ice problems dominate the hazards program in the Arctic. No proven technology presently exists for exploration, much less production, in the ice-covered waters outside the shorefast ice zone. On the ocean bottom, ice gouging is a serious hazard to pipelines and structures. Some data exist on areas of occurrence and density and depth of gouging, although less is known about the frequency of occurrence, age of the gouges and the forces involved. In the Beaufort Sea several more years of effort are needed to fill these gaps. In the Chukchi Sea, which is no longer on the Proposed OCS Planning Schedule and where no research activity is taking place at present, it will take longer.

Maps of annually occurring ice hazards on a large scale (satellite mapping) have been completed for both the Beaufort and Chukchi Seas but the mapping of smaller-scale features (ridge occurrence and geometries, floe sizes, leads, etc.) has not gone beyond a fairly broad and cursory classification in both areas. Routine remote-sensing flights by aircraft equipped with side looking airborne radar (SLAR), laser profilometer and cameras must continue to give details of ice features with a greater degree of geographical resolution. On the other hand, a historical look at ice conditions over the last hundred years has been completed.

The major gaps in information, and the ones that are of greatest concern to the petroleum industry and regulatory agencies, are in the area of mechanical properties of sea ice, forces applied by moving ice to structures, and the dynamics of shorefast and pack ice. OCSEAP's efforts in this area are very modest in comparison with the needs for information, particularly for later, offshore leases. While OCSEAP work, in some instances funded jointly with industry, is important and should clearly be continued at the present level until exploration commences, it cannot hope to give answers to even a fraction of the problems that remain to be solved. Most will be solved by the petroleum industry, but OCSEAP's continued involvement is important to safeguard environmental concerns.

In summary, ice hazards in the nearshore area of the present lease sale are being more or less adequately researched by OCSEAP and knowledge of major ice problems, even if it is not very extensive, will exist prior to the joint Federal-State Beaufort sale. The same cannot be said for the pack ice zone outside the present lease area, nor for the area-specific problems in the Chukchi Sea. These can only be tackled in new programs preceding additional lease sales.

Detailed understanding of the horizontal and vertical distribution of permafrost becomes important prior to production, when subsea pipelines have to be installed and drill pipes have to be protected. But it is also important to know some characteristics of subsea permafrost prior to exploration. For example, permafrost poses some limitatons to directional drilling (angle drilling can only commence after the permafrost layer has been penetrated vertically). If critical sea floor habitats are to remain undisturbed, a knowledge of the thickness of permafrost is required to determine if directional drilling can reach below the center of these seafloor habitats.

The initial, expensive drilling and coring program carried out by OCSEAP in the Beaufort Sea has been discontinued. Emphasis is now on quick and cheap jetting techniques (a jet of water delivered by a high speed pump, which allows pipes to be installed tens of meters into the sediments) to measure temperature, salinity, sediment types and depth to the icebonded interface. Modeling continues using these environmental parameters in a joint program with the National Science Foundation. Shallow seismic data, obtained from industry and by OCSEAP field measurements is being analyzed to give a picture of the horizontal and vertical distribution of permafrost on a large scale. These activities will continue at the present level beyond the exploration phase in the Beaufort Sea. In the Chukchi Sea very tentative subsea permafrost investigations have been discontinued until a lease sale is announced.

Although less serious than those posed by ice and permafrost, hazards associated with seismicity and sea floor instability also exist in the Arctic. Sea floor instability is important along the shelfbreak in the Beaufort Sea, well outside the present lease area, and has not yet been addressed as a problem. Seismicity is a potential problem east of the present Beaufort Sea lease area, also not yet addressed by OCSEAP, but it has been studied in the Chukchi Sea where seismicity is considerably higher. At the end of FY 79 a general understanding of the seismicity and major fault features around Seward Peninsula and into Kotzebue Sound will have been attained.

2.1.4 Transport

In an assessment of the potential impact of OCS development on the marine environment, the transport and transformation of petroleum-related contaminants is of key significance. Petroleum or other contaminants introduced into the environment can be transported in the atmosphere, water column and sea ice acting as an intercoupled system. During the transport process, oil and other contaminants undergo continual physical and chemical changes brought about by such processes as evaporation, flocculation, emulsification, weathering, biodegradation, and chemical decomposition.

OCSEAP transport studies are specifically designed to provide data that will enable the Department of the Interior and other agencies to:

- Plan stages and siting of offshore petroleum development to minimize the potential risk to environmentally sensitive areas.
- Provide trajectories, coastal landfall, and impact predictions required for cleanup operations in the event of an oil spill or the introduction of other contaminants, trajectories, coastal landfall, and impact predictions required for cleanup operations.
- Assist in planning the location of long-term environmental monitoring stations in the study area.

Three principal transport (physical) pathways are considered in the OCSEAP effort: water, ice and sediments. Of these, coastal circulation is the dominant transporting mechanism in subarctic regions. However, in the Arctic, ice is expected to provide the most significant pathway for much of the year. Consequently, the transport programs in the Gulf of Alaska and the Beaufort/Chukchi Seas have considerably different emphasis. The relative importance of sediments is currently under investigation. To date, OCSEAP investigators have not included studies of the atmosphere as a direct contaminant pathway, but rather as the principal driving mechanism for oceanic transport.

Gulf of Alaska

Oceanographic investigations in the Gulf of Alaska have been carried out sporadically for the past half century, with an increased intensity during the last twenty years. Most studies have been conducted in the open ocean during summer months. Existing knowledge has been limited to a description of the large-scale circulation patterns, based almost exclusively upon aperiodic, widely-spaced hydrographic data. Such information does not provide adequate insight into the smaller scale circulation features active on the continental shelf and responsible for the coastal transport of contaminants.

Prior to OCSEAP, no systematic physical oceanographic and meteorological studies had been conducted on the Gulf of Alaska continental shelf. Conspicuously absent were long-term direct measurements of coastal currents and winds. OCSEAP transport investigations in the Gulf of Alaska began in FY 75. These studies were designed to proceed sequentially from a regional description of mesoscale oceanographic and meteorological features to an analytical phase of process studies. The various elements of the investigations have included literature summaries, Lagrangian and Eulerian current measurements, hydrographic station data, remote sensing data, and computer models. Meteorological investigations have concentrated on field observations and computer simulation of coastal wind patterns, which, in Alaska, can differ markedly from synoptic geostrophic winds because of the strong effects of coastal orography and land-sea temperature differences.

As the NEGOA was the first OCS area in Alaska to be selected for oil and gas development, OCSEAP study efforts began there in 1975. Between that time and FY 77, studies were concentrated primarily in

NEGOA, with much smaller efforts in the western gulf and Lower Cook Inlet. Leasing in NEGOA occurred in April 1976, with results of OCSEAP transport studies contributing significantly to tract selection. By FY 77 all the previously described transport elements were involved in NEGOA studies.

Since 1977 studies in NEGOA have progressed to a stage where a comprehensive view of the regional oceanography and meteorology is emerging. Areas of probable impingement on the western side of Kayak Island and the entrance to Prince William Sound have been identified through field studies and computer simulation. The NEGOA program in FY 79 and FY 80 will consist of a modest field effort and completion of data analysis for the Kayak Island/Hinchinbrook entrance region, in anticipation of the second NEGOA sale presently scheduled for mid-1980.

FY 77 marked the beginning of the first systematic current measurement program ever conducted around Kodiak Island. These studies were intensified in FY 78 and supplemented with a program of mesoscale surface wind investigations. The FY 78 effort is a part of a larger regional study also containing Lower Cook Inlet and the Alaskan Peninsula.

Practically the entire body of existing information on mesoscale oceanic and atmospheric circulation patterns in the Gulf of Alaska, Bering Sea, and Arctic OCS areas has resulted from OCSEAP research. Prior to OCSEAP no such information existed. Studies in the Gulf of Alaska, as elsewhere, have initially focused on offshore areas with a spatial resolution of some tens of kilometers. The rationale for this offshore rather than nearshore initial emphasis is several-fold. First, as mentioned, no previous transport information existed commensurate with the spatial scale at which many OCS development activities will occur. A possible exception is for the Beaufort Sea, where ice conditions are so formidable that practically all OCS activity will occur in the nearshore. Second, mesoscale studies are necessary to identify potential contaminant impingement areas. Third, smaller-scale, nearshore processes are often driven by mesoscale mechanisms; thus offshore studies can provide necessary boundary information for subsequent inshore projects. Fourth, there has been a general lack of nearshore development scenarios to derive criteria to guide the design and placement of appropriate studies. Fifth, considering budgetary constraints and the amount of coastline included in the present lease areas, substantial nearshore investigations must be justified on the basis of either (1) process-oriented studies in select "model systems" whose dynamics may reasonably be extrapolated to other regions; or (2) the coincidence of an important biological community with either planned nearshore development activities or likely impingement established from previous studies.

Most field activity associated with transport studies in the Gulf of Alaska is being terminated at the end of FY 78. The effort in FY 79 will be devoted almost entirely to data analysis, interpretation and synthesis, and continuation of modeling activities. The modeling effort is expected to have progressed sufficiently to be routinely applied, and for the first time it will have the benefit of oil weathering algorithms and realistic surface wind inputs obtained from other OCSEAP studies.

In FY 79 and beyond, studies of sediments as a contaminant transport mechanism will not focus on obtaining estimates of sediment fluxes, but instead will be directed toward obtaining a more quantitative picture of the processes governing sediment interaction with petroleum. Such field studies will be confined to Lower Cook Inlet and Norton Sound, which can be considered to be natural laboratories in that they have both high suspended sediment loads and existing sources of hydrocarbons.

During the second half of FY 78, a major emphasis of the Gulf of Alaska transport studies program was the beginning of synthesis of all available OCSEAP information on oceanographic and meteorological circulation patterns and processes. The FY 79 effort will be devoted almost exclusively to this task through a collaborative effort among investigators of all relevant studies to summarize what is known about the Gulf of Alaska as a transport system.

Bering Sea

For the most part, the history, present status, and projected future of transport studies in the Bering Sea parallel the situation in the Gulf of Alaska. The Bering Sea effort began in Bristol Bay and St. George Basin in FY 75 as a pioneering program to obtain mesoscale hydrographic and long-term moored current meter data. Prior to this, essentially nothing was known about the energetics and spatial and temporal variability of mesoscale circulation anywhere in the eastern Bering Sea.

A modeling effort was initiated in July-September 1976 and the field program was intensified during FY 77. At the same time studies were also extended into Norton Sound and the Chukchi Sea. This effort produced a milestone set of data, including beneath-the-ice overwintering, from a current meter array moored for nearly a year. During FY 78, the Norton Sound studies were focused more heavily within the Sound itself, a primary objective being the estimation of residence times within the eastern and western portions of the embayment. FY 78 field studies were not conducted in the Chukchi Sea by virtue of its removal from the leasing schedule. For the same reason, and the fact that studies were initiated in FY 75, the field effort was sharply curtailed in the southern Bering Sea during FY 78.

OCSEAP does not plan to continue oceanographic field work in the southern Bering Sea during FY 79. The only field work planned for Norton Sound during FY 79 is the initiation of a coastal meteorology study. The lack of a meteorological field program in the Bering Sea is the one significant difference between OCSEAP-supported studies in this area and from those in the Gulf of Alaska. Since neither Bristol Bay nor St. George Basin appear on the August 1977 Proposed OCS Planning Schedule, meteorological field studies in these regions can be postponed.

Because observations conducted by NOAA suggest that the ice edge may play a dominant role in inducing significant mesoscale departures from geostrophic winds deduced from large scale pressure maps, such investigations are needed in Norton Sound. Proposed initiation of these in FY 79 will provide sufficient lead time for the nominal 2 to 3 year study period required to adequately describe the coastal wind field. As for the Gulf of Alaska, virtually the entire transport effort in the Bering Sea during FY 79 will be synthesis of existing information.

Beaufort/Chukchi Seas

In FY 75 a modest offshore study program was begun in the Beaufort Sea for the purpose of investigating the hydrographic regime and ocean circulation under the ice of the Beaufort Sea continental shelf. Prior to OCSEAP, no such information existed. By the end of FY 78 sufficient information will be in hand to terminate these studies in the offshore areas for the present and concentrate fully on important problems nearshore. This nearshore oceanography program only began in mid-1977 and must cover large existing information gaps on nearshore circulation and transport of sediments, detritus, nutrients and biota, as well as pollutants. The fluxes of these materials characterize and maintain the biota-rich nearshore environment. Their perturbation by offshore development (causeway construction, gravel pits or mining on islands, gravel island construction, etc.) may have major effects on an important segment of the biota in the Beaufort Sea. The nearshore transport studies are a part of an integrated ecological process study involving most of the OCSEAP disciplines.

The dominance of sea ice in the Beaufort and Chukchi Seas has caused the emphasis on transport studies in these areas to differ in two significant aspects from those in any other lease area. First, there is a considerable effort toward a better understanding of ice motion and oil-retention properties, since the ice itself is likely to be a major transport pathway for much of the year. Second, an emphasis on nearshore oceanography has occurred earlier in the Beaufort Sea than in the other lease areas. One reason for this early emergence of nearshore studies is the fact that overwhelming offshore ice hazards will restrict all OCS development activities to the nearshore region for the foreseeable future. Hence a clearer picture of probable nearshore development scenarios is available for the Arctic than for any other lease area.

In the Chukchi Sea, more was known about the large scale physical oceanographic processes than in the Beaufort Sea. OCSEAP has rounded out the picture for the offshore field studies in FY 78. The FY 79 effort will be devoted to data synthesis to complete the regional circulation picture of the northern Bering Sea and Arctic Ocean. A nearshore program has not yet materialized in the Chukchi Sea and awaits announcement of a lease sale.

Transport of pollutants by ice is more important in the Arctic, but also less well known. Large-scale ice drift trajectories have been studied by OCSEAP in both the Beaufort and Chukchi Seas and have contributed to the known picture of the general ice circulation, although year-to-year variations in this drift provide large excursions from the "normal", expected behavior of the ice. These studies were replaced in mid-1978 by a more comprehensive program examining all aspects of the behavior of oil in ice, including the microscale as well as large-scale transport of spilled ice in an ice matrix. This program is expected to continue at least two years.

No specific oil-in-ice program is planned for the Chukchi Sea at present, but results from the Beaufort Sea study can probably be extrapolated to some extent into the Chukchi Sea. Exceptions are the annual ice outbreaks from the Chukchi to the Northern Bering Sea, which are occurrences that do not reflect parallel events in the Beaufort Sea. These outbreaks are important in transporting large volumes of ice, with any pollutants entrapped in the ice, very rapidly over long distances. A sea-ice surveillance radar on Bering Strait has tracked these events for a year now and will continue to do so for another year.

2.1.5 Biological Populations and Ecological Systems at Risk

A major incentive for conducting studies of biological populations is to determine which populations, communities, and ecosystems are at risk from either acute or chronic insults. Estimates of the distribution and abundance, migration, feeding sites, and behavior of populations are among the first studies undertaken to establish potential vulnerability. The further criteria of uniqueness, importance to the ecosystem, sensitivity, and aesthetic considerations must be examined in order to define fully and assess the value of a species or community and the consequences of the insult. When vulnerability is indicated, detailed site-specific studies will be undertaken to focus on processes, trophic and population dynamics, sensitivity to disturbance, habitat dependence, and physiological characteristics. The interrelationships among various components and processes of ecosystems will be increasingly emphasized in site-specific studies.

The first several years of OCSEAP biological studies have generally been concerned with establishing the distribution and abundance of key biological species through "reconnaissance" surveys. For the higher trophic levels these investigations have also had as an objective the identification of critical habitats, migratory routes and principal breeding locations. Much of the required data on abundance, distribution, and timing of important or characteristic species in most lease areas had been obtained by the end of FY 77. Those few reconnaissance studies remaining in FY 78 will not be continued in FY 79. A major shift in emphasis in biological studies away from reconnaissance-level surveys to site-specific ecological studies was initiated in FY 78.

Gulf of Alaska

The shift in emphasis toward process-oriented biological studies is reflected in the design and implementation of two major biological programs in the Gulf of Alaska in FY 78. These studies, conducted in the Kodiak and Lower Cook Inlet lease areas, emphasize environmental factors affecting biological populations and communities and the phenology and ecology of selected species. The studies have as a basic objective the description, analysis and verification of the ecological community structure of selected coastal eocsystems with regard to potential impacts of oil and gas development in the Kodiak Archipelago and Lower Cook Inlet.

A similar study is in the planning stage for the NEGOA lease area; however, it is not clear at present what level of effort the FY 79 and future budgets will allow.

Bering Sea

As in the case of the Chukchi Sea, the OCSEAP support of biological studies in the southern Bering Sea declined sharply between FY 77 and FY 78 as a result of the postponement of sale dates for both Bristol Bay and St. George Basin beyond 1981. However, the importance of the southern Bering Sea as a region of extraordinarily high productivity supporting major fishery resources dictates that a modest level of biological research be continued.

One of the major tasks addressed at the Salishan workshop on the Bering Sea Ecological Processes Study (October 3-6, 1976) was conceptualization of process-oriented studies and initial data needed to develop a modeling approach to most closely fit OCSEAP objectives. Such a scheme should be designed to provide tools for an integrated interpretation of environmental data. In keeping with this approach, an important element of the modest FY 79 program in the southern Bering sea is the investigation of the feasibility of a multi-component, dynamic, numerical ecosystem model for the region. Preliminary results from this model, developed in FY 76, suggest that most of the qualitative and quantitative dynamics of the marine ecosystem, such as interactions between species, interactions between species and the environment and the effects of man's actions on species and the ecosystem, can now be studied and quantified. Thus, during FY 79, this project will be continued to incorporate all BLM/OCSEAP generated data into an evaluation of the sensitivity of the eastern Bering Sea ecosystem to perturbations from oil development.

Studies beyond FY 79 will depend partly on the future leasing schedule and partly on how well the ecosystem model performs as an integrative tool during the FY 79 testing phase.

In Norton Sound it is planned that FY 78 reconnaissance level surveys of intertidal and subtidal benthos and for certain species of birds and marine mammals not be continued in FY 79. Emphasis will be placed on synthesis of environmental data on factors affecting biological populations and communities and on the phenology and ecology of selected species. A sound knowledge of the spatial and temporal distribution of major organisms, their migratory pathways, habitat dependence and potential susceptibility to impact is a prerequisite to a thorough understanding of the ecosystem in sufficient appropriate detail and realism to assess impacts of OCS development.

A large amount of avian data have been obtained in Norton Sound and reported by several research units. Broad-scale reconnaissance studies were completed in FY 77, and reproductive ecology and phenology of certain bird species and foraging excursions from major rookeries are being addressed during FY 78. It is planned that these data be used to identify effects of large-scale environmental changes on bird communities and to estimate population density fluxes, biomass changes and bioenergetic demands of important bird species.

Studies on the seasonal distribution and feeding habits of marine mammals in Norton Basin will emphasize the synthesis of data from previous years, especially on the association of mammals with the ice edge and on the spatial and temporal variations in food habits. Field studies will be undertaken in late FY 79 or later only if this synthesis reveals significant information gaps requiring additional work.

Studies to determine pathological conditions and major causes of morbidity and mortality in marine mammals were initiated in this area in FY 78. It is planned that these studies be continued in FY 79.

Beaufort/Chukchi Sea

The OCSEAP biological effort in the Beaufort Sea began in FY 75. As in other lease areas studies were initially reconnaissance level surveys of distribution and abundance of principal biota. The shift toward specific process studies in geographically limited regions began somewhat sooner in the Beaufort Sea than in the other lease areas. By FY 76 initial planning activities for an interdisciplinary ecological process study in the Simpson Lagoon/Barrier Island system were already underway. Survey studies of distribution and abundance of marine mammals, birds, and fish were essentially completed by the end of FY 77, and in FY 78 the biological studies showed a marked change in direction toward an emphasis of process studies to determine the interdependence of the various biological species and their dependence on habitats and abiotic parameters. Population dynamics, year-to-year variability, life cycles, and food web dependencies received major attention in FY 78. These studies are scheduled to continue through FY 79.

By the proposed lease sale date, adequate survey and process information on biota seem fairly well assured for the purpose of environmental protection during the exploration phase of the nearshore lease tracts. Followup studies demand continued efforts at synthesis of information between 1979 and 1981, prior to development.

In the Chukchi Sea the biological program has progressed more slowly than in other lease areas because of the steady decline in funding level since that region was removed from the sale schedule. The total authorized funding level for FY 79 is about 20 percent of the FY 77 value and biological studies have been de-emphasized accordingly. The FY 79 program in the Chukchi Sea will still be largely in a reconnaissance mode.

By 1980, general information required on certain aspects of the biota will be: survey and process understanding on major bird and mammal populations; littoral zone work on invertebrates, plankton and birds; and some plankton and benthos information on the northern Chukchi. Noticeably absent will be a fisheries survey and inventory, as well as process understanding and coastal habitat knowledge in the Kotzebue Sound - Selawik Lakes regions, where the complex shoreline made survey efforts too expensive to undertake in FY 76, when they could have been done.

2.1.6 Effects

The OCSEAP effects program is an ongoing effort, not coupled specifically to the schedule for any particular lease area. The results of the effects studies are used in establishing causal relationships between OCS-related perturbations and physiological or biological change, and form the basis for developing discharge regulations and operating stipulations. In addition, OCSEAP is evaluating biological responses to OCS stresses for their potential usefulness as early warning indicators or monitoring aids in detecting or quantifying environmental change.

OCSEAP initiated the program of effects research at the inception of the lease area studies program. Effects studies to date have consisted mainly of laboratory efforts. In FY 79, however, there will be a substantial shift toward field studies designed (1) to verify or validate laboratory observation under realistic field conditions and (2) to generate data on exposure concentrations and compositions likely to occur under various environmental conditions. The field observations and data are important for improved interpretation of laboratory results. In addition, there will be an extension of the program from its previous focus on the direct effects of petroleum to include studies of other OCS-related perturbations on the marine environment.

2.2 FUTURE PROGRAM EMPHASIS

The following material summarizes briefly the major program directions that are expected to influence the nature and timing of OCSEAP studies over the next few years. This summary is based on the continuing evaluation of the program content by the OCSEAP and BLM staffs, as reflected in the discussion of the previous section, and on input from the external program reviews.

2.2.1 Contaminants

- Reconnaissance hydrocarbon surveys will be discontinued after FY 78.

- Trace metal injection into the marine environment is not considered to be a serious problem and trace-metal analyses will be discontinued after FY 78.
- The FY 79 chemistry program will be process- rather than survey-oriented. Studies during FY 79 and beyond will emphasize site-specific field investigations and field weathering and dispersal studies.

2.2.2 Hazards

- Seismic hazards studies in active areas will continue to receive strong OCSEAP support for the duration of the program.
- OCSEAP must seriously explore the feasibility of funding for OBS units and strong-motion accelerometers.
- Volcanism studies in the Gulf of Alaska will continue to receive strong support as an integral part of the seismic program.
- Bottom faulting and sediment stability studies will continue to receive strong support in advance of sales for those areas still on the current Proposed OCS Planning Schedule.
- Studies of severe storm hazards will be initiated in FY 79.
- Gas-charged sediments in Norton Sound are a potentially serious hazard. These investigations should continue in FY 79 and possibly FY 80.

2.2.3 Transport

- FY 79 is a "synthesis year" for oceanographic transport studies; the field effort will be substantially reduced in FY 79.
- Studies in FY 80 and beyond will depend on the results of the FY 79 synthesis effort.
- Nearshore physical oceanography studies should be planned on the basis of the coincidence of an important biological community with either planned nearshore development activities or with likely impingement from more distant sources as established from previous, large-scale trajectory studies.

- Studies of sediments as a transport mechanism will focus on obtaining a better understanding of the processes of oil-sediment interaction.
- A new two-year study addressing the transport and retention of oil by ice was begun in FY 78 because of the importance of ice as a transport mechanism in the Beaufort Sea.

2.2.4 Biological Populations and Ecosystems at Risk

- The biology program is shifting in emphasis toward ecological process studies; reconnaissance surveys of distribution and abundance of biota will not be continued in FY 79.
- Two major site-specific ecological studies are being designed and implemented in the Gulf of Alaska (Kodiak and Lower Cook Inlet) during FY 78; these studies could possibly last for three years and have a significant influence on the nature of subsequent biological studies conducted in these areas.
- By FY 79 the number of existing bird colony studies will be reduced to a minimum; viz, those addressing the critical seabird species most likely to be impacted by OCS development. Colony studies will emphasize those observations that will permit repopulation predictions following a major loss.
- Studies of man-induced perturbations on biota under controlled conditions will be solicited and encouraged during FY 79 and beyond.
- The current mammal field studies have been largely suspended during FY 78. Primary emphasis in FY 79 will be placed on the synthesis of information from all past studies and the preparation of a detailed marine mammal species account. The results of these activities will determine which, if any, field studies might be resumed in late FY 79 or beyond.

2.2.5 Effects

- Major effort in FY 79 will be placed on design and implementation of field studies to verify and validate observations made previously under laboratory conditions.
- Other field studies will address effects of OCS perturbations other than direct petroleum effects: for example, quantitative studies will be undertaken at selected bird colonies to assess the impacts of increased aircraft traffic on bird productivity.

2.3 INFORMATION NEEDS AND TIMING

Certain key decision points during the planning schedule for any lease area require the availability of progressively higher levels of environmental information. The timing of these information requirements is the driving force behind the planning of environmental studies and the generation of useful program products. These products are outputs of the six major tasks (program objectives) described in Section 1.5 and discussed above (with the exception of Sources). The major tasks contain an interlocking hierarchy of subtasks, each of the latter having been formulated to facilitate the identification and phasing of logical collections of smaller and more manageable activities. The complete hierarchy of tasks and subtasks, discussed in detail in Section 4.6.4 of the Program Development Plan (PDP), is listed without elaboration in the following section for future reference.

2.3.1 OCSEAP Tasks (Program Objectives) and Subtasks

TASK A

WHAT ARE THE EXISTING DISTRIBUTION AND CONCENTRATION OF POTENTIAL CONTAMINANTS ASSCIATED WITH PETROLEUM DEVELOPMENT?

Subtask A-1 Determine the total petroleum and selected potentially toxic hydrocarbon components of:

- neuston and floating tar - the water column (soluble and suspended material) - selected marine organisms - sea ice and the sea ice-water interface
- sediments

Subtask A-2 Determine the seasonal horizontal and vertical distribution of methane, ethane, propane, butane, and relevant olefinic homologies in the water column. Determine the practicality of detecting and monitoring petroleum sources in Alaskan coastal waters through the use of these light hydrocarbons.

Subtask A-3 Determine the total content and chemical species of selected toxic metals, and describe the distribution and concentrations of these contaminants in:

- the water column (soluble and suspended forms)
- selected marine organisms
- bottom sediments, interstitial water, and subsea permafrost
- sea ice and sea ice-water interface

TASK B

WHAT ARE THE NATURE AND MAGNITUDE OF CONTAMINANTS AND ENVIRONMENTAL DISTURBANCES THAT MAY BE ASSUMED TO ACCOMPANY PETROLEUM EXPLORATION AND DEVELOPMENT OF THE ALASKAN CONTINENTAL SHELF?

Subtask B-1 Obtain and continually update estimates of the location, nature, and timing of platform, pipeline, and facility development in each lease area.

Subtask B-2 Estimate the quantity and physical and chemical nature of contaminants from each potential source based on projected design characteristics and operating methods, as well as on experience with petroleum development operations in other locations.

Subtask B-3 Estimate the nature and amount of possible environmental disturbance likely to accompany development.

TASK C

WHAT HAZARDS DOES THE ENVIRONMENT POSE TO PETROLEUM EXPLORATION AND DEVELOPMENT?

Subtask C-1	Determine seismic and tectonic hazards in, and peripheral to, regions proposed for petroleum development.
Subtask C-2	Determine hazards to petroleum exploration and development resulting from surface and near surface faulting.
Subtask C-3	Determine the types and extent of natural seafloor instability.
Subtask C-4	Evaluate areas of seafloor erosion and deposition.
Subtask C-5	Evaluate rates of change in coastal morphology, with particular emphasis on rates and patterns of man-induced changes. Locate areas where coastal morphology is likely to be changed by man's activities and evaluate the effect of these changes.
Subtask C-6	Determine the extent and character of ice-bonded subsea permafrost along the Alaskan coast.
Subtask C-7	Characterize the frequency of occurrence, geographical distribution, and nature of ice gouging phenomena.
Subtask C-8	Determine, map, and interpret the distribution and pore pressures of shallow overpressured sediments.
Subtask C-9	Determine the stress-strain relationships in various types of sea ice encountered along the Alaskan coast to permit calculation of ice forces and loads on structures. Determine the range of forces and extremes of stresses and forces that may be placed on platforms and facilities by ice.
Subtask C-10	Synthesize existing literature to provide analysis of the frequency, intensity, and effects of extreme oceanic events.

TASK D

HOW ARE CONTAMINANT DISCHARGES MOVED THROUGH THE ENVIRONMENT AND ALTERED BY PHYSICAL, CHEMICAL, AND BIOLOGICAL PROCESSES?

Subtask D-1	Determine circulation patterns and develop the capability to predict the transport of petroleum-related pollutants in offshore regimes.
Subtask D-2	Determine circulation patterns and develop the capability to predict the transport of petroleum-related pollutants into inshore regimes.
Subtask D-3	Conduct theoretical and observational field and laboratory studies required to improve understanding of plume behavior and weathering processes to improve oil spill trajectory and toxicity forecasts.
Subtask D-4	Determine the types and characteristics of bottom sediments including benthos-sedimentary substrate interactions.
Subtask D-5	Characterize bottom sediment dynamics.
Subtask D-6	Characterize physically and chemically suspended particulates, and their influx, transport and deposition. Determine the mechanisms, pathways, and rates of suspended sediment transport including coastal morphological processes. Develop an understanding of oil/sediment interaction processes.
Subtask D-7	Map sea floor topography to support circulation studies and biologic work in spatial variations of populations.
Subtask D-8	Characterize the distribution and nature of the most important sea ice features (leads, ridges, polynyas, etc.) on a seasonal basis and the undersea morphology of sea ice on the Alaskan Continental Shelf.
Subtask D-9	Describe and analyze the dynamic behavior of sea ice (stresses motions, deformations, etc.) and the effects on transport processes of pollutants and on the safety of man-made structures.

Subtask D-10 Determine the possible interaction between ice and oil and other contaminant discharges.

Subtask D-11 Evaluate and quantify the extent and likelihood of transport of oil inland beyond the normal beach line by storm surges.

TASK E

WHAT ARE THE BIOLOGICAL POPULATIONS AND ECOLOGICAL SYSTEMS MOST SUBJECT TO IMPACT FROM PETROLEUM EXPLORATION AND DEVELOPMENT?

Subtask E-1 Determine the seasonal density distribution, critical habitats, migratory routes, and breeding locales for marine mammals. Identify critical species and sites, particularly in regard to possible effects of oil and gas development.

Subtask E-2 Describe population dynamics and trophic relationships for selected species of marine mammals.

Subtask E-3 Determine the seasonal density distribution, critical habitats, migratory routes, and breeding locales for principal marine bird species. Identify critical species particularly in regard to possible effects of oil and gas development.

Subtask E-4 Describe dynamics and trophic relationships of selected marine bird species at offshore and coastal study sites.

Subtask E-5 Determine the distribution and abundance of certain pelagic and demersal fish. Supplement current fisheries data when necessary. Determine the relative seasonal density distribution, critical habitats, growth and food habits of juvenile pelagic fish.

Subtask E-6 Determine the food dependencies of commonly occurring species of pelagic and demersal fish to establish principal ecological relationships.

Subtask E-7	Determine the distribution, abundance, diversity and productivity of the benthic community.
Subtask E-8	Provide a general description of the intertidal and shallow subtidal habitats.
Subtask E-9	Describe the ecosystem dynamics for littoral biota of the principal shore types with particular emphasis on potential, immediate and long-term impacts of contaminants and disturbances in species population dynamics, community composition, and productivity of the ecosystem.
Subtask E-10	Determine seasonal density distributions of principal species of phytoplankton, zooplankton, and meroplankton.
Subtask E-11	Determine seasonal indices of phytoplankton production, particularly the sea ice flora. Identify pathways of matter (energy) transport between synthesizers and consumers.
Subtask E-12	Determine non-population dependent physiological and population parameters of plankton communities.
Subtask E-13	Identify and characterize critical regions and habitats required by egg and larval stages of fish and shellfish species, especially those of commercial or ecosystem importance.
Subtask E-14	Development of ichthyoplankton key to aid identification of the ichthyoplankton occurring in Alaskan waters.
Subtask E-15	Characterize marine microbiological communities with regard to the normal biota of heterotrophs, chemotrophs, and pathogens.
Subtask E-16	Determine the behavior of heterotrophic microorganisms, pathogens, and chemotrophs and their response to normal environmental stresses in arctic and subarctic waters.

Subtask E-17 Determine the relationship of living resources to ice environment (including the edge of drifting ice, land fast ice, and inner pack ice), and examine the biological activities (species associations, food habits) under landfast ice on a seasonal basis in the Bering, Chukchi, and Beaufort Seas.

TASK F

WHAT ARE THE EFFECTS OF CONTAMINANTS AND ENVIRONMENTAL ALTERATIONS RELATED TO OCS OIL AND GAS ACTIVITIES ON INDIVIDUAL ORGANISMS, POPULATIONS AND ECOLOGICAL SYSTEMS

Subtask F-1 Review and evaluate the available literature and unpublished data on toxicity of crude oils and crude oil components (including toxic metals) on the basis of species, life stage, temperature at exposure, water source, oil source, geographic source of organisms, and presence of toxic metals.

Subtask F-2 Determine the acute and chronic effects of crude oil and its component fractions, toxic metal components of drilling muds, and other petroleum-associated chemicals on survival, growth, reproduction, and selected physiological and behavioral mechanisms of selected arctic and subarctic organisms.

Subtask F-3 Determine the effects of crude oil on the thermoregulatory mechanism and other functions of marine birds and mammals.

Subtask F-4 Determine by laboratory experiments the potential release of toxic metals from oil-impacted sediments, the occurrence of soluble and non-soluble toxic metals in sediments (with emphasis on organometallic complexes), and the relative importance of these toxic metals on various species in terms of uptake and effects on biota.

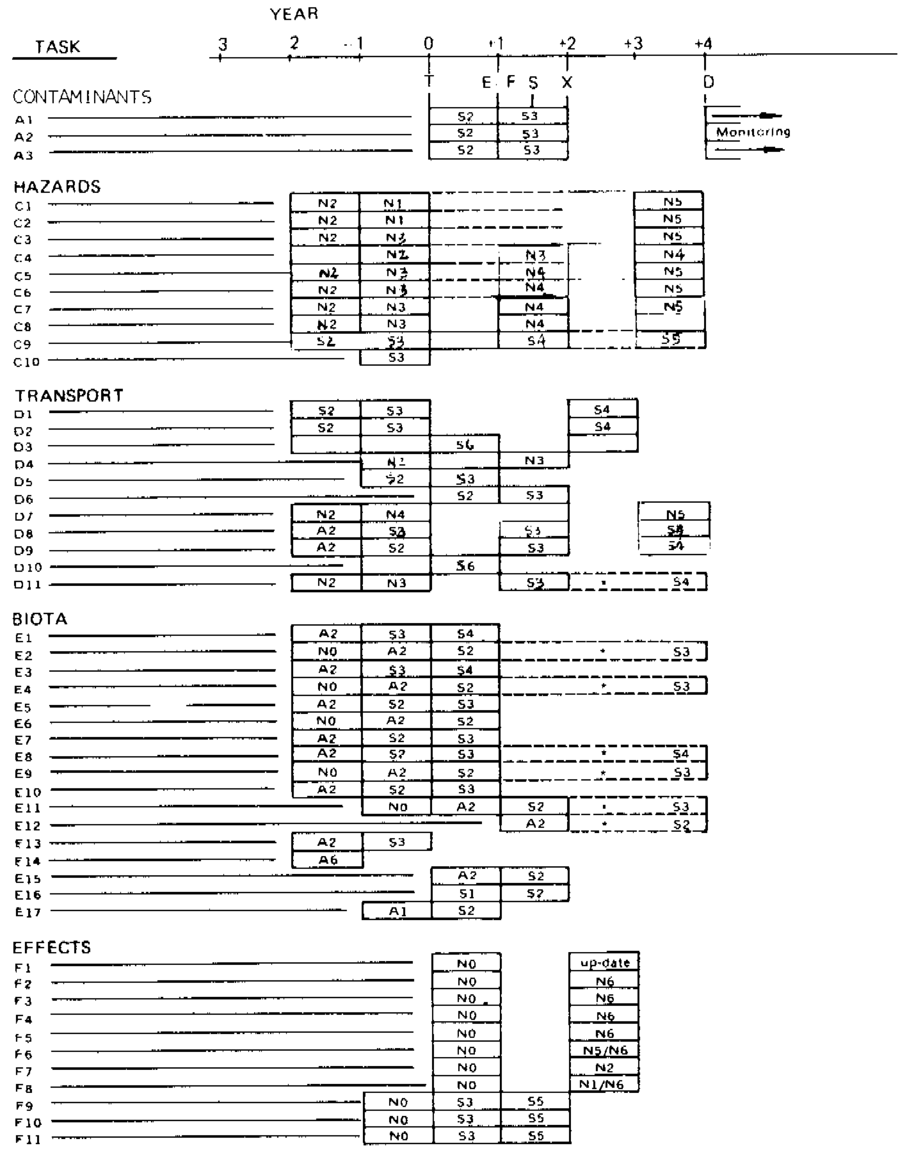
Subtask F-5	Determine by laboratory experiment the bioaccumu lation and relative effects of petroleum hydrocarbons and other OCS-related contaminants presented through various exposure pathways, including soluble forms, food chain exposure, suspended-particulate-borne contaminants and sediment-adsorbed contaminants.
Subtask F-6	Conduct laboratory and field studies to determine recovery rates of selected organisms and ecosystems from perturbations caused by either contaminantion or other disturbances associated with petroleum development.
Subtask F-7	Determine the types and incidences of diseases presently occurring in fish, shellfish, birds, and mammals for use in (a) evaluating future impacts of petroleum-related activity, and (b) designing experiments to test the effects of contaminant exposure to disease-susceptibilty.
Subtask F-8	Determine the potential ecological effects of alternative countermeasures to oil spills.
Subtask F-9	Describe, analyze and verify the ecological community structure and productivity of selected coastal ecosystems with respect to potential impacts of OCS oil and gas development.
Subtask F-10	Describe, analyze, and verify the ecological community structure of the ice-front production system with respect to potential impacts of OCS oil and gas development.
Subtask F-11	Describe, analyze and verify the community ecology of coastal detritus systems with respect to OCS development impacts.

2.3.2 Study Resolution and Timing

Figure 2.1 summarizes in matrix form the Department of Interior product needs and scheduling necessary in the planning of OCSEAP research. This figure is in many respects similar to Figure 5-2 in the Program Development Plan (PDP), which shows the generic time progression of the major program elements keyed to BLM needs. The two figures differ in the following important respect, however. The matrix in Figure 2.1 contains information denoting the temporal and spatial resolution judged by BLM to satisfy specific product needs at the indicated decision points.

This matrix is based on the Jamison Resolution Analysis submitted to the OSESAC by BLM on November 5, 1976 and on considerable subsequent discussion between the BLM and OCSEAP staffs. A primary objective of the particular format chosen was the quantification of the study timing and the spatial and temporal resolution required by BLM for each of the study elements identified in Section 2.3.1. The analysis that produced Figure 2.1 also added an important dimension to the needs specification not contained in the Jamison Resolution Analysis, namely, the inclusion of temporal resolution. Due to the complexity of the marine system under study, a knowledge of the required temporal resolution at various stages of the decision process is important for optimum resource allocation and design of individual investigations. Figure 2.1 contains a generic time axis which can be converted to apply to a specific lease area by the entry of a known date at any one of the decision points. Application to a specific lease area might, however, eliminate the need to address certain of the subtasks (e.g., ice hazards in NEGOA). However, the timing and resolution needs will be the same whenever a subtask is applicable.

It must be emphasized that the matrix in Figure 2.1 represents a summary of when and to what level of detail BLM needs hazards and environmental information to make leasing decisions. The matrix provides no indication of OCSEAP's progress in producing such information, nor does it attempt to address the question of the lead time required to bring



T = TRACT SELECTION
E–F = DRAFT OR FINAL EIS
S = SALE
X = EXPLORATION BEGINS (est.)
D = DEVELOPMENT – AT LEAST 2yrs. AFTER EXPLORATION
* = HIGHER RESOLUTION NEEDED IF OIL DISCOVERED

——RESOLUTION CODE ——

SPATIAL RESOLUTION

0 = information in hand, literature reviews
1 = qualitative, area wide, cursory
2 = semi-quantitative, hundreds of square miles scale or 25 miles of coastline
3 = quantitative, 3–10 tracts scale or 10 miles of coastline
4 = quantitative, tract specific (2 to 5 mile resolution)
5 = quantitative, site specific
6 = no spatial resolution (non-site-specific)

TEMPORAL RESOLUTION

N = no temporal resolution
A = annual
S = seasonal

FIGURE 2.1 RESOLUTION SCHEDULE FOR OCS STUDIES certain studies up to the indicated levels of resolution. Also, it is not the intent of the matrix to imply that all levels of resolution, particularly during exploration and development, should necessarily be provided by OCSEAP alone. This is clearly not possible. During the later stages of the leasing process, much detailed information can be provided more effectively and properly by the petroleum industry.

The actual products generated by the program in response to BLM needs are discussed in detail in Section 5.0 of each TDP. A modification of Figure 2.1 is used as the format for the presentation of these products. The program products format also contains the status of the past, present, and projected resolution of each product generated by OCSEAP. In this way, past and projected program progress can be measured against BLM needs summarized in Figure 2.1. However, such a comparison requires the recognition of three important factors: (1) Because of time and funding limitations, and the possible early identification of key environmental factors in certain locations, the levels of resolution indicated in the program products list for a given lease area are not necessarily uniform throughout that area; hence, in some cases, it may only be possible to provide information for a part of the lease area at the schedule and level of resolution indicated by Figure 2.1 with additional information for the total lease area to be provided in subsequent years. (2) Abrupt shifts in leasing priorities expressed, for example, by the last three Proposed OCS Planning Schedules (June 1975, January 1977, August 1977) have resulted in less than ideal conditions for an orderly phasing of studies in some lease areas. (3) As studies progress and more is learned about particular processes, the required and projected product resolution should be continually reevaluated in the light of improved understanding of the resolution level practically achievable.

The following material provides a brief discussion of the rationale underlying the timing and resolution requirements shown in Figure 2.1.

2.3.3 Contaminants

The resolution schedule for OCS studies does not require information on contaminant distributions prior to tract selection. Such information is first required, on a semi-quantitative level, at the time of environmental impact statement preparation for the primary purpose of providing a broad characterization of potential contaminant levels in the lease areas of concern. As the OCS exploration phase is reached, somewhat improved spatial resolution is required to update existing information and to obtain a more detailed picture of existing contaminant concentrations in specific areas about to undergo exploration. These latter studies will form the basis for the design of long-term monitoring programs to be undertaken during the development phase. As is evident from the task descriptions of Section 2.3.1, the issue of contaminants in the environment is actually much broader than that addressed by subtasks A-1 - A-3. A considerable number of important questions relating to contaminants are addressed under Task D, since sediment uptake, weathering, and other nonconservative transport processes will determine their final disposition.

2.3.4 Sources

As described in Section 1.3.2, the data required for this task are to be supplied to OCSEAP by BLM. Thus, while information on sources of potential contaminants and other environmental disturbances addresses an identified OCSEAP task, it is not included as such on the Resolution Schedule for OCS Studies.

2.3.5 Hazards

The resolution schedule indicates the need for semi-quantitative information on almost all hazards identified in Section 2.3.1 at least two years before tract selection. Hence, hazards information beyond the cursory or "in-hand level" can play an important role in the possible elimination of large areas from offer, even before tract selection. By the time of tract selection, hazards information must be upgraded, in general, to a level of resolution addressing individual or small groups of tracts. Considering the nature and the potential severity of the hazards in question, the studies required to produce information to the level of detail shown in Figure 2.1 are characterized by long lead times. Hence, the matrix beginning at two years before tract selection does not necessarily imply the beginning of studies. The hazards requirements are characterized by a general lack of need for temporal resolution (except for ice motion and extreme oceanic events) and a spatial resolution steadily increasing from the semi-quantitative to the site-specific some four years after tract selection. It is expected that industry will be heavily involved in providing information at the latter level of resolution.

2.3.6 Transport

The transport studies comprising tasks D-1 through D-11 can be roughly separated into three main categories: aquatic transport, ice transport, and modification of contaminant concentrations and forms due to various weathering processes. As discussed in Section 2.1.4, contaminant trajectories will be primarily determined by water motions in subarctic regions while ice will play a major role in transporting contaminants in the arctic. In either case, the ultimate fate of most contaminants will be determined by the rates of weathering and interaction with suspended particulates. The aquatic transport (Tasks D-1 and D-2) resolution requirements indicate a need for semi-quantitative, seasonal information on circulation patterns at least a year before tract selection. Such information can be used, along with other environmental data, to determine the size of the area offered at the call for nomination. At the time of tract selection, aquatic transport information should be available at a level of detail that will allow the identification of potentially adverse circulation features, on a seasonal basis, in areas comprising up to 10 tracts. This level of resolution will also be needed for the environmental impact statement. Tract selection and the preparation of the EIS will not necessarily mark the end of the need for information on coastal circulation. Several years after tract selection, seasonal, tract-specific information will be required during exploration to assess the likelihood of impingement of biological resources whose distribution has been established to a comparable level of resolution.

The required levels of detail for ice-related transport generally parallel those discussed above. In the case of ice, however, the tasks are not so clearly separable from those addressing the hazards problem and hence are expected to have a slightly longer duration than circulation studies. It should be noted that at the time of tract selection the required resolution for ice-related transport has increased temporally but not spatially, emphasizing the importance of seasonal variability in ice conditions.

2.3.7 Biota

Estimates of the distribution and abundance, migration, feeding sites and behavior of populations are among the first biological studies undertaken. The locations of the populations at each life-stage and activity are then related to likely contaminant pathways and incidence of disturbance to determine whether risk may exist. This study philosophy is reflected in the required resolution of information generated under Subtasks E-1, E-3, E-5 and E-7 (distribution and abundance of marine mammals, birds, fish and benthic communities, respectively). For example, the resolution requirement for the distribution and abundance of biota at the time of tract selection is comparable to that expected from the transport studies intended to predict impingement. This matching of required levels of detail on a multidisciplinary basis is an important planning consideration throughout the program.

After the biological populations potentially at risk have been established, the information considered in tract selection and in the preparation of the environmental impact statement, there is no need for additional studies of distribution and abundance of marine biota. Information needs shift focus to longer term studies of trophic relationships and ecosystem dynamics and the potential impacts of contaminants and other disturbances.

2.3.8 Effects

Effects studies are characteristically non-site-specific. Experimentation is required to document causal relationships between OCS development and potential changes in the biota or the ecosystem and to quantify the magnitude and reversibility of such changes. The results of effects experimentation are generally applicable to all lease areas in which the test species or habitats occur. The current program has been focused heavily on the lethal and sublethal effects of petroleum exposure in a variety of marine organisms, mainly under laboratory conditions. In FY 77, the program will be extended to include field experiments for verification of laboratory observations and experimentation on OCS perturbations other than the direct effects of petroleum contamination.

The resolution schedule for BLM needs indicates the requirement for best available information on the effects of OCS leasing and development at the time of tract selection. This information is an essential part of the assessment of potential environmental impacts of the development. An update is then required about two years after tract selection when exploration is underway and plans for development are proceeding. Since the leasing schedule now calls for lease sales of Alaskan areas at approximately 6-month intervals, a continuous program of effects research is required to ensure significant progress in the understanding of OCS impacts. The program directed at subtasks F-1 through F-8 is described in the Non-Site-Specific TDP; the ecosystem studies (subtasks F-9 - F-11) will be found in the appropriate lease area TDP's (e.g., the barrier island-lagoon study in the Beaufort TDP).

3.0 NEGOA PROGRAM

3.1 SCOPE AND DIRECTION

3.1.1 Background

Petroleum-related activities in the NEGOA began in the late 1800's. A minor amount of production and refining of oil took place at the onshore Katalla field between 1901 and 1933. Twenty-five exploratory wells were drilled unsuccessfully between Yakataga and Yakutat from 1954-1963. The State of Alaska has held six offshore sales in State waters here since December 1960; the lone drilling operation resulting from those sales was a dry hole drilled near Kayak Island.

As noted previously, the NEGOA was the first Alaskan OCS frontier area leased by the Federal government. The initial call for nominations was in February 1968. A sale was planned for the summer of 1974 but not held. OCSEAP studies were initiated in July 1974 in anticipation of a sale, and second call for nominations was made in November 1974. It was followed by OCS sale number 39 in April 1976. Figure 3-1 shows tracts offered, those for which industry bids were accepted, and their current status. Exploration began in September 1976 and is still underway. The OCS planning schedule of August 1977 indicates another announcement of tracts will be made in October 1978, to be followed by a second sale (OCS Sale #55) in June 1980. The following discussion reflects the influence of these events on the OCSEAP planning and implementation in NEGOA.

3.1.2 Premises

The OCSEA program's content, scope and emphasis in NEGOA is conditioned by various premises, some of which are of a general nature, others unique to this lease area. They are:

1. Shoreline hazards to development and biota resulting from petroleum development will be addressed only to the extent that they apply to OCS activities.
2. Only environmental-related effects of OCS development will be addressed. The evaluation of secondary effects (e.g., economic impacts on the commercial fishing industry) is outside the scope of the OCSEAP.

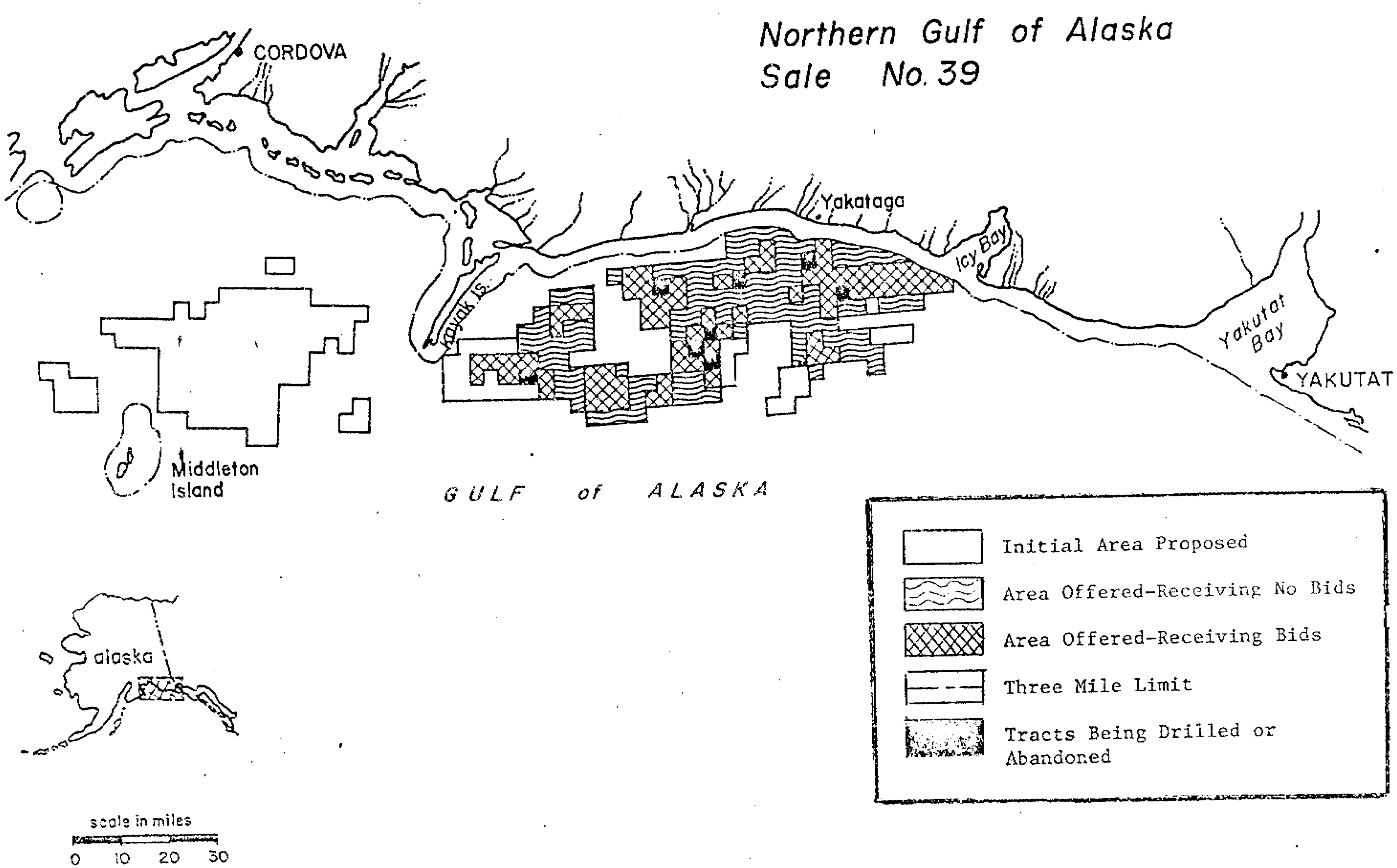
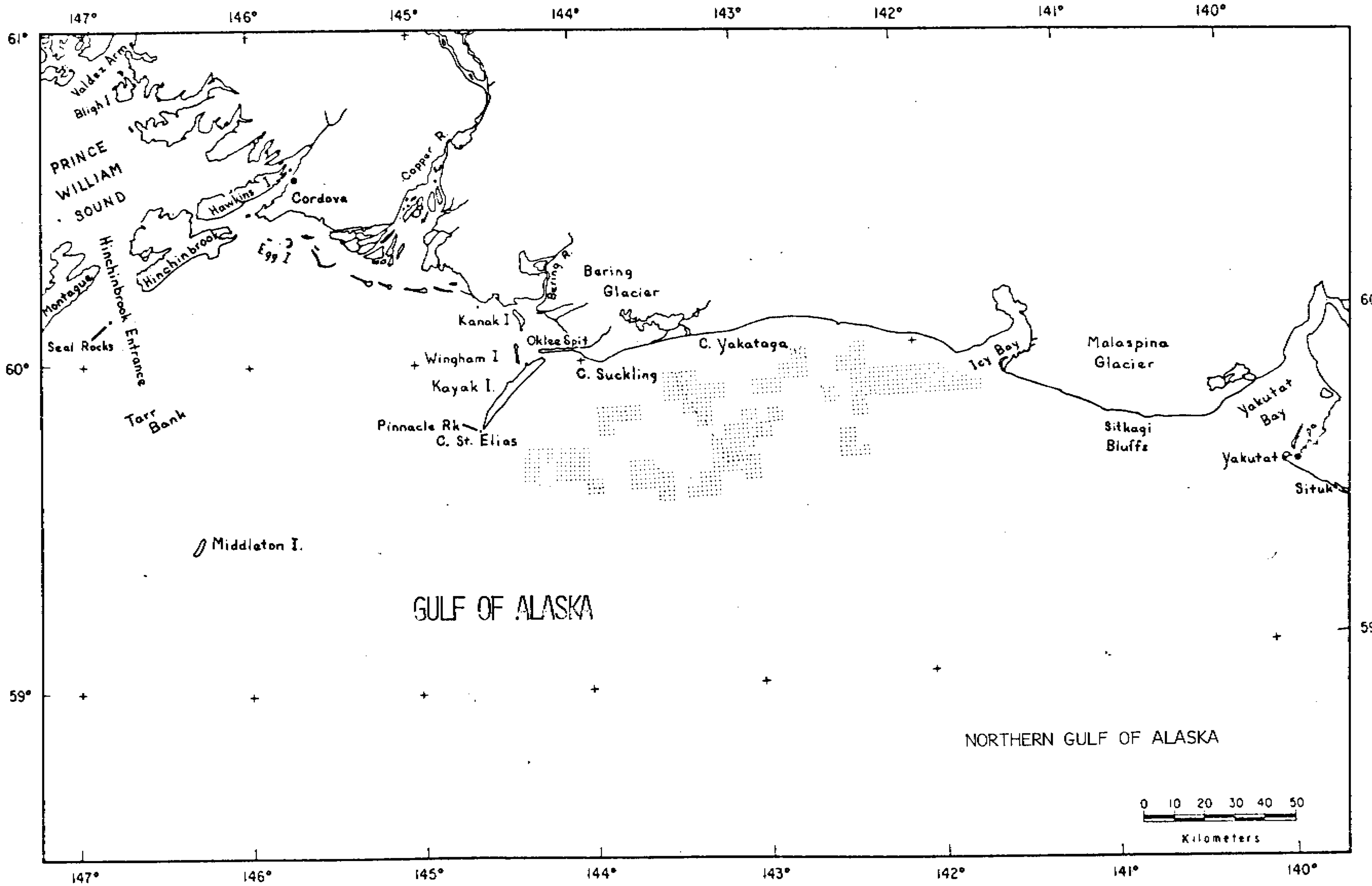


FIGURE 3-1. NEGOA LEASE AREA (after Alaska Marine Consultants, 1976)

3. Initial studies, while providing data on predevelopment levels of contaminants in water, substrates, and biota that are applicable to the planning of monitoring programs, are not specifically intended to fully address such needs.
4. Interactions between lease areas (biological, geological, circulation, etc.) must be considered in order to derive meaningful results applicable to a given lease area.
5. Comprehensive "ecosystem" studies cannot be adequately performed within the time constraints dictated by information needs; thus only selected "critical" components or processes characterizing such ecosystems will be studied.
6. Non-OCS related impingements or hazards will not be studied, although applicable information may be generated in the course of OCSEAP studies.
7. Integrated process ("ecosystem") studies are intended to furnish information useful for site-specific needs, but are not intended to supplant such studies. Site-specific information needs may be addressed through either OCSEAP or other BLM-sponsored special studies.
8. Prince William Sound is not considered to be within the purview of OCSEAP's NEGOA program, although some information on that region will result from studies in contiguous areas.
9. The second lease sale in NEGOA may include any of the areas originally offered for nomination and not sold and, in addition, may include portions of the Outer Continental Shelf east and southwest of the first sale area. Therefore, until the announcement of tracts for Sale #55, OCSEAP planning must be predicated on the assumption that the entire area between the tip of the Kenai Peninsula and Cape Spencer may be encompassed by the second sale.
10. Task B (Sources) will not be addressed by OCSEAP. Such information, necessary for OCSEA Program planning, will be provided by BLM on a routine basis as it becomes available.



PRINCE WILLIAM SOUND
Valdez Arm
Bligh I
Hawkins I.
Cordova
Copper R.
Hinchinbrook
Montague
Hinchinbrook Entrance
Egg I
Seal Rocks
Bering R.
Bering Glacier
Kanak I
Okalee Spit
Wingham I
Kayak I.
C. Suckling
C. Yakataga
Icy Bay
Malaspina Glacier
Yakutat Bay
Yakutat
Situk
Sitkagi Bluffs
Tarr Bank
Pinnacle Rk
C. St. Elias
Middleton I.
GULF OF ALASKA
NORTHERN GULF OF ALASKA
0 10 20 30 40 50
Kilometers
147° 146° 145° 144° 143° 142° 141° 140°
61° 60° 59°

3.1.3 Long-term Needs

The NEGOA program initially emphasized the characterization of geological hazards, the establishment of pre-development levels of data on contaminants in water, sediments, and biota, offshore transport studies, and the acquisition of reconnaissance level information on the biota in order to provide those essential types of information for leasing and exploration phase decision-making. Subsequent emphasis has been on the filling of data gaps identified as a result of the initial work and the refinement of hazards and biological data bases. Current and projected future emphasis is given to the characterization of ecosystems in coastal habitats considered to be at risk, continued acquisition of seismic data, and studies of nearshore circulation. In the event of oil discovery, these types of information will prove useful as a basis for planning site-specific investigations that respond to decision-making needs related to subsequent development and production. The current research also addresses information needs for the second lease sale, since the regional information base is being continually refined as a result of the ongoing program.

When the results of the call for nominations for sale #55 become available, some realignments of program content may be necessary in order to address information needs for decision-making relating to the tract selection for that sale. Little revision of program content is anticipated if industry's interest lies in the geographical area originally offered. On the other hand, extension of the second sale area significantly southwestward or eastward of the first sale area might require substantially augmented efforts in the areas of the new offering.

3.2 KEY ISSUES AND STATUS OF KNOWLEDGE

The NEGOA program responds to BLM's specific decision-making needs through applied studies tailored to address the particular features of the regional environment relevant to OCS oil development. Some of these features are unique to NEGOA; others are found in other Alaskan OCS areas. The varying emphases given to specific elements of the program reflect their relative importance. The NEGOA region's physical features, major issues related to OCS development, and an overview of the current status of knowledge are outlined in the following paragraphs in order to lend perspective to the subsequent sections on general research approach and the FY 79 program.

3.2.1 Setting

Most of the northern Gulf of Alaska shoreline is deeply incised and rocky, but from its eastern extension west to Prince William Sound only a few inlets intervene, the most important being Yakutat Bay. This shoreline is characterized by wave-washed beaches and sedimentation from glacier-fed streams. Several glaciers and their terminal moraines are present along the coast from Cape Spencer to Cape Suckling. The Copper River delta, composed of glacial sediments, is the most prominent feature. Prince William Sound has a deeply incised, rocky coastline and many rocky islands and glacial fiords. The barrier islands of the Sound are dominated on the ocean side by wave-washed beaches.

The NEGOA continental shelf includes approximately 52,000 square kilometers and varies in width from 13 to 105 kilometers. Generally, the shelf topography has gently undulating relief with clearly defined submarine valleys. Prominent shoal areas rise above the general relief of the shelf--Fairweather Ground, Middleton Platform, and Tarr Bank--and have depths of 37 to 100 meters. Several submarine canyons or valleys dissect the continental shelf. The continental slope is relatively smooth and steep, descending to 2,000 to 4,000 meters east of Kayak Island and 4,500 meters to the west.

Circulation in the Gulf of Alaska is dominated by the relatively warm Alaska Current. The counter-clockwise flow follows the continental shelf edge in the NEGOA region and westward to the Aleutian Chain where it divides. Some of the water flows northward into the Bering Sea, while the remainder returns eastward as the Subarctic Current. The entire system is called the Alaska Gyral.

The Alaska Current is the portion of the gyre that flows north and west along the NEGOA coast. Nearshore the general westward drift is influenced by tides, local winds, river and glacial discharge, and topography. Nearshore current velocities average eight to ten centimeters per second. West of Kayak Island a large eddy projects far into the gulf. At the continental shelf edge currents increase to 25 to 50 centimeters per second.

Tides are of the typical west coast mixed type with large inequalities in heights and durations of successive high and low waters. Tidal amplitudes range from two to four meters, and tides influence water circulation patterns, especially within estuaries or between island passes. Coupled with major storms, tidal currents can prove hazardous in shallow straits.

The Gulf of Alaska is well known as an area of cyclogenesis, producing frequent storms. As a maritime zone, it is characterized by slight temperature variations and high humidity, precipitation, clouds, and fog. Icing of both surface vessels and aircraft is common. Sea heights as much as nine meters have been reported during storms.

Sea temperatures follow a seasonal climatic trend of cool summers and mild winters. The average sea temperature varies from 2.3 to 2.5?C in winter to 5.5 to 5.7?C in summer. The relatively warm, north-flowing Alaska Current moderates surface temperatures in summer and keeps the coast free of ice in winter except in protected waters. The entire region is generally free of ice. Coastal and fiord glaciers calve occasional icebergs, and some sheet ice forms during winter in inlets, fiords, and harbors.

Oceanic circulation patterns influence the salinity regime in this region. A general increase in salinity varies with distance offshore to a maximum in the central part of the Alaska Gyre. In summer, salinities are generally lower, ranging from approximately 31.0 parts per thousand (ppt) in nearshore waters to 32.5 ppt in offshore regions. In winter, salinities increase to approximately 32.0 ppt nearshore and 33.0 ppt offshore. Fresh water drainage from runoff, glacial ice-melt, and abundant precipitation dilute saline waters along the coast.

Water transported into the northern gulf by the Alaska Current has chemical properties determined by processes occurring in the more southern latitudes of the North Pacific Ocean. Seasonal upwelling may bring deep, cold, nutrient-rich oceanic waters to sunlit nearshore waters, providing conditions for rapid phytoplankton growth.

Sediment plumes form along the coast around river mouths and tidal inlets and are significant at the mouth of the Copper River. These plumes usually are entrained in the upper few inches of the water column and become less dense with distance from the sources as the sediments disperse and settle out. Bands of turbid water may sometimes be observed several hundred kilometers offshore.

These local sediment sources determine to a large degree the types of bottom sediments in any given area. On the continental shelf bordering the coastal region, glacial deposits are probably the most conspicuous except where large rivers have contributed fine-grained sediments.

3.2.2 Major Issues

There are unique biotic and abiotic elements of the regional environment that are deemed to affect or to be affected by OCS activities. They fall into three general categories: hazards to development posed by the environment, plant and animal life which might suffer insults, and abiotic features of the environment that have potential to produce adverse impacts on biota as a consequence of oil development activities.

Hazards to Development

The Northeast Gulf of Alaska has numerous environmental characteristics that can adversely affect petroleum industry activities. The NEGOA lease area is within an active seismic belt. Hundreds of earthquake events have been recorded during the past 75 years, several of them of large magnitude. Faulting is associated with the seismic activity; the region is tectonically complex and numerous faults have been identified, some of which may be active. Regional uplift and subsidence also have accompanied earthquakes, vertical displacements of as much as 10 meters having occurred during the great 1964 earthquake. Further hazards are associated with sediment instability. High rates of sedimentation of glacial outwash materials occur along parts of the coast, producing large unconsolidated sediment deposits. Extensive slumping of these deposits has occurred, possibly triggered by earthquakes. Coastal morphology is undergoing rapid change in some areas due to active erosion and deposition, and tectonism.

Extreme oceanic events present a considerable hazard to offshore and onshore structures. The NEGOA is one of the stormiest oceanic regions in the world; it lies in the path of storms produced in the Aleutian Low. Major storms move northeastward through the region and are most frequent and intense during winter. Surface winds may reach 125 kmh (75mph). Wind waves produced by strong storms can attain heights of 12 m (40 ft.). Areas of the coast occasionally experience storm surges accompanying violent storms. Tsunamis associated with earthquakes have occurred in the region, the most recent (1964) notable one caused major damage to several coastal cities around the periphery of the Gulf. Katabatic or drainage winds constitute local hazards to activities along certain parts of the coast.

Biota at Risk

There are numerous plants and animals that might be at risk from or impinged upon by OCS activities in the Northeast Gulf of Alaska.

Plankton:

These organisms form the basis of food chains extending up through the fishes, seabirds and marine mammals. Plankton are not likely to suffer long-term impacts from development due to their rapid regenerative abilities, ubiquity and potential for reintroduction by currents. However, higher trophic level organisms may be affected by disruptions in plankton communities. The disruption could take the form of temporary absence of the prey item from an area during a time when the prey is critical to the well-being of a predator (e.g., certain ichthyoplankton). Hence, recruitment of certain species might be affected. Another possibility is the ingestion by predators of plankton containing contaminants and subsequent transfers of the contaminants to higher trophic levels. A third means of contaminant disruption is through transfers of pollutants from nearsurface waters to the sediments via active movements by diel-migrating zooplankton or incorporation of contaminants into fecal pellets which sink to the sea floor. The contaminants may then enter demersal and benthic trophic pathways.

Fish and Shellfish:

Large populations of pelagic, demersal, and forage fish and shellfish are present in the lease area. Numerous species utilize the region for spawning and rearing. Early pelagic life history stages of fish and shellfish are abundant in the plankton during spring and summer; they include such species as walleye pollock, halibut, Tanner and king crabs. Little is known about these early life stages in NEGOA waters. Herring, capelin, and smelt concentrate in the nearshore regions in spring preparatory to spawning along beaches or ascending rivers. Millions of young and adult salmonids are present during summer and autumn in the epipelagic zone in the coastal waters. Salmon, crab, halibut and herring form the bases of significant local fisheries. The roundfish and flatfish of the outer shelf are the targets of substantial foreign trawl fisheries.

Benthos:

These organisms constitute a potentially vulnerable group because many are sessile or have relatively low mobility. In the event of impingement, some could be adversely affected by contaminants. Because many of the benthic fauna are important prey items for species of commercial importance, this group warrants consideration.

Littoral Biota:

Diverse littoral habitats are present along the hundreds of kilometers of northeastern Gulf of Alaska coastline. They range from exposed sandy shores, as near Yakutat, to the rocky intertidal and estuarine settings around Hinchinbrook Entrance and the Copper River Delta. The potential for impact to littoral biota is variable, depending on community structure, substrate and the nature of the impingement. The intertidal habitat is important because it provides food and shelter for numerous species of commercial importance and, in some cases, serves as a source of energy export that helps to sustain offshore communities.

Birds:

Seabirds, shorebirds and waterbirds can be found in varying numbers in the NEGOA throughout the year. Numerous seabird species nest during summer at colonies around the periphery of the Gulf. They use the coastal and shelf waters near the colonies for feeding. Large numbers of shorebirds and waterbirds migrate seasonally through the coastal region. The Copper River delta is a concentration point for millions of waterfowl and shorebirds during spring and autumn. Hundreds of thousands of sea ducks and seabirds winter in sheltered inshore waters or offshore over the continental shelf. Of these birds, the sea ducks, alcids and certain gulls are notably vulnerable to oil spills.

Marine Mammals:

Harbor seals and Steller sea lions are the most numerous pinnipeds in nearshore and coastal waters. Both species utilize coastal habitat for foraging, breeding and resting. Large concentrations of harbor seals occur in Icy Bay and on the islands off the Copper River Delta. Sea lion rookeries are present at Cape St. Elias and near Hinchinbrook Entrance. Sea otters are numerous in Prince William Sound and present in lesser numbers in other parts of the northern Gulf coast. They are beginning to repopulate regions from which they had been eliminated by commercial hunting. Many species of cetaceans and pinnipeds (e.g., fur seals and grey whales) migrate through the region in spring and fall. Certain cetacean species utilize Prince William Sound throughout the year.

Physical and Chemical Factors

Because the speed and direction of movement of a contaminant from a source determine where and when impingement occurs, there is a need for information on currents and circulation patterns. The NEGOA lease area is characterized by a number of factors affecting contaminant transport. The Alaska Current flows northward along the shelf break and influences shelf water and circulation. Relatively complex circulation patterns on the shelf result from the interactions of topography, tides, winds, water properties and runoff from rivers. There is evidence that some areas of the shelf, e.g., the region between Kayak and Montague Islands, are low energy environments and therefore possess potential to retain contaminants for extended periods.

The role of suspended sediments in the removal of contaminants from seawater must be elucidated. In the event of a large oil spill in the Copper River sediment plume or one of the other glacial outwash plumes, considerable amounts of oil could be adsorbed onto the sediments and subsequently sequestered at the sea bottom after settling. The contaminants would then pose a potential hazard to the detritus-feeding organisms which are dominant constituents of the benthos in that area.

There is potential for introduction of contaminants such as petroleum hydrocarbons and toxic metals into the environment as a consequence of OCS development. These may have adverse impacts on biota. Therefore, pre-development levels of these contaminants in biota, sediments and seawater must be known in order to make meaningful inferences about cause-effect relationships. Thus, studies include petrogenic hydrocarbons and heavy metal levels in biota, sediments and seawater as a major issue in OCS oil activities in the NEGOA region.

3.2.3 Status of Knowledge

For the sake of brevity, only the status of knowledge is discussed here. Those readers desiring a comprehensive overview of pre-OCSEAP knowledge of the oceanography and renewable resources of the region are referred to Rosenberg (1972). Detailed information on the results of OCSEAP studies is available in the Principal Investigators' quarterly, annual and final reports, in synthesis meeting reports, and in annual technical summaries (see Bibliography). The occasional use of the future tense in the following paragraphs indicates information anticipated to be forthcoming subsequent to the preparation of this summary. The following discussion is organized in the context of the major tasks outlined in the OCSEA Program Development Plan.

Contaminants (Task A)

Kaplan (RU 430), Cline and Feely (RU 153), Shaw (RU 275) and Burrell (RU 162) have performed reconnaissance investigations. Surveys of hydrocarbon and trace metal levels in biota, sediments and water demonstrate that the NEGOA has a relatively clean environment. Additional reconnaissance studies are not considered necessary, as a reasonable regional characterization has been obtained. Suspended sediment distributions have been mapped and initial investigations of the processes of sediment deposition and resuspension begun. Studies of oil-sediment interaction being conducted with Lower Cook Inlet sediments should provide data useful for making inferences about similar situations in the NEGOA. Contaminant uptake by biota and subsequent transfers through food webs are not yet adequately understood. These investigations are underway, as are investigations of biodegradation of petroleum.

Hazards (Task C)

An adequate regional characterization of geological structure, coastal morphology, faulting, seismicity, stream flow, and sediments is available from the investigations of Meyers (RU 352), Lahr and Page

(RU 210), Carlson and Molnia (RU's 212, 216), Boothroyd, Hayes, and ... (RU 059), Cannon (RU 099) and Carlson (RU 111). Seismicity studies indicate that great earthquakes are likely to occur during the anticipated life time of NEGOA oil field production. These latter studies require additional observations in order to refine the geographical locations and recurrence rates of earthquakes. The Icy Bay region has been identified as an area of active seismicity. Offshore and nearshore faults and areas of unstable sediments have been mapped throughout the lease area. Active erosion and deposition processes have been documented in the Icy Bay area. It appears that gas-charged sediments are not a significant hazard in NEGOA. An interpretation of the vulnerability of NEGOA coastlines to impingement by oil indicates that over 50 percent of the coastline is a high risk environment.

Transport (Task D)

Schumacher and Hayes (RU 138), Galt (RU 140), Hansen (RU 217), Royer (RU 289), Wise (RU 347), Favorite (RU 357), Walter (RU 367), Feely (RU 152), and Laevastu (RU 235) have made oceanographic and meteorological investigations. The various elements of the investigations included Lagrangian and Eulerian current measurements, hydrographic station data, literature summaries, remote sensing data and computer models. A comprehensive view of the regional oceanography and a capability to predict contaminant movements have resulted. The seasonal features of the offshore circulation, water masses and controlling processes are reasonably well understood. However, the surface water movements over the shelf in winter have not yet been investigated through Lagrangian methods. The regional climatology has been described and investigations of coastal winds are underway. Research to date has pointed out the need for additional work in the Kayak Island-Montague Island area. Weak circulation and likelihood of impingement from sources east of Kayak Island have prompted nearshore studies in the region. The present investigations are addressing the details of circulation and causative processes through observational studies. The predictive transport model is being refined to provide higher spatial-temporal resolution.

Receptors (Task E)

Marine Microbiology

Atlas (RU 030) and Morita (RU 190) have studied micro-organisms and provided seasonal data on distributions and abundance of heterotrophs, chemotrophs and pathogens and those capable of degrading petroleum contaminants. Both sediment and water samples were obtained for the studies, which showed that the former matrix supported larger populations of heterotrophs. In general hydrocarbon degraders are not abundant in the Gulf of Alaska; those from NEGOA showed relatively poor ability to degrade oil during winter. Sediment samples had much greater glutamic acid utilization potential than the water samples. Crude oil degradation rates in NEGOA sediments may be higher than those in other lease areas studied by RU 190.

Plankton

The relatively scanty knowledge of these organisms is based on the studies of Anderson (RU 058), Larrance (RU 156c, 425b), Damkaer (RU 156b, 425a) and Cooney (RU 156d, 426). The bulk of the available data came from pre-OCSEAP offshore sampling. Relatively little is known about the neritic zone. Seasonal variations in phytoplankton appear to be more pronounced in coastal waters than offshore and annual variations in both zones are greater than either seasonal or geographic variations. Net production and zooplankton grazing seem to be the dominant factors influencing chlorophyll distributions. Productivity in Prince William Sound exceeds that over the shelf or in oceanic waters. Microflagellates and certain diatoms are the dominant phytoplankton groups. Insufficient data are available to make inferences about seasonality and succession of phytoplankters.

The available information on zooplankton comes from the literature and a relatively small number of OCSEAP stations. A few stations have been occupied during several seasons, but a definitive regional characterization is lacking. The data are too few to evaluate the seasonal abundance, distribution and succession of zooplankters or the causative factors leading to observed patterns. Over 200 species of zooplankton are present, of which only 21 are considered important.

Fish and Shellfish

Ronholt and Pereyra (RU 174), Macy et al. (RU 064), English (RU 424), Smith (RU 284), Morrow (RU 285), Stern (RU 353) and Kaiser RU 024) have been active in the NEGOA fish studies. Keys to ichthyoplankton and forage fish otoliths have been produced. Reasonably good data exist for demersal fishes. A literature summary of knowledge of salmonids is available and a similar study of non-salmonid pelagic fishes is forthcoming. Information on razor clams has been compiled. Data on the food habits of major commercial species are becoming available. However, little is yet known about ichthyoplankton, juvenile fish and forage fish in the region.

Benthos

The benthic organisms in NEGOA have been characterized by Feder (RU's 005, 281, 282). A literature summary has been compiled, as well as the results of an extensive field study of the epifaunal and infaunal distribution and abundance. Basic information on species diversity and dominance in the region has been developed. The seasonal distributions and trophic relations of the benthic communities and their relation to other biotic and abiotic components of the environment are not yet well understood.

Littoral Biota

Zimmerman (RU 078/079), Lees (RU 417) and Rosenthal (Dames and Moore) have conducted studies of the littoral and sublittoral biota in NEGOA. The reconnaissance phase of those studies will be completed when final reports on results of littoral investigations are submitted in FY 78. A final report on the results of sampling at representative intertidal sites is being completed by O'Clair and Merrell. An atlas of the intertidal zone has been published; it contains information on the entire NEGOA coastline exclusive of the inner portions of Prince William Sound. Lees, under subcontract to RU 078, has submitted an ecological assessment of sublittoral plant assemblages at sites in the Montague Island-Hinchinbrook Island area. Rosenthal made some exploratory SCUBA observations on biotic assemblages outside the laminarian zone near Hinchinbrook Entrance. The area has been nominated as a site for an intensive integrated inshore study of seasonal composition and abundance of biota, and their trophic relationships.

Birds

Arneson (RU 003), Patten (RU 096), Myres and Guzman (RU 239), Lensink et al. (RUs 337, 338, 339, 340, 341, 342, 343) and Wiens (RU 108) have investigated seabirds, shorebirds, waterbirds and coastal migratory bird habitat. Significant seabird colonies have been located and the numbers of nesting bird species quantified. Investigations have been conducted for one or more years at the major colonies and data are available on phenology, reproductive ecology and food habits for the dominant species. Non-colonial and nocturnal nesting seabirds or shorebirds are not yet well studied. Habitat along the entire NEGOA coastline exclusive of Prince William Sound has been categorized. Pelagic distributions of seabirds have been observed during all seasons, although some localized spatial-temporal gaps exist. Analyses of these data are forthcoming in late FY 78. Significant data on the food habits of seabirds and shorebirds have been accumulated and are being analyzed; the relative importance of many prey species is becoming evident. Migration and habitat use studies are revealing the importance of certain habitats for migratory birds with respect to timing of use and nutritional bases. Field experiments have demonstrated the adverse effects on hatching success of glaucous-winged gulls when crude oil is applied to egg shells.

Marine Mammals

Braham and Fiscus (RU 068), Pitcher and Calkins (RU 229), Calkins and Pitcher (RU 243), and Hall (RU 481) have studied pinnipeds and cetaceans in the lease area. Charts of seasonal abundance and distributions of mammals in the pelagic realm are available; the data are sparse for the summer period. There is a relatively good data base on harbor seal and Steller sea lion abundance, population biology, and distributions in the coastal waters and Prince William Sound. Several thousand sea lion pups at different Gulf of Alaska rookeries have been branded; continued observations of these animals will provide information on population discreteness and movements throughout the Gulf. There is evidence that many sea lions move eastward from the Kodiak area in autumn and overwinter in the NEGOA.

Considerable information on sea otters in the Prince William Sound area is available through non-OCSEAP investigations by Pitcher (1974) and Rosenthal (1977). The former investigator determined seasonal distributions and abundance of the animals, while the latter studied sea otter habitat.

3.3 GENERAL APPROACH

3.3.1 Introduction

The lease area program addresses three primary objectives through OCSEAP Tasks A-F: (1) Characterization of environmental hazards to OCS oil exploration, development and production. (2) Identification of populations and ecosystems at risk as a consequence of OCS oil-related activities. (3) Determination of probable impingements and impacts on biota from OCS activities. The attainment of these objectives furnishes the suite of environmental information needed by BLM for decision-making related to development, impact assessment, and operations in OCS frontier areas.

The sequence of events preceding and during OCS development dictates the types and timeliness of the information required. Therefore, the NEGOA program is structured to respond to data needs pertinent to the BLM activities shown in Table I. The development chronology is conjectural, but probably represents a sufficiently accurate approximation for illustrative purposes.

The differing data needs through the leasing and development sequence are met through reconnaissance, tract-specific, site-specific

TABLE I. HYPOTHETICAL SEQUENCE OF OCS EVENTS - NEGOA

Milestone	Date	Industry Activity	Development Timing (mo.)	BLM Activity
Call for nominations	10/74	Tracts nominated	N/A	Make initial risk, hazards, impact assessments
DEIS				Revise DEIS, make final tract selections
FEIS				
Sale #39	4/76	Bids made		Bids accepted, exploration orders promulgated
Exploration	9/76	Exploratory drilling begins; support activities begin		
Discovery of oil in quantity	?	Field tests begin; support locations selected		Production platform criteria developed and promulgated
Development		Platform design begins; pipe is ordered *	8	Support, storage stipulations promulgated
		Onshore facilities and production platform construction begins	20	
		Pipe received, stored	30	
		Platform installed	36	OCS operating orders promulgated
		Development drilling begins	39	Pipeline permits furnished
		Pipe is laid	42	Monitoring begins
Production		Production begins	54	

* Assumes sufficient quantities found. Otherwise, Single Point Moor might be used.

and special studies, each composed of several tasks as illustrated in Figure 3-2. The geographic scope of field studies becomes increasingly localized in response to needs for more specific information dictated by the progress of events.

The relationships of major objectives, study types and subtasks are defined in the matrix shown in Figure 3-3. The rationales for the various studies under each major objective are presented in the following paragraphs, as are the rationales for the subtasks comprising each study. Task descriptions are presented in Section 2.3.

3.3.2 Hazards to Oil Exploration, Development and Production

Introduction

BLM requires information on the regional environmental hazards in order to make informed assessments pertaining to all phases of leasing, exploration, development and production. The information is used in the development of DEIS and EIS documents; tract selection and deselection; platform design, location and operation; pipeline permitting and routing; onshore facility design and location; and the formualtion of stipulations and operating orders.

Three major classes of hazards must be considered in NEGOA: Seismicity, substrate instability and extreme oceanic events. Seismicity poses a danger through physical damage to structures (and, secondarily, through releases of contaminants). Seismic hazards include earthquakes and associated faulting, uplift or subsidence. Substrate instability can affect the integrity of structures; it takes the form of slumping, changes of coastal morphology and rapid deposition or erosion of sediments. Extreme oceanic events are comprised of storm seas and winds, storm surges, and tsunamis. All of these events have potential for adverse impacts on OCS oil and gas activities in the NEGOA lease area.

Three types of field surveys are employed; each provides differing resolution of detail. Initial information needs are met through broad-scale reconnaissance surveys. Tract-specific surveys are employed to obtain higher resolution data. Site-specific surveys are intended to address problems associated with specific locations. Tasks B (Sources), C (Hazards) and D (Transport) are applicable. (See Figure 3-4).

SUBTASK: STUDY COMPONENT	R.U. EMPHASIS
E-9: Littoral Ecology (RU 078)	Seasonal composition of biota in selected habitats; food webs; trophodynamics, selected species
E-9: Sublittoral Macrophyte Ecology (RU 417)	Laminarian production emphasized; some community composition, succession, food webs
E-6: Sublittoral Fish Ecology (P 905)	Community composition and succession; food webs
E-7: Nearshore Benthos Ecology (RU 005)	Community composition and succession; food webs; trophodynamics of selected species
E-13: Meroplankton (P 906)	Seasonal abundance and composition; life histories of dominant ichthyoplankton, crustacea, shellfish
E-5: Forage Fish (P 906)	Seasonal abundance and distribution; habitat use, migration, spawning of dominant species
E-5: Juvenile Fish (P 906)	Seasonal abundance and distribution; habitat use, migration, food habits of dominant species
E-4: Seabirds (RU 341)	Reproductive ecology and trophic relations; foraging areas with respect to colony locations
E-2: Marine Mammals (RU 243)	Trophic relations; habitat use and population discreteness of selected pinnipeds
F-7: Disease and Mortality (RUs 194,332, 341)	Mortality indices of birds and mammals; diseases of pinnipeds and fish
D-2: Inshore Transport (RUs 140, 217, 289, 367)	Circulation patterns, persistence; prediction of surface trajectories; coastal winds; driving processes

F-9: Nearshore Ecological Processes

FIGURE 3-2. NEARSHORE STUDY COMPONENTS - NEGOA

	SUBTASK	RESEARCH EMPHASIS	Hazards to Development			Biota at Risk			Impacts on Biota	
		MAJOR OBJECTIVE / AREAL EXTENT OF STUDY	Reconnaissance	Tract-specific	Site-specific	Reconnaissance	Tract-specific	Site-specific	Special	Tract-specific
Contaminants	A-1	Hydrocarbons in Biotic, Abiotic Matrices				x[1]		x		
	A-2	Light Hydrocarbons				x		x		
	A-3	Toxic Metals in Biotic, Abiotic Matrices				x		x		
	B-1 to 3	SOURCES (BLM subtasks)	x	x	x	x	x	x	x	x
Hazards	C-1	Seismicity and Tectonism	x	x						
	C-2	Faulting	x	x	x					
	C-3	Sediment instability	x	x	x					
	C-4	Erosion and Deposition of Sediments	x	x	x					
	C-5	Coastal Morphology	x		x					
	C-6	Character of Permafrost								
	C-7	Ice Gouging								
	C-8	Gas-charged Sediments	x		?[2]					
	C-9	Sea Ice Engineering Properties								
	C-10	Extreme Oceanic Events	x		?					
Transport	D-1	Offshore Circulation				x	x		x	
	D-2	Inshore Circulation					x	x	x	
	D-3	Oil Spill Plume Behavior							*[3]	
	D-4	Sediment-benthos Interactions				x				
	D-5	Bottom Sediment Dynamics	x		x					
	D-6	Suspended Sediments				x				
	D-7	Seafloor Topography			?					
	D-8	Sea Ice Morphology								
	D-9	Sea Ice Dynamics								
	D-10	Sea Ice/Oil Interactions								
	D-11	Storm Surges	x		?				?	
Receptors	E-1	Marine Mammal Distribution and Abundance				x	x	?		
	E-2	Marine Mammal Trophics and Population Dynamics				x	x			
	E-3	Seabird Distribution and Abundance				x	x	?		
	E-4	Seabird Trophics and Population Dynamics				x	x			
	E-5	Fish Distributions and Abundance				x	x	?		
	E-6	Fish Trophics				x	x			
	E-7	Benthos: Diversity, Abundance, Productivity				x	x	?		
	E-8	Littoral Habitat Characterization				x				
	E-9	Littoral Biota Dynamics				x	x	?		
	E-10	Plankton Density Distributions				x				
	E-11	Phytoplankton Production				x				
	E-12	Plankton Physiology								
	E-13	Distributions of Fish Eggs and Larvae				x	x	?		
	E-14	Ichthyoplankton Key							x	
	E-15	Microbial Communities				x		?		
	E-16	Microbial Responses				x				
	E-17	Sea Ice as a Habitat								
Effects	F-1	Review Literature on Toxicity							*	
	F-2	Toxic Effects of Crude Oil on Biota							*	
	F-3	Thermoregulatory Effects of Oil on Biota							*	
	F-4	Release of Toxic Metals from Sediments							*	
	F-5	Bioaccumulation and Pathways of Contaminants							*	
		Perturbation Studies								x
	F-7	Diseases of Biota							x	
	F-8	Ecological Effects of Counter Measures							*	
	F-9	Coastal Ecosystem Characterization								x
	F-10	Ice-Front Ecosystem Characterization								
	F-11	Coastal Detritus System Characterization								x

1 Study of a tract or group of tracts, dependent on relevant characteristics
2 Study dependent on location of site, biological and physical characteristics
3 Pertinent laboratory study or field study outside lease area

FIGURE 3-3. RELATIONSHIPS OF SUBTASKS, OBJECTIVES AND STUDY TYPES

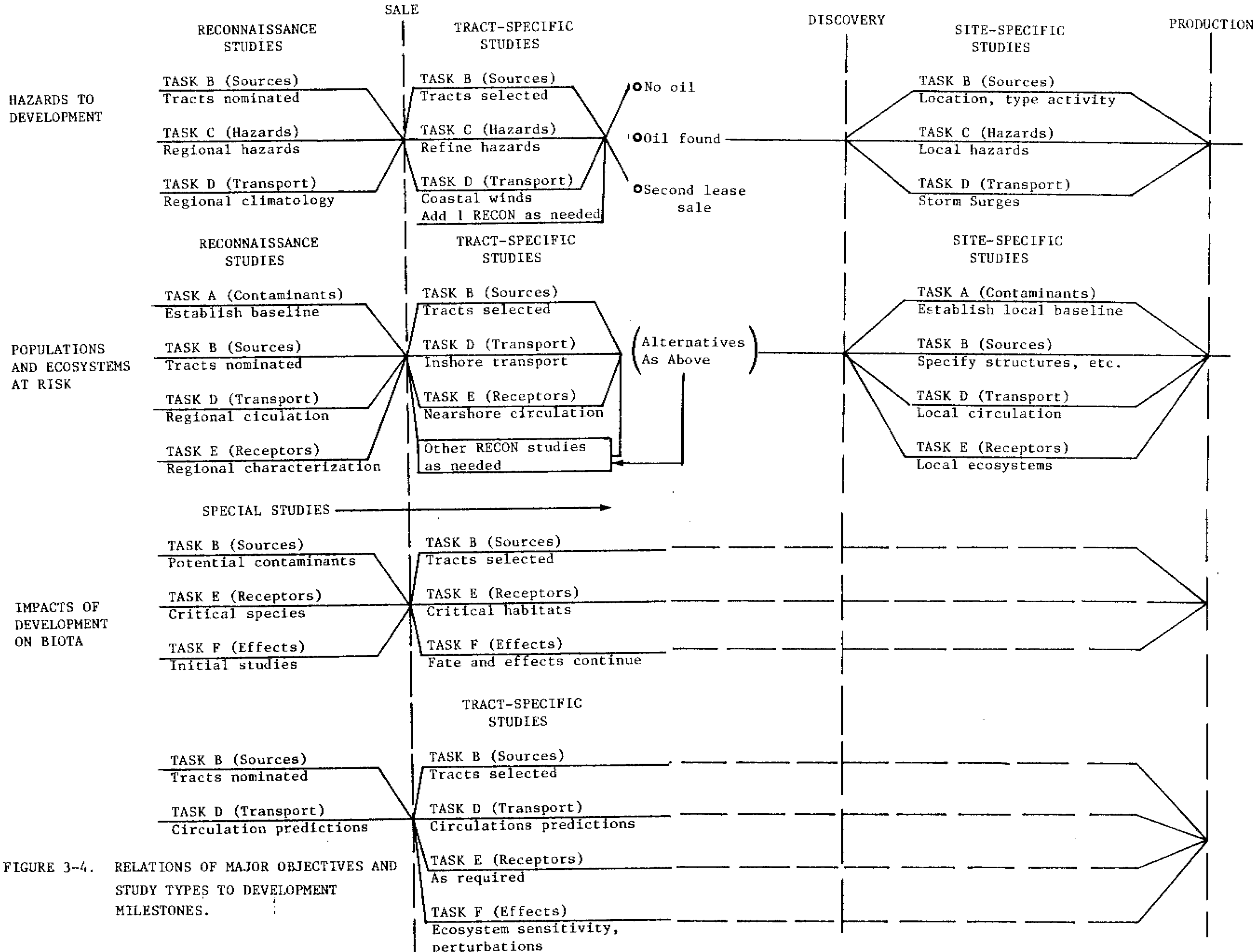


FIGURE 3-4. RELATIONS OF MAJOR OBJECTIVES AND STUDY TYPES TO DEVELOPMENT MILESTONES.

Reconnaissance Studies:

The scope of these investigations is lease-area wide. They are intended to provide a regional characterization of the geographic distribution and magnitude of the hazards present.

Reconnaissance surveys are employed by OCSEAP to plan tract- and site-specific studies. The information is employed by BLM to develop draft and final EIS, and to deselect tracts. The planning and implementation of reconnaissance surveys is based on available knowledge about environmental hazards, BLM information needs and projections of industry activities in the lease area.

Most reconnaissance data on geological hazards must be obtained prior to leasing. Certain hazards investigations (e.g., seismicity) must be continued beyond the lease sale in order to improve the ability to make seismic predictions and risk evaluation and to prepare for subsequent lease sales in the same area.

Reconnaissance studies for the evaluation of hazards to development combine elements of Tasks B (Sources), C (Hazards) and D (Transport). Task B provides information on lease tract nominations used to guide the geographic location and extent of the investigations. Tasks C and D provide the required information.

Subtask C-1 emphasizes regional seismicity and tectonism. The primary goals have been achieved through a literature summary and an observational program employing a network of seismographs. The historical study was performed by RU 352 and the (ongoing) observational study by RU 210.

Subtask C-2 is concerned with characterization of regional surface and nearsurface faulting. This has been accomplished by RU 216 in gross fashion through an extensive geophysical survey program. Industry data can be used to refine the survey.

Subtask C-3 emphasizes the delineation and characterization of most areas of seafloor instability in the NEGOA region. The geophysical surveys of RU 216 provided sufficient data to complete this task on a regional basis and identified areas possibly warranting more detailed studies.

Subtask C-4 emphasizes the delineation of the regional patterns of seafloor erosion and deposition. It has been addressed as a major objective by RU 212. In addition, general characterizations are available from the work of RU 210.

Subtask C-5 concerns the characterization of coastal morphology and evaluation of the current rates of change of same. The subtask has been addressed on a regional basis by RU 059 and by the SLAR studies of RU 099. More detailed investigations have been performed in the Icy Bay area by RU 212. These latter studies have documented very rapid changes of the coastal configuration in the area.

Subtask C-8 is concerned with the distribution and properties of gas-charged sediments, due to the hazard such sediments pose to bottom-mounted structures. A regional reconnaissance for gas-charged sediments was made by RU 212.

Subtask C-10 addresses extreme oceanic events. These consist of tsunamis, sea winds and waves, and storms. The initial information needs were met by RU 347 with a climatic atlas based on all available historical data. The atlas includes information on storm tracks and frequencies, wave heights and periods, and potential superstructure icing. Information on coastal meteorology is being compiled by RU 367 through observational and historical data analyses. The analyses will include evaluations of coastal katabatic winds.

Subtask D-11 concerns coastal storm surges. It may be applicable to certain onshore areas in the event development occurs. Preliminary information provided by RU 347 will be evaluated to determine needs for detailed studies.

Tract-specific Studies:

The primary objective of these investigations is to provide BLM information for the formulation of stipulations for offshore drilling platform placement, design, and operation. This is accomplished through studies intended to increase data resolution in areas identified as having potential for development. Planning input needs to include the specification of the tracts likely to be drilled by industry during development and production phases.

Tract-specific surveys precede the installation of offshore development and production platforms. They are initiated shortly after exploration has begun and combine elements of Tasks B, C and D. These studies provide medium resolution information from areas of particular interest identified during reconnaissance studies.

Subtask C-1 is a necessary component of tract-specific studies due to the requirement to obtain as much detail as possible on earthquake epicenter locations, recurrence rates, ground shaking, and tectonism prior to production. For this reason, the activities of RU 210 likely will be continued for an extended period.

Subtask C-2 is required to obtain additional data on specific faults revealed by reconnaissance studies and to extend the observational base into the nearshore zone. RU 212 has been addressing these objectives. In addition, the identification of possibly active faults has been aided through the epicenter location data obtained by RU 210.

Subtask C-3 is necessary to delineate in greater detail areas of unstable sediments. Specific objectives include the definition of areas of rapid sediment accumulation and those in which slumping has taken place. RU 216 has addressed these objectives at a tract-specific level of resolution in parts of the NEGOA.

Subtask C-4 is tentatively included at a tract-specific level of resolution. Data are needed to evaluate the erosion of the sea floor in areas likely to have production platforms.

Site-specific Studies

These investigations furnish very localized hazard assessment data to BLM. The data are employed to set stipulations on pipeline engineering design, routing and mode of operation. In addition, they are applicable to the design and location of shore facilities for support, storage and transport.

A large number of development alternatives are conceivable in NEGOA due to the geographical extent of the lease area, the widely scattered potential onshore sites and the unknowns concerning petroleum resources.

The location and size of the petroleum discovery will determine industry needs and selections of options with respect to the character and scope of activities. For example, it may not be economically feasible to construct a pipeline if a moderate size oil pool is discovered. Instead, a single point mooring may be used for loading petroleum on tankers.

Similarly, differing sizes and locations of petroleum discoveries will dictate differing geographical locations and capabilities with respect to shoreside support, storage and transport facilities. This information is necessary in order to properly design and implement site specific studies. The multiplicity of alternatives makes the presumptive implementation of site-specific studies impractical. A "wait and see" strategy is considered the optimum cost-effective approach, but implementation of site-specific studies should occur shortly after a discovery has been geographically defined and quantified, and when development plans with respect to that discovery are available.

Site-specific studies combine elements of Tasks B, C, and D. High resolution data will be needed on sediment stability and faulting in the event that development occurs. Time constraints for obtaining data applicable to onshore development are relatively stringent, those for offshore platforms and pipeline permitting less so.

Subtask C-2 is required to provide information on faults at platform sites and along proposed pipeline corridors (assuming pipelines are to be laid).

Subtask C-3 (sediment instability) is required to evaluate the sediment stability at platform sites and along pipeline corridors and platform sites.

Subtask C-4 (erosion and deposition) also applies to site-specific studies. It will be necessary to have a basis for evaluating possible bedform movement and seafloor erosion or deposition prior to selecting pipeline corridors.

Subtask C-5 (coastal morphology) is required for estimates of the stability of the coastal sites selected for onshore facilities and possible effects resulting from petroleum-related activities.

Subtask C-8 (gas-charged sediments) may be applicable if it appears that production platform sites may be located in areas of unconsolidated sediments. The requirement will be determined by the selection of sites with respect to inferred substrate characteristics.

Subtask D-11 (storm surges) may be required if evaluations of the proposed petroleum storage and support facility sites indicate potential danger from storm surges.

3.3.3 Identification of Populations and Ecosystems at Risk From OCS Activities

Introduction

The initial objective consists of evaluation of available information on the biota present and their probable vulnerability. Subsequent reconnaissance studies fill data gaps. Natural history and distribution and abundance information is merged with transport results and likely sources of insult to identify those species or ecosystems most vulnerable to impingement.

The biological populations in NEGOA potentially vulnerable to OCS activities range from the primary producers through the highest level consumers and, in addition, include the decomposers. Thus they encompass microbes, phyto- and zooplankton, benthic and littoral biota, birds, and marine mammals. The degree of risk varies within and among the groups and is a function of factors such as quantity, duration, and character of the insult, and susceptibility, behavior, reproductive potential, location and numbers of the organism at risk. The identification of those biota particularly vulnerable to insult is a formidable task in terms of time and effort that must be expended, especially in view of time constraints imposed by the progress of OCS activities.

This information is employed by BLM to make assessments of the potential risks to populations or ecosystems as a result of OCS activities. Vulnerability assessments are used in the development of the DEIS and FEIS documents. They are also employed for tract deselection, pipeline routing and burial, drilling platform location, onshore facilities siting and the formulation of stipulations and operating orders.

Reconnaissance, tract-specific and site-specific studies are employed. The initial needs to obtain broad-scale information are met through reconnaissance surveys. Tract-specific studies are employed to fill data gaps and to assess vulnerability of organisms from likely sources. Site-specific studies are mounted when the course of development is known. Four Tasks - A (Baseline), B (Sources), D (Transport) and E (Receptors) - contribute to the objectives.

Reconnaissance Studies

These studies provide lease area-wide data on the temporal-spatial distributions of biota and contaminants, and circulation patterns. Information on the natural history of organisms is obtained as needs dictate.

Contaminant data consist of observations of natural levels of hydrocarbons and heavy metals in biota, the water column and the substrate. Transport data are comprised of observed circulation patterns and water properties based on field studies, and derived circulation patterns stemming from numerical modeling. Data on biota consist of observations on the seasonal distribution and abundance of species, and features of species life histories (feeding, breeding, behavioral patterns, etc.) that may have bearing on their vulnerability.

The uses of reconnaissance-level risk study results are many. OCSEAP employs the information for input to program development. Needs for tract-specific studies are identified and the results are used to guide special studies (e.g. modeling, effects) in the selection of "critical" species or ecosystems processes. BLM uses of reconnaissance-level risk study results also are numerous. The information is assessed and forms the basis for recommendations in the EIS. Particularly high vulnerability may lead to tract deselection. The data influence the formulation of stipulations and regulations for offshore platform location, design and operations, for pipeline site selection and operations, and for the location of onshore facilities. Additional uses include the evaluation of tanker and helicoper routes with respect to possible contaminant release or disturbance. Finally, the information is useful for the establishment of contaminant cleanup contingency plans.

Supplemental information required for informed analyses of impingements includes knowledge about the likely source and nature of the impingement.

Reconnaissance risk studies take place early in OCS oil leasing and exploratory phases in order to identify at the onset the most vulnerable organisms or biological systems. Ideally, data on vulnerable biota should be available prior to leasing. The timely acquisition of this category of information is also necessary in order to plan and conduct impact studies prior to development. Reconnaissance studies may continue for a considerable period after the commencement of exploration in order to obtain secondary priority information that is necessary for special studies or to fill data gaps identified as information is developed.

Reconnaissance studies of biota at risk involve Tasks A (Contaminants), B (Sources), D (Transport) and E (Receptors). Task A provides pre-development information on contaminants in the environment. Task B guides the design of research under the other tasks. Tasks D and E are intimately related due to the requirement for transport information to identify biota at risk "downstream" from a source.

Subtask A-1 (hydrocarbon components) is applicable to NEGOA. It consists of the determination of total petroleum and selected potentially toxic components in neuston and tar balls, the water column, selected organisms, and sediments. The data are required before development occurs. RU 275 has addressed these objectives and provided adequate information.

Subtask A-2 (light hydrocarbons) is a relevant NEGOA task. The characterization of the seasonal vertical and horizontal distributions of light hydrocarbons and assessment of their potential for use as tracers of petroleum contamination are the major objectives of the subtask. Field studies to determine distributions of C_1-C_4 hydrocarbons and a research and development study of methods for detection and monitoring of petroleum sources in coastal waters have been addressed by RU 152.

Subtask A-3 (toxic metals) is a necessary area of study in the NEGOA lease area (excluding sea ice-related elements). Pre-development data are available through the investigations of RU 162.

Subtask D-1 (offshore transport) is necessary in order to characterize circulation patterns leading to transport of contaminants in continental slope and outer shelf waters of the NEGOA. A comprehensive understanding of seasonal circulation features, hydrography and causal factors is available from the work of RUs 138 (Eulerian current, sea level and CTD studies), 217 (Lagrangian drifter studies), 289 (Eulerian currents and CTD measurements), 347 (climatic atlas), 357 (literature assessment of GOA oceanography) and 152 (suspended sediment distributions). These studies also support the numerical transport model studies of RU 140 (discussed in Impacts on Biota).

Subtask D-4 (sediments and sediment-benthos interactions) is relevant due to the influence of sediments on the distributions of benthos. Distributional data on sediment types are available from the work of RU 005. Data on the organic components of sediments have been obtained by RU 480.

Subtask D-6 (suspended particulates) is pertinent to the coastal waters of NEGOA due to the large sediment inputs by glacial streams such as the Copper and Bering Rivers. RU 152 obtained regional data on the areal and depth distributions of suspended particulate matter and characterized its chemical composition.

Subtask E-1 (marine mammals) applies to regional distribution and abundance of the cetacean and pinniped populations of NEGOA. Shipboard transects are used for studies of pelagic distribution and abundance. The coastal pinnipeds are investigated through visits to rookeries and hauling areas. RUs 068 (pelagic distributions of marine mammals) 229 (harbor seals), 243 (Steller sea lions) and 481 (cetaceans) have obtained sufficient data to adequately describe seasonal distributions and relative abundance of the more common species. Relatively good information is available on use of coastal rookeries and foraging areas.

Subtask E-2 (mammal population dynamics and trophic relations) is a necessary part of the risk studies, with later application to ecosystem studies. Some of these data are obtained during reconnaissance studies. RUs 229 and 243 have collected such information on Steller sea lions and harbor seals in NEGOA investigations.

Subtask E-3 (marine birds) is important due to the large numbers of sea-, shore- and waterbirds in the NEGOA region. Means of studying the distributions and abundance of water birds include pelagic transects, seabird colony investigations, and coastal migration studies. RUs 239 (shearwaters), 337 (pelagic seabirds), 338 (photo mapping of seabird colonies), 339 (literature review of marine birds), 340 (migration), 343 (seabird colony catalog), 108 (community structure of marine birds), 096 (gull study), and 003 (coastal migratory bird habitat) have addressed this subtask. The reconnaissance investigations are essentially complete; additional work will be at a tract-specific level of resolution.

Subtask E-4 (marine bird trophics and population dynamics) is similar to subtask E-2 in that the data that apply to risk studies at a reconnaissance level of resolution also are essential for subsequent ecosystem studies. Seabird colony studies and pelagic investigations are used to obtain the necessary data on natural history features, nesting phenology and success, and food dependencies that might affect vulnerability. RUs 339, 341 (feeding ecology and trophic relations), 342* (population dynamics) and 108 have contributed to the reconnaissance level information base.

*Included in RU 341 in 1977.

Subtask E-5 (fish distributions and abundance) stems from the need to obtain basic information on the distribution and relative abundance of demersal and pelagic fish over the continental shelf and in coastal waters. The subtask also considers the regional fisheries and various aspects of juvenile salmonids and the young of other important species rearing in or migrating through the NEGOA. Data are obtained through the evaluation of available historical sources and from various types of field studies. The results of literature and historical data analyses on salmonids and non-salmonid pelagic fish are available from work by RUs 353 (salmonids) and 64 (non-salmonids). Field studies and historical data were used by RU 174 (demersal resources) to characterize the demersal fish and shellfish populations in NEGOA and to provide information on foreign and domestic fisheries. Insufficient data are available at present on juvenile and forage fish.

Subtask E-6 (fish trophic dynamics) has application through identification of food dependencies possibly affecting vulnerability and also through provision of data for subsequent foodweb and ecosystem studies. The primary use of the data is for the latter studies. RUs 284 (feeding relations of fish), 285 (skeletal and otolith key), and 005 (benthos) have contributed to this subtask. The data of RU 285 are useful for identification of gut contents in an advanced stage of digestion.

Subtask E-7 (benthos) addresses the regional characterization of benthic communities. Literature surveys and field sampling by RUs 005, 281, and 282 have provided an adequate level of resolution of the regional distribution, abundance, and diversity of NEGOA benthos.

Subtask E-8 (littoral habitat) addresses the characterization of coastal intertidal habitat, a major concern in view of the diverse habitats in the NEGOA region. This is accomplished by aerial surveys to delineate major habitat types and field sampling of those habitats to obtain information on littoral community composition and relative indices of productivity. RUs 078 (littoral) and 024 (razor clams) have obtained information of sufficient detail to fulfill this objective.

Subtask E-9 addresses more detailed characterizations of the littoral communities of principal habitats, thus information of this nature resulting from reconnaissance studies is more pertinent to tract-specific studies and is discussed later. Some information of this type applicable to tract-specific studies has been forthcoming from investigations by RUs 079 and 417.

Subtask E-10 addresses seasonal plankton distributions. There is a requirement for general information on zooplankton and phytoplankton populations in neritic and pelagic waters in order to adequately evaluate potential impingements on higher trophic level organisms. Also, the meroplankton include many species of commercial importance; the seasonal distribution and abundance of these species must be characterized to determine possible vulnerability to contaminant releases. RUs 058, 156c, 425b (phytoplankton) and 156b, 156d and 425a (zooplankton) completed initial literature and field studies of plankton in offshore and shelf waters of NEGOA. However, the available data are not yet sufficient to make generalizations about the temporal-spatial distribution of species or their abundance.

Subtask E-11 addresses the seasonal indices of phytoplankton production and energy pathways from producers to higher trophic levels. These categories of information are pertinent to the development of an understanding of plankton community structure and function. The numerical model study by RU 058 has furnished insights into factors influencing chlorophyll distributions in offshore waters of the Gulf of Alaska. RUs 156c and 425b have obtained a small amount of data on primary productivity from the shelf waters. The data are incomplete with respect to seasonality.

Subtask E-13 considers the delineation of regions and habitats containing numerous egg and larval stages of fish and shellfish. The seasonal locations and numbers of early life history stages of the species of commercial or ecosystem importance must be defined due to their vulnerability to contaminants. Emphasis given to those forms found at or near the sea surface and in nearshore waters. RUs 156a and

424 have obtained data on ichthyoplankton at a limited number of locations, but the information is unsufficient for delineation of spatial-temporal patterns of species abundance. The early life stages of important crustaceans and shellfish are relatively unknown.

Subtask E-14 concerns the development of a ichthyoplankton key. Because little is known about Alaskan ichthyoplankton, the development of a key is a necessary prelude to extensive field studies. RU 349 has produced an ichthyoplankton key applicable to NEGOA studies.

Subtask E-15 is required due to the lack of knowledge about microbial communities and their ecological relationships in the lease area. RU 030 has obtained sufficient data to characterize the composition and distributions of microbes in the water column and bottom sediments.

Subtask E-16 objectives include the behavioral aspects of heterotrophs, pathogens and chemotrophs with respect to environmental factors. Since some microbes play important roles in the degradation of petroleum, it is important to determine such responses in order to assess probable consequences of oil impingement. RU 190 has furnished such pertinent data from the NEGOA region.

Tract-Specific Studies

These studies are intended to characterize ecosystems in selected areas identified as vulnerable to impingement. The selections are based on results of reconnaissance and special studies. Five candidate sites have been identified to date in NEGOA: the Yakutat area, Kayak Trough, the Copper River Delta, the area around Middleton Island and the Hinchinbrook Entrance area.

Tract-specific studies are addressed through Tasks D (Transport) and E (Receptors), with significant input from Task B (Sources). Refined assessments of the effects of contaminants on biota in the areas require detailed information on circulation in nearshore areas. Characterizations of ecosystem structure and function with the objective of identifying those components that dominate or drive the system are also necessary. These are accomplished through investigations of population dynamics, species composition and trophic relations of the biotic communities found in the habitat.

Tract-specific study results are incorporated in OCSEAP program development. Food web and trophodynamics investigations may furnish data applicable to other lease areas or to clarification of relationships between lease areas, to laboratory effects studies (Task F), and to development of a biological data base for future monitoring studies. BLM obtains increased resolution of information from areas deemed at risk and such information may be employed to improve development and production-related decision-making. Information from research by investigators outside of the OCSEAP and any available industry inputs will also influence the planning and conduct of tract-specific studies.

Tract-specific studies will occur during the exploratory phase of the OCS program. The requirement for such studies, their timing, and scope are determined by the results of reconnaissance and effects investigations and by the course of development.

These studies include components of Tasks B (Sources), D (Transport) and E (Receptors). The first task furnishes information on industry activities which guides the latter two tasks. Due to the uncertainties about the course of development and the large geographical region in which development may occur, tract-specific studies emphasize refinement of data in probable development areas and the generation of information applicable to site-specific and special studies.

Subtask D-2 involves the characterization of circulation in nearshore and inshore regions identified as having potential for impingement. The coastal waters near Yakutat and those west of Kayak Island are considered relatively vulnerable to impingement; RUs 138, 217, 289, and 367 have provided the observational data leading to that conclusion. Transport modeling by RU 140 (a special study) has reinforced the observational data. Sufficient information is presently available from the Yakutat area. The present and near-term focus of effort is on the Montague Island - Kayak Island area. RUs 217 and 289 are investigating seasonal current patterns, the direction and persistence of flow through major passages into Prince William Sound, and the mechanisms driving the circulation. RU 367 is making seasonal meteorological observations in the same area. Both investigations support the transport modeling study of RU 140.

Subtask E-1 is scheduled to obtain data on marine mammal distribution, breeding and foraging areas, and migration routes in selected coastal areas. Relatively good information is presently available from the areas identified as having relatively high vulnerability. RUs 229, 243, and 481 have obtained data on the principal pinniped and cetacean species along the NEGOA coast and in the vicinity of Prince William Sound.

Subtask E-2 addresses marine mammal population dynamics and food habits; it is necessary in order to further refine risk assessments and to provide necessary information for ecosystem studies. Emphasis has been given to the dominant pinniped species, harbor seals and Steller sea lions. RU 229 will have completed harbor seal studies in FY 78. RU 243 will continue to obtain data on Steller sea lions.

Subtask E-3 applies to the acquisition of data on temporal-spatial distributions of shorebirds and seabirds in concentration areas identified by reconnaissance studies. Investigations of this nature will be conducted in high vulnerability areas to assess the risks to birds resulting from potential distrubance or contaminants. Foraging and wintering areas in coastal waters west of Kayak Island are being studied. These studies will be integrated with Subtask E-4 and the nearshore study described under Subtask F-9.

Subtask E-4 addresses trophics and population dynamics of marine birds, seaducks and shorebirds in areas having potential for impact. Numericallly dominant or vulnerable species, such as murres and seaducks, are emphasized. The focus of marine bird studies is on food habits, locations of foraging areas, phenology of nesting, reproductive potential and productivity of colonial nesting species. Shorebird and seaduck studies are primarily concerned with identification of food dependencies of bird species with respect to season, location and food type.

Subtask E-5 addresses requirements for information on juvenile and forage fish species in areas of probable risk. It forms a subset of the broader-scale requirements for this subtask outlined in the preceding section on reconnaissance-level information needs. The results of reconnaissance-level studies will determine whether tract-specific data resolution is necessary.

Subtask E-6 involves food habits studies of fish and thus is applicable on a tract-specific basis to the investigations of selected coastal ecosystems to be performed under Subtask F-9.

Subtask E-7 is concerned with the benthos. Tract-specific studies will be conducted in those areas identified as vulnerable to impingement, the chief objective being the characterization of the nearshore benthic communities. The studies will consist of investigation of seasonal changes in community structure, food web delineation, and the trophodynamics of selected species. The results of these studies will be incorporated into the coastal ecosystem studies of Subtask F-9. RU 005 will initiate the investigations in the latter part of FY 78.

Subtask E-9 concerns the ecosystem dynamics of littoral biota of principal shore types. It is necessary to investigate littoral community structure and function in order to make informed assessment of vulnerability. Also, knowledge of littoral communities is important to understand coastal ecosystems. Thus these studies will contribute to nearshore ecosystem studies (Subtask F-9).

Subtask E-13 concerns the early life history stages of fish and shellfish. The seasonal density distributions of eggs and larvae in nearshore and inshore waters must be determined in order to delineate the geographical locations and time periods during which species of commercial or ecosystem importance are present in abundance. The need for tract-specific studies will be determined by the results of reconnaissance-level studies.

Site-specific Studies:

Introduction

These are initiated to obtain information on biota at locations where development is likely to occur (e.g. onshore support facilities, pipeline corridors). The strategy for planning and implementation is similar to that given for hazards investigations of similar resolution.

Site specific risk studies respond to needs for information on the potential vulnerability of biota to onshore or offshore structures, transportation of petroleum or other associated activities. Onshore site studies related to support facilities are required first. The studies relevant to platform installation, pipeline permitting and operating regulation will probably follow in approximately the order listed. Site-specific risk studies are comprised of Tasks A (baseline), B (Sources), D (Transport) and E (Receptors). As with other studies, Task B provides the information needed for planning specific investigations.

Subtasks A-1 (hydrocarbons), A-2 (light hydrocarbons) and A-3 (toxic metals) are required in order to establish pre-development levels of contaminants in biota, water and sediments at development sites.

Subtask D-2 (inshore transport) is required in order to evaluate the vulnerability of biota in relation to transport of contaminants by currents. These studies may employ any one or a mixture of Eulerian, Lagrangian or Doppler shift radar current measurement techniques as dictated by local conditions.

Subtasks under Task E (Receptors) required to address risk assessment information needs at particular development sites cannot be determined a priori. The selection of the subtasks will follow evaluations of the habitats and probable vulnerable biota at each candidate site.

3.4 PROJECT SELECTION

3.4.1 Introduction

The FY 79 NEGOA program is reduced in magnitude and scope from previous years. The reasons for the decrease are several: completion of research goals pertaining to the first sale; a relatively higher BLM priority for information from other Alaskan OCS areas; decreased funding support for the overall Alaskan OCS program; and increased focus on restricted geographic areas.

The FY 79 program emphasized BLM information needs related to the first lease sale and begins to respond to specific needs pertinent to the second sale, which is currently slated for June 1980. The bulk of the effort will occur west of the tracts sold during the first sale as transport studies have demonstrated that contaminants are most likely to be carried in that direction. Also, there are some indications that tracts west of Kayak Island may be offered in the second lease sale; therefore, the concentration of effort west of the first sale tracts will respond most effectively to second sale information needs. It is conceivable that tracts may be offered east of the currently active tracts in the region between Yakutat and Cape Spencer, but because such information is not yet available, it is not possible to indicate requirements for information from that region.

With respect to the past sale, the focus of the FY 79 program is mainly tract-specific. The overall objectives are to fill identified data gaps preparatory to initiating an integrated ecological process study and to obtain more refined transport and geohazards information.

Current information needs or issues, identified by BLM, OCSEAP management and principal investigators at the NEGOA Synthesis Meeting are shown in Table II. The diversity and scope of the issues are considerable. Some issues are amenable to relatively short-term studies, while others require extended, major investigations. Also, while many of the issues are specific to NEGOA, others are of a general nature and apply to other Alaskan OCS areas. Several of the current needs are being addressed, but are not yet resolved. They are indicated in the Status of Knowledge section and in following pages.

Five NEGOA areas have been tentatively identified as vulnerable with respect to potential for impingement from gas and oil development: Hinchinbrook Entrance, Kayak Trough, the Copper River Delta, Middleton Island, and Icy Bay. Of these, all but Icy Bay are west of the Sale #39 lease area. Some features of each vulnerable area are listed in Table III. The close proximity, diverse habitats, and differing biota of the Hinchinbrook, Copper River and Kayak Trough areas make them especially suitable for proposed nearshore ecosystem studies.

3.4.2 Rationale

The FY NEGOA program composition is indicated in the context of previous and projected program emphases in Figure 3-5.

TABLE II. CURRENT INFORMATIONAL NEEDS IN THE NEGOA LEASE AREA

HAZARDS TO DEVELOPMENT:

Ground shaking accompanying earthquakes
Geohazards in the region west of Kayak Island (for second sale)
Identification of active offshore faults
Extreme wave heights

TRANSPORT AND CHEMISTRY:

Delineation of low flushing or exchange circulation regions
Near-bottom currents and their role in sediment transport
Sediment dynamics, including flux rates, ability to sequester oil
Effects of river discharge on nearshore circulation
Surface water movements during winter
Flow into/out of Prince William Sound
Contaminant trajectory predictions with respect to second sale tracts
Circulation features "downstream" of Middleton-Montague Island areas

BIOTA AT RISK:

Seasonal distributions of holoplankton, meroplankton and micronutrients
Seasonal distributions of juvenile and forage fish
Biodegradation rates of oil by microbes
Seasonal composition, trophic relations and abundance of biota in nearshore habitats
Early life history stages of commercailly important invertebrates
Nutrient regeneration processes

IMPACTS ON BIOTA:

Possible impacts of oil on Copper River barrier vegetation with respect to bird populations
Susceptibility of Tanner crabs to oil
Imbalances in ecosystems due to OCS activities (e.g., herring gull population growth)
Disturbance of bird and marine mammal populations in breeding and foraging areas from OCS activities
Relationships of food availability and reproductive potential to recover from impingement by selected biota
Microbial function in the presence of oil

TABLE III. POTENTIAL NEARSHORE STUDY SITES IN NEGOA

Site	Habitat Types	Criteria for Selection	Important Populations/ Species Present
Hinchinbrook Entrance	Rocky, muddy intertidal; laminarian zone; deeper subtidal. Exposed and sheltered areas.	Abundant biota Potential for impact Logistical ease Pristine conditions Existing data base	Macrophyte-associated biota Muddy intertidal biota Zoo-, phyto-, meroplankton Steller sea lions, sea otter Filter-feeding benthic animals Seabird colonies
Copper River Delta area	Muddy intertidal; estuarine; barrier islands	Potential for impact Biological populations Logistical ease	Detritus-feeding benthos Forage fish and salmonids Harbor seals Shorebirds and waterfowl Tanner and Dungeness crabs
Icy Bay area	Exposed sand beach; glacial embayment	Potential for impact Habitat types Biological populations Previous data base	Demersal fish Juvenile salmonids Harbor seals Razor clams
Controller Bay-Kayak Trough	Estuarine; exposed and sheltered areas; depositional environment	Potential for impact Position in gyre	Diverse communities anticipated
Middleton Island	Rocky intertidal; exposed, pelagic environment	Potential for impact Biological populations Previous data base	Filter-feeding benthic community Large seabird colonies Demersal fish and shellfish Pelagic plankton community

	FY 78	FY 79	FY 80	FY 81
HAZARDS TO DEVELOPMENT				
Tract-specific studies	Coastal winds, faulting seismology RUs 367,210,212	Coastal winds, faulting seismology, geohazards RUs 367,210,	Poss. add'l geohazards, seismology to monitoring	
Site-specific studies			Initiate if oil discovered	
POPULATIONS AND ECOSYSTEMS AT RISK				
Tract-specific studies	Inshore transport, various biota studies RUs 289,367,138,005, 078,229,243,337, 341,417,481	Inshore transport, various biota studies RUs 289,367,078,243,337 341,417,P905,P906	Poss. add'l studies to fill data gaps	
Site-specific studies			Initiate if oil discovered	
IMPACTS OF DEVELOPMENT ON BIOTA				
Special studies	Seabird mortality, inshore transport predictions RUs 341, 140	Marine mammal disease, mortality; inshore transport predictions RUs 194, 140		
Tract-specific studies			Initiate if requirement shown	

FIGURE 3-5. RESEARCH EMPHASIS DURING THE YEARS FY 78-81

Hazards to development will be addressed at a tract-specific level of detail. Research aims will emphasize refinement of seismicity data, acquisition of ground shaking information, and an integrated geohazards characterization composed of investigations of sediment instability, near-surface faulting, and gas-charged sediments.

Additional seismicity observations are required to improve the statistical data base on frequency, location and magnitude of offshore earthquakes and to identify active surface and nearsurface faults. Few ocean bottom data are available on ground shaking which accompanies earthquakes. Strong ground motion instruments will furnish quantitative data on earth movements in the event that a moderate or large magnitude earthquake occurs.

Coastal winds in the Hinchinbrook Entrance-Prince William Sound area are being studied as elements of a nearshore meteorological investigation. Observational and predictive data on katabatic and other strong winds that pose a hazard to OCS activities will result from these investigations, scheduled for completion in FY 79.

Geohazards studies conducted in 1975-76 have provided a reconnaissance-level information base from the continental shelf between Kayak Island and the lower part of the Kenai Peninsula. However, the resolution of the data is considered inadequate for assessments pertaining to tract selections for the second NEGOA lease sale. The integrated geohazards study proposed for 1979 will address those information needs.

There may be requirements for additional geohazards studies in FY 80 arising from the tract selections for lease sale #55. Such needs will become evident after industry nominations for tracts have been evaluated.

Transport and chemistry studies contribute to identification of biota at risk and impacts on biota. Particular emphasis is being given to the nearshore region between Kayak Island and Montague Island and to the passages into Prince William Sound. Previous observational results have shown--at least during the period from spring through fall--that surface waters are advected into the region from the first sale tracts. The ongoing transport investigations have as specific objectives the delineation of low energy regimes in which contaminants might be retained for extended periods, the characterization of circulation patterns on a seasonal and shorter-term basis, the identification of the mechanisms or processes leading to the observed circulation patterns and the prediction of current fields and contaminant movements resulting from various combinations of winds and hydrographic conditions. Observational data are used as input to the numerical transport model, which will be employed to predict current fields and surface water movements on a seasonal or shorter-term basis. The goal of the modeling study is to be able to furnish predictions of families of trajectories for hypothetical spills or routine operating losses of oil; this capability requires a closely spaced temporal-spatial series of observations as input to the model design. Such data will be forthcoming from the FY 78 and 79 field observations.

Nearshore meteorological studies in FY 79 are confined to laboratory analyses of the data obtained in FY 77 and 78. The studies include a coastal wind model that forms an element of the numerical transport model and thus directly applies to the transport investigation.

It is anticipated that the nearshore transport studies program in the Montague-Kayak Island area will be nearly complete by late 1979. Additional field investigations along other sections of the coast of the Northeast Gulf may occur in 1980 due to inclusion of unstudied regions into the forthcoming lease sale offering.

The characteristics of shelf surface currents in the region extending southwest of Middleton and Montague Islands are of interest due to potential for transport of contaminants downstream from the Kayak Island-Montague Island area. Data on Lagrangian transport trajectories and speeds collected in FY 78 from this region will be evaluated and, depending on results, additional satellite-tracked drifters may be released. Such information will prove useful for evaluating the potential for impingement by surface contaminants originating along the coastline between Montague and Kodiak Islands.

Sediment dynamics and potential interactions of sediments with petroleum contaminants are not currently being addressed in NEGOA. Suspended sediments are present in large quantities in coastal waters, thus there is potential for episodic or chronic incorporation of the contaminants into bottom sediments if suspended sediments adsorb petroleum and sink. Studies addressing petroleum adsorption and desorption suspended particulate matter are being conducted in Lower Cook Inlet. Information applicable to NEGOA should be forthcoming from those investigations.

Tract-specific studies of populations and ecosystems at risk will be conducted to fill information gaps for major groups of organisms not yet investigated in detail, to acquire population dynamics and community structure data, and to define food webs in selected habitats. This work will be concentrated in the nearshore zone between Montague and Kayak Islands. The investigations are intended to provide an adequate basis for planning and implementation of integrated ecological process studies in the event that requirements for such investigations arise.

Distribution, abundance and habitat use by meroplankton, forage fish and juvenile fish during the spring-fall period will be studied. Littoral and sublittoral biota in the vicinity of Hinchinbrook Entrance will be sampled on a seasonal basis. This latter work will emphasize seasonal fish assemblages, laminarian standing crops and food webs in various habitats. Seabird population dynamics will be investigated at Middleton Island, location of the largest seabird colonies in the northeastern Gulf of Alaska. A synthesis of the results of studies of coastal marine bird habitat and habitat use by shorebirds, waterfowl and seabirds is underway. It should be completed in late FY 79. The studies will furnish a two-year data base from which to determine seabird species abundance, nesting phenology and production. Marine mammal investigations are being conducted at a low level of effort. Population discreteness of Steller sea lions is being studied through observations of animals branded in 1976-77. The investigations are intended to show whether there is significant interchange of animals between rookeries in the Gulf of Alaska; thus the research includes rookeries at the Barren Islands and Kodiak. A final report on the results of previous years' field work on harbor seals is being prepared; the report will synthesize all Gulf of Alaska data.

Field programs addressing studies of biota at risk are expected to be continued in FY 80 in the Kayak Island-Montague Island region, with major emphasis given to population and trophic dynamics of selected biota in nearshore habitats. Redirection of effort may be necessary if requirements for reconnaissance or tract-specific studies in other areas of the NEGOA arise as a consequence of second lease sale information needs.

Field activities addressing impacts of OCS activities of biota in NEGOA during FY 79 consist of two special studies, one concerned with diseases and mortality of marine mammals, the other with coastal vulnerability to oil spills. The former study will be a low-level effort conducted concurrently with the Steller sea lion study. The major objectives of the investigation are to determine pre-development indicies of mortality and incidence of disease in the animals. These data can subsequently be used during OCS production and monitoring to evaluate possible effects of OCS activities on the animals. The latter special study is intended to delineate, on the basis of substrate composition and energy regimes, the relative vulnerability of coastal habitats to impacts from spilled oil. The region to be studied extends from Montague Island southwestward along the Kenai coast to the vicinity of the Chugach Islands.

Several experimental studies proposed for FY 79 and described in the non-site-specific TDP have relevance to the NEGOA program. They include:

- Accidental or experimental exposures to oil to determine effects on organisms or ecosystems and to examine recovery.
- <u>In situ</u> oil weathering studies employing oiled seawater inside plastic containers to evaluate effects of various processes naturally altering petroleum's chemical composition and physical characteristics.
- Evaluations of the hazards to biota posed by particular components of petroleum to identify the potentially most hazardous components and to nominate classes of compounds for

effective monitoring.

- Food chain hydrocarbon uptake and concentration studies using several trophic levels.

A computer simulation of seabird energetics will provide information on energy demands of seabirds.

3.4.3 Tasks

Hazards to Development (Task C)

The acquisition of seismology data will be continued in FY 79. It will address subtask C-1 (seismicity and tectonism). Specific objectives will consist of:

1. Further refinement of data on earthquake epicenters, intensities, hypocenters, foci, and seismicity.
2. Correlations between low magnitude earthquakes and surface and near-surface faulting.
3. Assessments of the relationships between earthquake intensity and ground shaking (in the event of a moderate or large magnitude earthquake).

Subtask C-1 will be addressed by RU 210.

BLM needs for additional geohazards information for the second NEGOA lease sale will be implemented through an integrated field program described under research unit 212. Standard shipboard geophysical survey methodology will be employed to acquire data pertinent to subtasks C-2, -3, -4, and -8.

Subtask C-2 (faulting) will be addressed through collection and interpretation of seismic reflection profiles along a network of tracks in areas for which insufficient data on fault location and activity are available.

Subtask C-3 (sediment instability) will entail collections of data on sediment geotechnical properties, unconsolidated sediment thickness, and evidence of seafloor slumping. The data will be obtained through sediment coring, deep penetration and high resolution seismic reflection profiling and, possibly, sidescan sonar observations.

Subtask C-4 (sediment erosion and deposition) will be concerned with identification of areas of severe bottom sediment erosion and deposition and, associated with this, areas having large-scale sediment movements as evidenced by sand waves and related mobile bedforms. Attempts will be made to quantify the dynamics of the operative processes. Observational methods likely will include high resolution bathymetric and seismic profiling.

Subtask C-8 (gas-charged sediments) will be addressed through acquisition of evidence of petroleum or gases in sediment core samples and from interpretations of the reflective properties of sediment revealed in high resolution seismic profiles.

Transport (Task D)

As noted previously, FY 79 objectives will be mainly tract-specific and supportive of the tentative nearshore ecosystem/process studies (discussed under Impacts on Biota). The various Transport and Receptors subtasks that will contribute to these studies are illustrated in Figure 6.

Transport studies will obtain a second year's field data from the Kayak Island-Montague Island region. The research is intended to define nearshore circulation patterns, water property distributions, and meteorological conditions. The data will be evaluated to determine the persistent patterns of circulation and their driving mechanisms and will furnish input for temporal-spatial refinement of pollutant pathway predictions by RU 140 (discussed in Impact section).

Subtask D-2 (inshore transport) will be addressed by RUs 217 (Lagrangian drifters), 289 (water properties and circulation) and 367 (coastal meteorology). RU 289 will continue studies on the currents through the major passages into Prince William sound and the physical processes leading to observed current patterns and water mass distributions in the Kayak Island-Montague Island region. This work will serve to furnish, on the basis of extended Eulerian current records, a verification of transport of surface waters into Prince William Sound inferred from Lagrangian drifters and an understanding of the conditions leading to such transport.

It is anticipated that RU 367 will have obtained sufficient meteorological field observations in FY 78 to enable the investigators to complete a characterization of the regional surface winds in the Hinchinbrook Island-Copper River area. FY 79 efforts will be concentrated on data analyses and interpretation. The regional meteorological model will be refined to provide more accurate predictions of coastal wind fields. The results will be applied to the general transport model of RU 140.

Biota at Risk (Task E)

Subtasks E-1 and E-2 (marine mammals) will address Steller sea lion and harbor seal studies. Seasonal population shifts, population dynamics, and feeding ecology will be emphasized in the continuing investigations by RU 243, and these studies will be conducted in conjunction with those of RU 194 (mammal disease and mortality). RU 229 will prepare a synthesis of the results of past years' field studies of harbor seals in the Gulf of Alaska. Subtask E-2 objectives will contribute to planned nearshore ecosystem/process studies.

Subtasks E-3 and E-4 (marine birds) will address seabird colony studies at Middleton Island and synthesis of coastal bird habitat data. The objectives of the field work to be conducted there during the nesting season will be to quantify, for major seabird species: phenology of arrival, nesting, hatching and fledging; productivity in terms of active nests, eggs laid, chicks hatched, and chicks fledged; and numbers of birds present and numbers of birds nesting. Data on the food habits of nestlings and adult birds will be obtained as time allows. Observations will be made of the distributions of foraging birds in the vicinity of the Middleton Island colonies. The information base resulting from FY 79 and previous year's work will allow comparisons to be made regarding changes in colony composition and productivity during the study period. The synthesis effort will include an overall Gulf of Alaska summarization of seabird use of coastal habitat.

Subtask E-5 (fish) will address forage fish and juvenile fish in the nearshore areas. Temporal-spatial changes in abundance, composition and habitat use by the principal species will be determined. Timing of migrations of juvenile fishes and spawning of forage fishes will be documented as the data permit. The objectives of this subtask are to identify critical habitats and periods of habitat use, and to obtain data applicable to food web studies. This subtask will contribute directly to planned nearshore ecosystem/process studies. It will be addressed by the provisional research unit P 906.

Subtask E-6 (fish trophics) is intended to furnish information on as yet little known sublittoral biological communities. Exploratory observations and collections in the deep waters accessible to SCUBA divers near Hinchinbrook Entrance have revealed that concentrations of fish occur in habitats in and outside of the laminarian zone. The initial study suggests that more detailed, intensive evaluations of habitats in sublittoral waters are warranted in order to obtain seasonal data on community composition and species abundance. The food habits of larger fish and their relationships to the littoral and sublittoral biological communities also warrant study. This subtask will contribute to nearshore ecosystem/process studies through unit P 905.

Subtask E-13 pertains to meroplankton in coastal waters. The objectives of these investigations are to determine the seasonal distribution and abundance of the early life stages of the dominant species of ichthyoplankton and invertebrates. The study area consists of the coastal waters between Kayak and Montague Islands. Currents in the area are believed to be weak, thus suggesting that contaminants released there would be retained for relatively long periods and would pose a threat to epipelagic eggs and larvae. Again, the results of these studies will be applicable to nearshore systems studies. The study will be addressed by provisional research unit P 906.

Impacts on Biota (Task F)

Marine mammal disease and mortality investigations will be conducted in the region extending west of Kayak Island. The relatively modest effort comprises a portion of a larger Gulf of Alaska study.

Subtask F-7 (diseases in biota) will be addressed by RU 194, which will conduct studies of marine mammal diseases and mortality in concert with the Steller sea lion investigations of RU 243 (Subtask E-2). These joint studies also include the Kodiak and Lower Cook Inlet lease areas and thus, information applicable to each lease area should result. Animals will be shot and autopsied to determine the incidence and types of diseases in natural populations. The autopsied animals also will be examined for parasites. Some post-mortem examinations of beached carcasses or moribund animals may be made as opportunities permit.

Special Studies

Subtask D-2 (inshore transport) will be addressed by RU 140. Numerical predictions of surface current fields and contaminant particle trajectories under various conditions will be provided. The focus of the study will be the Kayak Island - Montague Island region. RU 140 will employ observational data from RUs 367 (coastal meteorology) and RU 289 (nearshore oceanography) to generate temporal-spatial predictions on an "event" basis as opposed to the "seasonal" basis previously dictated by the relatively sparse data.

Subtask F-6 (recovery of ecosystems from perturbations) will be addressed by RU 059. The outer NEGOA coastline west and southwest of Hinchinbrook Entrance and extending to the tip of the Kenai Peninsula will be characterized with respect to vulnerability to spilled oil. The characterization consists of a delineation of coastal segments falling within identified risk classes. The various risk classes are based on longevity of oil in different types of coastal environments and coastal morphology. The FY 79 work will complement the vulnerability characterization already conducted east of Hinchinbrook Entrance by RU 059.

3.4.4 Determination of the Probable Impacts of Development on Biota

Introduction

Biota or habitats can be impinged upon through various pathways, some direct (e.g., ingestion of or coating by oil, disturbance), others indirect (e.g., through ingestion of prey containing toxic matter or removal of food resources due to alteration of the prey's habitat).

Investigations addressing such questions are broadly categorized as "effects" studies. They may be conducted in the laboratory or in the field. Initial effects research is focused on individual organisms (e.g., acute toxicity of species, oiling experiments, natural mortality and disease levels), then progresses to evaluations of the effects of impingements on ecosystems through controlled perturbation and modeling studies. The diversity of biota and habitats precludes comprehensive ecosystem investigations, therefore selected species and processes characteristic of various ecosystems are to be studied to define probable impacts of perturbations on an entire biotic community in terms of the effects on dominant or "indicator" species. OCSEAP effects studies are concentrated on the secondary and higher level consumers. Phytoplankton and zooplankton (excluding meroplankton) are considered to be sufficiently resilient to be negligibly affected in the long term. Decomposers (microbes) are studied due to their roles in the degradation of petroleum and nutrient cycling.

The information on potential impacts of development on biota are used by BLM for preparation of the DEIS and EIS documents, tract selection, drilling platform location, location of onshore facilities, pipeline routing, preparation of stipulations and operating orders, tanker routing, and the establishment of cleanup contingency plans.

The evaluation of probable impacts and recovery rates is made through special and tract-specific studies. Special studies include laboratory bioassays, uptake experiments, and ecological modeling. Many of these studies are applicable to several lease areas. Tract-specific studies include field challenge experiments involving the application of an known impingement, and observation of the impact on biota and their rates of recovery from the insult. Tasks A, B, D, and F are applicable to the objectives.

Special studies

These are conducted to address specific needs for information on processes or relationships. Several types of special studies apply to the NEGOA region. One of these is the prediction of movements of contaminants in offshore and nearshore waters, and of the weathering and dispersion of the contaminants. The predictive capability allows more refined estimates of the vulnerability of biota to contaminants to be produced. Oiling, acute and chronic toxicity testing, and bioaccumulation experiments are performed on selected species. Ecological models are used to perform sensitivity analyses. The incidences of diseases and natural mortality levels in populations are determined. Investigations of sediment sorption and desorption of contaminants are applicable since these processes may influence the amount and location of contaminants transported downward and incorporated into sediments, where they may be ingested by deposit-feeding benthos and subsequently incorporated into trophic pathways leading to higher level consumers.

Effects data should be forthcoming throughout the duration of the program, progressing from the acute toxicity, mortality and disease information generated at a relatively early time to the challenge and sensitivity studies. The former information should be provided as quickly as possible, while the latter should be available at the onset of development activities.

This information serves variously as input to OCSEAP planning and to the development of a data base for monitoring studies. BLM uses include assessment of the probable impacts on populations and ecosystems potentially at risk. The data are also employed to develop stipulations and guidelines for platform location, design and operations; for pipeline routing and operations; for onshore facility design, location and operations; for evaluation of transportation corridors; and for the establishment of cleanup contingency plans.

Required complementary information consists of pertinent data on the character, amount and duration of the likely insult. The estimates are furnished by Task B (Sources).

Special impact studies address specific problems or needs for information. Most are associated with Task F (Effects); however, Tasks B and D can logically be included. Task B (Sources) provides information on contaminants. Task D (Transport) furnishes predictions of contaminant trajectories and data on suspended sediments. Task F is comprised of studies of fate and effects of contaminants, and disturbance studies.

Subtask D-1 and D-2 include the numerical modeling of offshore and nearshore circulation. The objectives of the subtask are to provide maps of current fields based on observational data employed in a diagnostic fashion and to produce predictions of particle trajectories from selected sources. The model results guide the design of observational studies under subtasks D-1 and D-2. In addition, they are used to identify biota and habitat at risk. Numerical modeling is the responsibility of RU 140.

Subtasks F-1 (literature review of oil toxicity), F-2 (acute and chronic effects), F-4 (release of toxic metals), F-5 (bioaccumulation), and F-8 (oil spill countermeasures) are not specifically addressed by the NEGOA program. These studies are considered to be widely applicable, thus they are not associated with a particular lease area.

Subtask F-3 pertains to effects of oil on marine birds. It includes studies of direct oiling of adults and eggs, and of effects resulting from ingestion of petroleum. The effects of petroleum on marine birds must be known in order to make informed assessments of vulnerability to various insults. RU 096 has obtained data on the effects of oil on the hatching success of glaucous-winged gull eggs at colonies on the barrier islands at the mouth of the Copper River. Since this study has broad applicability to other lease areas, it is categorized as "non-site specific."

Another "non-site specific" study with applicability to NEGOA is the investigation of the responses of pinnipeds and sea otters to external oiling. These data are necessary to adequately evaluate the impact of oil spills on populations present in the area. RU 071 has made laboratory and field measurements of the physiological and behavorial responses to oil coatings by fur seals and other pinnipeds, and by sea otters. The studies on the latter species are continuing.

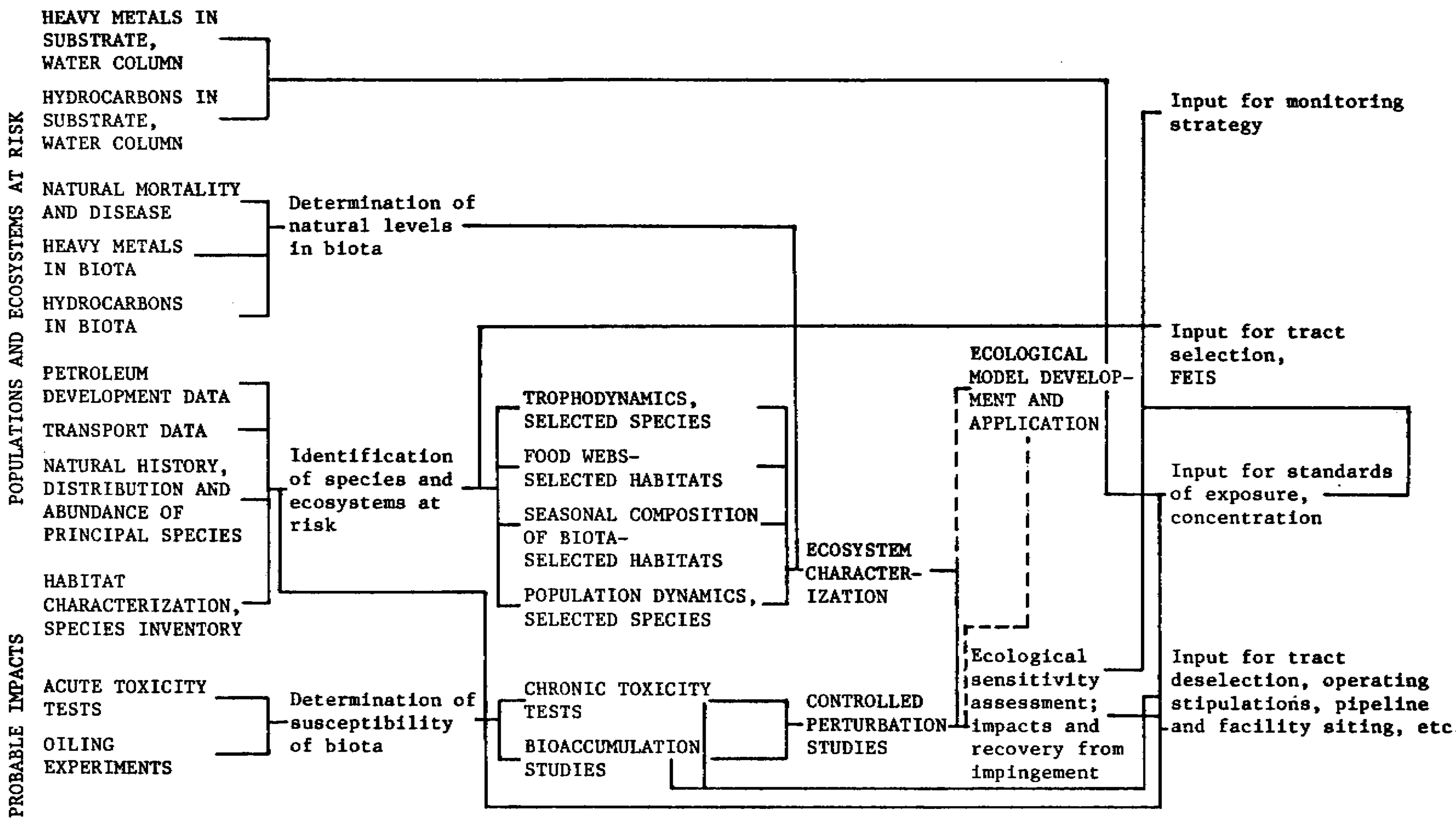
Subtask F-6 includes laboratory studies of perturbation effects on biota or ecosystems. There is potential for application of ecological models to determine the sensitivity of biota or ecosystems to contaminants. The need for such an approach has not yet been demonstrated; however, modeling may be employed to supplement or supplant field perturbation studies.

Tract-Specific Studies

These are concerned with the sensitivity of biological communities to impacts by contaminants, structures and activities, and their ability to recover from such impacts. The complex structural and functional relationships characterizing most biological communities make investigations of stress responses a complex task requiring a multi-faceted research approach. Thus these Task F studies are built on knowledge resulting from Tasks A-E (see Figure 3-6). The target communities and specific impact will determine particular trophic levels that will be investigated; however, it is conceivable that there may be requirements to investigate biota ranging from microbes through marine mammals. Highest priority will probably be given to nearshore or onshore communities based on the assumption that impacts on these communities are likely to be greater than those on offshore communities. The laminarian and littoral zone communities in the western part of the lease area, the estuarine communities of the Copper River delta, the benthic community in Kayak Trough and the exposed sandy coast communities near Icy Bay have been identified as potentially at risk and thus worthy of consideration for more detailed investigation. Seabird colonies in the region are vulnerable to aircraft disturbances and to contaminants in the vicinity of the colonies. Pinnipeds and sea otters foraging or breeding along the coastline may be directly or indirectly impacted by contaminants or facility location.

The information resulting from ecosystem sensitivity characterizations will enable OCSEAP to refine other special or site-specific studies of populations or ecosystems at risk and will furnish input to laboratory effects and process studies. BLM will be able to refine estimates of impact in areas deemed at risk due to siting of structures or pipelines, or from disturbance and contaminant releases.

Supplementary information on the location of facilities and petroleum transport corridors will be required in order to identify the areas requiring study and to develop research plans. Tract-specific ecosystem sensitivity assessments will begin during exploration.



- - - - - tentative or limited effort

FIGURE 3-6. RELATIONSHIPS OF VARIOUS RISK AND IMPACT STUDIES

Tract-specific impact studies are intended to determine through field investigations the characteristics of selected ecosystems and their vulnerability to contaminants or disturbances. This information can be applied to impact assessments for OCS development sites having comparable ecosystems or to characterizations of probable impacts resulting from a particular insult. Tract-specific studies involve Tasks B (Sources), D (Transport), E (Receptors) and F (Effects). Task B guides the selection of the studies and their objectives. Task D contributes information on the likely trajectories and landfalls of contaminants (in the case of perturbation studies addressing contaminant effects). Task E provides all of the biological data that support and guide the task F ecosystem characterization and sensitivity studies.

Subtasks D-1 and D-2 (offshore and inshore transport) provide necessary information on the habitats most likely to be impinged in the event of a contaminant release. Several habitats have been identified in the NEGOA; the region between Kayak and Montegue Islands appears relatively vulnerable to contaminants originating on the shelf east of Kayak Island.

RU 140 (numerical model) and those physical oceanographic studies (discussed under Biota at Risk-Reconnaissance Studies) have provided data applicable to this subtask.

Subtask F-9 addresses the characterization of ecosystems at risk. The objective of the subtask is to identify, through investigations of structural or functional relationships of biota and the physical environment, those processes or organisms that dominate the system. This characterization then serves as a basis for assessments of the sensitivity of the ecosystem to impingement and its rate of recovery from the impingement. Potential areas for ecosystem studies are most likely to occur along coastlines. The subtask is based on results of Task E and certain of those studies may be employed in concert with Subtask F-9.

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4.0 RU AND P UNIT DESCRIPTIONS

Research and P Units are shown in the order of the tasks to which they relate. Some RU's are associated with more than one task. The following index will assist in locating particular P and RU descriptions.

4.1 DESCRIPTIONS FOR PROJECTS IN TASK C (HAZARDS):

C-1:	RU 210	P 927
C-2:	RU 210	
	RU 212	
C-3:	RU 212	P 928
C-4:	RU 212	
C-8:	RU 212	

(RU 210) EARTHQUAKE ACTIVITY AND GROUND SHAKING IN AND ALONG THE EASTERN GULF OF ALASKA

This research unit addresses subtasks C-1, C-2 (BLM Study Types 10 - Seismic Hazards and 12 - Surface and Near Surface Faulting).

Estimated Costs, FY 79: $177,000 NEGOA

Schedule: October 1978 - September 1979

Performing Agency:

Agency: U.S. Geological Survey, Office of Earthquake Hazards
P.I., Degree: John C. Lahr, Ph.D.
Title: Geophysicist
Percent of time devoted to project and role: 50%; supervises research and field operations.

Other Principal Scientists Significantly Involved in Project:

P.I. Degree: Christopher D. Stephens, M.S.
Title: Geophysicist
Percent of time devoted to project and role: 50%; coordinates data processing, participates in field operations, assists in data analysis and interpretation.

Background:

In 1974, 13 seismograph stations were installed by the USGS, under OCSEAP support, to complement an existing network of 33 stations for monitoring earthquake activity in the northeastern Gulf of Alaska region. At the present time, 20 of these onshore stations are used to monitor offshore activity. In addition, eleven standard triggered strong-motion accelerographs are operated with OCSEAP support to provide data on ground motions associated with major earthquakes. Deployment of six Ocean Bottom Seismometers (OBS), three of which are being produced with OCSEAP funds, is scheduled for a one-month period in the summer of 1978 for the purpose of determining the seismic activity of offshore faults in the vicinity of Icy Bay. Due to difficulties in completing the construction and field testing of the units, this was postponed until 1979. However, to tailor the study to industry tract nominations for sale #55, the OBS system will be deployed in an area approximately 50 km south of Yakutat where active surface faults are suspected to be present. Continued operation of the basic epicenter and strong-motion monitoring program plus maintenance of a capability to utilize OBS units in selected offshore locations is necessary for improved seismic hazard assessment in the NE Gulf and to contribute to earthquake prediction capabilities in the entire Gulf region.

Objectives:

1. To record the locations and magnitudes of all detectable earthquakes within the study area.

2. To determine the seismic activity of surface and near-surface faults identified by geologic mapping.

3. To develop acceleration versus distance relations for major earthquakes.

4. In conjunction with Research Units 16 and 251 to evaluate the observed seismicity towards development of an earthquake prediction capability in the Gulf of Alaska.

Methods:

The present network of seismographs and strong-motion instruments will be maintained and updated to provide coverage over as continuous a period as possible. Ocean Bottom Seismometers will be deployed to monitor the activity of selected offshore faults in an area approximately 50 km south of Yakutat.

Outputs:

1. Narrative Reports: Reports will provide a detailed description of the seismic network, including the locations and spatial density of instruments and resulting accuracy of derived earthquake parameters. Frequency versus magnitude relationships, activity of surface and near-surface faults, and acceleration versus distance relationships will be evaluated and interpreted.

2. Digital Data: Derived earthquake parameters (e.g., date, time, location, depth, magnitude) will be submitted on punch cards or magnetic tape in the standard Hypocenter Date File format.

3. Visual Data:

    a) Maps of hypocenter locations and magnitudes.

    b) Maps and graphs of earthquake magnitude versus frequency relationships for selected areas.

    c) Maps with supportive text summarizing seismic activity of surface and near-surface faults identified in geologic mapping.

    d) Maps and figures with supportive text summarizing ground acceleration versus distance relationships.

    e) Maps and reports summarizing volcanic activity.

    f) Seismic and volcanic risk maps.

(RU 212) EROSION, DEPOSITION, FAULTING, AND INSTABILITY OF SHELF SEDIMENTS: NORTHEAST GULF OF ALASKA

This research unit addresses subtasks C-2, C-3, C-4, C-8 and D-7, (BLM Study Types 12-Surface and Near Surface Faulting, 13-Seafloor Instability, 14-Erosion and Deposition, 34-Bottom Sediment Characteristics, and 35-Basin Morphology).

Estimated Costs, FY 79: $100,000 NEGOA

Schedule: October 1978 - September 1979

Performing Agency:

Agency: U.S. Geological Survey, Marine Geology
Co-P.I., Degree: Bruce F. Molnia, Ph.D.
Title: Senior Geologist
Percent of time devoted to project and role: 40%; primarily directs sedimentologic research.

Co-P.I., Degree: Paul R. Carlson, Ph.D.
Title: Senior Geologist
Percent of time devoted to project and role: 40%; directs geophysical and engineering efforts.

Background:

Offshore geohazards studies were initiated by the above-named investigators in NEGOA under OCSEAP in FY 75. During the first field efforts in FY 75, reconnaissance level seafloor hazards data were collected over a broad area of the northern Gulf of Alaska outer continental shelf from Montague Island to Dry Bay. Subsequent surveys through FY 76 focused on describing in detail the hazards identified during reconnaissance studies, primarily between Kayak Island and Yakutat Bay, and provided timely and useful information for tract selection and leasing stipulations in the first NEGOA sale. Studies in FY 77 concentrated more on inshore areas, determining potential hazards to coastal facilities and pipelines. FY 78 is being spent compiling, analyzing, and synthesizing the data collected to date. In anticipation of the second NEGOA lease sale, efforts in FY 79 will be devoted to collecting seafloor hazards data in portions of the new call area for OCS Sale No. 55 not covered adequately by previous surveys. These include the Fairweather Ground area southeast of Yakutat and an area south of Montague Island.

Objectives:

1. To determine the location, length, orientation, offset, and relative age of surface and near-surface faults.

2. To locate and describe areas of existing and potential slumps and other unstable sediment masses, and to determine their present stability.

3. To locate and describe areas of significant erosion, deposition, and large-scale bedform movement.

4. To determine the distribution, depth, and stability of gas-charged sediments, if present.

Methods:

Sub-bottom profiling, bathymetry, side-scan sonar, and sediment sampling will be utilized to address the above objectives. The area between Kayak Island and Montague Island will be resurveyed to refine reconnaissance data obtained in 1974 and 1975, and a new reconnaissance survey will be performed between Montague Island and Kennedy Entrance.

Output:

1. Narrative Reports: These will provide a detailed description of the profiling and sampling methods, analytical and interpretive methods, background information, results of the field and laboratory work, interpretation of the nature and severity of geologic hazards likely to influence petroleum exploration and development, and recommendations for future work.

2. Digital Data: Grain size analysis data will be submitted on punch cards or magnetic tape in OCSEAP standard archive format file type 073.

3. Visual Data:

    a. Maps of surface and near-surface faults indicating apparent recency of movement.

    b. Maps of existing and potential slumps and other unstable sediment masses, indicating present relative stability.

    c. Isopach maps of unconsolidated sediment.

    d. Maps summarizing sediment grain size properties.

    e. Geologic cross-sections of potentially unstable sediment masses.

    f. Maps showing areas of severe erosion, deposition, and large-scale bedform movement.

g. Maps showing the distribution, depth, and stability of gas-charged sediments, plus any identifiable oil and gas seeps.

h. Bathymetric map of area.

4. Other Data: Sub-bottom profiles, fathograms, side-scan sonar records, and associated navigation will be submitted for inclusion in the OCSEAP data base.

(P 927) GROUND ACCELERATIONS ASSOCIATED WITH MAJOR EARTHQUAKES IN ALASKAN OCS AREAS

This unit addresses subtask C-1 (BLM Study Types 10 - Seismic Hazards and 12 - Surface and Near Surface Faulting).

Estimated Costs, FY79:		
	$25,000	Aleutians
	25,000	Kodiak
	25,000	Lower Cook Inlet
	25,000	NEGOA
	$100,000	Total

Schedule: October 1978 - September 1979

Performing Agency: To be determined

Background:

Knowledge of the probable offshore ground accelerations associated with major earthquakes is important in tract deselection and in setting design stipulations for seafloor-mounted structures. Although OCSEAP currently supports limited onshore networks of strong motion accelerographs, it has not been possible to obtain adequate data for determining what the ground motions offshore are likely to be. There are several reasons for this: 1) The technology is not yet available for economical and efficient operation of ocean bottom accelerometers and probably will not be available for several years; 2) Extrapolation of onshore measurements of ground accelerations to offshore is very difficult and requires very thorough knowledge of the subsurface geology and seismic velocity structure; and 3) accurate measurements of acceleration at the instrument site can only be made during larger events (most instruments are triggered by a magnitude 6 earthquake), requiring good spatial coverage and relatively long periods for data collections. This project will address problems 2) and 3) to improve our capability for approximating offshore ground accelerations.

Objectives:

1. To expand the coverage of the existing network of strong-motion accelerometers, as required by the BLM environmental programs, thereby increasing the areal extent of measurements of acceleration from major earthquakes.

2. To utilize available data and appropriate techniques for extrapolating measured accelerations to offshore areas.

Methods:

Additional strong-motion accelerometers will be installed in areas where there is presently no coverage, particularly in the Kodiak and Lower

Cook Inlet areas. Existing installations will be evaluated to determine whether there is adequate coupling to bedrock, and to re-install if necessary. Available data on subsurface and offshore geology, including existing seismic profiling records, will be compiled and analyzed to construct seismic velocity profiles. These will then be combined with the onshore accelerometer and seismograph data to approximate seafloor accelerations.

It is possible that part or all of the funds indicated under "Estimated Costs" may be applied to existing research units (16, 210, and 251).

Output:

1. Narrative reports: Reports will explain the design of the network and will provide a summary of the geology at each installation. A summary of acceleration data obtained each quarter will be presented in each quarterly report. The year-end report will contain interpretations of the data obtained; an explanation of the techniques used to analyze the data; an analysis of the effects of the subsurface geology; and an evaluation of estimated offshore accelerations.

2. Digital Data: None

3. Visual Data:

   a. Maps of peak accelerations determined for the land areas for which ground motion data were obtained during major earthquakes.

   b. Maps of estimated peak accelerations for offshore areas.

4. Other Non-digital Data: Copies of accelerograms will be submitted for inclusion in the data base.

(P 928) SEDIMENT GEOTECHNICAL STUDIES ON THE ALASKAN CONTINENTAL SHELF

This research unit addresses subtask C-3 (BLM Study Types 13 - Seafloor Instability and 17 - Overpressured Sediments).

Estimated Costs, FY 79: $102,500 NEGOA

Schedule: October 1978 - September 1979

Performing Agency: To be determined

Background:

Although lessees are required to perform site-specific studies of the geotechnical properties of bottom sediments within a tract, preliminary information of this type is necessary for tract selection and to provide an independent source of data as input to impact statements and leasing stipulations. Reconnaissance geological studies identify some areas of potential instability, but provide very little data that can be used to ascertain the geotechnical character of the sediment mass. In order to do this, a general geotechnical framework must be determined for each lease area in conjunction and concomitant with geological studies. This framework includes an examination of the effect of natural loading processes (storm waves, tidal fluctuations, tsunamis, and seismic activity) which might trigger sediment failure. These studies would help to resolve geotechnical hazards on an areal basis and provide input to earthquake response phenomena. The field study area will be selected in cooperation with BLM.

Objectives:

1. To determine the overall geotechnical framework of sediments in the proposed lease area in order to identify unstable features and zones.

2. To evaluate the feasibility of using *in situ* instrumentation to determine the triggering potential of natural loading processes on potentially unstable sediment masses.

3. To formulate a standard approach for geotechnical studies applicable to high latitude, seismically active regions such as the Alaskan OCS, which can be used as a guide for future investigations.

Methods:

Sediment samples collected during reconnaissance studies will be supplemented by additional samples to be taken in areas of potentially unstable sediment and analyzed aboard ship and in the laboratory to determine appropriate geotechnical properties (e.g. shear strength, bulk density, water content, consolidation, Atterberg limits, etc). At certain locations (slump features, areas undergoing cyclic loading, etc.), sampling and analysis will be accompanied by in situ testing. In the case of pore pressure determination, this will require recoverable piezometers (implanted in the sediment) which have the capability to record data internally for periods up to several months.

Output:

1. Narrative Reports: Reports will describe geotechnical survey planning techniques and the methods used to collect and analyze samples for engineering and mass physical properties. Methods for emplacement of the in situ devices and analysis of the resultant data will also be described. Interpretations will be presented regarding the overall geotechnical framework of the lease area, the geotechnical characteristics of specific potentially unstable zones and features, including the delineation of active and relict slumps, and the resultant implications regarding potential hazards to OCS exploration and development activities.

2. Digital Data: Sediment geotechnical properties will be submitted on punch cards or magnetic tape in OCSEAP standard Format File Type 074.

3. Visual Data:

    1) Maps of geotechnical properties (including derived or integrative; trend surface, etc.)
    2) Core profiles of geotechnical properties.
    3) Graphs of pore pressure variations with time.
    4) Maps summarizing sediment geotechnical hazards (areas of instability and potential failure).

4.2 DESCRIPTIONS FOR PROJECTS IN TASK D (TRANSPORT):

D-1:	RU 140
	RU 289
	RU 367
D-2:	RU 140
	RU 289
	RU 367
D-4:	RU 59
D-7:	RU 140
	RU 212

(RU 059) COASTAL MORPHOLOGY, SEDIMENTATION AND OIL SPILL VULNERABILITY OF MONTAGUE ISLAND AND THE KENAI PENINSULA

This research unit addresses subtask D-4 (BLM Study Types 35 - Basin Morphology and 55 - Environmental Recovery Rates of Ecosystems).

Estimated Costs, FY 79: $40,000 NEGOA

Schedule: October 1978 - September 1979

Performing Agency:

University: University of South Carolina
P.I., Degree: Miles O. Hayes, Ph.D.
Title: Director, Coastal Research Division
Percent of time devoted to project and role: 30%; directs and actively participates in project.

Co-P.I., Degree: Christopher H. Ruby, M.S.
Title: Research Scientist
Percent of time devoted to project and role: 30%; coordinates field activities and data analysis.

Background:

A technique has been developed by the investigator and his colleagues, from case studies of five major tanker spills, whereby a shoreline can be evaluated to determine its relative vulnerability to spilled oil. The shoreline is divided into units classified according to a ten-component Oil Spill Vulnerability Index, relating ultimately to the potential longevity of oil in each environment. This longevity is a product of shoreline morphology, material characteristics (sediment, grain size, vegetation, etc.), and hydrodynamic environment (high energy versus low energy beach, tide range, etc.). The technique has been applied under NOAA funding to coasts of the northeast Gulf of Alaska, Kotzebue Sound and Beaufort Sea, and under State of Alaska funding to Cook Inlet. In FY 79, OCSEAP will fund a study to determine the coastal oil spill vulnerability of the southeastern shore of the Kenai Peninsula and Montague Island.

Objectives:

1. To compile field data on shoreline morphology, beach sediment grain size characteristics, vegetation, sedimentation rates, wave heights, and longshore currents as input to oil spill vulnerability classification.

2. To produce maps summarizing these parameters and the relative oil spill vulnerability of the coastal zone.

Methods:

The investigator will utilize the "zonal method" which he and his associates have developed over the past few years. The first phase of this approach is a reconnaissance study consisting of extensive studies of aerial photos, charts, and literature, aerial field reconnaissance, and selection of station locations. At each of the selected stations, detailed studies will be conducted including beach profiles, estimation of grain size and composition, statistical topographic studies, and detailed freehand sketches of the coastal zone.

Output:

1. Narrative Reports: These will include a detailed description of field and laboratory methods, background information, results and interpretations, and recommendations for further study. Each distinct coastal zone will be described in detail and the basis for its classification on the vulnerability index scale well documented. Implications regarding possible effects on intertidal biota, noting in particular the results of former Research Unit 78 (Zimmerman), will be summarized.

2. Digital Data: Beach profiles and grain size analysis data will be submitted on punch cards or magnetic tape in OCSEAP standard archive format.

3. Visual Data:

   - Maps summarizing coastal morphology, longshore sediment transport, wave energy, beach sediment grain size properties, and vegetational characteristics.

   - Maps of coastal oil spill vulnerability keyed to the vulnerability index.

(RU 140) NUMERICAL STUDIES OF THE ALASKAN REGION

This research unit addresses subtasks D-1, D-2, D-7 (BLM Study Types 27 - Currents and Tides, 28 - Wind Fields and 37 - Trajectories of Oil Spills).

Estimated Costs, FY 79:	$ 65,000	Kodiak
	$ 35,000	NEGOA
	$100,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Agency: NOAA/ERL
P.I., Degree: Jerry Galt, Ph.D.
Title: Project Supervisor, Modeling and Simulation Studies
Percent of time devoted to project and role: 25%; project supervisor

Background:

A diagnostic circulation model has been developed to calculate currents over an area from density data and data from strategically located current meter moorings. The calculated currents are used to determine trajectories which include the effect of stochastic processes derived from the statistics of the empirically determined currents.

Results of the diagnostic model can now be coupled to a pollutant trajectory model to obtain trajectories and approximate landfalls under various environmental conditions.

Objectives:

The objectives of the modeling studies are to complete the model development effort and to calculate pollutant transport scenarios around each lease area under conditions not accounted for in the FY 78 development effort. In addition, larval transport simulations over Albatross Bank will be used in an attempt to quantify interchange across the Kiliuda Trough. Weathering process and spreading algorithms will be selected from among the many already reported in literature and incorporated in trajectory calculation.

Specific objectives are:

1. To predict current patterns over Albatross Bank and around Kodiak Island where current meter data are limited but where density in the water column and estimates of sea level slope are known.

2. To predict pollutant trajectories and landfalls by application of observed wind fields to the flows derived from the diagnostic model and other sources.

3. To predict pollutant trajectories and landfalls in areas where current meter, Lagrangian drifter or derived geostrophic currents are available.

4. To include turbulent mixing and weathering explicitly as transport processes.

5. To evaluate the success of the model by comparison of computed current fields and trajectories with currents and trajectories found empirically from other studies (RU's 138, 289, and 217).

6. To demonstrate the effect of errors in winds and currents by showing changes in landfall under conditions of assumed error.

Methods:

The existing suite of model sub-units will be optimized and used to synthesize most-probable current fields; pollutant trajectories, and pollutant concentrations using all available input and verification data.

Coordination will be effected with U.S.G.S. trajectory modelers. Coordination with RU 289 and RU 367 for data, will be effected.

Output:

1. Narrative Reports: The final report in FY 79 will include operational descriptions of the model, documentation of computer programs, and analyses and interpretations of currents and trajectories based on various scenarios and inputs to the model. Strategy of Model-verification methods will be planned and reported prior to computer runs made under Objective 5.

2. Visual Data: These will include computer graphics showing study area coastlines, current vectors, and pollutant trajectories under a variety of environmental conditions. These graphics include:

    a. Maps of nearshore surface currents, seasonally.

    b. Maps of probable oil trajectories under the suite of mesoscale wind conditions characteristic of the lease area, as obtained from RU 367.

(RU 289) CIRCULATION AND WATER MASSES IN THE GULF OF ALASKA AND SATELLITE IMAGERY OF MESOSCALE FLOW FEATURES IN OTHER ALASKAN OCS AREAS

This research unit addresses subtasks D-1 and D-2 (BLM Study Types 27 - Currents and Tides and 29 - Residence Time and Flushing).

Estimated Costs, FY 79:		
	$10,200	Aleutians
	10,200	Kodiak
	10,200	Lower Cook Inlet
	71,400	NEGOA
	$102,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

University: University of Alaska, Inst. of Marine Science
P.I., Degree: Thomas C. Royer, Ph.D.
Title: Research Associate Professor
Percent of time devoted to project and role: 50%; project supervisor

Other Principal Scientist Significantly Involved in Project:

Name, Degree: K. Ahlnas, M.S.
Title: Resident Associate
Percent of time devoted to project and role: 85%; remote sensing image enhancement, interpretation, and archiving.

Background:

Since FY 75, the Principal Investigator has studied the mean and seasonal variations of the water mass characteristics and currents in the Gulf of Alaska from observed temperature and salinity distributions and direct current measurement. Sea surface temperature measurements obtained from NOAA satellites have been used in conjunction with hydrographic data in an attempt to estimate and map the surface circulation in the entire Gulf of Alaska.

The incorporation of satellite remote sensing into this project has substantially improved its capability to define nearshore circulation features that are manifested in surface water temperature differences. This is particularly important in the Kodiak and Aleutian lease areas.

Similar satellite data for the entire Alaskan OCS coastline including Lower Cook Inlet is made available by this project for use by other OCS principal investigators.

Efforts under this project are closely coordinated with those under RU's 138, 140, 141, 217, 267, 367, 541, and 550.

Objectives:

The objectives of this project are to complete the studies of mesoscale circulation patterns in the Gulf of Alaska from hydrographic properties, direct current measurements and satellite imagery and to provide similar satellite data for the entire Alaskan OCS coastline for use by other investigators. Objectives specifically applicable to the NEGOA, Aleutian, Kodiak, and Lower Cook lease areas are:

1. To provide evidence of key circulation features, both offshore and nearshore, by use of satellite imagery.

2. To provide improved descriptions of the seasonal variability in hydrographic properties in each area, and particularly in front of Hinchinbrook Entrance.

3. To analyze moored current meter data from near Kayak Island to allow determination of the barotropic flow on the shelf and provide input and calibration data for modeling conducted under RU 140.

4. To correlate currents inferred from satellite imagery with meteorological and hydrographic conditions.

5. To estimate, to the degree the evidence allows, the frequency and lifetime of mesoscale circulation features, such as nearshore eddies and meanders with descriptions of residence time wherever possible.

6. To provide satellite data for use by other OCS principal investigators.

7. To provide archive identification of all imagery showing evidence of key circulation features.

Methods:

No field work is planned in the Aleutian, Kodiak, or Lower Cook Inlet areas. There will be limited work west of Kayak Island, but only if the modeling study in FY 78 shows a gap in data. Field measurement, calibration, and analysis techniques will be similar to those currently in use. Quasi-continuous depth profiles of temperature and salinity will be obtained on a trimesterly basis from a grid of hydrographic stations from Unimak Pass to Yakutat. Data analysis will involve standard techniques in producing maps of hydrographic properties and in performing geostrophic current calculations.

Imagery from satellites (e.g., ERTS, NOAA) transiting the Gulf of Alaska will be used to describe surface circulation features that are manifested as water temperature differences. Similar information will be provided to OCS investigators in other lease areas on a 60-day delay, with infrared enhancements to be carried out during this time period.

Output:

1. Narrative Report: A report will be provided containing discussion and interpretation of principal hydrographic features and inferred flow patterns occurring during the observation period. The report will contain surface maps and cross-shelf section contours of hydrographic parameters and surface maps of dynamic topography for each cruise. Time series plots of water properties will be provided at selected stations to describe the seasonal characteristics of the shelf hydrography.

   The report will contain discussions of satellite imagery interpretations, including criteria, for seasonal offshore and nearshore current patterns, and integration of observations with other OCSEAP and climatological data.

2. Digital Data: Digital STD, current meter and pressure gauge data will be submitted to EDS in OCSEAP-approved formats 022, 015 and 017.

3. Visual Data:

   a. Seasonal maps of hydrographic properties.

   b. Seasonal maps of dynamic topography and geostrophic currents.

   c. Images and maps of seasonal and shorter-lived surface currents features as inferred by satellite remote sensing.

4. Other Data: Both the visible and IR images from clear areas of the coastline will be retained. IR enhancements and enlargements of these data will be carried out and catalogued. Prints of these images will be made available to OCSEAP principal investigators on request. Assistance in interpreting the imagery will be provided.

(RU 367) NEARSHORE METEOROLOGY

This research unit addresses subtask D-2 (BLM study type 28 - Wind Fields)

Estimated Costs, FY 79:

$ 64,170	Kodiak
30,500	Lower Cook Inlet
20,330	NEGOA
$115,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Department: NOAA/ERL
P.I., Degree: R. Michael Reynolds, M.S.
Title: Oceanographer
Percent of time devoted to project and role: 50%; project supervisor

Background:

Nearshore winds along the Alaskan coastline can differ significantly from those determined from synoptic weather charts because of strong coastal orographic effects. These differences can lead to errors in pollutant transport predictions that are based on synoptic geostrophic winds.

The FY 79 program will consist of studies in the Lower Cook Inlet, Kodiak, and NEGOA lease areas, continuing studies dating back to FY 76 in the NEGOA lease area. During FY 77 and 78, the studies were extended into the Copper River Delta and Cook Inlet areas where shipboard and land-based instrumentation was used to obtain local wind data. In the Cook Inlet area, Alaska State ferries obtained local winds during transits of the Homer-Kodiak run.

The Principal Investigator has performed field studies between Yakutat and Icy Bay during FY 76-77 to obtain empirical data with which to drive and verify a numerical atmospheric circulation model modified in FY 77 and 78 from an existing model previously developed by Lavoie. This model predicts local wind fields that are significantly different from synoptic or geostrophic winds due to coastal orographic effects. Verified output from this model will be used to improve the wind stress input to the pollutant trajectory model used by RU 140.

Objectives:

The objectives of this study are to provide an improved understanding of mesoscale features of the surface wind field resulting from coastal orographic effects.

Specifically these objectives are:

1. To relate observed over-the-water winds to winds forecast from synoptic weather charts.
2. To relate land-based local weather observations with winds observed over the water in the lease area and to provide the relationship for each identifiable weather type.
3. To devise a procedure whereby, from a knowledge of synoptic wind data combined with local land-based data, the surface winds over the lease area may be forecast.
4. To find, for each lease area from historical records, a set of wind and weather patterns which typify the conditions that might be expected during a spill. This information will be assembled in a manner suitable for use in trajectory analysis.
5. Acquire and analyze data from Kiliuda Bay (Kodiak Island) and relate winds there to currents.

Methods:

Methods used will be similar to those employed in FY 77-78.

Study methodology will include the following:

1. Installation of instruments on drill rigs in Cook Inlet and portable land stations at Kiliuda Bay.
2. Shipboard and aircraft (if possible) meteorological observations and acquisition of coastal wind data. Correlations will be made between the long term over-the-water observations and those obtained from shipboard and from land-based stations. Data recorded aboard Alaska State ferries will be included when available.
3. To the degree that the mesoscale wind model is applicable, it will be used to obtain the forecasts in objective 3. Otherwise, empirical relationships will be resorted to.

Output:

1. Narrative Reports: A report will be provided containing:

   a. A procedure for finding over-water winds in the lease area, given land-based and synoptic data (This is a joint effort with RU 140).

b. Discussions of analysis and interpretation of the results of field experiments which integrate as fully as possible all supportive data from other research programs.

c. A description of most probable wind fields expected in each area.

d. Documentation of model development and verification, results of simulation runs, and operational procedures.

2. Digital Data: All meteorological data obtained in field work which include:

   a. Wind speed and direction; time series at two or more sites.

   b. Wind speed and direction at several points as synoptically as ship and aircraft allow.

   c. Auxiliary meteorological information such as obtained from tethered balloons and rawinsondes.

   d. Computed winds in digital format as required in trajectory models.

   Data will be archived in format 101.

3. Visual Data: These will consist of:

   a. Charts of synoptic wind vectors.

   b. Graphical presentations of computed local winds versus observed winds.

   c. Graphical presentations of surface current measurements.

4.3 DESCRIPTIONS FOR PROJECTS IN TASK E (BIOTA):

E-1:	RU 229	
	RU 243	
E-2:	RU 194	
	RU 229	
	RU 243	
E-3:	RU 003	
	RU 341	
E-4:	RU 003	
	RU 341	
E-5:		P 905
		P 906
E-6:		P 905
E-7:	RU 005	P 922
E-8:	RU 417	
E-9:	RU 417	
E-10:		P 906
E-13:		P 906

(RU 3) IDENTIFICATION, DOCUMENTATION AND DELINEATION OF COASTAL MIGRATORY BIRD HABITAT IN ALASKA

This research unit addresses subtasks E-3, E-4 (BLM study types 39 - Vulnerable Populations, 40 - Life History, 41 - Critical Habitats, 42 - Food Web Dependencies, 44 - Wetland Ecosystems.)

Estimated Costs, FY 79 :

$ 5,200	NEGOA
26,000	Lower Cook Inlet
1,560	Kodiak
19,240	Bristol Bay
$52,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Agency: Alaska Department of Fish and Game
P.I., Degree: Paul Arneson, Ph.D.
Percent time devoted to project and role: 100%;
Project direction, sample collection, analysis and data processing.

Background:

Collection of information on the seasonal composition, distribution, abundance, timing of migrations and coastal habitat preference by migratory birds in the Gulf of Alaska was completed during 1976. Field work in 1977 was concentrated in Bristol Bay, Lower Cook Inlet, Kodiak, and the Alaska Peninsula. In 1978 winter surveys were conducted in Lower Cook Inlet to determine distribution and abundance of marine birds in relation to ice conditions and also to limited colony studies during the summer to determine bird usage of selected small colonies on the west of Lower Cook Inlet. Field investigations will be completed at the end of FY 78. However, the project will be continued in FY 79 to allow complete analysis of data and preparation of two comprehensive final reports.

Objectives:

The objectives of this study are to determine seasonal changes in the composition, distribution, abundance, feeding and breeding ecology of birds associated with coastal habitats. Specifically, the objectives are:

1. Determine seasonal density, distribution, and use of coastal habitat by migratory bird species.

2. Determine primary feeding and staging areas.

3. Determine breeding locales for selected species.

Methods:

Data collected from previous years will be analyzed and synthesized to provide two comprehensive final reports. Marine bird coastal habitat maps produced by this research unit have been duplicated on 35mm slides and submitted to the Program Office.

Output:

1. Final Narrative Report: Seasonal changes in distribution, density, and use (feeding, breeding, etc.) of coastal habitats by migratory birds will be described and evaluated. This report will include information available on the spring migration of birds past Cape St. Elias, a winter population estimate for Kodiak Island, and winter and spring distribution and abundance estimates of birds in Lower Cook Inlet related to ice conditions and other environmental parameters. Scientific input will be provided by RU 341 (Sanger), RU 005 (Feder), RU 424 (English), RU 512 (Blackburn) and RU 059 (Hayes) in developing this report.

   A second narrative report will be developed in which the phenology, reproductive ecology, life histories, and foraging areas for selected colonies in Lower Cook Inlet and Bristol Bay will be assessed. Literature synopses of food habits for principal life stages of selected species will be included. Input will be provided by RU 341.

2. Digital Data: By FY 79 study results will have been provided in OCSEAP format under file types FY 040 - Bird Habitat and the new bird colony format presently being developed, FT135.

3. Visual Data: Narrative reports will be supported by maps, charts, figures, and tables. Specifically, these products are:

   a. Maps which identify:

      (1) Coastal area surveyed and associated habitat.
      (2) Sampling locations.

   b. Charts which illustrate:

      (1) Seasonal changes in distribution and densities of migratory birds.
      (2) Primary breeding locales for selected species.
      (3) Primary foraging areas for selected species.
      (4) Primary migratory routes.

c. Figures and tables which illustrate:

(1) Changes in bird distribution and density.
(2) Changes in seasonal use patterns.
(3) Seasonal changes in feeding habits of birds associated with coastal habitat.

(RU 5) FOOD WEB RELATIONSHIPS AND PRODUCTIVITY OF INVERTEBRATE SPECIES IN THE NEARSHORE ZONE

This research unit addresses OCSEAP subtask E-7 (BLM study types 39 - Vulnerable Populations, 40 - Life History, 42 - Food Web Dependencies).

Estimated Cost, FY 79:		
	$ 94,350	Lower Cook Inlet
	85,100	Kodiak
	5,550	NEGOA
	$185,000	Total

Performing Agency:

University: University of Alaska
P.I., Degree: Howard M. Feder, Ph.D.
Title: Professor of Marine Science and Zoology
Percent of time devoted to project and role: 33%; Project Director.

Background:

Exploration of the benthos on the Alaskan OCS began in 1974 in the Gulf of Alaska. In subsequent years, the geographic coverage was expanded to include the benthic populations of the Lower Cook Inlet, Kodiak Island, Chukchi Sea and the St. George Basin, Bristol Bay and Norton Sound regions of the Bering Sea. Due to recent shifts in the OCS leasing schedule, efforts to investigate these offshore epi- and infaunal populations have been focused on the Lower Cook Inlet, Kodiak, and, again, on the Northeast Gulf of Alaska. The methodology has included extensive trawl studies conducted during FY 76 and FY 77 to provide broadscale information on the composition, distribution and relative abundance of the epifaunal invertebrates. Similarly the infauna have been studied primarily through use of grab and dredge surveys except in Norton Sound where only the epifauna has been intensively investigated by trawling equipment.

The results thus obtained will yield data on the distribution, abundance, species diversity and community structure of the benthos necessary in determination of their critical habitats in offshore regions. Reports synthesizing the results from these reconnaissance level surveys are expected to be completed for each lease area during FY 78.

Investigations have also been conducted closer inshore in the Lower Cook Inlet and Kodiak Island regions. This began in FY 77 with summer trawl surveys in Alitak and Ugak Bays (Kodiak) to provide a preliminary look at the temporal and spatial distributions of epifaunal populations in these nearshore waters. The two large bays of Lower Cook Inlet and Kachemak and Kamishak Bays were sampled as early as FY 76 with equipment such as the pipe dredge. Additional data will be obtained in conjunction with the food web studies in the Kodiak region during the FY 78 field season through summer cruises in the two bays of Kodiak Island, Izhut and Kiliuda. The intensified spatial and temporal scheme will yield

the higher resolution data presently needed. A limited field effort was also conducted in the Hinchinbrook entrance area in FY 78. It consisted of a single reconnaissance survey of nearshore benthos in both protected and exposed coastal habitats. The research emphasis was also shifted in FY 78 from solely a reconnaissance level survey to inclusion of trophic relationships studies focused on commercially important members of the epibenthic invertebrate community. This project is also a component of the integrated studies on the feeding relationships of both ecologically and commercially important marine organisms in the Kodiak and Lower Cook Inlet lease areas.

Objectives:

Studies in the lease areas will continue to center upon food web relationships and supportive data. Data and information exchanges with the other research units involved will also continue to be an important part of the research efforts. Specifically the objectives for each lease area are:

NEGOA (in principal nearshore habitats, <100m in depth):

1. Describe the distributions and relative abundance of dominant epifaunal invertebrates.

2. Determine the food habits of selected benthic invertebrates and demersal fishes.

Kodiak:

1. Determine the feeding habits of the principal inshore epi faunal invertebrate species emphasizing the commercially important king crab and pink shrimp.

2. Exchange data and information with RU's 341, 551, 552, and 553 in order to develop a food web structure for selected inshore areas.

3. Synthesize information on distribution, abundance, and life histories of key species of benthic invertebrates.

Lower Cook Inlet:

1. Determine the feeding habits of the principal inshore epifaunal invertebrate species, emphasizing key commercially important species such as the snow crab.

2. Develop food webs integrating the invertebrate, fish, mammal and bird trophic relationship data in conjunction with RU's 229, 243, 341, 417, 424, and 512.

3. Synthesize available information on the distribution, abundance, and life histories of commercial invertebrates.

4. Describe and evaluate the potential for impact by OCS gas and oil exploration activities, and subsequent development and production, on those epi- and infaunal habitats of Lower Cook Inlet using data from studies conducted in FY 76 through FY 78.

Kodiak and Lower Cook Inlet:

1. Assess spatial and temporal distribution and relative abundance of epifaunal invertebrates in selected bays and inshore areas.

2. Review and analyze the existing data base to provide a comprehensive description of benthic biota and environment.

Methods:

Analyses of the trawl, dredge and grab samples will be conducted by those procedures previously utilized by this research unit and documented by a quality control memorandum. In particular the trawl analyses are comparable to those methods employed for the epibenthic samples taken in Norton Sound in 1976. Food habits of the key, commercially important species of epibenthic invertebrates will be determined through stomach analyses utilizing those standard gravimetric procedures defined in RU's 486 and 512.

Trophics work in the bays of Kodiak Island will continue in the same bays as the other food web studies. Epibenthic invertebrate populations were sampled monthly during the spring and summer of FY 78. These efforts, initiated in FY 78, will continue quarterly in the fall and winter of early FY 79 for completion of a full year of data. Samples will be obtained primarily through the use of otter trawl and diving surveys with infaunal food sources sampled by dredge and grab equipment. Site selection for intensive sampling will be based on results from studies conducted during FY 78.

Objective 3 for Lower Cook Inlet will require several additonal sources of information. These include the location of leased tracts, the location of exploratory rigs, the BLM development scenario, results of trajectory analyses for Lower Cook Inlet made by OCSEAP in FY 78, and the results of Miles Hayes' (RU 59, 1977) work on vulnerable habitats of Lower Cook and NEGOA. In addition, the existing information on sensitivity of specific components of the ecosystem must be considered. This latter information will be supplied to the investigator by the project office.

Output:

1. Narrative Reports: Reports will describe methods, temporal and spatial intensity of sampling, current status of knowledge, description of statistical treatment, results, discussion and conclusions. Recommendations for future investigations will be defined. Reports will provide an analysis of biological activity at each study site and a discussion of trophic relationships in the Kodiak and Lower Cook Inlet lease area with an identification of the critical links in the food web. A final report will be prepared for those lease areas already intensively studied which will focus on contrast and comparison of results. This effort should result in better resolution of any future studies of the benthos in these areas.

2. Digital Data: Results of this study will be submitted on OCSEAP defined formats in the File Type 032 - Benthic Organisms. Data from the analysis of stomach contents will be submitted in a new File Type developed during FY 78.

3. Visual Data: Data supporting the narrative report will be provided in the form of maps, charts, figures and tables. Specifically, the products will be:

    a. Maps of sampling sites.

    b. Charts illustrating:

        (1) The seasonal distribution and abundance of dominant benthic organisms.

        (2) The seasonal distribution of major predator and prey species.

    c. Figures and tables illustrating:

        (1) The benthic food web.

        (2) The major prey species.

        (3) The productivity/biomass of selected species.

        (4) Species inventories for various habitats (embayments, outer coast).

        (5) Indices of composition of phyla (numbers, weight and biomass - as allowed by the data) in various habitats.

        (6) Frequency and percent frequency of occurrence of food items in stomachs of selected invertebrates and fish species.

(RU 194) MORBIDITY AND MORTALITY OF MARINE MAMMALS

This research unit addresses subtasks E-2 and F-7 (BLM study types 39 - Vulnerable Populations, 40 - Life History).

Estimated Costs, FY 79:		
	$30,000	Kodiak
	10,000	Lower Cook Inlet
	10,000	NEGOA
	4,000	Norton
	2,000	Chukchi
	4,000	Beaufort
	$60,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

University: University of Alaska
P.I., Degree: Francis H. Fay, Ph. D.
Title: Associate Professor
Percent of time devoted to project and role: 33% Project direction sample collection, and data analysis.

Background:

FY 76, FY 77, and FY 78 efforts consisted of aerial reconnaissance to locate stranded, dead and moribund animals and necropsy of selected individuals. A review of historical information on marine mammal morbidity and mortality was completed and an annotated bibliography prepared and cross-indexed. Research will be continued into FY 79 to provide information on annual variation in disease occurrence of stranded and beached carcasses. No further necropsy or analysis of mammal specimens obtained through selective collecting is anticipated in FY 79. A very large body of unpublished observations on many aspects of arctic fox (Alopex lagopus) biology is available to this P.I. As an alternative to commencing fieldwork on the problems of foxes, this RU will be asked to deliver a summary report dealing with fox biology as it relates to OCS activities.

Objectives:

Level of effort will be reduced in FY 79. Specifically, the objectives are:

1. To determine the number (by species, sex, and age) of stranded marine mammals along the Alaskan coast.

2. To determine the pathological conditions and agents that caused or contributed to the moribund condition or death of stranded animals.

3. To analyze and determine the major cause of natural mortality of those species of marine mammals that have been selectively collected by RU 229 (Pitcher), RU 243 (Calkins), RU 230 (Burns), and RU 232 (Burns) during the past three years.

4. To determine annual variation in the pathological agents that cause or contribute to moribund conditions or death of marine mammals.

5. To determine the occurrence of pathogenic agents in the natural populations of marine mammals.

6. To determine the source and probable drift trajectories for these areas where the highest incidence of beached mammal carcasses occur.

7. Synthesize and report on previously obtained, unpublished data (non-OCSEAP) on arctic foxes, relating their trophic dependencies to marine-derived beached carcasses, pathological conditions, and to offshore oil and gas development activities.

Methods:

The only significant change in sampling methods during FY 79 will be the concentration of sampling efforts on stranded dead mammals, rather than those collected for research purposes.

Output:

1. Narrative Reports: These will describe the distribution of stranded dead and moribund animals along the Alaskan coast, the type of pathogenic conditions that caused or contributed to the moribund condition or death of stranded animals, and of the annual variation in the incidences of selected pathogenic agents in natural populations.

2. Digital Data: These will be in OCSEAP formats File Type (FT) 011 - Histopathology, FT 025 - Mammal Specimen and FT 026 - Mammal Sighting 02.

3. Visual Data: Data supporting the narrative report will be provided in the form of maps, charts, figures, tables and, where appropriate, photographs. Specifically, the products will be:

   a. Maps of stranded, moribund, and dead marine mammals.

   b. Charts illustrating probable carcass drift based on stranding from known sources.

c. Figures and tables illustrating:

(1) The occurrence of pathogenic agents in selected species.

(2) The annual variation in the occurrence of pathogenic agents for selected species.

(3) The occurrence of pathogenic agents in principal life stages of selected marine mammals.

(RU 229) BIOLOGY OF THE HARBOR SEAL IN THE GULF OF ALASKA

This research unit addresses subtasks E-1 and E-2 (BLM study types 39 - Vulnerable Populations, 40 - Life History, 41 - Critical Habitats, 42 - Food Web Dependencies, and 53 - Effects of Noise).

Estimated Cost, FY 79:	$34,500	Kodiak
	17,000	NEGOA
	$51,500	Total

Schedule: October 1978 - September 1979

Performing Agency:

Department: Alaska Department of Fish & Game
P.I., Degree: Kenneth Pitcher, M.S.
Title: Marine Mammals Biologist
Percent time devoted to Project and role: 75% Project Director

Other Principal Scientist significantly involved in Project:

P.I., Degree: Donald Calkins, M.S.
Title: Marine Mammals Biologist
Percent time devoted to project and role: 25%, Participant in field work.

Background:

During FY 77 and FY 78 a large number of animals were collected, yielding data on population composition, reproductive biology, food habits, and pathology. A large collection of organ and tissue samples have been accumulated for analysis of baseline levels of hydrocarbons and metals. During FY 78, specimen collection was limited and directed toward filling seasonal and geographical gaps and preliminary work was done in development of radio-tracking techniques for monitoring population status. FY 79 efforts will be directed toward the final synthesis and analysis of the preceding years' field data and the preparation of a comprehensive final report on the studies.

Objectives:

Objectives of this study will provide information on population dynamics, reproductive ecology, and food habits of the harbor seal in the Gulf of Alaska. Specifically, these objectives are:

1. To determine food habits and identify important prey species.

2. To determine seasonal distributions and abundance estimates and identify critical habitats.

3. To determine age of sexual maturity, age specific reproductive rates, growth rates, and seasonal changes in mean body condition by life stage and area.

4. To determine the effects of disturbance on harbor seal populations.

5. To complete the analyses of tissue samples and specimen materials for hydrocarbons and trace metals. No additional hydrocarbon and tissue sample analysis (beyond what is presently being conducted) is anticipated in FY 79.

6. To determine activity patterns, haul out behavior and seasonal use patterns for harbor seals at Tugidak Island.

Methods:

Data collected from previous years will be analyzed and a comprehensive final report will be submitted in FY 79. Distribution information will receive further interpretive analysis based on the results of intensive fish studies conducted by other research units.

Output:

1. A final narrative report describing growth rates, reproductive biology, population discreteness and patterns of movement, abundance estimates, food habits, behavioral aspects, critical habitats and seasonal use patterns, radio tracking techniques and methods, and effect of disturbance with recommendation for OCS activity stipulations which will protect populations.

2. Maps showing areas of concentration, seasonal movements, and critical habitats.

3. Digitized data will be in OCSEAP File Type 025 for information outputs listed in (1) and (2) above.

4. Specimen materials, including appropriate tissues for establishing baseline levels of hydrocarbons and metals.

5. Participation in Synthesis meetings and report review, as requested.

(RU 243) POPULATION ASSESSMENT, ECOLOGY AND TROPHIC RELATIONSHIPS OF STELLER SEA LIONS IN THE GULF OF ALASKA

This research unit addresses subtasks E-1 and E-2 (BLM Study Types 39 - Vulnerable Populations, 40 - Life History, 41 - Critical Habitats, 42 - Food Web Dependencies, and 1 - HC Baselines).

Estimated Cost, FY 79:		
	$51,000	Kodiak
	65,500	Lower Cook Inlet
	29,000	NEGOA
	$145,500	Total

Schedule: October 1, 1978 - September 30, 1979

Performing Agency:

Department: Alaska Department of Fish and Game
P. I., Degree: Donald Calkins, M.S.
Title: Marine Mammals Biologist
Percent of time devoted to project and role: 75%; project direction and field work

Other Principal Scientist significantly involved in project:

P.I., Degree: Kenneth Pitcher, M.S.
Title: Marine Mammals Biologist
Percent time devoted to Project and role: 25% participant in field work.

Background:

This project has produced a catalog and map of all hauling-out areas for sea lions in the general Gulf of Alaska region including information on numbers seen at each site. Results are improved understanding of the seasonal use patterns associated with hauling-out areas and, in most cases, determining areas actually used as rookeries (breeding locations). A large number of animals has been collected, yielding data on population composition, reproductive biology, food habits, and pathology. A large collection of organ and tissue samples has been accumulated. Analysis of this material for levels of hydrocarbons and metals began in FY 77 and will be completed in FY 79. Most of these analyses are being performed by investigators working with other research units. A major element of the work in FY 76 and FY 77 was the branding of young sea lions at principal rookeries. During FY 78 further specimen collection was limited and directed toward filling specific gaps. Considerable effort was spent in locating previously branded animals. A series of preliminary surveys to determine the population size, discreteness, and movements of the belukha whale population in Lower Cook Inlet was conducted in FY 78.

FY 79 studies will locate previously branded animals and further elucidate breeding population discreteness, dispersal, and movements from and to major rookeries. Completion of analyses of specimens and materials collected in previous years and a major synthesis effort of all existing data will be stressed.

Objectives:

1. To determine the seasonal distribution and abundance of Steller sea lions in the Gulf of Alaska, their reproductive ecology and food habits. More specifically this will involve:

    a. Determination of numbers and biomass in the Gulf of Alaska.

    b. Determination of age and sex composition at major rookeries and hauling grounds.

    c. Determination of population discreteness and seasonal patterns of movement.

    d. Determination of population productivity, age of sexual maturity, age specific reproductive rates, and mortality/ survival rates as a function of age and sex.

    e. Determination of food habits and important prey species.

2. To determine the distribution and abundance of belukha whales in Lower Cook Inlet.

3. To provide a complete synthesis of all ecological information on marine mammals in Lower Cook Inlet with emphasis on describing and evaluating the potential for impact by OCS oil and gas exploration, development, and production. Synthesis should consider the following information where available:

    a. Distribution and abundance
    b. Seasonal patterns of movement
    c. Location and characterization of important habitats
    d. Population productivity
    e. Food habits and foodweb relationships

Objective 3 will require several additional sources of information besides available ecological information on mammals. These additional sources include: the location of leased tracts, the location of exploratory rigs, the BLM Development Scenario, the results of the trajectory analysis which is being run by OCSEAP in FY 78, the results of Hayes' work on vulnerable habitats in Lower Cook Inlet (1977 - RU 059) and existing information on the sensitivity of specific components.

Methods:

Following systematic collection of specimens, standard laboratory procedures are used for analyses, including taking of standard marine mammal measurements, gross and microscopic examination of reproductive condition, reading of cementum annuli, and identification of stomach and intestinal contents. Aerial and vessel-based surveys are employed to determine patterns of use of hauling-out areas and to locate branded animals, supplemented by on-land observations. Animals are branded to distinguish place and year of birth, principally at the major rookeries.

Output:

1. Narrative reports providing syntheses of information on subjects and parameters listed above will be furnished in FY 80. These syntheses will be initiated in FY 79. Specific products to be furnished are:

   a. A synthesis of all available information on seasonal distribution and abundance, breeding and concentration areas, population and trophic dynamics, effects of disturbance, seasonal movement patterns and critical habitats of Steller sea lions in the Gulf of Alaska;

   b. Analyses of sea otter behavior and ecology in the Afognak-Marmot Islands area;

   c. Distribution and abundance estimates of beluga whales in Lower Cook Inlet;

   d. A complete synthesis of all information available on the marine mammals of Lower Cook Inlet. Interpretaion of data relating behavior to OCS development activities will be stressed;

   e. All of the synthesis information available on marine mammals of Lower Cook Inlet (addresses Objective 3) will be provided as a final report in FY 79.

2. Digital data as listed in appropriate marine mammal formats: 025 and 027.

3. Visual data in the form of maps showing hauling-out areas and rookeries, numbers present at various seasons, and sightings of branded animals.

4. Participation in synthesis meetings and review of synthesis reports.

(RU 341) POPULATION DYNAMICS AND TROPHIC RELATIONSHIPS OF MARINE BIRDS IN THE GULF OF ALASKA

This research unit addresses subtasks E-3 and E-4 (BLM Study Types 41 - Critical Habitats and Habitat Dependencies and 42 - Food Web Dependencies).

Estimated Costs, FY 79:		
	$120,000	Lower Cook Inlet
	81,000	NEGOA
	120,000	Kodiak
	$321,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Agency: U.S. Fish and Wildlife Service
P.I., Degree: Calvin J. Lensink, Ph.D.
Title: Activity Leader
Percent of time devoted to project and role: 25%; direction and data analysis

Other Principal Scientists significantly involved in project:

P.I., Degree: Gerald Sanger, B.S.
Title: Project Leader, Seabird Trophics
Percent of time devoted to project and role: 100%; supervision, data collection and interpretation

P.I., Degree: P. J. Gould, Ph.D.
Title: Study Leader, Seabirds and Seabird Habitat
Percent of time devoted to project and role: 60%; supervision, data collection and interpretation

This research unit originally addressed only population dynamics of marine birds, but subsequent incorporation of RU's 338, 342, and 343 enlarged its scope to include seabird colony mapping and trophics studies.

Definition of foraging areas originally took part under RU 337 as part of the work on the seasonal distribution and abundance of marine birds utilizing pelagic habitats. During FY 77 emphasis on shipboard surveys was reduced and aerial surveys emphasized to complete the reconnaissance phase of the program.

The characterization of the food habits and feeding ecology of marine birds was initiated in 1975. It consists of collections of data at breeding colonies, on the open ocean and in coastal concentration areas.

The major emphasis of the work has been on seabirds, but some data are available on shorebirds and waterfowl. In 1976-77, the bulk of the field effort was concentrated in the Kodiak area and included collections

at colonies and coastal waters in support of an integrated nearshore ecosystem study. An integrated food web study was initiated in FY 78 in Lower Cook Inlet.

Population dynamics studies at major seabird colonies and selected coastal estuaries began in 1975. This work, continued through 1978, has provided information bases ranging in length from one to four years at 14 seabird breeding colonies along the Alaskan coast between Kayak Island in NEGOA and St. Lawrence Island in the northern Bering Sea. Data on shorebirds and waterfowl have been obtained from the Yukon delta, lagoon systems on the northern Alaska Peninsula, and from the Copper River.

Seabird colony mapping was largely completed in FY 77. A small study of colonies on the southwestern side of Kodiak Island was the only work addressing that objective in FY 78.

A beached bird study was initiated as a relatively modest project in FY 78. The work, intended to produce indices of seabird mortality, was discontinued when it became apparent that the low data return would not produce conclusive results within a reasonable time period.

Most of the research unit objectives have been satisfied, thus the emphasis of FY 79 work will be on completion of the field work on population dynamics, phenology, and productivity studies at colonies not yet intensively investigated, and the acquisition of seabird trophics data on selected species, including elements of integrated foodweb investigations. These studies will be confined to the NEGOA, Lower Cook Inlet, and Kodiak lease areas. The work in the latter two areas will continue to support the integrated nearshore ecosystems investigations in progress, while work in the NEGOA will concentrate on further definition of the foraging areas around Middleton Island in conjunction with the colony studies. Field efforts in all three lease areas will be substantially reduced to a few identified colonies, aimed at selected species representative of various marine bird environments in terms of behavioral characteristics.

Objectives:

The major thrust of the research is to develop a capability to predict the rate of recovery of seabird species from impacts of petroleum spills. Recovery is largely a function of productivity, thus this aspect of seabird studies is stressed. Many factors affect productivity, so the research objectives consist of several elements. This study addresses the reproductive ecology, phenology, foraging, and trophic relationships of selected marine bird species in the Gulf of Alaska. Specifically, the objectives are:

1. To determine timing and use of major rookeries by marine birds in NEGOA, Lower Cook Inlet, and Kodiak Island areas.

2. To describe on an annual basis, species productivity, i.e., hatching, fledging, and growth rates in those rookeries.

3. To describe year-to-year variations in phenology and productivity of seabird species as a function of location, environmental conditions and other pertinent factors.

4. To define feeding habits of principal life stages of selected marine bird species in terms of prey taken, season, and location, with emphasis on the species of diving birds.

5. To locate primary seabird foraging areas in coastal waters and determine the extent and timing of use and conditions fostering concentrations of prey.

Methods:

Methods will be similar to those used in previous years. Field camps will be established at the rookeries and manned throughout the nesting season. The work at the colonies will consist of mapping rookeries, determining species composition and abundance, monitoring timing and success of egg laying, hatching and chick fledging, and making collections for food habits studies. Seabird trophics studies in the coastal waters of Lower Cook Inlet and Kodiak Island will involve periodic collections of samples of selected seabird species, and observations of feeding locations and food available. Foraging surveys in the Gulf of Alaska adjacent to Middleton Island will utilize standard shipboard transect methodology to locate and delineate the size of these areas.

Outputs:

1. Narrative Reports: Population dynamics reports will describe the phenology of major events in the nesting cycle at each colony and the reproductive ecology of species studied. They will also include, as the data allow, estimates of the number of individuals in each seabird species present at the colony.

   Seabird trophics reports will consist of discussions of the feeding ecology of selected species, including data on prey species, size and numbers with respect to season and location. Information will be included on the extent, location, and temporal changes in foraging areas as well as other aspects of feeding ecology as the data-gathering effects allow.

   Discussions of population and trophic dynamics should include evaluations of inter-year and inter-colony variability when sufficient information is available.

2. Digital Data: The results of this study will be submitted on magnetic tape for archival in EDS under the following OCSEAP

file types: 031 - Marine Bird Specimens, 033 - Bird Sighting, 034 - Bird Sighting, 135 - Bird Colony, 038 - Seawatch for Birds, and 040 - Bird Habitat.

3. Visual Data: These will consist of:

   a. Maps which show:

      (1) Location of rookeries selected for study.
      (2) Study sites, nest locations, etc.
      (3) Shipboard transect lines.

   b. Charts which show foraging areas

   c. Tables and figures which illustrate:

      (1) Timing of use of rookeries for individual species.
      (2) Timing of use of rookeries for all species combined.
      (3) Times of arrival, egg laying, egg hatching, fledging and departure from the rookery by species studied.
      (4) Hatching and fledging success and growth rates for species studied.
      (5) Food habits for species studied as functions of bird size, age, and sex, and prey species, size and numbers.
      (6) Changes in intensity of use of major foraging areas.
      (7) Changes in the range of foraging excursions by selected species for major rookeries.

(RU 417) ECOLOGICAL STUDIES OF INTERTIDAL AND SHALLOW SUBTIDAL HABITATS IN LOWER COOK INLET AND NEGOA

This research unit addresses subtasks E-8 and E-9 (BLM Study Types 39 - Vulnerable Population, 40 - Life History, 41 - Critical Habitats, and 42 - Food Web Dependencies).

Estimated Costs:	$ 90,000	Lower Cook Inlet
	30,000	NEGOA
	$120,000	Total

Schedule: October 1978 - September 1979.

Performing Agency:

Agency: Dames and Moore
P.I., Degree: Dennis Lees, MS
Present time devoted to project and role: 50% - Project supervisor, sample collection, and data analysis.

Background:

During the 1975 field season, Dames and Moore personnel under subcontracts to NMFS-Auke Bay Lab (RU 78) and ADF&G (RU 27) initiated subtidal habitat studies in NEGOA (RU 78) and in Lower Cook Inlet (RU 27). In FY 76, the scope of work in Lower Cook Inlet was expanded to an intertidal reconnaissance survey and the NEGOA work was de-emphasized. In FY 77, work in Lower Cook Inlet evolved into site specific intensive studies consisting of comprehensive assessment of seasonal changes in the composition of dominant intertidal organisms in representative habitats in Lower Cook Inlet. These specific sites were: Deep Creek, Homer Spit, Gull Island, Jakalof Bay and Seldovia on the eastern side of Lower Cook Inlet; Chinita Bay, Inishin Bay, Bruin Bay, Nordyke Island, Douglas River, and offshore reefs near Bruin Bay on the western side of Lower Cook Inlet; and Port Etches/Constantine Harbor and Latouche Point in NEGOA.

The work continued in FY 78, with research directed toward seasonal and shorter-term estimations of production, standing crop, and growth for major macrophyte species, trophic relationships of dominant organisms, and growth and standing crop for selected invertebrate species. Clarification of the littoral and shallow, subtidal food webs at the specific sites has required close coordination with RU's 005 (deeper water benthos), 512 (fishes, including nearshore forms), 341 (marine birds), and 424 (seasonal distribution of meroplankton).

Work during FY 79 will involve completion of field work in NEGOA, and final laboratory and data analysis, synthesis of all available information, interpretation, and final report preparation on the intertidal and shallow subtidal habitats of Lower Cook Inlet and NEGOA.

Objectives:

1. To assess the seasonal changes in composition and define the trophic relationships amoung dominant intertidal and subtidal organisms in representative habitats in Lower Cook Inlet and NEGOA.

2. To determine the seasonal patterns of primary production, growth, and standing crop for the major macrophyte species.

3. To describe and evaluate the potential for impact by OCS oil and gas exploration, development and production on those intertidal and shallow subtidal habitats studied from FY 76 through FY 78.

Methods:

In order to address objective 1 for Lower Cook Inlet, information exchange will be required with Research Units 005 (Feder), 424 (English), and 512 (Blackburn). Objective 3 will require several additional sources of information including: the location of leased tracts, the location of exploratory rigs, the BLM Development Scenario, the results of the trajectory analysis which is being run by OCSEAP in FY 78, the results of Hayes' work (059) on vulnerable habitats in Lower Cook Inlet (1977) and NEGOA (1977) and existing information on the sensitivity of specific components.

There will be no field work in Lower Cook Inlet in FY 79. Effort will instead be devoted to completion of laboratory and data analysis, synthesis, interpretation and final report preparation.

Field work in NEGOA will be restricted to two sampling periods during the first half of the fiscal year and the rest of the year devoted to data analysis interpretation, synthesis, and final report preparation. The field sampling in NEGOA in FY 79 is necessary in order to obtain a seasonal data base for those habitats studied. The final report on the NEGOA studies will also include a comparison of the habitats with those studied in Lower Cook Inlet. If extrapolations from the larger data base in Lower Cook Inlet to NEGOA appear feasible, such extrapolations and their related findings will be discussed in the NEGOA report.

Output:

1. Narrative Reports: This will describe in detail methods used, spatial and temporal intensity of sampling, frequency and duration of measurements, background data and information, statistical analysis, results discussion, and conclusions, recommendations, and graphics illustrating data synthesis and conclusions.

2. Digital Data: The results of this study will be provided on magnetic tape in OCSEAP defined format. The data and procedures for quality control will be submitted to OCSEAP for archival in Environmental Data Service (EDS). This study will produce digital data in File Type 030 - Intertidal Data.

3. Visual Data: These will include maps, charts, figures and tables.

   a. Maps that identify:

      (1) Area surveyed.
      (2) Location of sampling sites.

   b. Charts that illustrate vertical zonation at each sampling site.

   c. Figures and tables that illustrate:

      (1) Seasonal composition of subtidal biota.
      (2) Trophic hierarchy at each study site.
      (3) Seasonal growth rates, standing biomass, and production of macrophyte communities.
      (4) Size/weight regressions for selected species, with estimates of seasonal production.

(P 905) ECOLOGY OF NEARSHORE FISHES: SEASONAL ABUNDANCE, HABITAT USE AND TROPHIC RELATIONS

This research unit addresses OCSEAP subtasks E-5 and E-6 (BLM Study Types 39 - Vulnerable Populations, 41 - Critical Habitats and 42 - Food Web Dependencies).

Estimated Costs, FY 79: $20,000 NEGOA

Schedule: October 1978 - September 1979

Background:

The shallow sublittoral zone is important to many fish, seabird and marine mammal species. Notable groups using this zone in NEGOA include sea otters, salmon and seaducks. The shallow sublittoral zone also is relatively more susceptible to impingement by surface-borne contaminants than deeper offshore waters due to a lesser volume of water present for dilution to take place and often to vigorous vertical mixing which can spread contaminants throughout the water column.

This study addresses the ecology of fishes in sublittoral habitats through SCUBA study techniques. Conventional surface sampling techniques do not provide sufficient information from this type of environment due to limitations of traditional sampling gear. Diving methods provide a valuable adjunct to shipboard techniques, providing information on behavioral relations of fauna that otherwise would not be available.

Objectives:

Determination of the ecology and seasonal abundance of nearshore sublittoral fishes in vulnerable habitats by:

1. Assessing the distributional patterns, relative abundance, habitat usages, and trophic dependencies of abundant and dominant nearshore fish species.

2. Analyzing the role of ecologically important fish species in the nearshore environment.

The ultimate objective of the study is to be able to make inferences about nearshore fish assemblages in similar habitats in other parts of the NEGOA.

Methods:

Seasonal SCUBA dives will be made at selected nearshore and inshore study sites in the Hinchinbrook Entrance and Montague Straits areas. The study sites will be representative of various major habitat types and depth zones. The compositions of the fish communities at each site will be determined. Selected fishes will be collected for analyses of stomach contents. Relative abundance of individual species will be determined along permanent transect lines. Inter- and intra-species behavior will be observed and noted.

Output:

1. Narrative Reports: These will consist of the characterization of the seasonal composition, relative abundance, and ecological relationships of fish species in various shallow sublittoral habitats and, insofar as other investigators' data permit, their relationships to deeper sublittoral and intertidal communities and top-level predators.

2. Digital Data: Species observed and stomach contents in proper File Type.

3. Visual Data: These will consist of:

   a. Maps and charts which show locations of study sites.

   b. Figures which show:

      (1) Topography and other features of study sites.
      (2) Foodwebs at each study site.

   c. Tables listing relative abundance of species present as a function of location, habitat, and season.

(P 906) MEROPLANKTON, JUVENILE FISH AND FORAGE FISH: RELATIVE ABUNDANCE AND DISTRIBUTION IN NEARSHORE WATERS

This research unit addresses subtasks E-5, E-10 and E-13 (BLM Study Types 39 - Vulnerable Populations and 41 - Critical Habitats).

Estimated Costs: $25,000 NEGOA

Schedule: 1 October 1978 - 30 September 1979

Performing Agency: To be named

Background:

Relatively little is known about the abundance and distribution of meroplankton, juvenile fish and forage fish in the nearshore and inshore water of NEGOA. OCSEAP surveys on the outer shelf and - on a more limited scale - in Prince William Sound have furnished initial information on broad-scale seasonal distributions and abundances of dominant zooplankters, including some meroplankton. However, the data are discontinuous in time and space. A small amount of seasonal data on pelagic early life stages of fishes and commercial crab and shrimp species is available from Prince William Sound. Also, there are limited data on pelagic juvenile and forage fish of commercial importance resulting from State and Federal fisheries assessment surveys; these consist mainly of studies of salmonid and herring populations in Prince William Sound and in the Copper River delta region.

The use of nearshore and inshore habitats by meroplankton, juvenile fish and forage fish must be known in order to evaluate the importance of these habitats to the organisms. It is likely that the greatest impact of petroleum spills would be on biota inhabiting shallow coastal waters. For example, oil may be concentrated in embayments or persist for extended periods along shorelines having permeable substrates, thus causing prolonged exposure for biota in those habitats. Also, petroleum may be incorporated in tissues of intertidal and nearshore biota and subsequently passed to higher trophic levels through predation. In addition, it has been demonstrated that the early life stages of many fish and shellfish species are relatively more sensitive to petroleum contaminants than adults.

Objectives:

To determine, for dominant meroplankton, juvenile fish and forage fish species (low energy habitats will be emphasized):

1. Seasonal changes of distribution and relative abundance.

2. Habitat use and migration patterns.

Methods:

Sampling will be focused on the Hinchinbrook Entrance/Constantine Harbor and Controller Bay/Kayak Trough areas during the period April - September. Detailed sampling designs will be jointly formulated by OCSEAP staff and the Principal Investigator; however, the tabulations below indicate the tentative features of the study.

1. Meroplankton

   a. Sampling periods: April, May, July

   b. Target species: Key fish and shellfish species, including Dungeness and snow crabs

   c. Habitats: Open coast, epipelagic regime. Sheltered embayments, estuaries

   d. Sampling methods: MARMAP bongo net techniques Isaacs-Kidd trawl, neuston nets

   e. Life stages: Pelagic eggs and larvae

2. Juvenile Fish

   a. Sampling periods: e. May, e. July, e. Sept.; day, night

   b. Target species: Walleye pollock, chum salmon, pink salmon, dominant forage fish and rockfish species.

   c. Habitats: Open coast, epipelagic realm, Sheltered embayments, estuaries

   d. Sampling methods: Mid-water trawls
Seines
Gillnets/trammel nets
Trynets
Acoustic devices
Surface tow nets

3. Forage Fish

   a. Sampling periods: May, July, Sept.; day, night

   b. Target species: Pacific herring, osmerids, sandlance, capelin, sandfish

c. Habitats: Open coastal, epipelagic realm
Sheltered estuaries, embayments

d. Sampling Methods: Mid-water trawls
Seines
Gillnets/trammel nets
Acoustic devices
Trynets

Field work should be completed in FY 79. The study will be continued into FY 80 to allow for completion of analyses and reporting.

Output:

1. Narrative Reports: These will describe the sampling design, sampling methods, current status of knowledge, results, discussion and conclusions. Recommendations for further investigations will be included.

   The importance of various habitat types will be evaluated in terms of species present, their life stages, timing of habitat use, relative abundance and inferred seasonal movements.

2. Digital Data: These will be submitted on magnetic tape for archival in EDS under OCSEAP file types 008-Zooplankton 01, 024-Zooplankton 02, 023-Ground Fish.

3. Visual Data: These will include the following:

   a. Charts that illustrate:

      (1) Locations of sampling sites.
      (2) Temporal distribution of study organisms.
      (3) Migration routes of selected species

   b. Tables or graphs that illustrate, for each habitat type, species present and abundance with respect to time of day and season.

(P 922) HABITAT REQUIREMENTS AND EXPECTED DISTRIBUTION OF ALASKAN CORAL

This research unit addresses subtask E-7 (BLM Study Types 39-Vulnerable Populations and 40-Life History).

Estimated Cost, FY 79: $10,000 NEGOA

Schedule: October 1978 - September 1979

Performing Agency: To be determined.

One of the categories of biological resources that the Alaskan OCS Office of the Bureau of Land Management has been mandated by law to protect is the coral resource on the Alaskan OCS (ref. Public Law 94-265, Fisheries Conservation and Management Act of 1976 and Federal Register Notice 43 CRF 6224, Protection and Preservation of Natural Values). Since the entire outer continental shelf of Alaska is too vast to sample for the occurrence of corals, a study is needed that has an ultimate goal of formulating a predictive model for occurrence of coral on the Alaskan OCS.

Objectives:

In order to develop a predictive model for occurrence of coral, information on habitat requirements of Alaskan corals must be coupled with information regarding the presence and values of these key habitat parameters in areas of concern on the Alaskan OCS. The first step in this process is to ascertain what types of corals might be expected to occur. Next, available information on their habitat requirements is needed. This must be compared with available information on these habitat parameters that may have been collected during the course of other investigations (e.g., physical oceanography determinations of currents, temperature, and salinity, or geology determinations of bottom type). If necessary additional field studies may have to be made. Finally, in order that BLM may fulfill its mandate to protect these resources, judgments as to the sensitivity of corals to oil and gas development activities need to be made.

At this phase of the study, a literature search is envisioned, with the following objectives:

1. To gather information on the types of coral that might be expected to be found on the Alaskan OCS, including maps of known distributions, if available.

2. To gather information from the literature and BLM on environmental parameters related to habitats of the corals identified above in 1.

3. To identify areas in which future research is needed in order to formulate a predictive model for locating corals.

4. To provide information on potential effects of oil and gas development on corals in significant coral areas.

Methods:

This phase will primarily involve library research methods, with interpretations made by someone experienced in the field of corals (of Northern Pacific waters, if possible) as to possible impacts of oil and gas development, research needs, and potential problem areas.

Output:

1. Narrative Reports: Periodic result and progress reporting as required of all OCSEAP projects; plans for future research to formulate a predictive model.

2. Digital Data: None.

3. Visual Data: Distribution maps of known corals, if available.

4.4 DESCRIPTIONS FOR PROJECTS IN TASK F (EFFECTS):

F-7: RU 194

5.0 TIMING SCHEDULE AND PRODUCTS OF OCS STUDIES IN THE NORTHEAST GULF OF ALASKA (NEGOA)

The following products list and timing schedule of OCS studies addresses the Northeast Gulf of Alaska lease area. The list of deliverables is a shorthand approximation for a complex, interlocking set of studies that are often difficult to represent by codes only and in which many qualifiers are necessarily left out.

The Codes used to identify BLM-required temporal and spatial resolution are as tabulated below. The same code is used to indicate present and projected levels of resolution in columns headed 77, 78, and 79. Appearance of the code in the FY 79 column indicates that funding is planned for FY 79.

Temporal Resolution

N = no temporal resolution
A = annual
S = seasonal
St = short term, days to weeks
D = diurnal, diel

Spatial Resolution

0 = information in hand, literature review
1 = qualitative, area wide, cursory
2 = semi-quantitative, hundreds of square miles scale or 25 miles of coastline
3 = semi-quantitative, 3-10 tracts scale or 10 miles of coastline
4 = quantitative, tract specific (2 to 5 miles resolution)
5 = quantitative, site specific
6 = no spatial resolution (non-site specific)

Several codes are also used to indicate existing (Pre-1978) and Projected (1978 and on) status of the effort to attain the specific products in the Data Products List. The codes used are as follow:

1. The research is ongoing, i.e. funded for FY 79.

2. The research unit effort has been terminated, and there are no plans for its resumption. The available data are, or may be, sufficient to meet stated needs.

3. Data are available from non-OCSEAP sources.

4. The data are insufficient to meet stated needs but the project has been terminated due to budget restrictions or lease area priorities.

5. Proposed research units.

117

Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	Status
	DATA PRODUCTS					Resolution Schedule for OCS Studies by Fiscal Year — Required										Projected			
A	CONTAMINANT BASELINE																		
A-1	Distribution and concentration of hydrocarbons	Determine existing levels of hydrocarbons, prior to initiation of petroleum-related OCS activities.	Seasonal and spatial distribution patterns of hydrocarbons:																
			. in sediment	Table/Maps	275											N2			2
					480											N2			2
			. in benthic biota	Table/Maps	275					S2	S3					N6			2
			. in pelagic biota including neuston	Table/Maps	275											N6			2
			. dissolved in the water column.	Table/Maps	275											S2			2
			. in particulate matter within water column	Table/Maps												N0			0
		Determine probable sources of existing levels of hydrocarbons, i.e. biogenic or petroliferous.	Comparison of ratios of C_1/C_2 t with $^{13}C/^{12}C$	Tables	480					N2	N3					N6?			2
		Monitor hydrocarbon levels over broad geographical areas to determine significant changes in ambient concentration patterns following OCS development.																	
A-2	Distribution and concentration of low molecular weight (LMW) hydrocarbons in the water column	Determine existing levels of LMW hydrocarbons prior to initiation of petroleum-related OCS activities	Seasonal and spatial distribution patterns of C_1-C_4 hydrocarbons							S2	S3								
			. in water column	Maps Figures	153											S2			2
			. in sediments	Maps Figures	153											S2			S

77-969

118

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
A-2		Determine probable sources of existing levels of hydrocarbon, i.e., biogenic or petroliferous.	Comparison of methane and C_2-C_4 hydrocarbon concentrations.		153					N6	N6					N2			2
		Use LMW hydrocarbon as an indigenous tracer or detection parameter to discern accumulation of hydrocarbon during or after OCS development.																	
		Examine the dispersion and diffusion of natural LMW hydrocarbons.																	
A-3	Distribution concentration and chemical speciation of selected toxic metals	Determine the concentration and distribution of nonvolatile petroleum components, especially toxic metals, prior to OCS development.	Seasonal and spatial distribution patterns selected metals:							S2	S3								
			. in sediment	Maps	162											S2			2
			. in benthic biota	Maps	162/506											N6			2
			. in pelagic biota	Maps	162											N6			2
			. in water column (soluble and suspended forms)	Figures	162/506											S2			2
		Determine chemical speciation and transport mechanism of selected metals and characteristics of substrates to which they are absorbed.	Elemental composition and distribution of suspended particulate matter.	Tables	152					S2	S3					N6			2
			Hydrocarbon absorption characteristics of suspended matter.	Tables	152					N6						N6			2

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
A-3		Monitor selected metal concentrations over broad geographical areas to determine significant changes following OCS development.																	0

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
B-1	Locations of drilling platforms, pipelines and	Planning of OCSEAP field and related studies.	Information required from BLM.	Charts	N/A														
B-2	Quantity and nature of contaminants from each source.	Planning of OCSEAP field and related studies.	Information required from BLM.	Charts	N/A														
B-3	Areas of altered current patterns, removed habitats, or altered migration paths.	Planning of OCSEAP field and related studies.	Information required from BLM.	Charts	N/A														

77-969

(2)

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1	+2	+3	+4	+5	77	78	79	
C-1	Description of seismic and volcanic activity.	To determine the potential hazards to platforms, pipelines and other structures due to earthquakes and volcanic equptions, as input to tract de-selection and design stipulations.	Historical earthquake epicenters, focal depths, and magnitudes	Map	210 352	NO				D3		D4				N4 N4			1 2
			Earthquake magnitude vs. frequency relationships for selected areas.	Map Graph	210 352	NO				N2					N4	N2 N2			1 2
			Seismic activity of surface and near-surface faults identified in geologic mapping.	Map	210	NO				N3		N4			N5	N3	N4		1
			Relationships between earthquake magnitudes and strong ground motion.	Map Report	210	NO				N2		N4				NO	N2	N3	1
			Description of volcanic activity and resulting phenomena such as flows and nuees ardentes.	Maps Report	N/A	NO				N3		N4							0
			Seismic risk map.	Map	210					N3		N4				N2		N3	1
			Volcanic risk map.	Map	N/A					N3		N4							0

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
C-2	Description of the distribution and relative ages of surface and near-surface faults.	To determine the potential hazards to platforms, pipelines, and other structures due to active faulting; serves primarily as input to tract deselection and to provide geographic focus for earthquake studies.	Locations of surface and near-surface faults classified according to apparent recency of movement (from geologic relationships).	Map Report	212	NO				N3		N4				N4			2
					P901											NO		N3	1
					216											N4			2
C-3	Description of the types and extent of natural seafloor instability.	To determine the potential hazards to platforms, pipelines, and other structures due to slumping, compaction, and liquefaction of bottom sediments; serves as input to tract deselection and siting/design stipulations.	Delineation of existing and potential slumps and other unstable sediment masses, classified according to present relative stability.	Map	212	NO				N3		N4				N3	N4	–	2
					P901											–	–	N3	1
					216											N3	N4		2
			Thickness of unconsolidated sediment.	Map	212	NO				N3		N4				N3	N4	–	2
					P901											–	–	N3	1
					216											N3	N4		2
			Description of sediment physical properties.	Map	212	NO				N3		N4			N5	N3			2
					P901											NO		N3	2
					216											N3			2
			Geologic cross-sections of potentially unstable sediment masses.	Profile	212	NO				N4					N5	N4			2
					P901											NO		N3	1
					216											N4			2
			Description of the geologic history of unconsolidated sediment units.	Map	212	NO				N3						N3			2
					P901											NO		N3	1
					216											N3			2

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
			Interpretation and description of the nature and severity of sediment instability.	Report	212 P901 216	N0				N3		N4				N3 - N3	N4 - N4	- N3	2 1 2
C-4	Identification and description of areas of potentially hazardous seafloor erosion, deposition, and bedform movement.	To determine the potential hazards to platforms, pipelines, and other structures due to seafloor erosion, deposition, and beform movement; serves as input to tract deselection and siting/design stipulations.	Locations of areas of of severe erosion and deposition (indicating rates where possible).	Map	212 P901	N0				N3		N4				N3 -	N4 -	- N3	2 1
			Distribution and description of large-scale mobile bedforms showing directions and rates of movement.	Map Report	212 P901	N0				N3		N4				N3 -	N4 -	- N3	2 1
			Interpretations regarding the nature and severity of erosion, deposition, and bedform movement.	Report	212 P901	N0				N3		N4				N3 -	N4 -	- N2	2 1
C-5	Identification and description of potential coastal hazards.	To determine the potential hazards to onshore development due to coastal erosion, accretion, faulting, and other onshore surface processes; serves primarily as input to siting/ design stipulations and development plan verification.	Identification of coastal areas with severe erosion or accretion, indicating rates where possible.	Map	59 212	N0				N2			N3	N4	N5	N4 N4	- N4	- -	2 2
			Description of nearshore sediment dynamics.	Map	59 212	N0				N2			N3	N4	N5	N3	N3	-	2

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
C-5			Description of onshore coastal geology, including active faults and surface processes.	Map Report	99	NO				N2			N3	N4	N5	N4	–	–	2
			Interpretation of the potential hazards to coastal facilities.	Report	59	NO				N2			N3	N4	N5	N3	–	–	2
					99											N3	–	–	2
					212											N3	N3	–	2
C-6	(Not applicable to GOA-BS)																		
C-7	Description of the geographic distribution of ice gouging, its severity, and frequency of occurrence.	To determine the potential hazards to pipelines and other seafloor installations due to ice gouging; serves as input to siting/design stipulations.	Description of ice gouging activity, distribution, frequency, and gouge depth.	Map Report	N/A	NO				N3		N4							
			Interpretations regarding the nature and severity of ice gouging and its relation to ice structures and behavior.	Report	N/A	NO				N4		N4							
C-8	Description of the distribution and nature of gas-charged sediments.	To determine the potential hazards to platforms, pipilines and other structures due to gas-charged sediments; serves primarily as input to siting/design stipulations.	Description of the distribution and depth of gas-charged sediments.	Map Profile	212	NO				N3		N4				N3	N4	–	2
					P901											–	–	N3	1
			Identification of oil and gas seeps.	Map	212	NO				N3		N4				N3	N4	–	1
					P901											–	–	N3	1
			Descriptions of the origins and characteristics of gas-charged sediments and their potential hazards	Report	212	NO				N3		N4				N3	N4	–	2
					P901											–	–	N3	1

DATA PRODUCTS: Task	Product	Intended Use	Specific Product	Format	R.U.	Resolution Schedule for OCS Studies by Fiscal Year — Required: -4	-3	-2	-1	0	+1	+2	+3	+4	+5	Projected: 77	78	79	Status
C-9	Engineering properties of sea ice.	Calculation of ice forces and loads on structures.	1. Measurements of physical properties of various types of sea ice.	Narrative	N/A	NO													
			2. Estimates of ratios of stress to strain in various types of ice.			NO													
			3. Estimates of forces of extreme ice conditions.			NO													
			4. Calculatons of ice forces and loading on structures.			NO													
C-10	Characterization of frequency, intensity and effects of extreme oceanic events	To identify hazards to OCS exploration, development, and production activities.	1. Observational and historic information on storm surges as a function of location, season, and magnitude.	Tables Charts	367 347	NO				S3						S3 S3			2 2
			2. Observational and historical information on coastal katabatic winds as a function of location, season, and magnitude.	Tables Charts	367	NO				S3						S2	S3		1
			3. Historical information on tsunamis (see Subtask C-1)	Tables Charts	352	NO				S3						S3			2
			4. Marine and coastal climatology, including . temperature . wind . cloud cover . wave heights . storm tracks and frequencies . coastal flooding . vessel icing	Tables Graphs Charts Figures	347	NO				S3						S2			2

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D D-1	TRANSPORT Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	To predict or estimate trajectories of pollutants and time of impact.	1. Analyses of historic data in the literature and previously unreported data.	Narrative with maps	357 289			S2	S3							A2 A2			2 2
			2. Analyses of historical data on climatic systems and meteorological events for their effects on circulation.	Narrative with maps	347			S2	S3							S2			2
			3. Seasonal temperature and salinity distribution.	Narrative with maps	289 138			S2	S3							S2 S2			2 2
			4. Baroclinic circulation.		289 138			S2	S3			S4				S2 S2			2 2
			5. General circulation, based on moored current meter data.	Narrative with figures	289 138			S2	S3			S4				S2 S2			2 2
			6. Trajectories of drogues.	Maps and narrative	217			S2	S3			S4				A2	S2	-	1
			7. Discussion of mixing and estimates of Lagrangian dispersion coefficients.	Narrative	217			S2	S3			S4				A2	A2	-	4
			8. Estimates of sea-surface slope.	Narrative	138			S2								S2	-	-	2
			9. Measurements of local wind fields.	Narrative	367			S2								S2	-	-	1
			10. Analyses of synoptic weather data to obtain local wind and temperature fields.	Narrative with maps	367			S2	S3	S3	S3	S4				S2	-	-	1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-1	Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	To predict or estimate trajectories of pollutants and time of impact.	11. A procedure for determining local wind fields when synoptic data and local station data are available.	Narrative	367			N6								N6			1
			12. Currents, calculated by diagnostic model.	Narrative	140											S2	-	S3	1
			13. Currents calculated by hydrodynamical model.	Map	-			S2											0
D-2	Seasonal and shorter term description of water masses and circulation patterns in near-shore	To predict or estimate trajectories of pollutants and time of impact	1. Analyses of historic data in the literature and previously unreported data.	Narrative	357 289			S2								S2 S2			2 1
			2. Analyses of historical data on climatic systems and meteorological events for their effects on circulation.	Narrative with maps	367			S2									S2		1
			3. Seasonal temperature and salinity distribution.	Narrative with maps	289 357			S2								S2 S2			2 2
			4. Baroclinic circulation.	-	289			S2								S3			1
			5. Near-shore circulation, based on moored current meter data.	Narrative	289 138			S2								S3		S_t4	1 2
			6. Trajectories of drogues.	Maps and Narrative	217				S2							S2			1

77-369

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-2	Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	To predict or estimate trajectories of pollutants and time of impact.	7. Discussion of mixing and estimates of Lagrangian dispersion coefficients.	Narrative	217				S2							S2			1
			8. Estimates of sea surface slope.	Narrative	138				S2								S2		2
			9. Nearshore currents by means of a current mapping radar.						S4										0
			10. Analyses of satellite photos for oceanographic data.	Narrative	289				S2							S2	S2		1
			11. Surf zone dynamics; wave refraction diagrams, rip-current distributions.	Narrative with maps	-				S2										0
			12. Storm surge probability and intensity.	Narrative	347				S2							S2	S2		2
			13. Measurements of local wind fields near shore.	Narrative	367				S3							S2		S3	1
			14. Analyses of synoptic weather data to obtain local wind and temperature fields.	Narrative with maps	367				S2							S2		S3	1
			15. A procedure for determining local wind fields when synoptic data and local station data are available.	Narrative	367				S2							S2	S3		1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-2	Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	Used to assess potential for air pollution by onshore development offshore facilities	16. Measurements of the stability of the surface (air) boundary layer and ice nuclei baseline.	Narrative	N/A				S3										0
			17. Results of analysis by models.	Narrative															
			a. General circulation.	Maps	140		S2	S3				S4				S3			1
			b. Tidal current (hydrodynamical).	Maps	235		S2	S3				S4							4
			c. Trajectory.	Maps	140		S2	S3				S4				S3		S_t3	1
			d. Trajectory with plume dynamics.	Maps	-		S2	S3				S4							0
D3	Description of oil spill plume behavior and oil weathering processes.	Evaluation of degree of impact, areal scale of impact and contingency requirements.	1. Oil spill weathering mechanisms and estimated rates.	Narrative	499 935														4 5
			2. Laboratory determined weathering rates.	Tables	499														0
			3. Field studies to determine weathering rates.	Tables	499 935														4 5
			4. Description of mechanisms which cause dispersal of oil plumes.	Narrative															1
			5. Pollutant dynamics model general.	Computer code and documentation	140														0
			6. Pollutant dynamics model subroutine accounting for weathering).	Computer code and report															0

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-4	Description of the types and characteristics of bottom sediments and their probable interaction with oil and biota.	To determine the probable fate of oil in association with bottom sediments, its longevity, cleanup difficulty, and possible effects on intertidal and benthic biota; serves as input to tract deselection.	Description of sediment grain size properties.	Map	290 212 P901					N2	N3					N3	 N3	 N3	2 2 1
			Description of coast-morphology, beach materials, and relative vulnerability of the coast to spilled oil.	Map Report	 059					N2 .	N3					 N2			2 2
			Interpretation regarding the interaction between oil and bottom sediment, oil retention capability of the substrate, and implications regarding possible effects on intertidal and benthic biota.	Report	290					N2	N3					N3			2
D-5	Description of bottom sediment dynamics.	To determine the transport trajectory of oil in association with bottom sediments. Serves as input to tract deselection and to hazards studies.	Description of the directions and rates of bottom sediment movement.	Map Report						N2	N3								0
			Interpretation regarding the mechanisms of entrainment and transport of bottom sediment and their relationship to physical oceanographic processes.	Report	152					N2	N3					S			2

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-6	Character of suspended particulates and their effectiveness as transporters of oil.	Assessment of the impact potential of oil spills.	1. Sediment and suspended sediment distributions.	Narrative with maps	152					S2	S3					S2			2
			2. Sediment movements.	Narrative with maps	152					S2	S3					S2			2
			3. Tabular data, indicating extent of oil/sediment interaction under varying environmental condition.	Narrative with maps.	152					S2	S3							N6	1
			4. Relation of suspended particulate matter to terrestrial and marine sources.	Narrative	152					S2	S3					S2			2
D-7	Description of sea-floor topography.	To provide input to circulation studies and hazards studies	Description of sea-floor topographic features.	Map	212 [90]			N4								N2	N4	N4 N4	2 1
D-8	Characterization of sea ice morphology including under-ice morphology.	Assessment of role of ice cover as a habitat and in transport of spilled oil.	Analysis of the historical records of ice conditions.	Report	N/A			N2											
			Description of ice conditions, seasonally and areally from contemporary data; position of ice-front, ex.	Report seasonal maps	N/A N/A			S2											
			Under-ice morphology, and its potential as a trap for oil.	Report	N/A														

77-969

132

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-9	Description of ice dynamics and their effects on transport of oil and safety of structures.	As input data to transport models and in evaluation of construction plans for safety.	Oil trajectories in over and under ice of various types.	Narrative	N/A			S2	S3			S4							
			Model of ice motion under various environmental conditions.	Narrative Documentation of model	N/A			S2	S3			S4							
D-10	Description of interaction between sea ice and oil and movement of oil in a ice field.	As input to transport models.	Model of behavior of oil incorporated in, ice matrix.	Narrative with algorithms				Resolution scale not applicable.											
			Field measurements of oil movement in the presence of ice.	Narrative with maps	N/A			Resolution scale not applicable.											
			Comparison of model results with field results.	Narrative	N/A			Resolution scale not applicable.											
D-11	Susceptibility of marshlands near the coast to inundation by oil transported by storm tides.	To assess the probability of insult to critical habitats.	Calculated probability of storm surge.	Narrative	-			S2											0
			Verification of probability of storm surge by field studies	Narrative	059			S2								N3			2
			Analysis of historical storm surge records.	Narrative with tables	347			S2								S2			2

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-1	Description of seasonal distribution and abundance of marine mammals.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available marine mammal data and literature.	Narrative	068											NO			2
			2. Review of available literature and data on marine mammals.	Narrative Charts Tables	068											NO			2
					ADF&G[1]											0			2
			3. Seasonal distributions and relative abundance of marine mammals.	Charts Tables	068					S1	S2	S3				S2			2
					481											S2			2
					229											S2			2
					243											S2		S3	1
			4. Locations of marine mammal migration routes.	Charts	068					S2	S2	S3				S2	S2		2
					481											S2			2
			5. Locations of breeding and concentration areas.		229					S3	S4	S4				S3	S4		2
					243											S3	S4		1
E-2	Description of population dynamics and trophic relations of marine mammals.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	1. Population dynamics of marine mammals, including: . reproductive biology . growth . population composition . habitat dependencies	Tables Graphs Figures	229					S2				S3					2
					243														1
			2. Trophics of marine mammals, including: . major prey species . foraging areas	Tables Charts	229					S2				S3		S1	S2		2
					243											S1	S2		1
			3. Behavioral aspects of marine mammals relative to OCS activities.	Narrative	243					N6								S2	1
					229												S2	S2	2

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-3	Description of seasonal distribution and abundance of marine birds.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of marine bird data and literature.	Narrative	340											NO			2
					339											NO			2
			2. Literature review of marine bird data and literature.	Narrative	003											NO			2
				Chart	339											NO			2
				Tables	340											NO			2
			3. Seasonal distribution and abundance of marine birds.	Charts	003					S2						S1	S2		2
				Tables	108											S1			2
					239											S2			2
					337											S1	S2		1
			4. Locations of marine bird breeding colonies.	Charts	338					S5							S5		2
					343														
			5. Locations of marine bird concentration areas.	Charts	003					S2		S3				S3			2
					096											S3			2
					337											S2			1
			6. Locations of bird migration routes.	Charts	003					S2						S2			2
					337											NO	S2		1
					340											NO	S2		2
E-4	Description of population dynamics and trophic relations of marine birds.	To evaluate the potential effects of OCS activities on the stability of of populations within a considered critical habitat.	1. Population dynamics of marine birds, including: . breeding phenology . reproductive ecology . growth . habitat dependencies	Tables Graphs Figures	096					S2		S_t1		S_t1		S_t1			2
					341											S_t1			1
			2. Trophics of marine birds, including: . major prey species . foraging areas	Tables Charts	108					S2				S3					2
					341														1

77-569

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
E-4	Description of seasonal distribution and abundance of marine birds.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	3. Behavioral aspects of marine birds relative to OCS activities.	Narrative						S0						N6			2
E-5	Description of the seasonal distribution and abundance of marine fish.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available marine fish data and literature.	Narrative	064					NO		NO				NO			2
					174											NO			2
					353											NO			2
			2. Review of available marine fish data and literature.	Narrative with figures	174					NO		NO				NO			2
					284											NO			2
					064												S2		2
			3. Seasonal distributions and relative abundance of marine fishes.	Charts	174					S2									2
					353											S2			
			4. Locations of spawning and concentration areas, and migration routes.	Charts	174					S2		S3				S2			2
					353											S2			2
			5. Locations of important commercial fishing areas.	Charts	174					S2		S3				S3			2
E-6	Description of population dynamics and trophic relations of marine fish.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	1. Trophics of marine fishes, including: . identification of major prey species . foraging areas	Tables	284					N1		S2				NO	N1		2
					285											N6			2
					281											N1			2
					P905											NO		S2	1
					P906											NO		S2	1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
E-6 cont.	Description of population dynamics and trophic relations of marine fish	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	2. Population dynamics of marine fishes including: . reproductive biology . growth . habitat dependencies	Tables Graphs Figures	P905 P906					N1		S2				N0 N0		S1 S1	1 1
E-7	Description of seasonal distribution and abundance of benthic biota.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available literature and data on benthic biota.	Narrative	282											N0			2
			2. Review of available literature and data on benthic biota.	Narrative	005											N0			2
			3. Distribution and abundance of dominant benthic organisms.	Charts Tables	282 281					N2		S3				N2 N2			2 2
	Description of population dynamics and trophic relations of benthic biota.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	4. Population dynamics of benthic organisms including: . Seasonal community structure . Seasonal abundance of dominant organisms . Productivity estimates	Tables Graphs Figures	005 281					N1		S2				A1 A1	S2		2 2
			5. Trophic relations of selected benthic organisms including: . food webs . identification of major prey species	Tables Figures	005					N1		S1		S3		A1	S2		2

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
E-8	Description of distribution and abundance of biota in littoral communities.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available data and literature on littoral biota.	Narrative						NO									0
			2. Review of available data and literature on littoral biota	Narrative	078											NO	NO		2
			3. Regional characterization of littoral habitat, including: . Substrate . Littoral community structure . Population density distributions	Charts Figures Tables	078 428 024					S2		S3		S4		S3 A3 A3			2 2 2
E-9	Description of the ecosystem dynamics and relative abundance of biota in littoral communities.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat	1. Population dynamics of intertidal biota, including: . Seasonal community structure . Productivity	Tables Figures Graphs	078 417					S2				S3		S2 S2		S3 S3	1 1
			2. Trophic relations of littoral fauna, including: . Food webs . Identification of major predator-prey relations	Tables Figures	078					S2				S3		N6		S3	1

77-569

138

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
E-10	Seasonal density distributions of principal species of plankton.	To identify critical habitats and to determine the likelihood of impact based on transport data and probable sources.	1. Time of appearance	Table Graph	058					S1		S2				S1			2
					156b/											S1			2
					425a														
					156c/											S1			2
					425b														
					156d											S1			2
			2. Quantitative distributions	Chart	058					S1		S2				S1			2
					156d														
E-11	**Seasonal indices of phytoplankton standing crop and production.**	**To identify critical habitats and to determine the likelihood of impact** based on transport data and probable sources.	**1. Composition**	Graph	058					**N1**		**S2**							2
					156c/											S1			2
					425b														
			2. Standing crop	Graph	058					N1		S2		S3					2
					156c/											S1			2
					425b														
			3. Productivity	Graph	058					N1		S2		S3					2
					156c/											S1			2
					425b														
			4. Ecology of sea ice flora.	Graph	N/A					N1		S2				N/A	N/A	N/A	N/A
E-12	Non-population dependent physiological and population parameters of plankton communities.																		
E-13	Identification and seasonal characterization of critical habitats for egg and larval stages of fish and shellfish species.	To identify critical habitats and to determine the likelihood of impact based on transport data and probable sources.	1. Time of appearance	Charts Tables Graphs	156a/ 424					S1		S2		S3		S1			2
			2. Quantitative distributions.	Charts Figures Tables	156a/ 424					S3				S6		S1			2
E-14	Ichthyoplankton key for Alaskan waters.	OCSEA Program development.	Ichthyoplankton key.	Key	349				N6							N6			2

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
E-15	Characterize marine Microbial communities with regard to quantitative levels of indigenous heterotrophs, chemotrophs and Pathogens.	To identify critical habitats and determine likelihood of impingements based on transport data and probable sources.	1. Geographical density distributions of physiological groups in: . Water . Sediments	Tables Graphs Charts	030					N2		S2				N2			2
		To define the potential for petroleum degradation in specific habitats and therefore, likelihood of impact.	2. Hydrocarbon degradation rates.	Tables Graphs	030					N1		S1		S2		S2			2
			3. Evaluation of techniques used to ation in sediments.	Narrative	030					N6						N6			3
E-16	Response of microorganisms to normal environmental stresses.	To obtain the range of variation in microbial activity in order to provide a basis for evaluating the effect of hydrocarbon contamination.	1. Microbial activity and respiration ratios	Tables Graphs	190					S1		S2				S2			2
			2. Nitrogen fixation rates in: . Sediment . animal guts	Tables Graphs	140					S1		S2				S2			2
E-17	Relationship of ice movements and types to distributions and abundance of various living resources.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	Species abundance and distributions relative to: . Ice characteristics . Ice movements.	Charts Tables Graphs	N/A											N/A			N/A

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
E-15	Characterize marine microbial communities with regard to quantitative levels of indigenous heterotrophs, chemotrophs and pathogens.	To identify critical habitats and determine likelihood of impingements based on transport data and probable sources.	1. Geographical density distributions of physiological groups in: . Water . Sediments	Tables Graphs Charts	030					N2		S2							2
		To define the potential for petroleum degradation in specific habitats and, therefore, likelihood of impact.	2. Hydrocarbon degradation rates.	Tables	030					N1		S1		S2		S2			2
			3. Evaluation of techniques used to determine oil degradation in sediments.	Narrative	030					N6									3
E-16	Response of microorganisms to normal environmental stresses.	To obtain the range of variation in microbial activity in order to provide a basis for evaluating the effect of hydrocarbon contamination.	1. Microbial activity and respiration ratios	Tables Graphs	190					S1		S2				S2			2
			2. Nitrogen fixation rates in: . Sediment . Animal guts	Tables Graphs	140					S1		S2				S2			2
E-17	Relationship of ice movements and types to distributions and abundance of various living resources.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	Species abundance and distributions relative to: . Ice characteristics . Ice movements.	Charts Tables Graphs	N/A											N/A			N/A

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
F-1	Review of available literature and data on toxicity of crude oils as related to species, life stage and source of oil.	To provide a basis of information on which to set priorities for research exploring the effects of oil development of the Alaskan OCS.	Summary of available information on effects of oil on Alaskan marine organisms and ecosystems.	Report	075	N0	N6									N6			2
F-2	Acute and chronic effects of crude oil and other petroleum associated chemicals on selected organisms.	To provide a basis for assessment of the potential impact of oil development of the Alaskan OCS to the shelf areas and adjacent shorelines	1. Toxicity of oil to:	Graphs Tables Charts															
			. marine mammals		071		N0				N6					N6			1
			. marine birds													N0			0
			. fish		072		N0									N6			1
			. plankton		-						N6					N0			0
			. benthos		454						N6					N6			1
			. bacteria		029						N6					N2			1
					190						S2					S2			1
			2. Sublethal effects on:	Graphs Charts Tables															
			. marine mammals		071						N6					N6			1
			. marine birds		423						N6					N6			1
			. fish		073						N6					N6			1
			. plankton		-						N6					N0			0
			. benthos		454						N6					N6			1
			. bacteria		190						N6					S2			1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
F-3	Effects of petroleum contaminants on metabolic and reproductive functions	To evaluate the potential for a petroleum contaminant to alter the stability of a population by affecting a key metabolic process in a way which increases the possibility of the organisms death before it reproduces.	1. Evaluation of effects of crude oil on carbon and nitrogen fixation in:	Graphs															
			. sediments		190					S1		S3				N6			1
			. guts of animals		190							S3				N0			0
			2. Evaluation of effects of crude oil on hatching success of bird eggs.	Graphs	096							S_t6				S_t6			2
					243							S_t6				S_t6			1
			3. Evaluation of effects of crude oil on thermoregulation of marine mammals	Graphs	071							N6				N6			1
F-4	Characterization of release of toxic metals from oil impacted sediments and relative importance of metals uptake and effects on biota	To evaluate negative effects of metals associated with OCS activities on biota, to assist in siting stipulations for development.	1. Uptake/depuration of metals in benthic organisms.	Graphs Charts Tables	–											N6			0
			2. Metabolic and other sublethal effects in benthos.		454							N6				N6			1
F-5	Bioaccumulation and effects of hydrocarbons, and other contaminants through various exposure pathways.	To determine areas of greatest sensitivity in marine organisms.	1. Evaluate accumulation of hydrocarbons through experimental food chains.	Charts Graphs Tables	073							N6				N6			1
					275							N6				N0	N6		1
					389							N6				N6			4
			2. Evaluate accumulation through sediment-sorbed contaminants.		454							N6				N6			1
					029							S3				S3			1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
F-6	Characterization of responses of selected organisms and ecosystems to perturbations induced by contaminants or disturbances associated with OCS activities	To identify ecosystems or organisms that are potentially susceptible to adverse cimpact from OCS activities.	1. Characterization of perturbations due to OCS activities on selected organisms and activities.	Charts Tables Graphs	072 073 275									S5					1 1 1
			2. Recovery rate of selected communities in terms of:	Charts Tables Graphs										S5					
			. composition and density		029						S3					N2			1
			. productivity		190						S3					S2			1
F-7	Types and incidences of diseases present in marine **organisms.**	Development of a baseline of information with which to evaluate future mortality and/or morbidity relative to OCS activities. Identify species highly susceptible to impact from OCS activities.	1. Incidence of pathological conditions in:	Charts Tables Graphs						N1				N2					
			. marine mammals		194											N0			1
			. marine birds		-											N0			3?
			. marine fish		332											N0	N1		3
			2. Identifications of pathological agents and causes in:	Narrative Tables						N6									
			. marine mammals		194											N0	N6		1
			. marine birds		-											N0			3?
			. marine fish		332											N0	N1		2
			3. Incidence of mortality or morbidity in natural populations of:	Charts Tables															
			. marine mammals		194											N0		N1	1
			. marine birds		341					N1						N0		N1	2

77-49

Task	Product	Intended Use	Specific Product	Format	R.U.	Required −4	−3	−2	−1	0	+1	+2	+3	+4	+5	Projected 77	78	79	Status
			4. Effect of oil on disease susceptibility in:	Charts Tables															
			. marine mammals		071									N6		N6			1
			. marine birds		096									N6		N6			4
			. marine fish		073									N6		N6			1
F-8	Ecological effects of oil spill countermeasures.	To provide data to be used in determining preferred countermeasures to oil spill.	1. Toxicity of dispersants to:	Charts Tables Graphs															
			. marine birds		072							S6				N0		N6	0
			. marine fish		–							S6				N0			–
			. marine mammals		–							S6				N0			0
			2. Sublethal effects of dispersants in:																
			. marine fish		073							S_t6				N0	N6		1
			. marine birds		–							S_t6				N0			0
			. marine mammals.		–							S_t6				N0			0
F-9	Characterization of structure and function of select-coastal ecosystems with respect to potential impacts of OCS development.	Identification of critical links in the food web relative to fish, benthos, birds, and mammals.	Descriptions of: . seasonal community structure . trophic relations of key species in various habitats at selected study sites.	Charts Tables Graphs	–							S1		S2	S5	N1			0

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
F-10	Characterization of structure and function of ice front ecosystem with respect to potential impacts of OCS development	Identification of critical links in the food web relative to fish benthos birds and mammals.	Descriptions of: . community structure . trophic relations of key species . primary and secondary production In the vicinity of the ice front.	Charts Tables Figures Graphs	N/A											-	-	-	-
F-11	Descriptions of coastal detritus systems with respect to OCS development.	Identification of critical links in the food web relative to fish, benthos, birds and mammals.	1. Definition of seasonal composition and origin of organic detrital materials.	Charts Tables Graphs	-							S1		S2		NO			0
			2. Role of detritus in ecosystem energetics.									S2			S5				

3.0 GENERAL RATIONALE FOR LOWER COOK INLET

3.1 RESEARCH APPROACH

3.1.1 Background

Oil production has occurred in the upper portion of Cook Inlet (above the Forelands) for most of the last ten years (Figure 3-1). The oil-producing wells in Upper Cook Inlet are the result of offshore oil and gas leasing of State lands which began in 1959. A cumulative total of 1.9 million acres were leased between 1959 and 1974, the date of the last State sale. Before 1976, 700 million barrels of oil and 743 billion cubic feet of gas had been produced here. The Cook Inlet Basin has accounted for the major part of the total oil and gas production from State land.

The first OCS oil and gas lease sale of Federal lands was held in October 1977. One hundred fifty-two tracts were selected for inclusion in the environmental assessment process (Figure 3-2). Seventeen tracts along the Kenai Peninsula were subsequently eliminated from the sale for environmental reasons. Therefore, 135 tracts were actually for sale in October, of which 89 tracts were offered on the basis of a fixed 16 2/3 percent royalty plus a cash bonus bid and 46 tracts were offered on a royalty bid basis with a fixed cash bonus.

For these 135 tracts, a total of 240 bids were submitted on 91 tracts, of which 87 were accepted, and leases were signed on 495,307 acres. The three highest bids for single tracts were made on blocks 318, 274, and 128; while the three highest royalty bids were on blocks 972, 402, and 358. Exploration began in the summer of 1978.

Nine stipulations were attached to each lease offered in the Lower Cook Inlet sale of October 1977. Five of these stipulations were environmental in nature and included (Warren, 1978): a requirement that lessees include an environmental training program for all personnel involved in exploration and development; a prohibition against barging except in special circumstances or in cases of emergency; a restriction on the use of boats and aircraft between May and September at prescribed distances and altitudes to protect seabird colonies and marine mammal rookeries; a requirement that lessees submit to the Governor of Alaska,

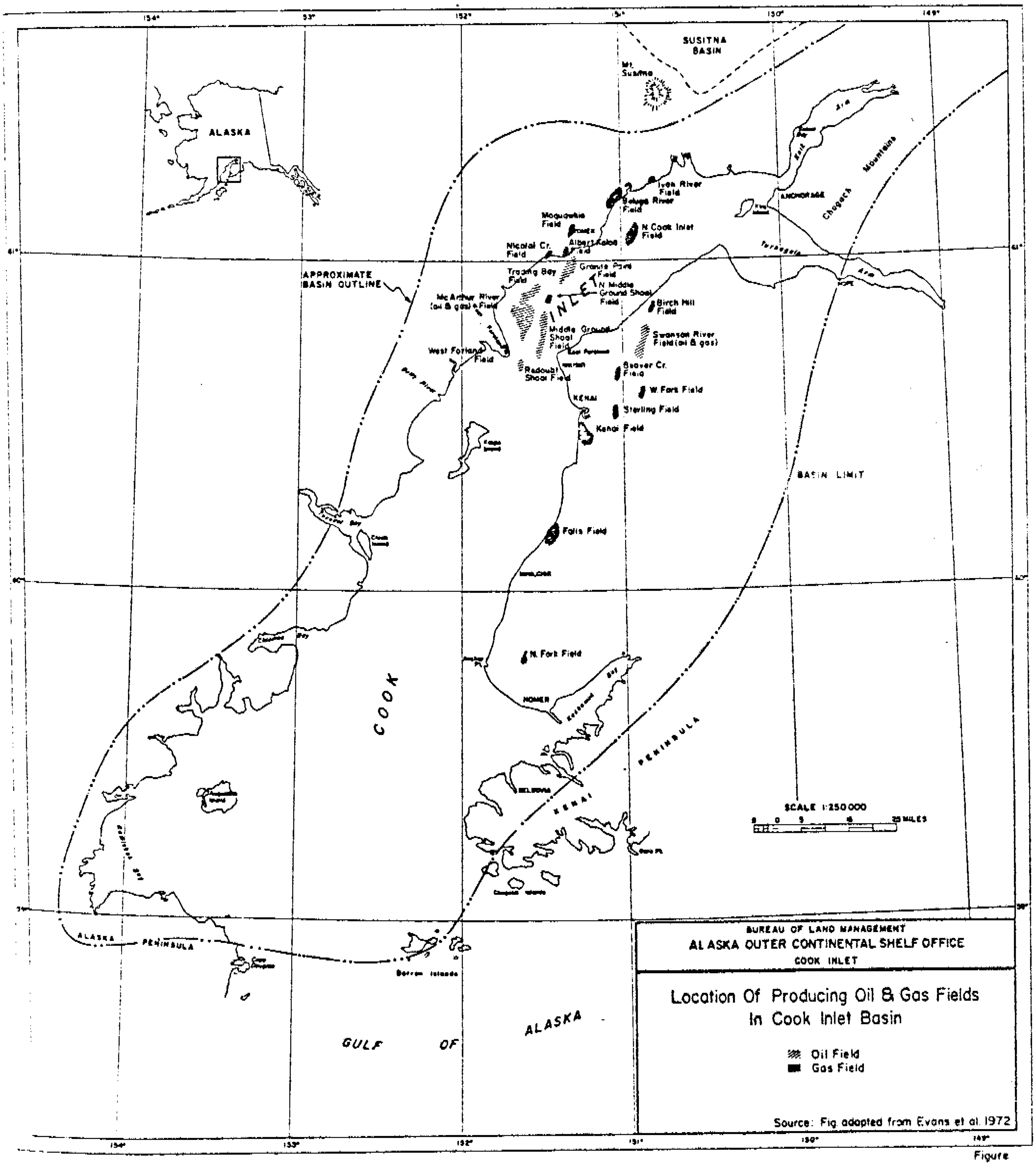

SUSITNA BASIN
ALASKA
APPROXIMATE BASIN OUTLINE
BASIN LIMIT
Ivan River Field
Beluga River Field
Moquawkie Field
N. Cook Inlet Field
Albert Kaloa Field
Nicolai Cr. Field
Granite Point Field
Trading Bay Field
N. Middle Ground Shoal Field
Mc Arthur River (oil & gas) Field
Birch Hill Field
Middle Ground Shoal Field
Swanson River Field (oil & gas)
West Foreland Field
Redoubt Shoal Field
Beaver Cr. Field
W. Fork Field
KENAI
Sterling Field
Kenai Field
Falls Field
N. Fork Field
HOMER
ANCHORAGE
Chugach Mountains
INLET
COOK
KENAI
PENINSULA
ALASKA
PENINSULA
Barren Islands
GULF
OF
ALASKA
SCALE 1:250000
BUREAU OF LAND MANAGEMENT
ALASKA OUTER CONTINENTAL SHELF OFFICE
COOK INLET
Location Of Producing Oil & Gas Fields
In Cook Inlet Basin
Oil Field
Gas Field
Source: Fig adapted from Evans et al. 1972
Figure

FIGURE 3-1.

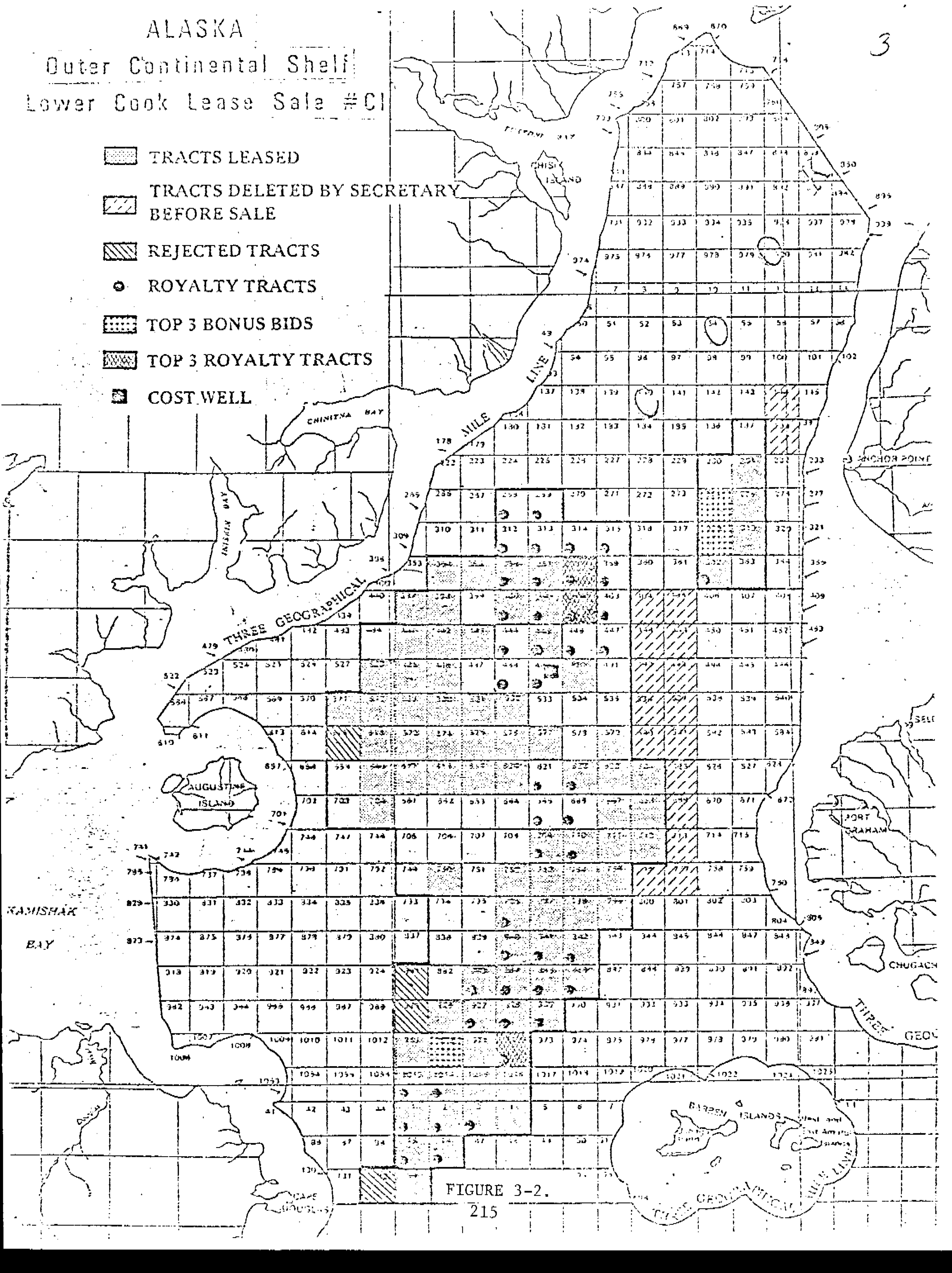

ALASKA
Outer Continental Shelf
Lower Cook Lease Sale #CI
TRACTS LEASED
TRACTS DELETED BY SECRETARY BEFORE SALE
REJECTED TRACTS
ROYALTY TRACTS
TOP 3 BONUS BIDS
TOP 3 ROYALTY TRACTS
COST WELL
THREE GEOGRAPHICAL MILE LINE
AUGUSTINE ISLAND
KAMISHAK BAY
CHINITNA BAY
PORT GRAHAM
BARREN ISLANDS
3

FIGURE 3-2.

and to local jurisdictions, information about activities necessary to support exploratory operations before an exploration plan can be approved; and a requirement that biological surveys be performed in areas of special biological significance to determine special biological communities that may be adversely affected by any lease operation. In the case of the last stipulation, the areas requiring biosurveys by industry are shown in Figure 3-3.

In addition to the stipulations, new requirements have been placed on the lessees. These requirements are (Warren, 1978): lessees will be required to use recommended boat traffic lanes established by the Coast Guard for the transport of supplies to the lease areas; bird scare techniques will be used in the event of an oil spill; the monitoring of exploratory drilling will be required to determine the effects on aquatic life (alternative disposal methods may be required for drilling muds and formation waters); the Department of Interior will seek the advice of state and federal agencies to identify areas that might require the burial of pipelines, alternative methods for disposal of drilling muds and formation waters, and the reduction of boat and air traffic; and an environmental impact statement will be required for the development phase in Lower Cook Inlet.

Each of the new requirements listed above will have to be taken into consideration in the formulation of the research program in Lower Cook Inlet. OCSEAP-generated information will not only provide information for tract deselection decisions and the environmental impact assessment for the second lease sale (draft in February 1980) but will also provide some information necessary for making decisions relative to exploration and development activities and to provide input to the environmental impact statement required for the development phase.

The OCS planning schedule of August 1977 indicates that another announcement of tracts will be made in May 1979 and will be followed by a second sale (OCS Sale #55) in March 1981.

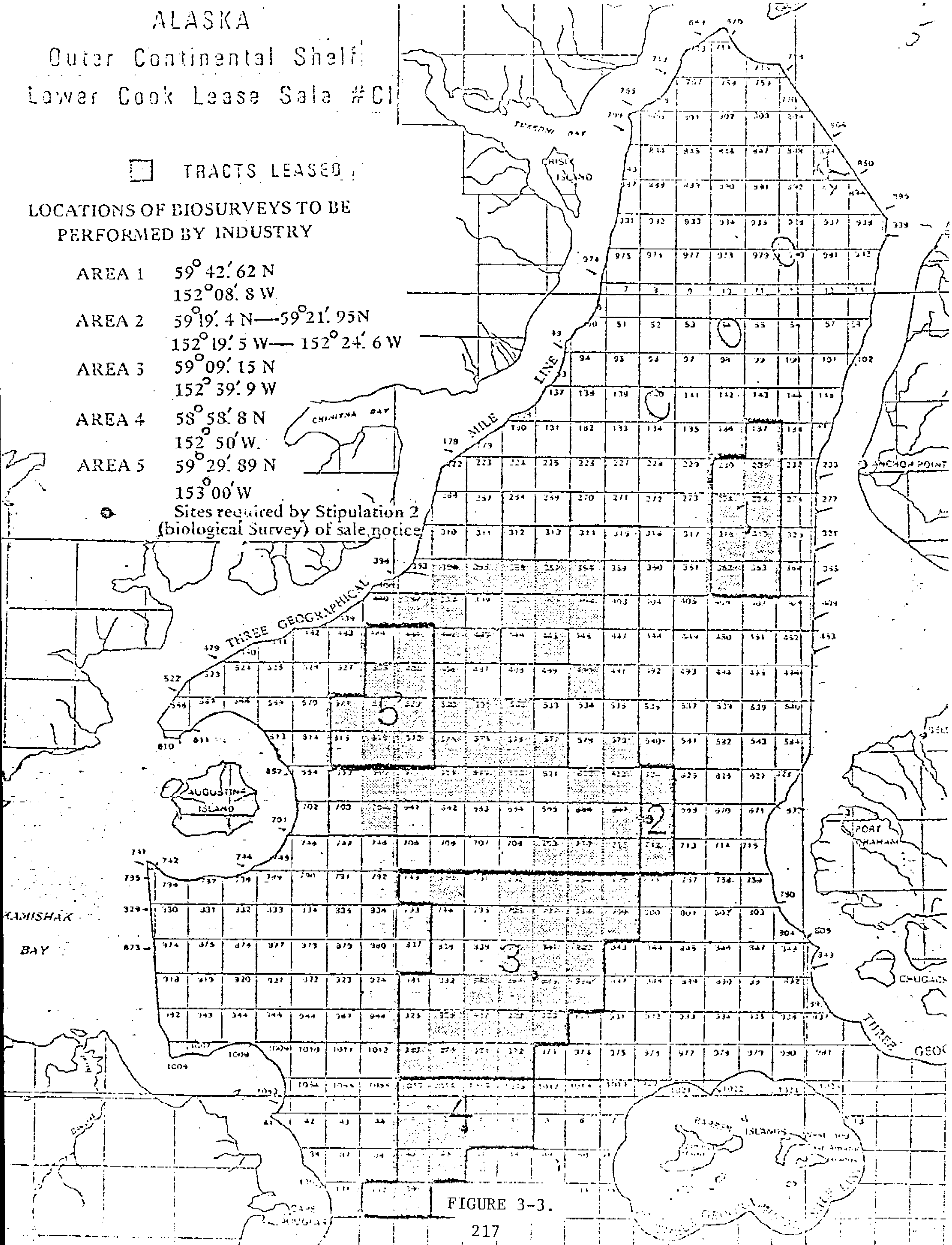

ALASKA
Outer Continental Shelf
Lower Cook Lease Sale #CI
TRACTS LEASED
LOCATIONS OF BIOSURVEYS TO BE PERFORMED BY INDUSTRY
AREA 1 59° 42.' 62 N 152° 08.' 8 W
AREA 2 59° 19.' 4 N—59° 21.' 95N 152° 19.' 5 W— 152° 24.' 6 W
AREA 3 59° 09.' 15 N 152° 39.' 9 W
AREA 4 58° 58.' 8 N 152° 50' W.
AREA 5 59° 29.' 89 N 153° 00' W
Sites required by Stipulation 2 (biological Survey) of sale notice
THREE GEOGRAPHICAL MILE LINE
CHINITNA BAY
CHISIK ISLAND
AUGUSTINE ISLAND
KAMISHAK BAY
ANCHOR POINT
PORT GRAHAM
BARREN ISLANDS
CAPE DOUGLAS
5
2
3
1

FIGURE 3-3.

3.1.2 Premises

The research program in Lower Cook Inlet has been based on the following premises:

Premise Number One. Investigations of the possible impacts of OCS activities will extend from the open ocean shoreward. The limit of shoreward extension will usually be the strand line or the maximum possible inshore penetration by tsunamis.

Premise Number Two. OCSEAP studies will be restricted to the determination of the effects of OCS activities on biological systems and the associated environment, and to the definition of those physical hazards posed by the environment to OCS activities. OCSEAP will not address related effects from potential impacts, such as economic and sociological effects resulting from impacts on commercial fisheries.

Premise Number Three. Second sales in lease areas already being developed or explored may include any of the areas originally offered for nomination; therefore, the scope of the planning must consider the entire OCS area.

Premise Number Four. Interactions (biological, development, impingement, etc.) among lease areas must be considered.

Premise Number Five. OCSEAP will not address non-OCS related impingements (e.g. tanker spills). OCSEAP will, however, generate general information that may be applicable for such purposes.

Premise Number Six. Comprehensive "ecosystems studies" cannot be adequately performed within the program's time constraints; therefore, only selected components or processes characterizing major ecosystems and/or having a high potential for being affected by OCS activities will be studied.

Premise Number Seven. The design and conduct of baseline/monitoring programs are not considered to be a present responsibility of OCSEAP. However, data generated by OCSEAP should provide some usefulness in establishing baseline and monitoring designs. Consequently, OCSEAP planning should consider the needs of future monitoring programs.

Premise Number Eight. OCSEAP is concerned with the nature and magnitude of contaminants and environmental disturbances that may accompany petroleum exploration and development (Task B). Information will be provided to OCSEAP by BLM on the following: location, nature and timing of platform, pipeline, and development; the quantity and physical and chemical nature of contaminants from potential sources; and the estimation of the nature and severity of possible environmental disturbances likely to accompany development. Such information is needed by OCSEAP in order to develop specific plans for future research units in a lease area.

Much of the required information is lacking or is of an uncertain nature during the early stages of activities (before the lease sale). This type of information will, therefore, probably not begin to reach OCSEAP until after a lease sale.

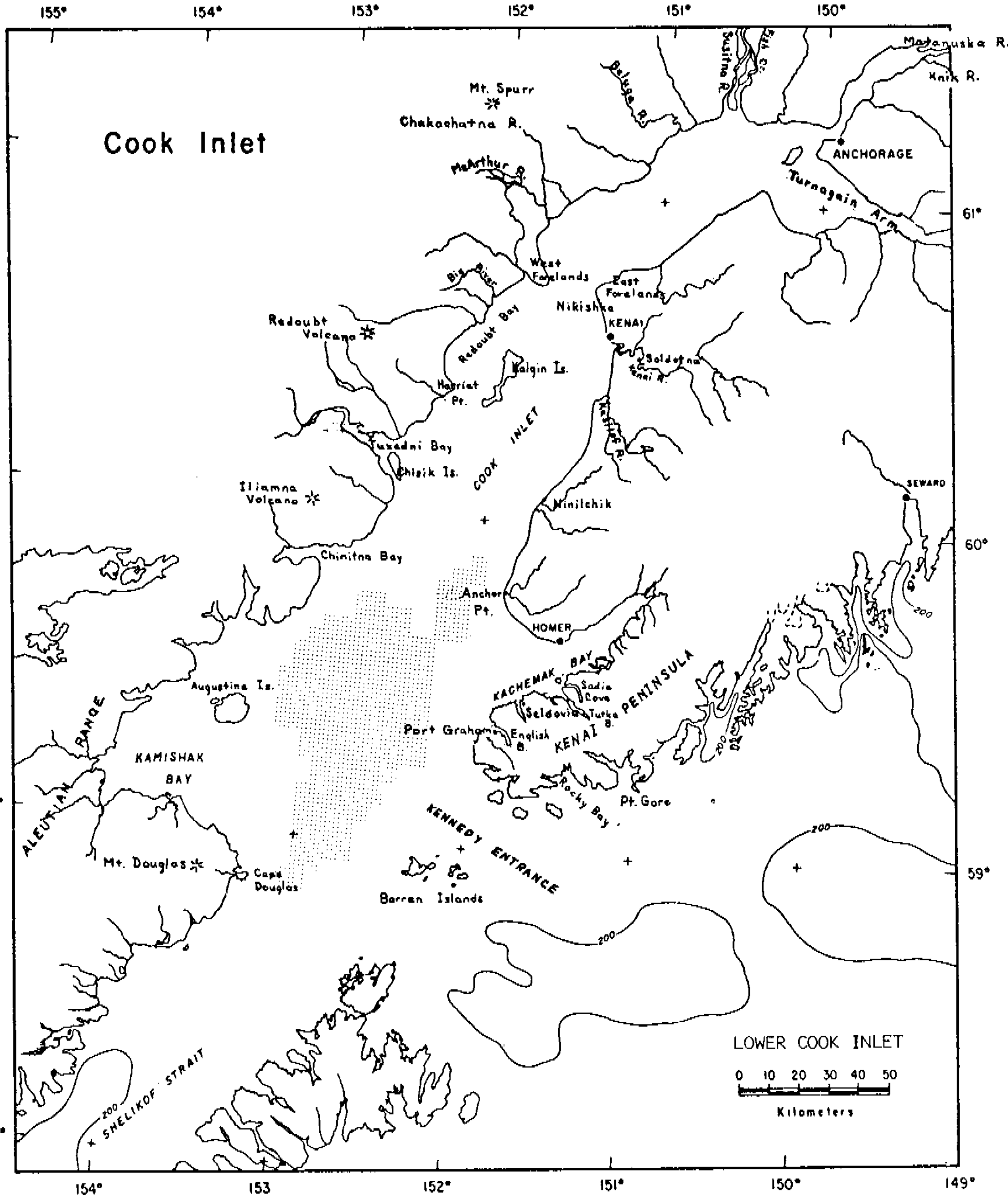
Premise Number Nine. The design of the research program in each lease area will respond to the long-term needs of BLM and other users of the information. The program will be related to the types of assessment activities, plan development, and the decisions that have to be made by BLM before and after a lease sale.

OCSEAP's design in Lower Cook Inlet will consider the needs of the following basic procedures and decisions to be conducted by BLM and other users: environmental assessment and EIS preparation; tract deselection decisions; stipulations and guidelines for platform placement, design and operation; stipulations and guidelines for selection of submarine pipeline corridors and mode of laying pipelines; stipulations and guidelines for the location and design of onshore facilities; evaluation of tanker routes; establishment of containment and cleanup contingency plans.

3.2 KEY ISSUES AND THE STATUS OF KNOWLEDGE FOR LOWER COOK INLET

3.2.1 Introduction

The status of knowledge for Lower Cook Inlet is extensively described in the Final EIS (February, 1977) and in "Lower Cook Inlet, Alaska, an Interim Synthesis Report", December 1977. No attempt will be



Cook Inlet
Mt. Spurr
Chakachatna R.
McArthur R.
Beluga R.
Susitna R.
Matanuska R.
Knik R.
ANCHORAGE
Turnagain Arm
West Forelands
East Forelands
Big River
Redoubt Volcano
Redoubt Bay
Nikishka
KENAI
Soldotna
Kenai R.
Kalgin Is.
Harriet Pt.
Tuxedni Bay
Chisik Is.
COOK INLET
Kasilof R.
Iliamna Volcano
Ninilchik
SEWARD
Chinitna Bay
Anchor Pt.
HOMER
KACHEMAK BAY
KENAI PENINSULA
Sadie Cove
Seldovia
Tutka B.
Augustine Is.
Port Graham
English B.
KAMISHAK BAY
ALEUTIAN RANGE
Rocky Bay
Pt. Gore
KENNEDY ENTRANCE
Mt. Douglas
Cape Douglas
Barren Islands
SHELIKOF STRAIT
200
LOWER COOK INLET
0 10 20 30 40 50
Kilometers
155° 154° 153° 152° 151° 150° 149°
61° 60° 59° 58°

made to repeat that information here. This section will limit itself to statements relative to the adequacy of the existing base of knowledge and the identification of areas that will require additional research. Additional, and more in-depth, descriptions of the status of knowledge will be presented in Section 3.3, where appropriate and where such information aids in understanding the rationale for a reseach unit. The following descriptions of the natural regions of Cook Inlet are primarily taken from the December 1977 Synthesis Report.

3.2.2 Natural Regions

Cook Inlet is a large tidal estuary which is located in south-central Alaska. It is about 370 km long and 139 km wide at the mouth and is considered to be part of the Gulf of Alaska. The biological components, such as marine mammals, birds, and migratory fish, move relatively freely between Cook Inlet, the Gulf of Alaska, and waters off Kodiak Island. Therefore, it is sometimes difficult to distinguish the boundaries of concern between the Lower Cook Inlet, Kodiak, and Northeast Gulf of Alaska lease areas. Much of the information derived for one of these lease areas probably has application to the other two.

Based on the results of the Lower Cook Inlet Synthesis Meeting of 1976, Cook Inlet was designated as having six natural regions (Figure 3-4) of principal concern relative to the lease areas. These are (1) the Lower Central Zone, (2) Kamishak Bay, (3) Kachemak Bay, (4) Kennedy Entrance, (5) the Kalgin Island area, and (6) Upper Cook Inlet.

The Lower Central Zone includes most of the tracts offered in the October 1977 lease sale. This region is the deepest portion of Cook Inlet and appears to be a transition zone between Kamishak and Kachemak Bays. It appears to be an important overwintering area for snow and king crab and may also provide overwintering for some species of demersal fish and Pacific herring.

The Central Zone is an area of tide-dominated circulation and poorly sorted sand bottoms; it also contains numerous fields of sand waves and ridges. The water column is turbulent and does not become

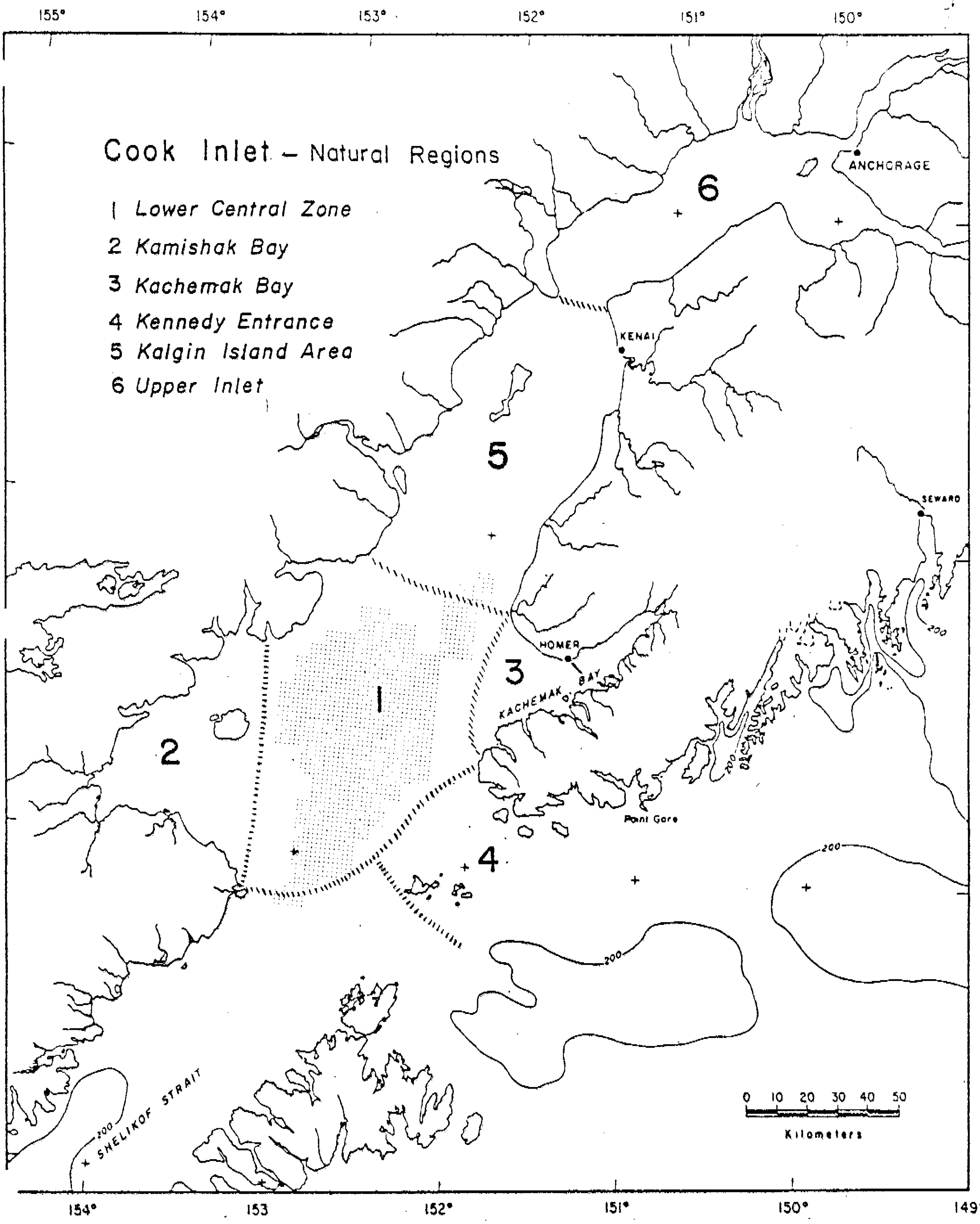


FIGURE 3-4. COOK INLET - Natural Regions (from Interim Lower Cook Inlet Synthesis Report, OCSEAP/SAI, Dec. 1977).

highly stratified. Turbidity increases from the east (<2 mg/l) to the west side (10 - 20 mg/l). Primary production peaks a few weeks after that in Kachemak Bay and coincides with the onset of thermal stratification.

Kamishak Bay is a shallow, rocky bay with tide-dominated circulation of low energy. It receives the net transport of suspended matter and drift ice from Upper Cook Inlet. Use of Kamishak Bay by overwintering birds and the reduced standing crop of intertidal macrophytes and benthos reflect the results of extreme ice conditions and associated scouring that take place here during the winter.

Although Kamishak Bay is turbid compared to the Central Zone and Kachemak Bay, primary production can be high during short periods. Large commercial catches of snow and king crabs occur here and the area between Iniskin Bay and Chinitna Bay appears to be a spawning area for snow and king crabs in the spring and summer. It appears to be an important spawning and juvenile feeding area for chum and pink salmon and also provides important habitat for herring and halibut.

Kamishak Bay may provide winter feeding grounds for belukha whales; however, this has not been substantiated. The bay also has resident populations of sea otters and harbor seals.

Kachemak Bay is composed of inner and outer bays separated by Homer Spit and is characterized by high primary production (from both phytoplankton and macrophytes), an abundant zooplankton community, an abundance of overwintering birds, the largest population of shrimp in Cook Inlet, important spawning areas for shrimp, snow crab, king crab and dungeness crab, and major commercial halibut catches, with smaller catches of salmon and herring. Mammals include sea otters, Steller sea lions, harbor seals, and harbor porpoises.

The high primary production and rich faunal communities in Kachemak Bay probably reflect the influence of seasonal stratification, influx of runoff and associated nutrients from the Fox River wetlands, and the clear Gulf of Alaska water which moves through the Kennedy Entrance and up the east side of Cook Inlet.

The Kennedy Entrance is narrow, deep, and scoured by tidal currents. It provides the entrance through which Gulf of Alaska waters enter Cook Inlet. The productivity and standing biomass of macrophytes along the shoreline are high. The Barren Island area supports significant snow and king crab fisheries, marine bird colonies, sea lion rookeries, and concentrations of harbor seals. The Entrance provides not only water mass exchange between the Gulf of Alaska and Cook Inlet but also migration routes for marine birds, anadromous fish, and marine mammals.

The Kalgin Island area is a convergence zone for the clear, highly saline Gulf of Alaska water moving up the east side of the Inlet and the turbid, lower salinity water moving from Upper Cook Inlet down the west side of Lower Cook Inlet. Tidal currents are very fast (up to 150 cm/sec) and result in bottom scouring. Ice scouring of the shoreline occurs here during the winter.

Primary production in the Kalgin Island area is low, due to high turbidity, ice scouring, and variation in salinity. However, the region is the most important commercial fishing region in Cook Inlet for salmon and halibut. Chisik Island, in Tuxedni Bay, supports the largest breeding bird colony in Lower Cook Inlet.

Upper Cook Inlet is characterized by extreme tidal range, a well-mixed water column, fresh water influence from runoff, extreme icing conditions in the winter, high concentrations of suspended glacial sediment (100 - 1000+ mg/l) and low primary production in the water column.

The productivity in Upper Cook Inlet is supported by extensive wetlands and intertidal mudflat algal production. The rivers entering the upper portions provide spawning streams for salmon and the wetlands provide important feeding grounds for migratory waterfowl.

Upper Cook Inlet is unique in that oil production from platforms has taken place just above the Forelands for the last ten years. Such an area might be thought of as providing an excellent base from which to predict possible impacts of oil production in Lower Cook Inlet. Surveys of petroleum-related contaminants are being conducted at the Forelands in FY 78. However, such areas exhibit high tidal currents, and because of dilution and dispersion processes, it might be difficult to demonstrate any significant increase in concentrations over ambient levels, even after ten years of production.

3.2.3 Geological Hazards

The principal hazards to OCS structures and activities in Lower Cook Inlet are seismic related; they include faulting, bottom slumping, and tsunamis, instability of sediments due to gas pockets, and volcanic activity on the western coastline of the Inlet.

Cook Inlet occupies a portion of an elongated structural basin, the Matanuska-Wrangell forearc basin, extending from the tip of the Alaska Peninsula to the Alaska-Yukon border. This basin is fault-bounded and lies at the leading edge of the North American Plate. It is presently being underthrust by the Pacific Plate along the Aleutian Trench.

The location of Cook Inlet above a zone of active underthrusting results in significant regional seismic and volcanic hazards. Meyers' (1976) summary of Alaskan earthquake epicenter data, for example, indicates that hundreds of seismic events have been recorded from the Cook Inlet region since 1889. At least 17 of these have been marked by earthquakes of magnitude six or greater. The mapping of near surface faults, unstable bottom areas, and the distribution of gas pockets has been undertaken by OCSEAP since July 1976 (RU 327). The data base is now adequate over the general area.

Cook Inlet is included in seismic risk zone 3 -- areas susceptible to earthquakes of magnitude 6.0 to 8.8 and subject to major structural damage. No maximum ground acceleration data for earthquakes in this area have been located, but the seismic array established by Pulpan and Kienle (RU 251) can provide such data for future earthquakes. Present information indicates that a large portion of seismic strain release in the whole area is associated with the Benioff zone (subduction of the Pacific tectonic plate beneath the American plate) which is intense below Iliamna. Shallow seismicity (<50 km depth) is diffuse and does not show any strong association with major known fault systems. However, some linear seismic trends offshore in Lower Cook Inlet might correlate with recently mapped shallow faults.

Five active volcanoes lie along the western shores of Cook Inlet. From north to south these are: Spurr, Redoubt, Iliamna, Augustine, and Mt. Douglas. All but Mt. Douglas have erupted in historic times. In common with other volcanoes in the Aleutian Alaska Arc, these volcanoes yield andesitic magmas and experience moderate to violent eruptions.

Of the volcanoes adjacent to Lower Cook Inlet, Augustine probably represents the greatest threat to the proposed lease areas. In 1883 a violent eruption of Augustine created a large summit crater. Augustine is presently building a lava dome within the 1883 crater and a future, violent eruption is most likely. Offshore hazards relative to an Augustine eruption include ashfalls, acid rains, lightning storms, noxious fumes, pyroclastic flows, glowing clouds of extreme heat, and falling bombs. Ballistics indicates large volcanic bombs will generally be restricted to a range of less than 10 km. One important unanswered question, however, is the distance that large glowing clouds, which accompany pyroclastic flows, would travel across the sea and how far the pyroclastic flow would travel offshore.

RU 251 has been studying volcanic activity on a regional and on a site-specific basis since 1976. Since the evaluation of volcanic risks requires a broad long-term statistical base, this RU will continue, at least until 1980.

3.2.4 Contaminants

The ambient levels of petroleum-related contaminants such as light and heavy hydrocarbons and metals have been investigated in Lower Cook Inlet since March, 1976 (RUs 152, 153, 162, 165, 275, 480, and 506). An adequate data base now exists. Ambient levels in Lower Cook Inlet are relatively low. However, investigations conducted since 1976 have documented elevated levels of low molecular weight hydrocarbons (methane, ethane, propane, and butanes) in the upper part of Lower Cook Inlet near the Forelands. Due to the high solubility of these components and low natural concentrations, such low molecular weight hydrocarbons may indicate input from the petroleum producing activities above the Forelands. Research in FY 78 is attempting to clarify the source or sources of these indicators.

Chemistry studies in FY 79 and in the future will focus on site-specific studies of ambient levels in sediments, water column, and selected biota in areas identified as having elevated hydrocarbon levels, evaluating the potential of suspended material to transport contaminants, and defining the potential rates of petroluem degradation in sediments.

3.2.5 Transport

Basic general circulation patterns in Lower Cook Inlet are known, based on the work of RU's 267, 289, 347, 138 and 367. Flow is dominated by tides and generally follows bathymetric contours. There is a seasonal highly variable input of freshwater. Lower Cook Inlet does not form estuarine, two-layered systems except in isolated embayments, such as Inner Kachemak Bay. This is due to high turbulence in Cook Inlet.

The primary flow within Lower Cook Inlet is probably driven westward toward Kennedy Entrance by a surface level difference and is constrained by bottom topography to curve southward and out through Shelikof Strait. A second primary flow occurs southward along the western shore of Lower Cook Inlet. This is driven by highly turbid, freshwater input from Upper Cook Inlet. A northward flow of clear oceanic water occurs along the eastern shore of Lower Cook Inlet, replacing water entrained into the southerly flow on the western side. This inflowing oceanic water of high salinity and the outflowing low salinity water on the western side are separated laterally, especially in the vicinity of Kalgin Island. This results in a "convergence area" or shear zone which is considered to be an advective barrier to transport.

The converging water masses in the central area of Lower Cook Inlet result in an area of complex circulation patterns with transient eddy-like features. Anticyclonic flow appears to occur at the mouth of

Kachemak Bay. During FY 78, RU's 267, 289, 347, 138, and 367 have been attempting to better define circulation patterns in the central area of Lower Cook Inlet, between Kachemak and Kamishak Bays.

The ability to predict direction and rate of transport away from a potential source of petroleum contamination is somewhat limited and will require the application of various transport models. The ability to make such predictions will be required before any adequate selection can be made of populations of organisms and habitats that are at greatest risk from particular OCS activities in specific areas. Modification of existing wave-driven and tidal-driven models from Cook Inlet and the application and field verification of these models should take place in the future.

The role of sediment transport in the dispersal of petroleum contaminants is an additional question that will require site-specific studies of the rates of bottom sediment transport (RU 430) and suspended sediment transport (RU 152), as well as the sorption/desorption capacity of the various types of sediments. Preliminary information from FY 78 investigations (RU 152) indicates high horizontal gradients of suspended matter, salinity, and temperature which can probably be attributed to the convergence of southward flowing freshwater input on the western side and northward flowing oceanic input on the eastern side. Near-bottom suspended matter distributions are similar to surface distribution, suggesting that Lower Cook Inlet is well mixed with respect to suspended matter. However, 24- and 36-hour time series run at two stations indicated relatively high temporal variability in the concentration of surface and nearbottom suspended matter.

Preliminary experiments to determine the capacity of Cook Inlet suspended matter to adsorb crude oil were conducted by RU 152 and RU 275. The results of RU 152 indicate high capacity, while those of RU 275 indicate a much lower capacity. Clarification of the disparity in these results will take place in FY 78 and during the first half of FY 79.

3.2.6 Biota

Reconnaissance studies to determine the general seasonal distribution and relative abundance of biological populations in Lower Cook Inlet will be essentially complete in October, 1978. The emphasis of the biological studies in the future will center around population dynamics studies, definition of food webs and clarification of important ecological processes in specific geographical areas that have been identified as being at risk.

Marine Mammals

Harbor seals, Steller sea lions, sea otters, and belukha whales are known to reside year-round in Lower Cook Inlet (RU 068). The seasonal distribution is fairly well-known for these species. The relative abundance and seasonal use of various habitats have been documented for the harbor seal (RU 229) and the Steller sea lion (RU 243). Some population variables, such as reproductive rates, individual growth rates, principal prey, and rates of return to seasonal habitats, are also known for these two species (RU 229 and RU 243). In the case of the Steller sea lion (RU 243), rates of return to seasonal habitats will require a short additional survey in FY 79.

Belukhas and harbor seals undergo seasonal density redistributions within Cook Inlet, being most abundant in the summer north of the Cape Ninilchik-Tuxedni Bay region and most abundant in the winter further south (K. Schneider and K. Pitcher, ADF&G, Anchorage, personal communication, 1976).

The distribution of sea otters and location of critical habitats were determined by RU 240 in 1976. High to medium density populations occurred in Kachemak Bay, along the lower Kenai Peninsula and in Kamishak Bay. It was the feeling of the investigators that these populations were expanding and that the most probable direction of expansion was northward along both sides of Lower Cook Inlet. Due to the possibility of an expanding sea otter population in Lower Cook Inlet, it might be necessary to conduct additional field surveys in the future.

The least amount of data is known about the cetaceans that possibly use the Inlet as feeding grounds. Low effort surveys of the belukha whales were begun in October, 1977. These surveys may continue through FY 79. Any effort to expand these surveys will have to consider the state-of-art limitations in estimating population numbers and migrations of an animal that exists in such sparse numbers.

Marine Birds

Lower Cook Inlet appears to be an important area for the passage of migratory waterfowl. Feeding grounds exist in the Fox River wetland of Kachemak Bay, Tuxedni Bay, and the wetlands of the Upper Inlet (revised data, RU 003).

A great influx of migrants and breeding birds occurs in the spring. Components of this migration are waterfowl, gulls, shorebirds, and common murres. A minor influx of gulls and waterfowl occurs in Kachemak Bay during the fall. The most abundant offshore birds in the summer are the shearwaters. The highest offshore bird densities in Lower Cook Inlet extend from the mouth of Kennedy Entrance to the mouth of outer Kachemak Bay (RU 003).

Seasonal surveys of bird populations in Lower Cook Inlet will be essentially complete in FY 78 and will result in a definition of seasonal distribution and relative abundances (RU's 003, 337, 338, and 343). Foraging areas that coincide with concentration areas are also fairly well known.

Marine bird colonies are not as predominant here as in some other parts of Alaska (such as the Gulf of Alaska, Bering Sea and Kodiak); however, relatively large colonies do exist in the Barren Islands and Tuxedni Bay. Those of the Barren Islands have been studied since 1975, but the study of seasonal population variables and relative abundance of bird colonies in the other two areas began in October 1977 and will probably continue to October 1979 (RU 341).

The locations of smaller bird colonies with population estimates have been determined (RU 003, 338, and 343). Investigations of seasonal prey items and food habits by principal bird species have been conducted in Lower Cook Inlet starting in FY 77, and together with food habit data from Kodiak and NEGOA, should provide an indication of important prey items in the diet of principal species.

Fish and Associated Biota

The distribution of pelagic and demersal fish (including life stages), benthic invertebrates, plankton, primary production and intertidal habitats is fairly well known based on the reconnaissance work that has taken place since 1975. The time of appearance and general distribution of fish eggs, ichthyoplankton, and invertebrate meroplankton have been investigated by OCSEAP since 1976 (RU 424). ADF&G sponsored studies of shrimp and crab larvae have also been conducted during this period (Haynes, 1977 and Sundberg and Clausen, 1977). Investigation of benthos during the same period has been conducted (RU 005, 024, and 417), resulting in seasonal distribution patterns. Mapping of intertidal and shallow subtidal habitats has been conducted by RU 024, 078, and 417, while general primary productivity patterns were determined for macrophytes (RU 417) and phytoplankton (RU 425). A reconnaissance of the seasonal distribution of pelagic and demersal fish (RU 174, 284, 353, and 512) has been completed. The reconnaissance work in Lower Cook Inlet is essentially at an end. The emphasis for FY 78 and beyond has been and will continue to be a shift toward more in-depth studies to understand the functioning of habitats, ecological processes, and important populations in specific areas, identified as being at risk from OCS activities.

The importance of certain species in the food web of Lower Cook is known, but the role of many more forms is totally unknown. Information resulting from mammal studies (RU 229 and 243) and birds studies (RU 341) in NEGOA and Kodiak, as well as Lower Cook Inlet, have identified species of fish and invertebrates that constitute important prey for mammals and specific birds in Lower Cook Inlet. Additional information is needed to clarify principal dietary components of fish and invertebrate biota in the intertidal and shallow subtidal communities, as well as deeper open-water areas of Lower Cook Inlet. Emphasis in FY 79 through FY 80 will be placed on defining the food web in these particular areas.

Ecological processes which have been studied in Lower Cook Inlet since FY 77 include definition of microbial activity and respiration ratios and the determination of nitrogen fixation rates in sediments and the guts of detritus feeding invertebrates (RU 190). These studies in FY 78 have expanded to evaluate the effect of crude oil on these nitrogen fixation processes as well as microbial activity. Such studies will continue in FY 79.

3.3 GENERAL APPROACH

The general research approach which is being employed by OCSEAP in Lower Cook Inlet involves the application of field surveys (reconnaissance studies), tract-specific and site-specific field and laboratory studies, and special studies on ecological processes by the use of field studies, laboratory studies, and modeling studies to address the following goals:

a. Identify and analyze hazards to oil exploration, development, and production.

b. Identify biological populations and ecological systems at risk from oil exploration, development, and production.

c. Determine the probable impact of oil exploration, development, and production on those biological populations and ecological systems identified as being at risk.

Figure 3-5 presents the relationship of each of these three major goals to the various tasks of OCSEAP, the types of studies used within each task to address these goals, and the relative timing of each study to the sale, discovery, and production phase of a lease area. The relative duration of each of these phases and the activities occurring in each phase are presented in Table 1.

The following description of the research approach, including tasks, subtasks, and specific descriptions of the research units, will be within the context of the three general goals and the relationship between types of studies presented in Figure 3-5.

Table 1. HYPOTHETICAL SEQUENCE OF OCS EVENTS - LCI, FIRST LEASE SALE

MILESTONE	DATE →	INDUSTRY ACTIVITY →	DEVELOPMENT TIMING (mo.) →	BLM ACTIVITY →
Call for nominations	8/75	Tracts nominated	N/A	Make initial risk, hazards, impact assessments
DEIS				
				Revise DEIS, make final tract selections
FEIS				
Sale CI	10/77	Bids made		
				Bids accepted; exploration orders promulgated
Exploration	1978	Exploratory drilling begins; support activities begin		
Discovery of oil in quantity		Field tests begin; support locations selected		Production platform criteria developed and promulgated
Development		Platform design begins; pipe is ordered*	8	
				Support, storage stipulations promulgated
		Onshore facilities and production platform construction starts	20	
		Pipe received, stored	30	
		Platform is installed	36	OCS operating orders promulgated
		Development drilling begins	39	
				Pipeline permit furnished
		Pipe is laid	42	
				Monitoring begins
Production		Production begins	54	

* Assuming sufficient petroleum or gas found to justify pipeline.

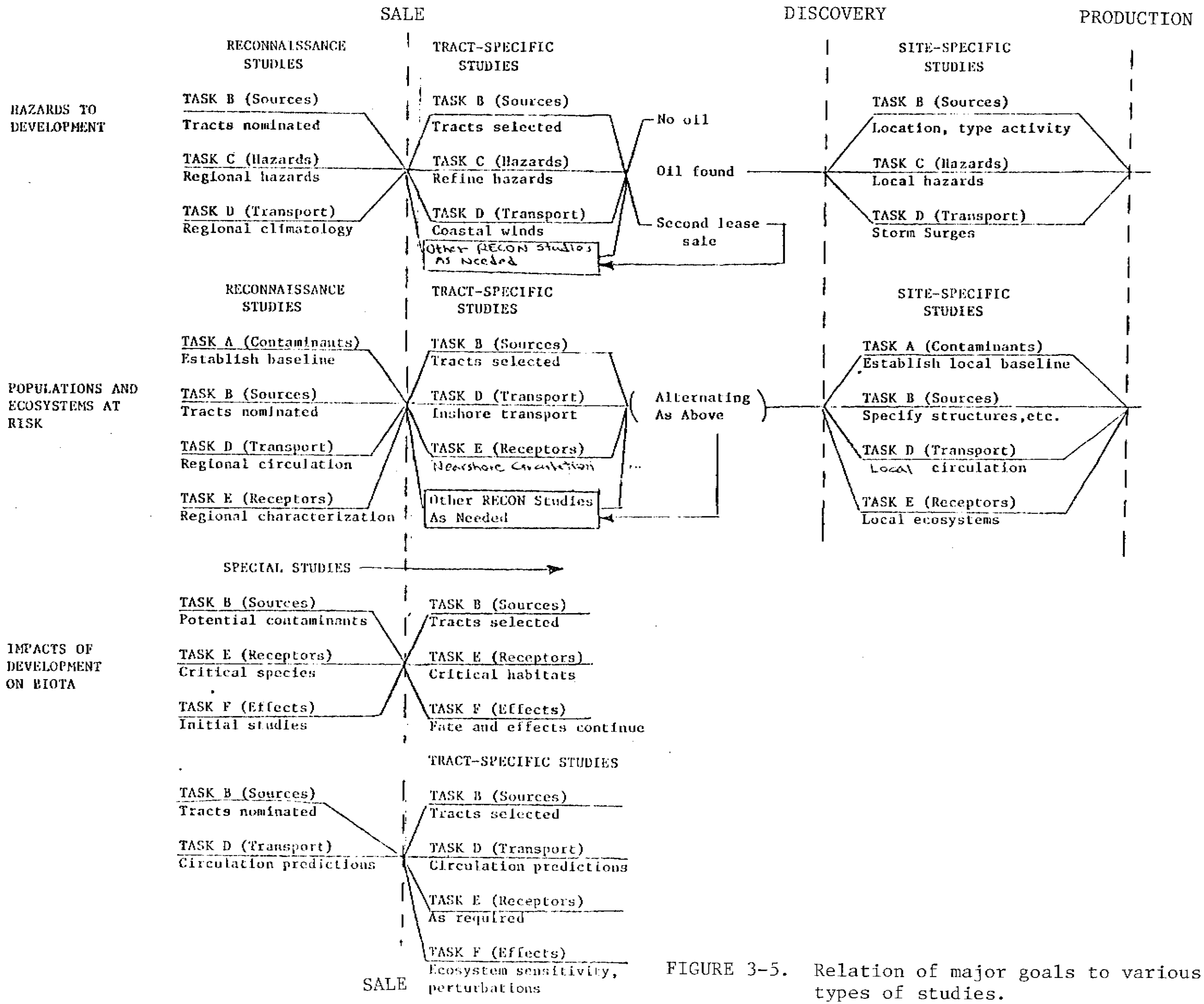


FIGURE 3-5. Relation of major goals to various types of studies.

3.3.1 Program Emphasis

Hazards to Oil Exploration, Development, and Production

This portion of the research program is represented by a single task (Task C), the objective of which is to identify, map, and analyze geological hazards to oil exploration, development and production. Serious hazards in Lower Cook Inlet are primarily seismic related. These include faulting, sediment instability, and extreme oceanic events such as tsunamis. Volcanic activity is also an important hazard since five volcanoes of recent activity are found on the west coast of Cook Inlet.

The information resulting from OCSEAP investigations of hazards in Lower Cook Inlet will enable BLM and other users to evaluate the degree of risk existing at specific areas, to arrive at decisions relative to tract deselection before the second lease sale, and to develop stipulations on platform placement, design, and operation. The evaluation of methods for transporting crude oil or gas to shore, including the selection of pipeline routes, will be made by the Department of Interior in the context of a planning program for the assessment and management of transportation. Although the OCSEAP program in Lower Cook Inlet is not specifically designed to address this type of decision, the information resulting from the hazards studies will provide input. This hazards information will also provide some input to the environment impact statement required during the development phase of OCS activities.

Figure 3-6 presents the approach that will be taken in Lower Cook Inlet until October 1980. This approach makes use of general area surveys, or reconnaissance studies, and site-specific studies of areas deemed of more than usual importance within the system, areas identified as being at risk from certain specific geological hazards, and specific areas where OCS activities are to occur.

Reconnaissance Studies (Figure 3-6):

Initial investigation of hazards in Lower Cook Inlet has involved reconnaissance or general area surveys to determine the general distribution of seismic hazards (subtask C-1 and C-2) and unstable bottom

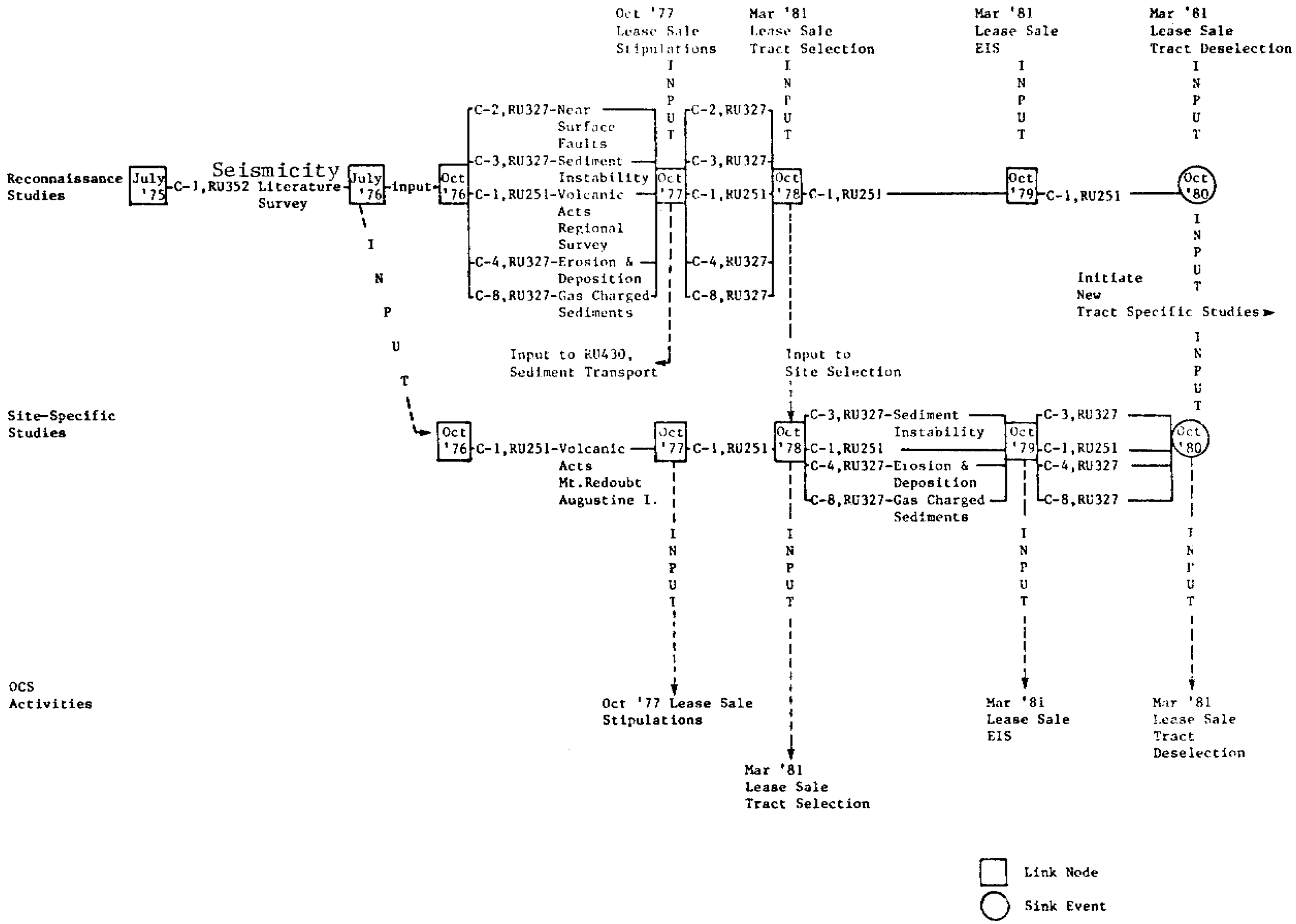


FIGURE 3-6. Hazards to Oil Exploration, Development, and Production (Task C).

sediments (subtasks C-3, C-4, and C-8) in Lower Cook Inlet. Based on these surveys, areas of hazards were identified which required more detailed site-specific investigations. These site-specific investigations are required to delimit the extent and relative importance of these hazards to OCS tracts offered for sale, taking into consideration probable activities in these tracts. Such reconnaissance studies are important in the environmental assessment, preparation of EIS, and tract deselection before sale.

Hazards research was initiated in Lower Cook Inlet in July 1975 with RU 352 (subtask C-1) which compiled literature data on epicenter locations with associated magnitude and recurrence rates of previously recorded earthquake activity. Based on this compilation, general area surveys were initiated in July 1976. These studies included regional surveys of volcanic activity and associated seismicity (subtask C-1, RU 251), distribution of near-surface faults (subtask C-3, RU 327), distribution of areas of rapid accumulation or erosion of sediment (subtask C-4, RU 327), and distribution of gas-charged sediments. All of the above hazards have the potential for limiting the degree of OCS activities and development in the areas where each hazard occurs. Thus, such mapping of distributions provides an initial basis for deselecting specific tracts for OCS petroleum sale.

Some reconnaissance studies will continue through FY 82. These are studies that require a long-term statistical base in order to evaluate seismic and volcanic risks on a regional basis. Such studies include RU 251, which has established a network of short-period seismic stations covering the Lower Cook Inlet, Kodiak Island, and the Alaska Peninsula between the west coast of Kodiak Island and the Semidi Islands. Expansion of this seismic network involves P 927, which will add onshore ground motion accelerometers to the existing network, and P 925, which wll employ state-of-art ocean bottom seismometers to improve the sensitivity and geographical accuracy of the existing network.

Site-Specific Studies (Figure 3-6):

Site-specific studies are used for more detailed analysis of hazardous processes that are deemed of more than usual importance within the Lower Cook Inlet area. Tract-specific studies of geological hazards will not be addressed by OCSEAP after a lease sale, since that responsibility falls under the mission of the USGS, Conservation Division.

The first site-specific study of hazards in Lower Cook Inlet was initiated in October 1976 (subtask C-1, RU 251). Research Unit 251 has established seismic monitoring stations on Augustine Island and Mt. Redoubt, two active volcanoes in Cook Inlet. Such monitoring will continue in order to document the frequency of volcanic activity, to delineate areas that might be affected, and possibly to achieve a capability to predict the next eruption.

Based on reconnaissance data, site-specific studies will be initiated in October 1978 and will run to October 1982. These site-specific studies will include a more specific delineation of existing and potential slumps in addition to other unstable sediment masses, with an emphasis on defining and describing the most important factors involved in sedimentation processes (subtask C-3, RU 327). The distribution and description of areas of severe erosion and deposition, and the directions and rates of movement of large-scale bedforms will also continue (subtask C-4, RU 327) as will the description of the distribution, origins, and characteristics of gas-charged sediments and their potential hazards (subtask C-8, RU 327), and the determination of the extent of volcanic flows into Lower Cook Inlet from Augustine (subtask C-1, RUs 251 and 327).

Such site-specific information will provide input for determining the potential hazards to platforms, pipelines, and other structures, and will provide information needed for tract selection/deselection decisions and the EIS required for the second lease sale (March 1981) in Lower Cook Inlet.

Biological Populations and Ecological Systems at Risk

The objective of this portion of the research program is to identify those biological populations and ecological systems which are at risk from oil exploration, development, and production. This identification provides a first approximation by which BLM and other users can identify areas of risk within their environmental assessment procedures, evaluate the degree of risk based on experimental studies of probable impact and arrive at decisions relative to tract selections/deselections and stipulations on structure placement, design, and operation. Additional uses include input to the environmental impact assessment of the second lease sale and development phase, if oil and gas are discovered, and input to the selection of transportation routes, including pipeline corridors.

Figure 3-7 illustrates the relationship between the tasks involved in identifying the populations and ecological systems at risk and those tasks addressing the principal goal of determining probable impacts. The approach makes use of general area surveys or reconnaissance, site-specific field studies of areas deemed of more than usual importance within the system or areas initially identified as being at risk, and special studies for defining important ecological processes. The design for setting up baseline/monitoring programs has not been delegated by BLM to the OCSEA program. However, the utility of OCSEAP data in the design of monitoring is being considered in the planning.

Reconnaissance Studies

The initial approach, which has been employed before selection of tracts to be sold, and before the development of an EIS, is to make general area field surveys or reconnaissance of the geographical area concerned. This involves describing general seasonal transport patterns relative to surface and water column circulation, suspended sediment transport, and bottom sediment transport (Task D). This description is on a large scale basis and is a necessary first step in identifying those geographical areas which might be at risk from OCS activities.

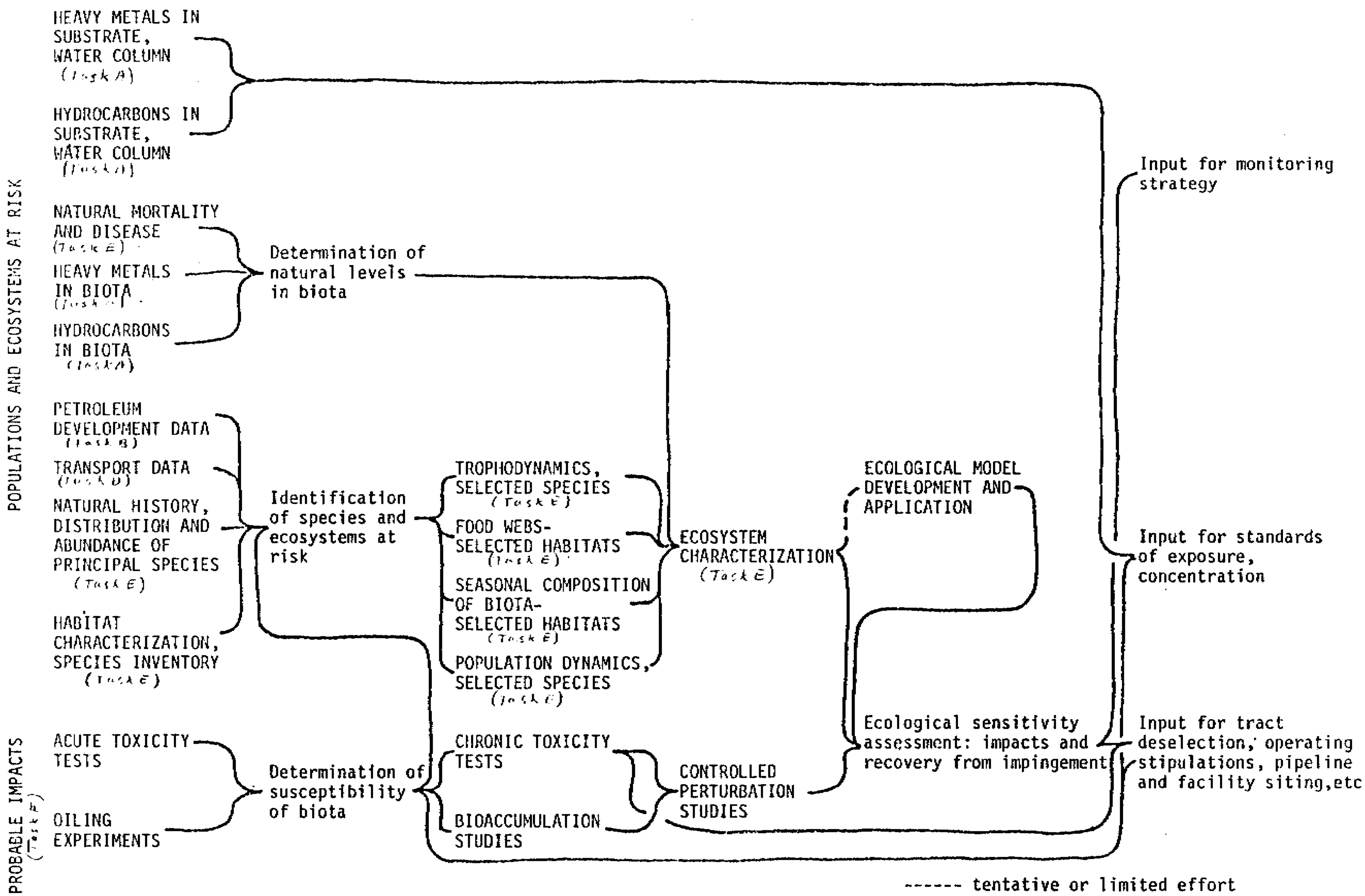


FIGURE 3-7. Relationships of Various Risk and Impact Studies.

In addition to describing general transport patterns, reconnaissance has also been made to determine the existing distribution, concentration, and variability of petroleum-related contaminants in the water column, in bottom sediments, and in selected biota of the lease area and associated area of concern prior to petroleum industry activities (Task A). A special effort has been made to identify areas in which elevated concentrations occur and to determine if these higher levels are due to natural oil seeps or are related to existing oil production activities. Identification of such areas will provide a basis for the design of site-specific studies to further define concentration levels and variability of such contaminants in the water column, sediments, and biota, and the community structure and function at such sites. Such information can provide some basis for predicting the possible impact of chronic contamination from OCS activities and may also provide a baseline reference for design of monitoring programs.

Reconnaissance has also included a determination of the general seasonal distribution and relative abundance of biota in the area of concern (Task E). Such studies involve surveys of both higher and lower trophic levels including marine mammals, birds, fishes, planktonic components, microbiota, benthic invertebrates and macrophyte communities. In the mapping of seasonal distribution and relative abundance, identification of geographical areas and seasons have been made relative to use -- feeding grounds, breeding colonies, staging areas (birds and mammals), pupping rookeries (mammals), feeding, spawning, and nursery areas (fishes and benthic invertebrates) and life history stages using these areas.

The reconnaissance of contaminants (Task A), transport (Task D), and biota (Task E) will provide information necessary to identify geographical areas and associated populations and communities which are possibly at risk from OCS oil exploration and development activities. These reconnaissance studies also provide data necessary for the selection and design of site-specific studies and special studies of ecological processes, and would provide input to the design of future monitoring programs.

Reconnaissance studies are initiated prior to the development of the EIS and, therefore, provide a primary input to the environmental assessment process. Information resulting from such studies can be used to decide which tracts, if any, should not be included in the lease sale (deselected) due to possible impact on specific populations and communities identified as critically important. In certain instances reconnaissance studies may continue after the lease sale. However, in most cases, when the tracts have been selected for exploratory drilling, more site-specific and special laboratory and field studies will already be underway and the reconnaissance mode of research will be completed. In the case of Lower Cook Inlet, the second lease sale will include the same area of study as was involved in the first lease sale. No additional reconnaissance work will be required, therefore, for this second sale unless important information gaps are identified within the existing program.

After the lease sale, the information collected by reconnaissance studies will probably also have some utility in developing stipulations and guidelines for drilling platform placement, mode and timing of operations, identifying areas to avoid in selecting pipeline corriders, evaluation of tanker routes, and in establishing containment and clean-up contingency plans for anticipated oil spills.

The individual subtasks and research units which compose the reconnaissance studies in Lower Cook Inlet are presented in Figures 3-8 and 3-9. The general area surveys of petroleum related contaminants were initiated in March 1976. These surveys included distribution of total petroleum and selected hydrocarbon components of the water column, biota, and sediments (subtask A-1, RU 275), the distribution of light hydrocarbons in the water column -- methane, ethane, propane, butane, olefinic homologs, (subtask A-2, RU 153) and concentration and distribution of toxic metals in water column, bottom, sediments, and selected biota (subtask A-3, RU 162). The research on light hydrocarbons (RU 153) also has the principal objective of evaluating the use of various ratios of light hydrocarbons in distinguishing between natural sources of oil

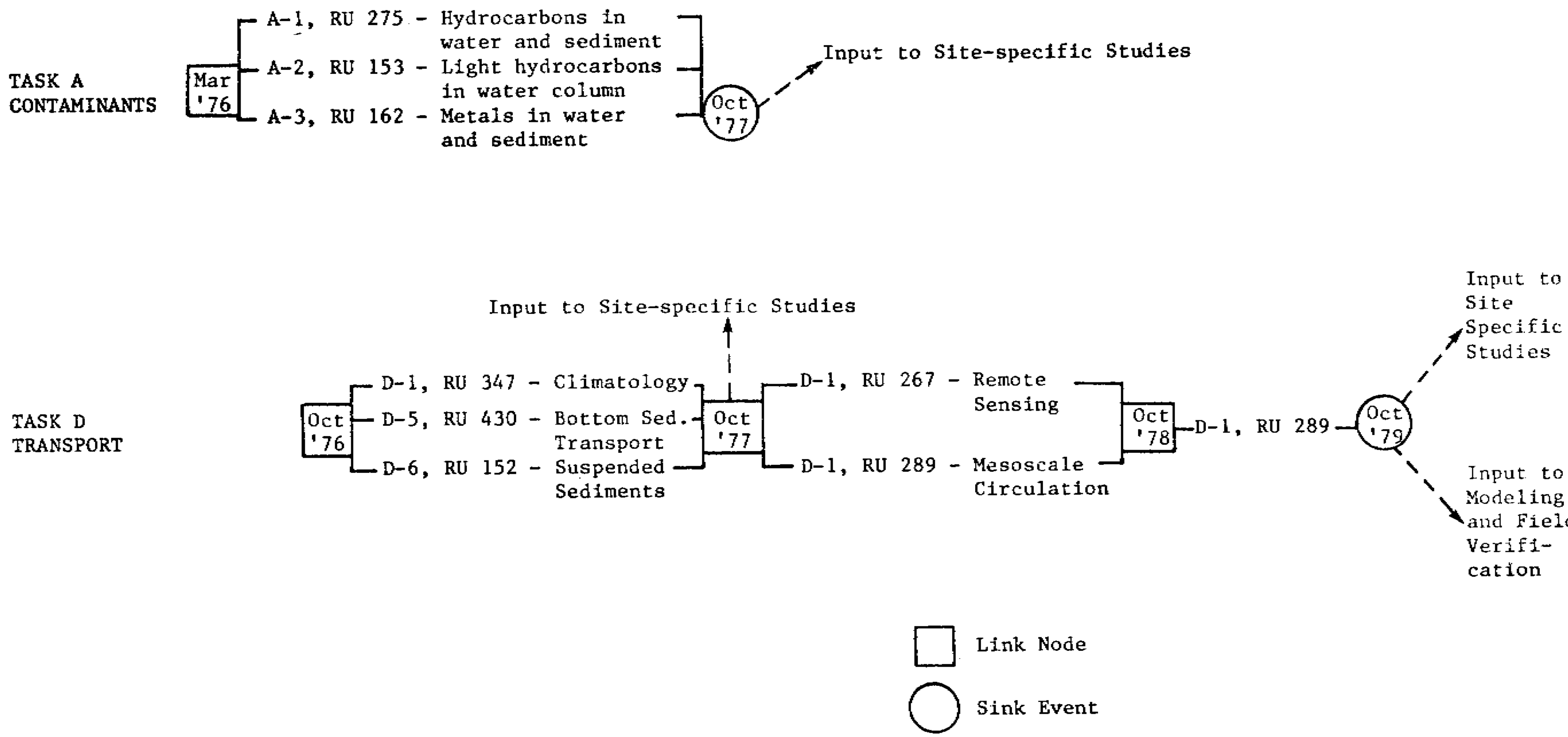


FIGURE 3-8. Identification of Populations and Ecological Systems at Risk - Reconnaissance Studies

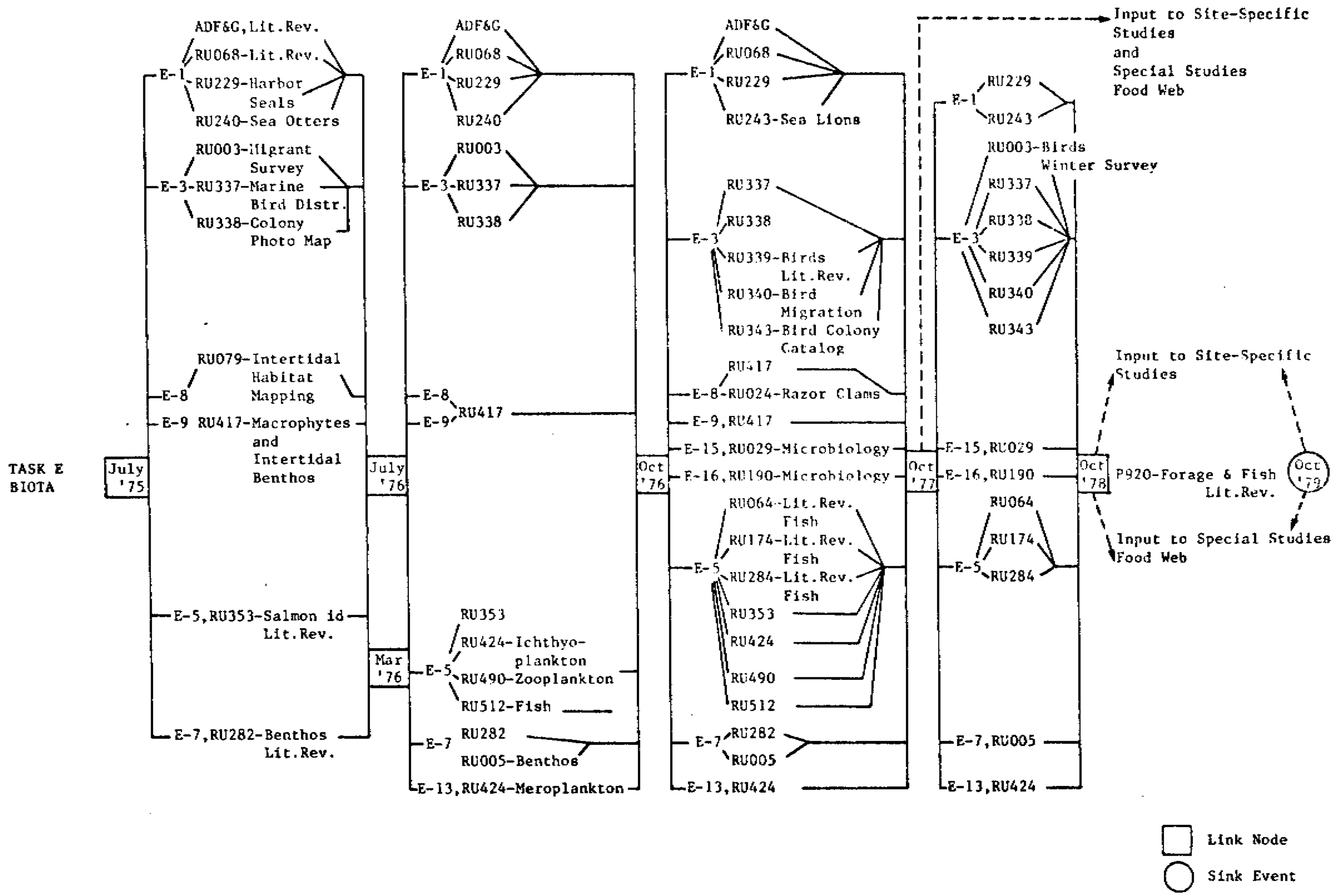


Figure 3-9. Identification of Populations and Ecological Systems at Risk - Reconnaissance Studies.

and OCS oil producing activities. The basic results of the reconnaissance program were used to identify areas where site-specific studies would be required -- Kamishak and Kachemak Bays, Upper Cook Inlet, just above the Forelands, and Lower Cook Inlet, just below the Forelands.

General area surveys of transport patterns were initated in October 1976. These surveys included the description of seasonal climatology of the Lower Cook Inlet area (subtask D-1, RU 347), a characterization of bottom and near bottom sediment dynamics (subtask D-5, RU 430), and a characterization of suspended particulates relative to vertical flux, transport, and deposition (subtask D-6, RU 152). The results of these studies provided information for the design of site-specific studies which were initated in October 1977.

In October 1977 additional reconnaissance studies began. Decriptions of mesoscale circulation, surface water mass flows, and sea ice conditions were begun with application of satellite, remote sensing imagery (subtask D-1, RU's 267 and 289). RU 289 is proposed to continue to October 1979. Such empirical field information will provide important input to the modification of transport models for Lower Cook Inlet. (See Special Studies in transport)

Reconnaissance level studies to determine the distribution and relative abundance of biological populations and communities were begun early in the program in Lower Cook Inlet (July 1975, Figure 3-9). Studies of the distribution and relative abundance of marine mammals began in July 1975 with literature reviews of available information on marine mammals in the Gulf of Alaska (subtask E-1, RU 068, ADF&G). Surveys were also conducted on the distribution and relative abundance of sea otters in Lower Cook Inlet (subtask E-1, RU 240).

The distribution and relative abundance of marine mammals is presently being addressed by RU's 229 and 243 (subtask E-1). Research Unit 229 has been studying the harbor seals of the Gulf of Alaska and Lower Cook Inlet since July 1975. Research Unit 243 was initiated in October 1976 to study Steller sea lions. Besides determining distribution and abundance, additional effort by both research units has been devoted to the study of life history patterns, population productivity, variation in growth and body conditions, and food habits (subtask E-2). Reconnaissance efforts by research units 229 and 243 will be completed by October 1978.

In October 1977 the efforts of RU 243 were expanded to include the documentation of seasonal distribution and abundance of cetaceans in Lower Cook Inlet, with emphasis on the belukha whale. The continuation of this in FY 79 will depend on the results and quality of the data resulting from FY 78 effort.

The determination of the distribution and relative abundance of marine birds (subtask E-3) has been addressed in the Gulf of Alaska by RU's 003, 337, 338, 339, 340, 341, and 343. The identification and mapping of coastal migratory bird habitats were initiated in July 1975 by RU 003 and completed in October 1977. In FY 78 RU 003 has concentrated on the mapping of the distribution of wintering birds, and spring and summer migrants in Lower Cook Inlet with emphasis on Kamishak Bay. The distribution of wintering birds is being related to the extent of ice conditions. Literature reviews of marine birds (RU 339) and the migration of birds along the Alaskan Coast (RU 340) began in 1976 and are scheduled to be completed by October 1978.

Reconnaissance studies of the benthos have been conducted primarily by RU's 005, 079, and 417. RU 282 was a literature review of benthic organisms in the Gulf of Alaska. This review began in 1975 and was completed in October 1977.

Reconnaissance studies of the benthos have been conducted primarily by Research Units 005, 079, and 417. Research Unit 005 has been mapping the distribution, relative abundance, composition, and associations of benthic infauna and epifauna of offshore communities since March 1976. The emphasis in FY 78 has been to shift the reconnaissance studies to nearshore, subtidal benthos with initiation of more site-specific studies for some of the more dominant (clam species) and important commercial species (snow crabs and shrimp). The selection of the site-specific studies is presented.

From July 1975 through July 1976, aerial surveys of intertidal habitats in Lower Cook Inlet (Research Unit 079) were conducted with some ground truth verification. This investigation has resulted in general survey maps with documentation of areas of sandy, rocky, or muddy intertidal areas, beach slope, and probable associated biota. Reconnaissance studies of razor clam beaches were conducted by RU 024 in FY 77. This involved the mapping of major and minor razor clam beaches, and the determination of relative densities, age class structure, and seasonal reproductive cycles.

Intertidal and shallow subtidal habitats have been under investigation in Lower Cook Inlet by RU 417 since 1975. These investigations have included both macrophytes and associated fauna. Many species of fauna found in the intertidal and shallow subtidal areas are also found in nearshore and some offshore areas. Information exchange and coordination between RU's 417 and 005 have, therefore, been required.

Studies of intertidal and shallow subtidal habitats (RU 417) began to shift from reconnaissance to site-specific studies early in FY 77, with the result that, in FY 78, the research was centered strictly around site-specific studies at various representative habitats (sandy beach, rocky intertidal, muddy intertidal) in Lower Cook Inlet (see Site-Specific Studies for description).

Additional information relative to the benthic communities is also being provided by RU 424. This research unit is determining the distribution and relative abundance of planktonic life history stages of the benthos. This research will provide some basis for determining seasonal spawning periods and those geographical areas of Lower Cook Inlet that might be of importance as nursery grounds to these stages.

Microbiological surveys were initiated in FY 77 in Lower Cook Inlet. Research Unit 029 is mapping microbial species relative to densities, geographical locations, is employing cluster analysis to determine the physiological groups of microbes in the water and sediments, and is mapping the rates of hydrocarbon degradation in the sediments. This research unit is coordinating very closely with RU 190, which is evaluating techniques used to determine oil degradation in sediments.

As is indicated in Figure 3-9, reconnaissance level studies of biota in Lower Cook Inlet will be essentially completed in October 1978. Future continuation of biological studies will involve special lab and field studies of various important ecological processes and site-specific studies in geographical areas which have identified as at immediate risk from OCS oil exploration and development activities.

Site Specific Studies

Site-specific studies are those field investigations which are conducted on very site-specific and important ecological processes, and on specific habitats that have been designated as important to the Cook Inlet ecosystem and at risk from OCS activities based on contaminant and biota reconnaissance (Tasks A and E) and on transport reconnaissance and/or transport modeling studies (Task D). Site-specific studies have a much higher resolution than reconnaissance studies since they address a smaller spatial area and have a greater frequency of sampling.

Certain site-specific investigations have already been initiated. Studies of the circulation patterns on the central, lower region of Lower Cook Inlet have been initiated to clarify transport of materials in this region (Task D). Whether transported materials are retained in this area of low net currents for significant periods of time is debatable. Since this may have an important bearing in evaluating potential effects due to transport of oil-related contaminants, site-specific investigations of transport in this area are required.

During the period of exploratory drilling, the use of site-specific studies will gradually increase. If oil is discovered in commercial quantities within the lease area, the use of interdisciplinary site-specific studies will be required throughout the development phase (Figure 3-10). The assessment of onshore facilities, including tanker terminals, and its effect on the Lower Cook Inlet system will require identification and description of habitats at risk and an evaluation of the probable effects due to chronic oil contamination. Such assessment will also require an evaluation of community structure and function, and contaminants at onshore facilities now existing in Cook Inlet such as at Nikiski and Drift River.

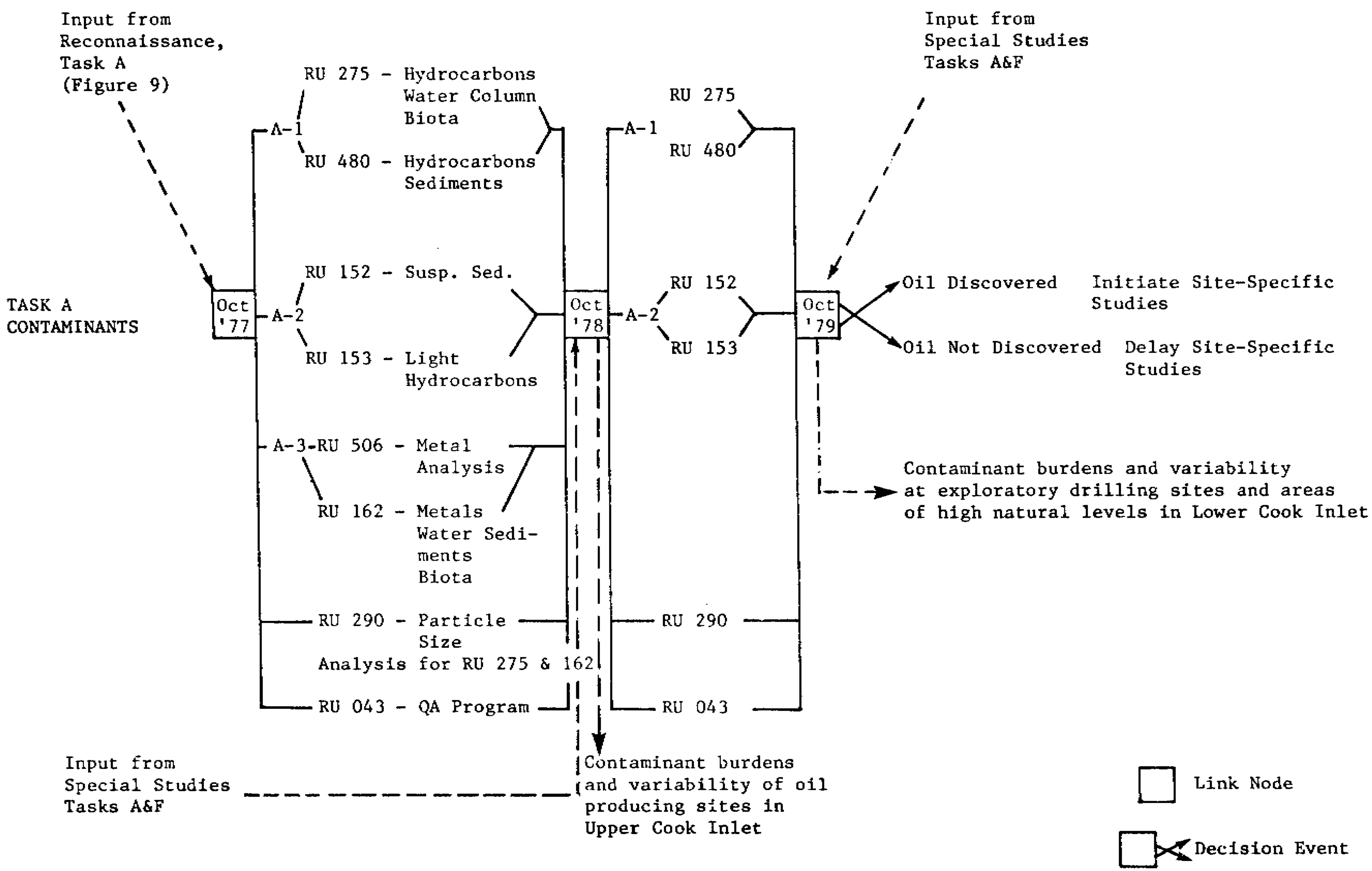


FIGURE 3-10. Identification of Populations and Ecological Systems at Risk - Site-Specific Studies.

Site-specific studies will provide a better basis of resolution for the development of baselines and monitoring programs, provide input to certain special studies, such as transport modeling, food web delineation and population dynamics of selected species, and provide field information at a level which can be used to design controlled laboratory and field experiments on the chronic impacts of oil and oil-related contaminants.

The individual subtask and research units which compose the site-specific studies in Lower Cook Inlet are presented in Figures 3-10, 3-11, and 3-12. Based on information gained from reconnaissance studies, site-specific studies of contaminant distribution (Task A), circulation and transport mechanisms (Task D), and the relative abundance and distribution, population dynamics and food web relationships of selected biota (Task E) were initiated in October 1977. These studies are directed toward comparing the pre-OCS development conditions of Kachemak and Kamishak Bays with conditions in the Upper Cook Inlet where oil production has been occurring for the last ten years. Such comparisions will provide a basis for selecting those variables which appear to be associated with OCS activities and, therefore, should be considered in future monitoring programs.

Both aerial and shipboard surveys of marine birds have been conducted by RU 337 since July 1975. This information plus some resulting from photo mapping of seabird colonies (RU 338), data from RU 003, and data from USFWS reports covering the period 1972-1975 are being used to determine the seasonal distribution of birds in Lower Cook Inlet. The data from RU 337 is being analyzed and additional work in this line of reconnaissance, minimal in FY 78, will be phased out in October 1978. An important product resulting from all of the marine bird RU's listed above will be a seabird colony catalog (RU 343) which is scheduled to be completed in October 1978.

The major emphasis in FY 78 has been biological studies of bird colonies. This work will continue in FY 79 (see Site-Specific Studies).

Literature reviews of marine fish resources of the Gulf of Alaska were initiated in 1976 (subtask E-5, RU's 064, 174, 284, 353). RU 064

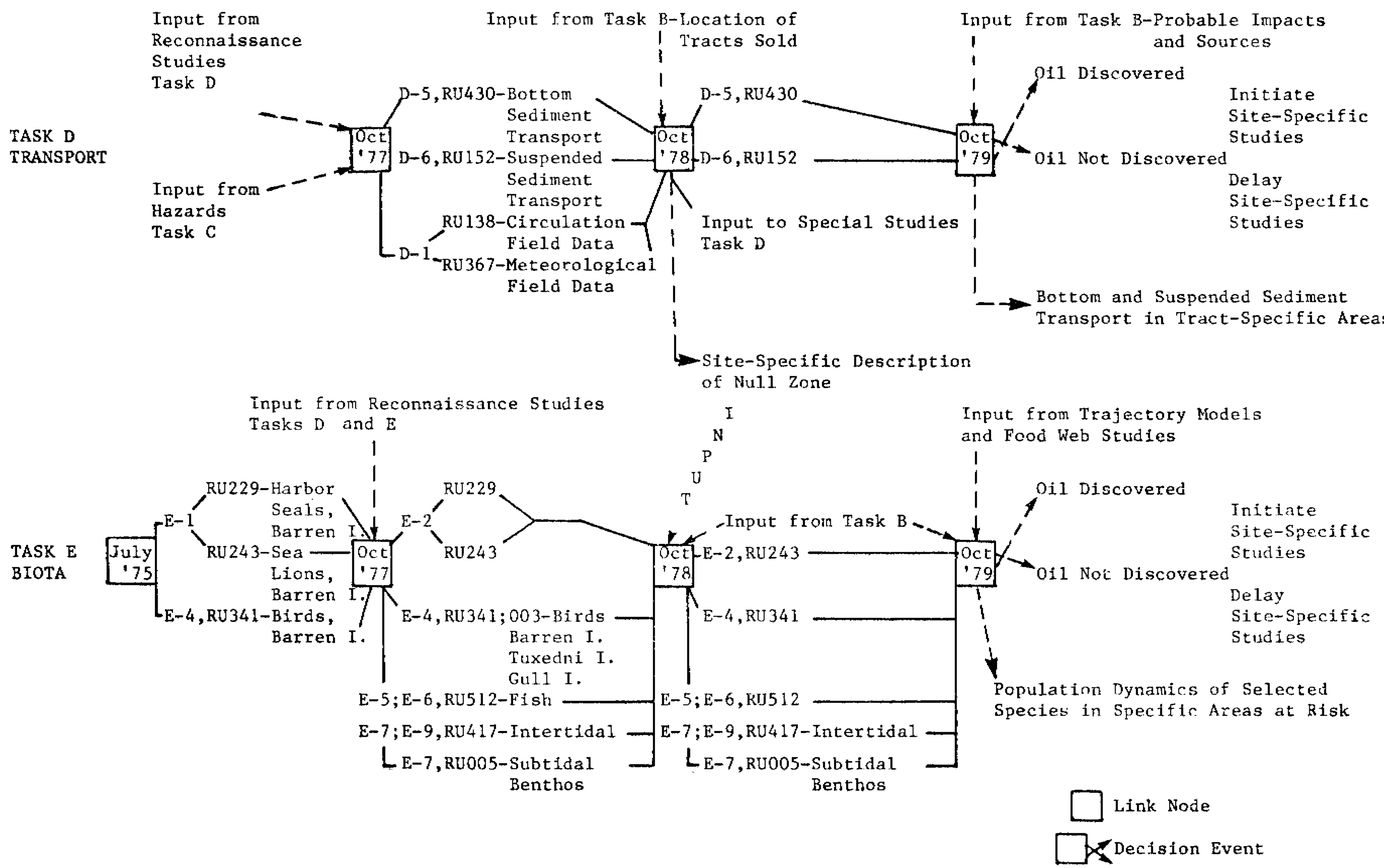


FIGURE 3-11. Identification of Populations and Ecological Systems at Risk - Site-Specific Studies.

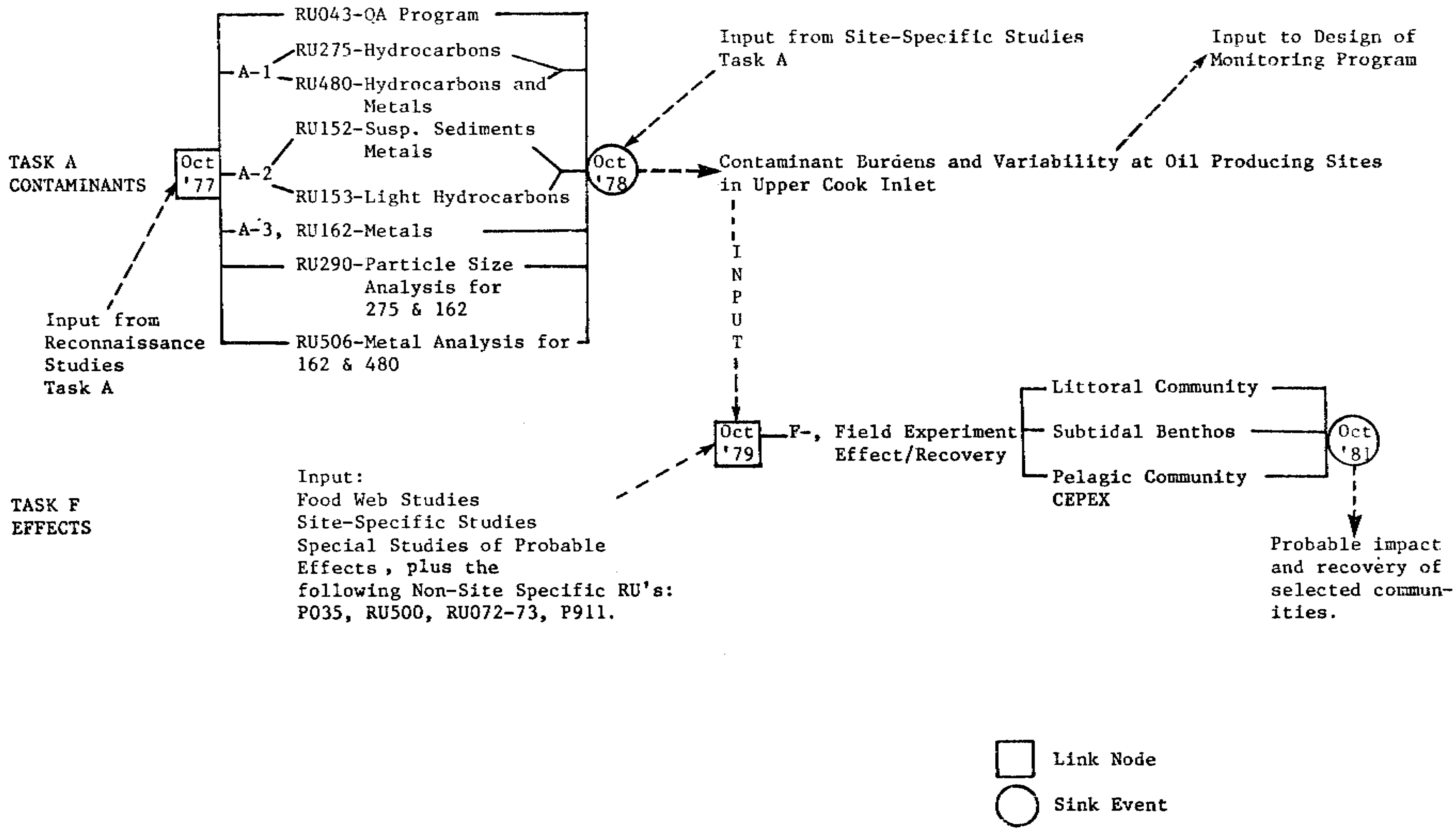


FIGURE 3-12. Determination of the Probable Impact of OCS Development - Studies Specific to Lower Cook Inlet (Site-Specific Studies).

has been conducting a historical review of non-salmonid pelagic fish, and RU 174 has been reviewing information on demersal fish. Both will be completed by October 1978. RU 353, which was completed in October 1977, reviewed the status of knowledge of salmonids for the Gulf of Alaska. A literature review of the food and feeding relationships of fish by RU 284 will be completed in October 1978.

An additional literature review is proposed for FY 79. The objectives of this research unit (subtask E-1, P 920) are to compile a bibliography of information sources and available data and to prepare species accounts for major forage fish species in Alaskan waters. Such information will provide important input to the food web studies taking place in Lower Cook Inlet.

Field investigations of the seasonal distribution and abundance of pelagic and demersal fish in Lower Cook Inlet were initiated in March 1976 by Research Units 424 (ichthyoplankton and fish eggs), 490 (zooplankton), and 512 (adult and juvenile fish). The reconnaissance mode of research ended in October 1977, and the more site-specific studies of Kamishak and Kachemak Bays began for RU's 424 and 512. Research Unit 490 was completed in October 1977.

The emphasis on Kachemak and Kamishak Bays has resulted from reconnaissance information on biota and circulation patterns which suggest the importance of these bays from the standpoint of production of fisheries and other biota and also their probable risk of impact from OCS activities.

The studies include the distribution of light hydrocarbons in the water column (subtask A-2, RU 153), concentration, distribution, and variability of hydrocarbon components (subtask A-1, RU 275, RU 480), the toxic metals (subtask A-3, RU 162), and the comparison of levels of light hydrocarbons in the water column. The measure of levels of hydrocarbons associated with suspended material (subtask A-1, RU 152) will provide some guidance in evaluating the role of suspended material in the transport of oil contaminants.

Service functions are provided to the other research units in Task A by RU 43, a quality assurance program, RU 290, which conducts particle size analysis for RU's 275 and 162, and RU 506, which conducts metal analysis for RU 162.

It is anticipated that these research units, with the exception of RU's 162 and 506, will continue until October 1979 as part of the site-specific studies. The continuation of a chemistry program in Lower Cook Inlet after October 1979 will depend to a great extent on whether oil is discovered or not. If oil is discovered, additional chemical studies might be required for drilling areas in order to establish a baseline for monitoring programs. (Figure 3-10).

A site-specific study of the circulation patterns in the Lower Cook Inlet between Kamishak and Kachemak Bays was initiated in October 1977. Available information for this area indicated two possibilities--either an area of maximum energy of dispersal or an area of low energy of dispersal ("Null" Zone). Since clarification of this controversy was required before an assessment could be made as to the area's potential for accumulating oil related contaminents, seven research units were initiated. These research units include RU 138 (subtask D-1) which characterizes circulation patterns in the area by means of direct field measurements of currents, pressure, surface transport, sea levels, temperature, and determines the relationship between circulation patterns and weather conditions (subtask D-1, RU 367), wind speed and direction, air temperature, relative humidity and barometric pressure.

Site specific studies of the direction and rate of bottom sediment movement including periods of high energy events, such as storm and tides is being conducted by RU 430 (subtask D-5). Sites have been selected based on the need for clarifying the "Null Zone" in Lower Cook Inlet as well as based on those identified in the Hazards research (Task C) as being areas of potential high sediment transport. These areas are also being described relative to the rates of vertical flux of suspended sediments and correlation of high frequency fluctuations with temporal fluctuations in concentration (subtask D-6, RU 152).

Besides clarifying the "Null Zone", the site-specific transport studies will provide important input to efforts to adapt available transport models to Lower Cook Inlet.

Based on information relative to the probable exploratory drilling schedule and tracts to be drilled first (Task B), additional tract specific studies of bottom sediment and suspended sediment transport might be required (Figure 3-11). Such site-specific studies after October 1979 will depend on oil discovery.

Site-specific studies of biota in Lower Cook Inlet (Figure 3-12) have been based so far on preliminary identification of areas at risk (general circulation information, Task D) and also identification of areas containing important habitats for selected biota (Task E). Research Unit 341 was initiated in July 1975. A portion of that research addressed the timing, use, feeding habits, reproductive success, breeding chronology and phenology of bird colonies on the Barren Islands. This is continuing through FY 78. Additional site-specific studies, similar to those in the Barren Islands, were initiated in October 1977 at Chisik Island (subtask E-4, RU 341). Investigations of small bird colonies were begun in Kachemak and Kamishak Bays in October 1977 (subtask E-3, RU 003). These investigations describe the phenology of events from time of arrival by birds until time of departure. They also include a description of habitat utilization during the breeding season. The site-specific colony studies of RU 341 will continue to October 1979. FY 80 will then be devoted to final data analysis and synthesis.

Research Unit 229 (subtask E-2) began in July 1975. A portion of the research has involved estimations of population, feeding habits, productivity, and variations in growth and body conditions of the harbor seal. Special emphasis for Lower Cook has involved attempting to identify the relationship of harbor seals in Lower Cook Inlet to Tugidak Island. This RU will be completed in October 1978.

Studies of the growth rates, feeding habits, and population production of Steller sea lions on the Barren Islands began in July 1975 and will continue up to October 1978 (subtask E-2, RU 243). Field work in FY 79 will be restricted to determining the return rates of young sea lions marked in FY 78. The most important objective of RU 243 will be a complete synthesis of all ecological information on the marine mammals in Cook Inlet with emphasis on describing and evaluating the potential for impact by OCS oil and gas exploration, development and production.

Site-specific studies of the benthic communities began early in FY 77. Research Unit 417 (subtasks E-7 and E-9) has been documenting the seasonal patterns of macrophyte growth rates, production, and standing biomass in selected areas of Lower Cook Inlet. Also, the distribution and relative abundance of associated benthic fauna, food webs, and the distribution and relative abundance of benthic fauna in other types of nearshore communities have been documented. Specific sites of investigation are at Deep Creek, Homer Spit, Gull Island, Seldovia, and Jakolof Bay on the east side of Cook Inlet, and Chinitna Bay, Iniskin Bay, Bruin Bay, Nordyke Island, Douglas River, and offshore reefs between Amakdedori Beach and Augustine Island on the west side of Cook Inlet.

. Research Unit 005 began site-specific studies of the distribution, relative abundance, position in the food web and reproductive biology of snow crabs off Cape Douglas and the distribution patterns, age class structure, growth, and mortality of selected clam species in selected areas in October 1977. The Cape Douglas area has been identified as an important snow crab habitat. In addition to the Cape Douglas area, the areas selected for detailed studies of clam species were identified as important habitats based on reconnaissance studies undertaken by RU 005 (subtask E-7) in the years prior to FY 78.

The determination of seasonal composition of principal life stages of nearshore pelagic and demersal fishes in Kamishak Bay began in October 1976 (RU 512). Fish sampling on a monthly basis includes scuba surveys. All catches are identified by species, enumerated by age class, weighed, and stomach analysis conducted for determining prey items.

RU 425 (subtask F-11) was initiated in FY 78 to define the seasonal composition and origin of organic detrital material in pelagic areas and to determine short- and long-term vertical fluxes of organic particles to the offshore benthic communities. This unit is providing quantitative information to be used by RU 005 in describing the food web of offshore benthic communities.

RU 424 (subtasks E-6, E-10 and E-13) is describing the time of appearance and quantitative distribution of meroplankton with emphasis on ichthyoplankton, fish eggs, and the planktonic larval stages of shrimp and crabs. This information is needed by RU's 005, 417, and 512 for defining the seasonality and productivity of the benthic and fish components of specific sites.

For the great majority of the biological investigators conducting both reconnaissance and site-specific studies in Lower Cook Inlet, FY 79 will be a year of final data analysis, interpretation, synthesis, and projections as to the probable impacts resulting from OCS oil and gas exploration, development and production. Each of the research units listed below will be in this "synthesis" mode of research and will be involved in identifying the geographical location and biological characteristics of habitats at risk, defining the trophic relationships of the major components occupying these habitats, and making preliminary projections as to the probable sensitivity of these components and their productifity: RU 003 - migrating and other marine birds in cooperation with RU 341; RU 005 - benthos of offshore areas; RU 243 - marine mammals; RU 417 - littoral and shallow subtidal habitats; RU 424 - plankton including larval stages of fish, shellfish, and benthos; RU 512 - demersal and pelagic fish with special emphasis on commercial, potentially commercial, and sport fishing species.

These syntheses will use all available information on Cook Inlet (both OCSEAP and non-OCSEAP). In order to identify more accurately the habitats at risk, information as to exploratory drilling sites will be used as well as the BLM Development Scenario, the results of trajectory analysis, and the results of Hayes' identification of vulnerable habitats in Lower Cook Inlet (Hayes, 1977).

The synthesis of the biological information in FY 79 is very important since it is required in order to provide information for the planning and initiation of studies on the probable impact of OCS activities on habitats at risk. These process-oriented ecological studies are planned for FY 80 (See the section of "Probable Impact of OCS Activities").

Special Studies:

Special Studies include research efforts designed to develop analytical techniques, such as predictive models, and special field or laboratory studies of important ecological processes.

Transport model development (Task D) was initiated early in the research program. The resulting wind-generated and tidal-generated transport models, although not specifically developed for Lower Cook Inlet, can be modified for the lease area using reconnaissance data and some site-specific data collected previously. Additional field verification of the models will be necessary for the lease area.

The models which have been developed to date do not take into consideration the dispersion of spilled oil and decrease in concentration of oil components due to weathering. In order to improve the resolution of the model, weathering algorithms will need to be developed.

Transport models should prove to be very useful in providing a method for more clearly delimiting those areas at greatest risk of impact from oil spills originating at various specific points within the lease area. The resolution should be much finer than obtained from reconnaissance studies alone. Therefore, the selection of locations for proabable impact site-specific studies on the structure and functioning of biological communities will be aided by the use of transport models. In addition, the identification of the habitats at risk, with relation to specific drilling sites and the prediction of direction and rates of transport of possible oil spills, will provide some information necessary to establish containment and clean-up contingency plans and evaluate tanker routes.

Additional special studies have been initiated to determine the adsorption/ desorption rates of Cook Inlet crude oil with Cook Inlet suspended material (Task A). The results of these laboratory experiments will provide some basis for evaluating the importance of suspended material in the transport of oil contaminants.

Special laboratory studies of the absorption/desorption rates of Cook Inlet crude oil relative to Cook Inlet suspended material were initiated in October 1976 (subtask A-1, RU 275; subtask A-2, RU 152) and will continue until October 1978 (Figure 3-13). Defining suspended materials as a transport mechanism will have important input to the design of site-specific transport studies as well as to Special Studies of contaminant uptake by biota (see section on determination of the probable impact of OCS development).

Dames and Moore (1977) calculated a series of oil spill trajectories by means of a computer model for Lower Cook Inlet (Figure 3-13). By referring to selected points within the lease area, various areas were identified as being at risk from oil spills under the wind and current conditions tested. However, these calculations were based on incomplete data. Currents and weather data collected by transport studies in FY 78 will provide an updated data base to be used for additional trajectory analysis.

Trajectory simulations from selected hypothetical spill sites will be conducted (subtask D-2, P 093) under selected wind and current condition data resulting from previous circulation studies in Lower Cook Inlet. Additional surface and nearsurface current data will be provided by RU 048 and P 910 (subtask D-2). RU 048 is a research effort (FY 77) to apply radar techniques to surface current measurements (Doppler effect). Radar surface current measurements will be made in FY 79 and compared to surface current data obtained simultaneously by drogues (subtask D-2, P 910).

The hypothetical spill sites that will be used in the trajectory modeling will include, but will not be restricted to, existing exploratory drilling sites. It is felt that sufficient data on surface currents will be obtained in FY 79, but the modeling effort itself might continue at least through FY 80.

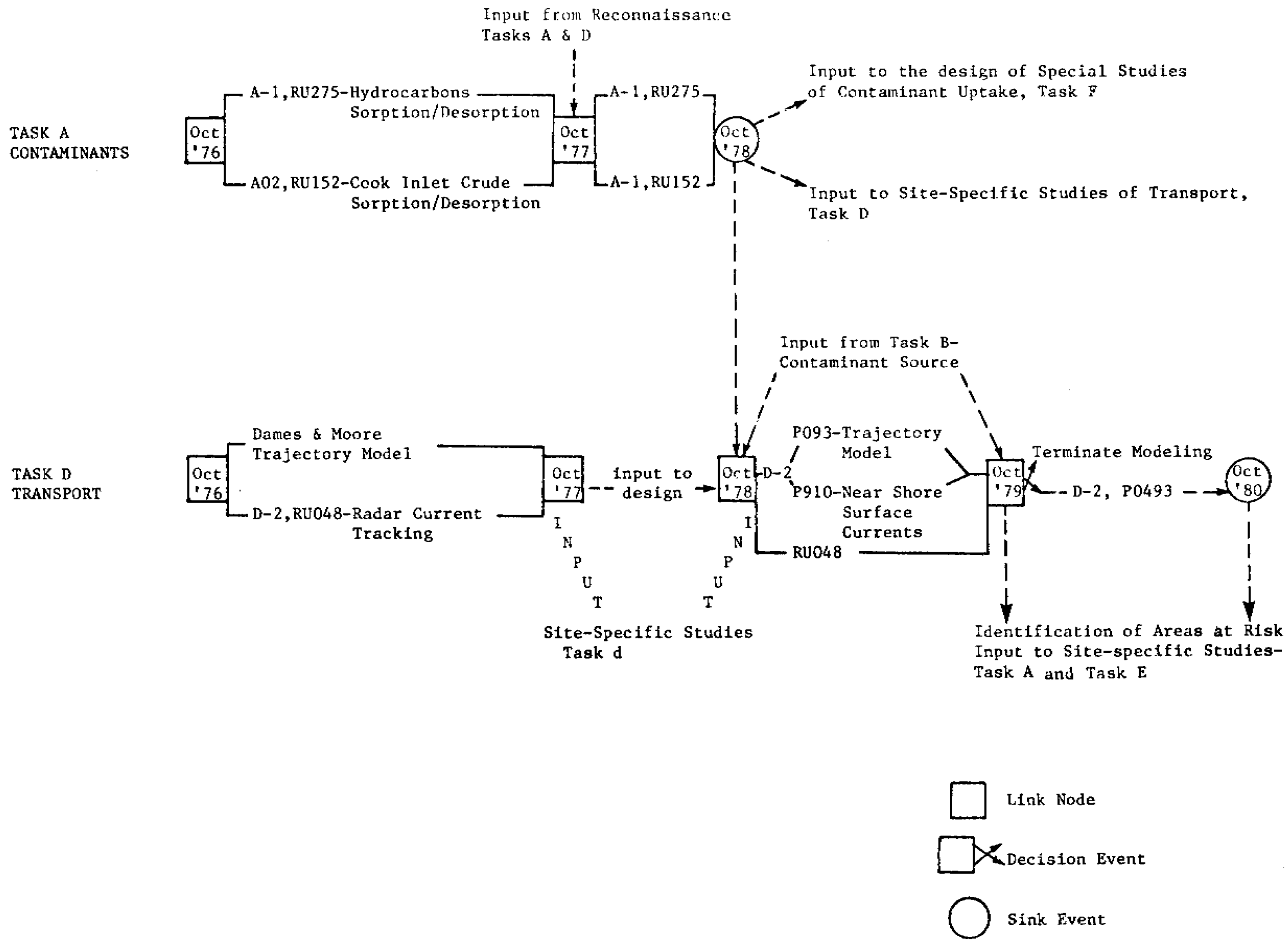


FIGURE 3-13. Identification of Populations and Ecological Systems at Risk - Special Studies.

Summary

The identification of biological populations and ecological systems that are at risk from oil exploration, development, and production is the necessary first step in environmental assessment. It is also necessary in order to make informed decisions about tracts which should not be leased due to environmental considerations, to develop containment and clean-up contingency plans in case a spill does occur, to evaluate transport routes, to develop stipulations on platform placement, design, and operation, and to make recommendations as to tanker terminal design and location.

The first level approach is by general area surveys or reconnaissance of contaminants, populations and communities, and transport patterns. Subsequent and simultaneous site-studies and special laboratory, modeling, and field studies of various ecological processes have the principal objective of improving the precision, accuracy, and resolution of this risk identification. This latter approach is discussed in the following section.

Probable Impact of OCS Activities (Figure 3-14):

This research in Lower Cook Inlet has the primary objective of determining the probable impact of oil exploration, development and production on those biological populations and ecological systems identified as being at risk. The identification of populations and systems at risk through use of field surveys and transport modeling is relatively straightforward.

However, the estimation of probable impact on these populations and systems is not straightforward and does require some degree of subjective analysis and evaluation. The estimation of probable impact is limited by the state-of-the-art and the tools that are available to accomplish this objective. Principal tools include laboratory experiments and bioassay, experimental field studies, and ecological modeling studies.

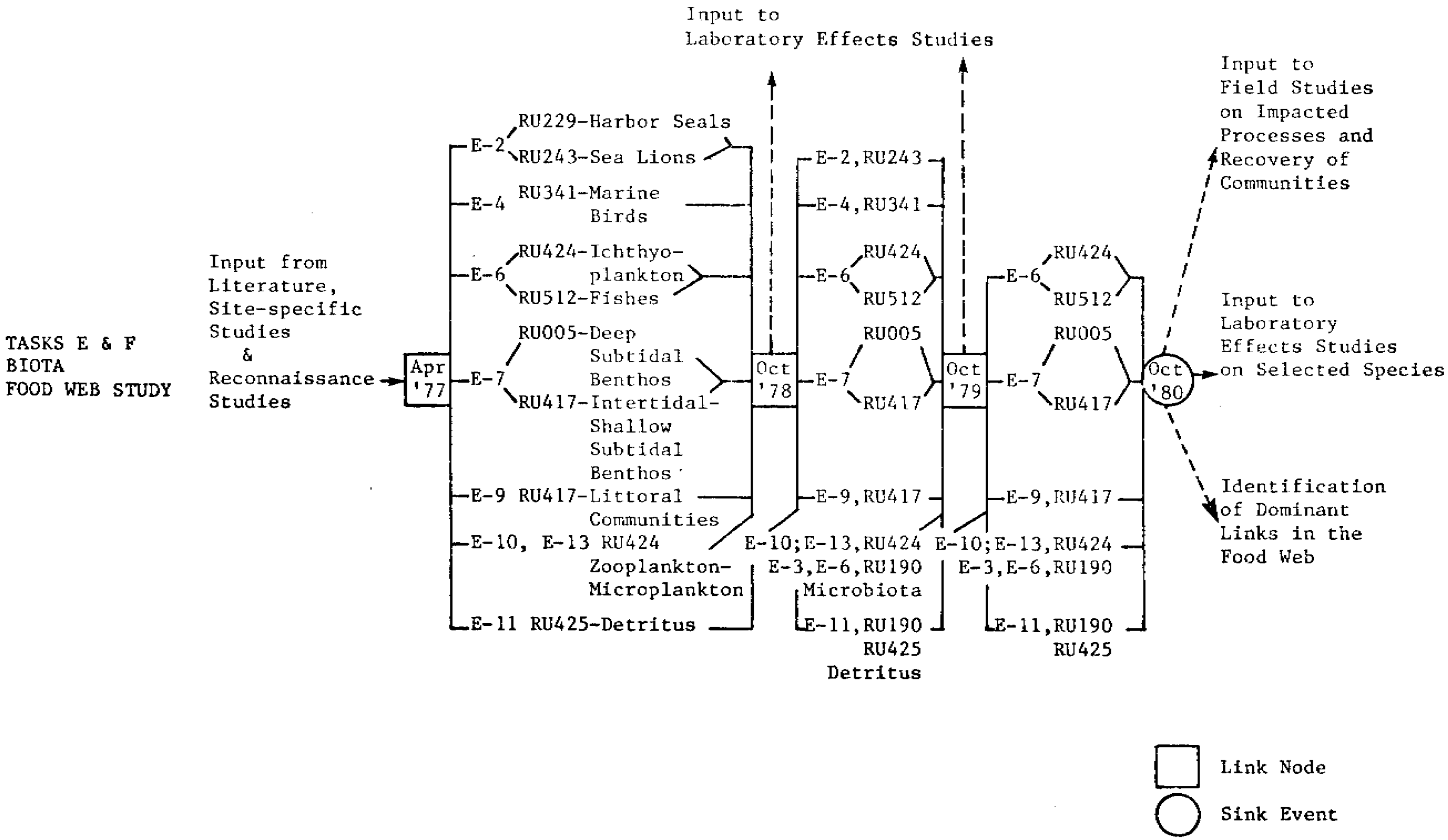


FIGURE 3-14. Identification of Populations and Ecological Systems at Risk - Special Studies.

Laboratory experiments, laboratory bioassays, and studies of ecological processes under controlled laboratory conditions provide a means of generating precise data capable of rigorous statistical analysis. The principal limitation of such data is the uncertainty involved in extrapolating results obtained in the laboratory to actual conditions in the field with its associated, almost infinite, range of variables. The range of variables and interactions present in the field cannot, within today's state-of-the-art, be addressed adequately in laboratory experimentation.

Experimental field studies are those which involve actual manipulation of variables in selected sites and the measurement of the response of biota and/or critical ecological processes. An example might be the selection of a small field site of a quarter of an acre in the intertidal zone, the establishment of a series of permanent sampling plots in the site, the addition of specific and varying amounts of oil to each plot, and the measurement of community response to these impacts, with comparison to unperturbed control sites. Although such an experiment does lend itself to better extrapolation to the field, problems do result in the analysis and the evaluation due to the lack of control over variables and the difficulty in interpreting community responses to environment variables other than those related to the imposed impact.

Ecological models have shown promise as tools for predicting the response of biota to changes in specific and critical variables of the environment. For example, the "Bird Model" which is being developed in RU 108 appears to hold promise for estimating the population size and feeding range of birds in specific marine colonies under different environmental conditions. Ecological modeling is, however, in its infancy. Within the foreseeable future, it is very doubtful that ecological modeling will replace other approaches for estimating probable impact.

The estimation of the probable impact of oil exploration, development, and production will require the application of all of the techniques described above. All techniques have limitations affecting their objectivity. These limitations must be kept in mind during program planning.

Some of the research addressing the problem of determining probable impact is specific to Lower Cook Inlet. Other research not directly applicable to Lower Cook Inlet is being performed as Non-Site-Specific, Effects Studies. The research resulting from such studies (described in the Non-Site-Specific TDP) will, however, add to a general base of knowledge which will aid in the interpretation of Lower Cook Inlet research. It will also provide some basis for the evaluation of the probable effects of OCS activities on populations and ecological processes in Lower Cook Inlet.

Site-Specific Studies

Site-specific studies were initiated in October 1977 to define the variability of concentration of oil-related contaminants in areas around platforms where oil has been produced for the last 10 years (Upper Cook Inlet, Trading Bay). Such data will aid in identifying those variables to be monitored in an oil-producing area, and will also provide some basis for predicting the probable impact of chronic contamination from offshore drilling and production activities.

The research units conducting these studies are RU 275 and RU 480 which measure the levels of hydrocarbons in the water column and sediments, RU 153 which measures the levels of light hydrocarbons in the water, RU 152 which measures hydrocarbons associated with suspended materials, and RU 162 which documents the levels of metals in water column and sediment.

Besides providing some information for developing predictions, the studies in Upper Cook Inlet will provide an area of reference which might be used in analyzing and evaluating the data gathered in any monitoring program established at producing platform locations.

Additional interdisciplinary investigations of the impacts of existing OCS oil and gas-related activities are proposed for FY 80 through 82. These investigation will function as a single coordinated project and will be oriented toward defining the levels of contaminants and evaluating the community structure, function, and degree of impact studies. If suspended material is capable of adsorbing and transporting oil, it must also be considered a possible uptake pathway. These adsorption/desorption experiments will be completed by October 1978.

Special studies of important ecological processes and the impact of oil contamination on these processes were initiated in October 1976 and are scheduled to be completed by October 1979. Research Unit 190 (subtask E-16) is determining the levels of microbial activity, respiration ratios, and the rates of nitrogen fixation in sediments and the guts of selected invertebrates. Research Unit 029 (subtask E-15) is working closely with RU 190 to provide concomitant data on rates of hydrocarbon degradation in the sediments. In October 1977, RU 190 began laboratory studies on the effect of crude oil on the nitrogen fixation process (subtask F-3). This work will continue to October 1979.

The information developed by RU's 029 and 190 will aid in defining the potential for petroleum degradation in specific habitats and the likelihood of impact, and will provide an evaluation of the potential for petroleum contamination to alter nitrogen fixation processes.

Research Unit 194 (subtask F-7) began surveys in Lower Cook Inlet in October 1977 to determine the occurrence of pathological conditions and agents in beached mammal carcasses. Such data is related to time, location, species, sex, and age and will develop information with which to evaluate future mortality and/or morbidity relative to OCS activities.

The following research units describe investigation that are not specific to Lower Cook Inlet. Due to their broad-based application, such as investigation of processes that occur in all lease areas or effects studies that address species that occur in Lower Cook Inlet, they do provide information that can be used to evaluate the probability of impact in Lower Cook Inlet. The description of each research unit is limited here to a simple statement relative to its applicability to Lower Cook Inlet. Detailed description of each is presented in the "Non-Site-Specific TDP."

Applicable bioassay work is being performed by RU 389 (subtask F-5) and RU 072-073 (subtask F-5). Research Unit 389 is studying the transport, associated with existing onshore facilities, such as at Nikiski and Drift River. This coordinated project will be entitled, "Evaluation of Community Structure and Function, and Contaminant Levels at Existing shore Facilities."

Two non-site-specific research units, proposed for FY 79, should provide valuable guidance as to the approach and technique for such experimental field studies. These are P 035 and P 911. P 035 will employ containers in the field to determine the rate and extent of weathering of Alaskan crudes under different environmental conditions. In addition, P 035 will also consider the effects of oil on planktonic organisms. The technique could prove to be appropriate for studying the impact of spilled oil on pelagic communities and subtidal benthos in Lower Cook Inlet.

Since the community most vulnerable to oil spills is the littoral, it is the one which should receive the primary emphasis in any experimental field study. The design of experimental, controlled spills in the littoral should be provided with valuable guidance from P 911, which is proposed to develop design criteria for experimental petroleum spills. This design will include past exposure measurements to demonstrate rate and extent of recovery.

Valuable input to the design of experimental field studies will also be provided by RU's 072-73 and RU 500 which are described in the following section.

Special Studies (Figure 3-15):

Special studies designed to provide information for the determination of the probable impact of OCS activities were initiated in October 1976. Both RU 275 and RU 152 have been determining the capacity for, and rate of, Cook Inlet suspended materials to adsorb and desorb petroleum hydrocarbons and Cook Inlet crude oil. The results of these studies will provide some indication of the importance of suspended material in the transport of oil in Cook Inlet. The results should also provide guidance for the design of experimental contaminant uptake

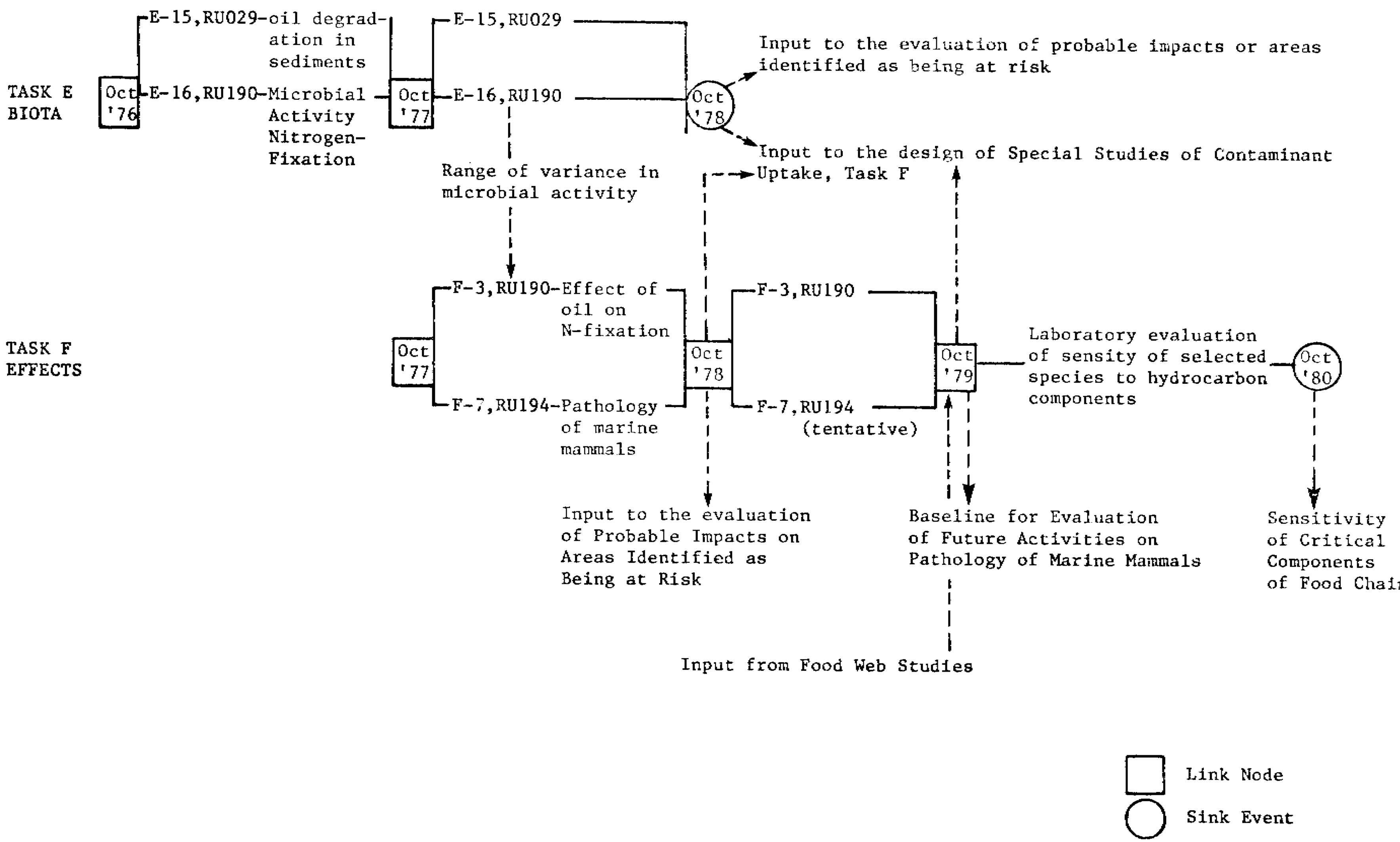


FIGURE 3-15. Determination of the Probable Impact of OCS Development - Studies Specific to Lower Cook Inlet (Special Studies).

retention, and effects of toxic petroleum hydrocarbons in experimental food chains. The information resulting from this RU could provide a basis for evaluating the potential for magnification in food chains and could provide a basis for comparing the results of the food web study to the effects of potential OCS activities on dominant trophic links. Research Unit 389 began in late FY 76.

Additional information for evaluating the probable impacts of OCS activities on populations at risk will be provided by RU 072-73, which began in mid-FY 75. This laboratory study is attempting to determine the significance of low-level contaminant exposure on the reproduction ability of representative marine organisms.

The evaluation of probable impacts will also be aided by information from RU 071 (subtasks F-3, F-6) on the effects of oiling on temperature regulation and physiology of sea otters (mid-FY 75-FY 79), and RU 423 (subtask F-2), investigating the influence of petroleum on egg formation and embryonic development in seabirds (mid-FY 77-FY 79). The former will provide evaluation of the probable effect of oil spills on sea otter survival, and the latter will provide an evaluation of the effects of such events on seabird reproductive capacity.

Valuable information for the design of monitoring programs and the selection of critical variables to monitor is provided by RU 500 (subtasks F-2, F-5). This RU began in FY 77 and is tentatively scheduled to end in FY 80. It is attempting to determine those components of petroleum that are potentially most hazardous and possibly good analytical indicators of petroleum impact by weathered and fresh crude oil.

3.3.2 Fy 79 Rationale and Approach

The rationale and research approach for the FY 79 program in Lower Cook Inlet was presented in 3.1, Research Approach Section, within the context of the past research and future projected research efforts. In summary, the research in Lower Cook Inlet has progressed from the reconnaissance phase of research to site-specific investigation of habitats, geographical areas, and ecological processes identified as being at risk from OCS activities and possible associated oil spills.

The second lease sale, scheduled for March 1981, will occur in the same area as that of the first lease sale, recently past (October 1977). Reconnaissance studies will, therefore, probably not be required in the future for the second sale.

Based on present projections, environmental research in Lower Cook in FY 80-82 will emphasize experimental field studies of oil contaminant impacts and recovery of selected communities, laboratory effects of contaminants using selected species, experimental studies of important physical, chemical, and biological processes affected by OCS activities, and the environmental evaluation of biological communities and contaminant levels at existing gas and petroleum shorebased facilities. Hazards research during this period will include continued studies of submarine volcanic flows, site-specific studies of sediment scour and deposition and bedform movement, coastal hazards relative to erosion and deposition, and contined monitoring of volcanic and seismic activity by means of the existing seismic network and on-bottom seismometers.

3.4 SELECTED PROJECTS

The bar chart in Figure 3-16 presents FY 79 research units in Lower Cook Inlet and their proposed duration.

3.4.1 Hazards to Oil Exploration, Development, and Production (Task C)

RU 251 (subtask C-1) will continue its regional monitoring of seismic events related to volcanic activity as well as its specific monitoring of the volcanic activity of Augustine Island and Mt. Redoubt.

RU 327 will involve specific delineations of existing and potential slumps and other unstable sediment masses with emphasis on defining and describing the most important factors involved in sedimentation processes (subtask C-3). This RU will also describe areas of severe erosion, deposition, and the directions and rates of movement of large scale bedforms (subtask C-4); as well as the distribution, origins, characteristics of gas-charged sediments and their potential hazards (subtask C-8).

	FY78	FY79	FY80	FY81
HAZARDS TO DEVELOPMENT				
Reconnaissance Studies	Volcanism, Seismiety, Faulting, Sediment Instability RU's 251, 327	Volcanism, Seismiety RU 251	Volcanism, Seismiety RU 251	
Site-specific Studies	Volcanism, Seismiety RU 251	Volcanism, Seismiety Sediment Instability RUs 251, 327	Volcanism, Seismiety Sediment Instability RU's 251, 327	Indicate if Oil Discovered
POPULATIONS AND ECOSYSTEMS AT RISK				
Reconnaissance Studies	Mesoscale Circulation Various Biota RU's 267, 289, 229, 243, 003, 337, 338, 339, 340, 343, 029, 190, 064, 174, 284, 005, 424	Mesoscale Circulation Forage Fish, Lit., Rev. RU 289, P 420		
Site-specific Studies	Contaminants, Transport Various Biota RU's 275, 480, 152, 153, 506, 162, 290, 043, 138, 367, 229, 243, 341, 512, 417, 005	Contaminants, Transport Various Biota RU's 275, 480, 152, 153, 290, 043, 430, 243, 341, 512, 417, 005	Indicate if Oil Discovered	
Special Studies	Contaminants, Food Web, Population Dynamics	Transport, Food Web Population Dynamics	Transport (Tentative) Food Web, Pop. Dynamics	
IMPACTS OF DEVELOPMENT ON BIOTA				
Site-specific Studies	Contaminants RU's 043, 275, 480, 152, 153, 162, 190, 506		Field Experiments of Impacts, Processes of Feeding and Recovery of Selected Communities at Risk	
Special Studies	Marine Mammal Pathology Microbial Activity	Marine Mammal Pathology Microbial Activity	Sensitivity of Critical Food Web Components	

FIGURE 3-16. RESEARCH EMPHASIS DURING THE YEARS FY 78-81.

3.4.2 Biological Populations and Ecological Systems at Risk

Transport (Task D)

RU 289 (subtask D-1) will provide a final report on the mesoscale circulation and surface water mass flows in the entire Gulf of Alaska and provide input to RU 138.

RU 152 (subtask D-6) will involve site-specific studies of suspended sediment transport in conjunction with RU 430. Objective of this RU will include determining the rates of vertical flux in areas of high sedimentation and the correlation of high frequency fluctuations with temporal fluctuations in the concentrations of suspended materials.

RU 430 (subtask D-5) will also involve site-specific studies of bottom sediment transport. The efforts of this RU will be coordinated with both RU 152 and RU 327 (subtask C-4, Hazards) in order to define the role of sediment dynamics in the possible transport of contaminants as well as its capacity to present engineering problems to platform contruction.

P 093 (subtask D-2) will conduct trajectory simulations from selected hypothetical spill sites under selected wind and current conditions. Field data will be based on studies conducted in FY 78 by RU 138 and 367 and FY 79 field data provided by RU 048 and P 910.

RU 367 (subtask D-1) will be conducting a final analysis and report preparation on seasonal meteorology based on the FY 78 field program. This RU will be providing field data for the trajectory simulations (P 093) and input to RU 138.

RU 138 (subtask D-1) will be conducting a final analysis and preparing a final report synthesizing all available information on the circulation in Lower Cook Inlet based on the results of RU's 289, 138, 367, and 048. This RU will be providing the data for the trajectory simulations (P 093).

RU 048 (subtask D-2) will conduct field measurements of surface currents by means of radar, obtaining data verification from drogue studies (P 910), which will be conducted simultaneously, and providing data input to P 093.

Contaminants (Task A)

The chemistry program in Lower Cook Inlet has evolved to the point where individual research units have become one coordinated package of research. The program in FY 79 will involve a characterization of contaminant burdens and variability at specific sites of oil production in upper Cook Inlet and in areas that have been identified as having high natural levels of petroleum contaminants. This characterization will include sediments, water column, and selected benthos and will involve the following RU's:

RU 275 (subtask A-1) - concentration and variability of heavy hydrocarbons in sediments, water column, and biota.

RU 152 (subtask A-1) - levels and variability of hydrocarbons associated with suspended materials.

RU 153 (subtask A-2) comparison of levels of hydrocarbons (high vs. low molecular weight) in specific areas.

Receptors (Task E)

Biological investigations have evolved to a stage requiring site-specific and special studies for FY 80-82. The emphasis in FY 79 will be completion of data analysis and synthesis of all available information on the marine biological populations of Cook Inlet. Such will be a necessary first step in order to select important species, identify critical habitats, and provide input to site-specific, ecological studies which are scheduled to begin in FY 80. The individual RU's for FY 79 are:

RU 243 (subtasks E-1 and E-2) will continue its biological studies of the Steller sea lions at a reduced level as well as continue its survey of the belukha whale. Emphasis in FY 79, however, will be on final report preparation and synthesis of all available information on the marine mammals of Cook Inlet, including food web relationships.

RU 003 (subtask E-3) will involve a final data analysis and production of a final report synthesizing the seasonal distributions and abundance of bird species, documentation of migration routes, staging and stopover areas, habitat dependencies and the identification of critical habitats for waterfowl and marine birds.

RU 341 (subtask E-4) will continue studies of reproductive ecology, breeding phenology, growth and habitat dependencies of populations of marine birds at Chisik Island in Tuxedni Bay colonies. Foraging areas and principal prey studies will be continued for a few selected species.

RU 512 (subtasks E-5 and E-6) will involve completion of field work, laboratory and data analysis, and the production of a final report synthesizing all available information on the seasonal composition and food web relationships of the fisheries of Cook Inlet. Special emphasis will be placed on describing and evaluating the potential for OCS oil and gas exploration, development and production activites to impact commercial, potentially commercial, and sports fisheries.

RU 424 (subtasks E-6, E-10, and E-13) will complete all data analysis and produce a final report which synthesizes all available information on the holoplankton and meroplankton of Cook Inlet. Seasonal distribution and abundance of meroplankton will provide important information on the larval stages of fishes, shellfishes, and benthos which are being studied by RU's 512, 005, and 417.

RU 005 (subtask E-7) will complete all data analysis and produce a final report synthesizing all available informaton on the food web and trophic relationships of offshore communities, emphasizing the commercial shellfish.

RU 417 (subtasks E-7, E-8, and E-17) will complete all data analysis and produce a final synthesis of all information on the food web and trophic relationshps of nearshore and intertidal communities. Additional emphasis will be placed on identifying critical habitats in these areas and identifying those that are at risk from OCS oil and gas exploration, development, and production activities.

RU 029 (subtask E-15) will continue its identification of physiological groups of species as a service to RU 190 and determine hydrocarbon degradation rates on a site-specific basis.

3.4.3 Effects

RU 425 (subtasks F-9 and F-11) will be conducting final data analysis and preparation of the final report on the field study conducted in FY 78. This field study was initiated to define the seasonal composition and origin of organic detrital material in offshore areas of Lower Cook Inlet, to determine the primary productivity, and to determine the short- and long-term vertical fluxes of organic particles to the benthic communities. Such information will provide input to the studies of food webs in these areas being conducted by RU 005.

RU 190 (subtasks F-3, F-9) will use information from RU's 425, 417 and 005 to quantify the levels and variability of microbial activity associated with organic detritus in littoral and shallow subtidal communities, evaluate the role of microbiota in the food web, evaluate the effect of oil on this microbial activity and nitrogen fixation processes, and evaluate the hydrocarbon degradation potential of the microbiota.

3.4.4 Probable Impact of OCS Activities

Research units specific to Lower Cook Inlet which will be addressed in FY 79 are:

RU 190 (subtask F-3) which will be measuring microbial activity and nitrogen fixation at specific sites and evaluating the effect of oil contamination on these processes and

RU 194 (subtask F-7) which will continue to identify pathological conditions and agents in marine populations in relation to time and location, and species, sex, and age of the mammals affected. FY 79 will also include a final data analysis and report preparation for Lower Cook Inlet.

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4.0 RU AND P UNIT DESCRIPTIONS

Research and P Units are shown in the order of the tasks to which they relate. Some RU's are associated with more than one task. The following index will assist in locating particular P and RU descriptions.

4.1 DESCRIPTIONS FOR PROJECTS IN TASK A (CONTAMINANTS):

A-1:	RU 152
	RU 275
	RU 480
A-2:	RU 153

(RU 152) SUSPENDED SEDIMENTS IN ALASKAN OCS AREAS

This research unit addresses subtask A-1 (BLM Study Types 1-Hydrocarbon Baselines and 30-Effluent Dispersion).

Estimated Costs, FY 79:		
	$66,000	Lower Cook Inlet
	42,200	Norton Sound
	$108,200	Total

Schedule: October 1978 - September 1979

Performing Agency:

Agency: NOAA/PMEL
P.I., Degree: Richard Feely, Ph.D.
Title: Oceanographer
Percent time devoted to project and role: 40%; Supervising all laboratory and field phases of the studies.

Background:

Since FY 76, RU 152 has investigated the distribution and dynamics of suspended particulate material (SPM) in several lease areas including southeastern Bering Sea, NEGOA, Kodiak and Lower Cook Inlet. More recently laboratory investigations have demonstrated that SPM from Cook Inlet can "agglutinate" and sink emulsified oil in significant quantities. Thus, SPM may be an important transport and sinking mechanism for spilled oil. Cook Inlet and Norton Sound have high concentrations of SPM and this process may be particularly important if oil is spilled in these areas.

Objectives and Methods:

For FY 79, RU 152 will be involved in site-specific studies in Cook Inlet and in Norton Sound and will continue the investigation of SPM-emulsified oil interactions. Complementary RU's include 29, 190, 275, 480 and 153.

Specific objectives and methods in Lower Cook Inlet are:

1. Conclude laboratory analysis of samples collected in summer 1978.

2. Perform nephelometry and CTD casts at the time series stations to be reoccupied in spring 1979.

3. Deploy sediment traps, in conjunction with the physical oceanography program, to determine sedimentation rates in selected embayments and to provide settled material for

hydrocarbon analysis. This effort will be coordinated with RU 327 for sampling locations and with RU 430 for suspended sediment flux. This effort will be coordinated with RU 327 with regard to sampling locations and with RU 430 with regard to suspended sediment flux.

4. Collect large quantities of SPM for continued laboratory studies of oil/SPM interactions.

Objectives and methods for Norton Sound are:

1. Perform nephelometry and CTD casts at stations occupied in the seep area.

2. Deploy sediment traps to determine sedimentation rates and to provide material for mineralogical and hydrocarbon analysis.

3. Collect large quantities of SPM for laboratory studies of oil/SPM interaction.

4. Determine oil/SPM loadings and relate these results to the mechanisms and subsequent risks for biotic uptake of hydrocarbons from SPM.

Output:

1. Narrative Reports: These periodic reports will present, discuss and interpret the data with particular emphasis on the role of SPM as a hydrocarbon transporter and will relate the data to the mechanisms and risks of biotic uptake of oil associated with SPM. Graphical and tabular data will support the text.

2. Digital Data: Trace metal data from the analysis of FY 78 samples will be reported in format 061.

(RU 153) NATURAL DISTRIBUTION AND DYNAMICS OF LIGHT HYDROCARBONS IN WATER AND SEDIMENTS

This research unit addresses subtask A-2 (BLM Study Type 2-Low Molecular Weight Hydrocarbon Baselines).

Estimated Costs, FY 79:		
	$75,640	Lower Cook Inlet
	46,360	Norton
	$122,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Department: NOAA/PMEL
P.I., Degree: Joel Cline, Ph.D.
Title: Oceanographer
Percent time devoted to project and role: 50%; Supervision of all field and laboratory phases of the studies and coordination of the 1978 Norton Sound seep study expedition.

Background:

The extensive studies of background light hydrocarbons conducted by RU 153 in the Norton Sound in FY 76 discovered a major submarine seep. These studies will be intensified in FY 79 by making site-specific surveys to provide a data base to understand the nature and processes occurring near and around the submarine seeps in the Norton Sound.

The region of interest lies due south of Nome approximately 20 nautical miles and forms an arcuate plume trending NW-SE. The length of the plume is approximately 60 nautical miles, and its width nominally about 10-20 nautical miles. The occurrence of a submarine seep has been qualitatively identified on the basis of unusually high concentrations of saturated C_2 - C_5 hydrocarbons. Ethane concentrations reach a maximum of 10 nP/P in the near-bottom waters, a factor of 20 greater than normal ambient levels. Similarly, elevated concentrations of propane, and iso- and n-butanes were also detected, each of these being approximately a factor of 10 above background. No significant increases in the levels of unsaturated C_2 and C_3 hydrocarbons was observed. Recent evidence indicates the presence of gaseous and gasoline range hydrocarbons in the sediments of the seep area, Kvenvolden (USGS).

Preliminary data on the structural geology of Norton Basin support this interpretation based on the observed chemical and physical characteristics of the plume. Strata truncated by an unconformity dip basinward from the seep locus, velocity pulldowns, and numerous steeply dipping faults in the immediate vicinity of the seep provide corroborating evidence for gas or petroleum-charged sediments and strata with favorable avenues for migration of mobile hydrocarbons to the sea floor.

These factors, taken in concert with the sedimentological regime, a recent increase of basin depth estimates, and the highly localized origin of the hydrocarbons, strongly suggest a petrogenic rather than a recent biogenic origin for these gases.

In FY 78, seasonal and short-term variability of light hydrocarbons in the water column were determined at two locations in Lower Cook Inlet. Kachemak Bay, an area of high biological productivity, and Redoubt Bay, possibly impacted by oil production activities in upper Cook Inlet were selected for study. These stations will be reoccupied in spring of 1979 to obtain more information on seasonal variability and degree of parameter correlation.

Objectives:

For FY 79 RU 153 will focus on site-specific topics in two lease areas. Cline will participate in an interdisciplinary cruise to Norton Sound in the summer of 1979. The overall objectives of the cruise are as follows:

1. To determine background levels of light hydrocarbons and to assess the compositional character of the seep and delineate its range of impact on the sediments and waters of Norton Sound. A gas probe will be used to sample gases in interstitial waters. This data will be compared to data collected by USGS from samples extruded from sediment cores.

2. To evaluate plume dimensions and trajectory, through appropriate hydrographic observations.

3. To investigate the role of suspended matter in the transport and remobilization of petroleum hydrocarbons from the region of the seep, through laboratory studies of oil/SPM interaction.

4. To investigate the usefulness of the low molecular weight aromatics as indigenous tracers of natural petroleum seeps and to assess their usefulness to the documentation of such anthropogenic sources as surface and subsurface injections.

Complementary investigations will be conducted by RU's 152, 480, 29, 190 and P 902.

In Lower Cook Inlet, RU 153 will continue to evaluate light hydrocarbon variability as a function of biological productivity and petroleum production activities as well as heavy hydrocarbon contents of suspended particulate matter. This will be a continuation of FY 78 work and will include continued evaluation of the light aromatic hydrocarbons as tracers for petroleum input. Complementary investigations will be conducted by RU's 152, 275, 480, 29 and 190.

Methods:

RU 153 will deal primarily with analysis of gaseous and gasoline range hydrocarbons in the water column and interstitial water. Sorption-desorption-g.c. techniques will be used. Gasoline range aromatics as well as aliphatics will be determined. Techniques for heavy hydrocarbon analysis will be taken from RU 557. RU 153 will participate in the hydrocarbon intercalibration program.

Output:

1. Narrative Reports: Data will be presented, interpreted and discussed in light of the RU objectives and will include graphs, charts, tables and chromatograms to support the text.

   Data on oil/SPM interaction will be discussed in relation to the mechanisms and risks of biotic uptake of oil associated with SPM.

2. Digital Data: Light hydrocarbon data will be reported in format 043, and heavy hydrocarbon data in format 044.

(RU 275) PETROLEUM CONTAMINANTS: DISTRIBUTION AND DYNAMICS IN THE ALASKAN OCS AREAS WITH EMPHASIS ON WATER AND BIOTA MATRICES

This research unit addresses subtask A-1 (BLM Study Type 1-Hydrocarbon Baseline).

Estimated Costs, FY 79: $40,000 Lower Cook

Schedule: October 1978 - September 1979

Performing Agency:

University; University of Alaska
P.I., Degree: David Shaw, Ph.D.
Title: Associate Professor of Marine Science
Percent time devoted to project and role: 10%; Supervises all field and laboratory phases of the studies, as well as data and report submission.

Background:

RU 275 has been heavily involved in reconnaissance studies of heavy hydrocarbons in water, suspended material, biota and sediments from several lease areas. This work began in FY 75 and was concluded in FY 78. With few exceptions the Alaskan OCS was determined to be pristine with regard to heavy hydrocarbons. Also in FY 78, time-series variability of hydrocarbons in the water column was investigated at two sites in Lower Cook Inlet.

Objectives:

RU 275 will focus on site-specific investigations in Lower Cook Inlet in FY 79. Field sampling will be designed to accomplish the following objectives: 1) To assess the temporal variability of heavy aliphatic and aromatic hydrocarbons dissolved in the water column, associated with filterable suspended matter and with zooplankton at the two sites studied in FY 78 to determine seasonal variability; and 2) to investigate the uptake of heavy hydrocarbons (aliphatic and aromatic) by zooplankton from the water column of upper Cook Inlet in the vicinity of active production platforms. Complementary investigations will be conducted by RU's 480, 152, 153, 029, 190, 557, 417 and 425.

Methods:

Methodology will be identical with that currently in use by RU 275. This includes solvent extraction of heavy hydrocarbons from environmental samples, fractionation of the hydrocarbons by column or thin-layer chromatography and analysis by g.c. and g.c./m.s. Intra-laboratory separation and recovery efficiency will be determined using a synthetic hydrocarbon mixture and precision and interlaboratory comparability will be determined by analysis of a reference sediment.

Output:

1. Narrative Reports: These periodic reports will discuss the data in light of the stated objectives and will include graphical and tabular data to support the text.

2. Digital Data: Heavy hydrocarbon data will be reported in Format 044.

3. Visual Data: Representative chromatograms, mass spectra and charts of hydrocarbon distribution will be included in the narrative reports. Copies of all chromatograms and spectra will be archived by the PI.

(RU 480) DISTRIBUTION AND DYNAMICS OF PETROLEUM COMPONENTS IN SEDIMENTS OF THE ALASKA OCS AREAS

This research unit addresses subtask A-1 (BLM Study Type 1-Hydrocarbon Baselines.

Estimated Costs, FY 79:		
	$39,312	Lower Cook Inlet
	36,288	Norton Sound
	$75,600	Total

Schedule: October 1978 - September 1979

Performing Agency:

University; University of California at Los Angeles
P.I., Degree: I. Kaplan, Ph.D.
Title: Professor of Geology
Percent time devoted to project and role: 10%; Planning and supervision of all field and laboratory phases of the studies, as well as data and report submission.

Background:

Sediments are often hypothesized to be the major sink for spilled petroleum. This conclusion seems particularly valid for those areas with a high suspended sediment load. Recent results from Feely (RU 152) and Cline (RU 153) have demonstrated high suspended sediment loads can "sink" mechanically emulsified oil. The usually high suspended sediment loads in Lower Cook Inlet and in Norton Sound argue in favor of detailed analysis of hydrocarbons in the benthic sediments of these areas. RU 480 began investigations of sediment heavy hydrocarbons in FY 76 and have completed analysis of sediments from Cook Inlet, Kodiak, St. George, Norton Sound and the Beaufort lease areas. Analytical difficulties in FY 77 severely limited the amount of information generated. These difficulties have been resolved and analysis of all backlogged samples will be completed in FY 78.

Objectives:

For FY 79, RU 480 will focus on site-specific topics in two lease areas, Lower Cook Inlet and Norton Sound. The Lower Cook Inlet sampling program will be designed to address the potential sedimentary impact of petroleum released during exploration and production activities. The three major objectives are: 1) determine the heavy hydrocarbon content of sediments which may have received petroleum input from production activity in upper Cook Inlet; 2) determine the heavy hydrocarbon content of sediments which may have been impacted by exploratory drillings in Lower Cook Inlet with complementary investigations conducted by RU's 29, 190, 275, 152, 153 and 557; and 3) investigate the process of hydrocarbon modification from seeps in Norton Sound.

The seep in Norton Sound is bringing both gaseous and liquid hydrocarbons to the surface as demonstrated by recent data from Cline (RU 153) and Krenvolden (USGS). In FY 79, a multi-investigator cruise to the seep area is planned. RU 480 will participate, with the following objectives: a) characterize more fully the hydrocarbon content of sediments at the seep location; b) determine the distribution of these hydrocarbons with depth in cores taken from the seep to elucidate hydrocarbon flux; c) determine the geographical extent of seep-derived hydrocarbons to gain information on transport and weathering processes. Complementary investigations will be conducted by RU's 29, 190, 152, 153, 557 and P902.

Methods:

Methodology will be identical with that currently in use by RU 480. This includes solvent extraction of heavy hydrocarbons from sediments, fractionation of the hydrocarbons by column or thin-layer chromatography and analysis by g.c. and g.c./m.s. Intra-laboratory separation and recovery efficiency will be determined using a synthetic hydrocarbon mixture and precision and interlaboratory comparability will be determined by analysis of a reference sediment.

Output:

1. Narrative Reports: These periodic reports will discuss the data in light of the stated objectives and will include graphical and tabular data to support the text.

2. Digital Data: Heavy hydrocarbon data will be reported in Format 044.

3. Visual Data: Representative chromatograms mass spectra and charts of hydrocarbon distribution will be included in the narrative reports. Copies of all chromatograms and spectra will be archived by the PI.

4.2 DESCRIPTIONS FOR PROJECTS IN TASK C (HAZARDS):

C-1:	RU 251	P 927
C-2:	RU 327	
C-3:	RU 327	
C-4:	RU 327	
	RU 430	

(RU 251) SEISMIC AND VOLCANIC RISK STUDIES -- WESTERN GULF OF ALASKA

This research unit addresses subtask C-1 (BLM Study Types 10-Seismic Hazards, 11-Volcanic Hazards, and 12-Surface and Near Surface Faulting).

Estimated Costs, FY 79:		
	\$81,640	Kodiak
	75,360	Lower Cook Inlet
	\$157,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

University: University of Alaska
P.I., Degree: Hans Pulpan, Ph.D.
Title: Assistant Professor of Geophysics
Percent of time devoted to project and role: 50%; co-principal investigator for seismology

Other Principal Scientist significantly involved in Project:

P.I., Degree: Juergen Kienle, Ph.D.
Title: Associate Professor of Geophysics
Percent of time devoted to project and role: 50%; co-principal investigator for volcanology

Background:

A regional network of short-period seismic stations is being operated to cover the Lower Cook Inlet, Kodiak Island, and the Alaska Peninsula offshore area between the west coast of Kodiak Island and the Semidi Islands. A large portion of this seismic network has been installed under the current program. The operation of the Alaska Peninsula portion of the system is largely funded through a contract with the United States Department of Energy (DOE).

Hypocenter data files and epicenter maps have been generated routinely since January, 1976. Besides providing seismicity data with greatly improved accuracy and lower magnitude level, the system monitors the seismic activity associated with several active Cook Inlet volcanoes. Preliminary results of the 1976 eruption of Augustine Volcano have been presented. During 1977, the entire seismic network was redesigned, telemeter links were upgraded, and every field unit was replaced with a laboratory tested and calibrated unit. This has resulted in a significant improvement in data quality and successful continuous operation of the network during the past winter (1977-78). Three strong motion instruments were installed in the southern portion of the study area to allow recording of ground accelerations during major earthquakes.

Tentative risk maps are presently in preparation. Continued maintenance of the seismic network will greatly improve the data base for evaluation of the seismic and volcanic risk and may contribute to ability to predict eruptions.

Objectives:

1. To record the locations and magnitudes of all detectable earthquakes within the study area and to evaluate frequency of occurrence versus magnitude relationships.

2. To determine the seismic activity of surface and nearsurface faults identified by geologic mapping.

3. To evaluate the observed seismicity in cooperation with Research Units 210 and 16 towards development of an earthquake prediction capability in the Gulf of Alaska.

4. To report magnitude/frequency relationships of seismicity in Cook Inlet.

5. To monitor activity of volcanoes within the study area to evaluate volcanic hazards and to contribute to an understanding of the regional tectonics.

6. To complete preliminary seismic and volcanic risk analyses for Lower Cook Inlet.

Methods:

The present regional network of seismographs and the stations on Augustine and Redoubt volcanoes will be maintained and updated to provide data coverage over as continuous a period as possible. Data from these networks will be processed and combined with historical data to assess the seismicity and volcanic activity of the area. Close coordination with other investigators will be maintained to maximize the use of available data on the seismicity of nearby areas, offshore features such as faults and submarine volcanic flows, etc.

Output:

1. Narrative Reports: Reports will provide a detailed description of the operation of the seismic network, including number and spatial density of instruments and resulting accuracy of derived earthquake parameters. A summary of seismic and volcanic events recorded during the survey will be presented and interpreted. Reports will include an evaluation of frequency versus magnitude relationships, activity of surface and nearsurface faults, and conclusions regarding implications for OCS exploration and development activities.

2. Digital Data: Derived earthquake parameters (e.g., date, time, location, depth, magnitude) will be submitted on punch cards or magnetic tape in the standard Hypocenter Data File format.

3. Visual Data:

1) Maps of hypocenter locations and magnitudes.

2) Maps and graphs of earthquake magnitude versus frequency relationships for selected areas.

3) Maps with supportive text summarizing seismic activity of surface and nearsurface faults identified in geologic mapping.

4) Maps and reports summarizing volcanic activity.

5) Seismic and volcanic risk maps.

(RU 327) SHALLOW FAULTING, BOTTOM INSTABILITY, AND MOVEMENT OF SEDIMENTS IN LOWER COOK INLET AND WESTERN GULF OF ALASKA

This research unit addresses subtasks C-2, C-3, C-4, and D-7 (BLM Study Types 12 - Surface and Near Surface Faulting, 13 - Seafloor Instability, 14 - Erosion and Deposition, 34 - Bottom Sediment Characteristics and 35 - Basin Morphology).

Estimated Costs, FY 79:	$79,200	Kodiak
	40,800	Lower Cook Inlet
	$120,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Department: U.S. Geological Survey
P.I., Degree: Monty A. Hampton, Ph.D.
Title: Geologist
Percent of time devoted to project and role: 75%; co-principal investigator

P.I., Degree: Arnold H. Bouma, Ph.D.
Title: Geologist
Percent of time devoted to project and role: 75%; co-principal investigator.

Background:

Reconnaissance geological and geophysical surveys were conducted in 1976 over the outer continental shelves of Lower Cook Inlet and Kodiak Island. These surveys identified, on a regional scale, potential seafloor hazards due to faulting, slumping, erosion, deposition, and large scale bedform movement. Detailed studies of specific problems, such as large fault zones on the Kodiak Shelf, possible weak volcanic sediments in the troughs that cut the Kodiak shelf, and large-scale bedforms in Lower Cook Inlet, were begun in 1977 and continue into 1978. Results from the 1977 cruise were limited because of adverse weather. These studies will continue into FY 79, with the focus on improved mapping and age determinations on surface and nearsurface faults on the Kodiak shelf and areas of sediment instability on both the Kodiak and Lower Cook Inlet shelves.

Objectives:

This study addresses the overall objective of evaluating geologic hazards associated with seafloor instability, erosion and deposition in the Lower Cook Inlet and Kodiak lease areas. Specific objectives for FY 79 are:

Lower Cook Inlet

1. To determine the rate of migration of large scale bedforms by re-surveying tracklines run previously under this project and by industry.

2. To determine what processes (e.g. tides, winter storm waves, etc.) exert the most influence over large-scale bedform movement.

3. To coordinate with Dr. Juergen Kienle (RU 251) in a pilot study toward determining the offshore extent and frequency of pyroclastic flows from Augustine volcano.

Kodiak Shelf

1. To complete collection and analysis of data begun in 1978 to determine the recency of movement of major shallow faults. Close coordination will be maintained with Pulpan and Kienle (RU 251) in assessing the possible recent activity of these faults.

2. To identify and map areas of potential seafloor instability associated with weak, fine-grained or ash-bearing sediments and oversteepened slopes.

3. To determine the area distribution, depth, and thickness of gas-charged sediment masses, their gas contents, origins, and potential severity as a hazard to offshore petroleum exploration and production.

Methods:

Seismic profiling surveys, including side-scan sonar, will be used to identify and map seafloor features. Previous tracklines run in Lower Cook Inlet will be re-run to determine the extent that large scale bedforms are migratory. Sediment samples will be collected for analysis of physical properties. Close coordination will be maintained with RU 430 (Cacchione and Drake) in order to relate estimates of bottom sediment flux to the distribution of sediment types, movement of bedforms, and patterns of erosion and deposition.

Studies by Juergen Kienle (RU 251) show the possibility exists that volcanic flows from eruptions of Augustine Volcano extend far enough onto the shelf to indicate potential hazards from future eruptions. Coordination between these two research units will establish whether offshore sampling and profiling in this area are needed to better address this problem.

Output:

1. Narrative Reports: Reports will provide a detailed description of profiling and sampling methods, spatial density of the survey, analytical and interpretive methods, background information, results of the field and laboratory work (including graphic illustrations), interpretation of the nature and severity of potential seafloor hazards on the Kodiak shelf and in Lower Cook Inlet, and recommendations for future work.

2. Digital Data: Grain size analysis data will be submitted on punch cards or magnetic tape in OCSEAP standard archive format file type 073.

3. Visual Data:

   Maps:

   a. Location, geometry, offset, and apparent age of last movement of surface and nearsurface faults.

   b. Delineation of existing and potential slumps and other unstable sediment masses, indicating present stability.

   c. Isopach maps of unconsolidated sediments

   d. Sediment grain size properties

   e. Locations of areas of severe erosion, deposition, and bedform movement.

   f. Location of gas charged sediments and oil and gas seeps, if present.

   g. Seafloor topography

   Figures: Geologic cross-section of potentially unstable sediment masses.

4. Other Data: High-resolution seismic profiles, fathograms, side-scan sonar records, and associated navigation will be submitted for inclusion in the OCSEAP data base.

(RU 430) BOTTOM AND NEAR-BOTTOM SEDIMENT DYNAMICS IN LOWER COOK INLET

This research unit addresses subtask C-4, (BLM Study Type 14-Erosion and Deposition).

Estimated Costs, FY 79: $20,000 Lower Cook Inlet

Schedule: October 1978 - September 1979

Performing Agency:

Department: U.S. Geological Survey
P.I., Degree: David A. Cacchione, Ph.D.
Title: Geologist
Percent of time devoted to project and role: 75%; co-principal investigator.

P.I., Degree: David A. Drake, Ph.D.
Title: Geologist
Percent of time devoted to project and role: 50%; co-principal investigator

Background:

Surveys conducted by RU 327 (Hampton and Bouma) in Lower Cook Inlet have identified large bedforms composed of coarse, well-sorted sediments, indicating possible large-scale bottom sediment movement associated with strong bottom currents. These processes could have important implications with regard to hazards from erosion, deposition, and bedform movement, and transport of sediment-borne contaminants. In order to determine the types and amounts of sediment and bedform movement to be expected under certain oceanographic conditions, simultaneous measurements of bottom currents and sediment motions will be performed in FY 78. During FY 79 analysis of these data will be oriented toward a final report to characterize the observed processes and to relate these to events such as tides and storms.

Objectives:

This study addresses the overall objectives of evaluating geologic hazards associated with erosion and deposition on the seafloor and of characterizing bottom sediment dynamics. Specific objectives are to:

1. Provide a spatial and temporal description of bottom sediment transport.

2. Develop estimate of bottom sediment flux related to high energy events such as storm and tides.

3. For each sedimentary environment, relate the magnitude of bedshear to the initiation of bottom sediment movement.

4. Provide detailed descriptions of seafloor physiography and surface sediment characteristics in selected areas of observation.

5. Describe changes in the surface character of the seafloor over relatively long duration (at least one month).

Methods:

Specially designed ocean bottom instruments (GEOPROBES) are used to measure current velocities near the seafloor, pressure variations related to sea surface activity, temperature (for water mass identification), and suspended sediment concentrations. Bottom cameras attached to the GEOPROBES record bottom sediment activity, bed forms, and long term bed changes. Close coordination has been maintained with RU 327 to identify appropriate areas of study and to obtain sediment samples and other data. Analysis of data collected during FY 78 will be completed in advance of preparation of final products. No field work is planned.

Output:

1. Narrative Reports: Reports will provide detailed descriptions of the field methods and instrumentation, analytical and interpretive methods, background information, and results of the field and laboratory work addressing each of the stated objectives.

2. Digital Data: None.

3. Visual Data: Maps showing bottom sediment dynamics, including transport flux and direction for selected time periods and during high-energy events such as storm and tides.

(P 927) GROUND ACCELERATIONS ASSOCIATED WITH MAJOR EARTHQUAKES IN ALASKAN OCS AREAS

This unit addresses subtask C-1 (BLM Study Types 10 - Seismic Hazards and 12 - Surface and Near Surface Faulting).

Estimated Costs, FY79:		
	$25,000	Aleutians
	25,000	Kodiak
	25,000	Lower Cook Inlet
	25,000	NEGOA
	$100,000	Total

Schedule: October 1978 - September 1979

Performing Agency: To be determined

Background:

Knowledge of the probable offshore ground accelerations associated with major earthquakes is important in tract deselection and in setting design stipulations for seafloor-mounted structures. Although OCSEAP currently supports limited onshore networks of strong motion accelerographs, it has not been possible to obtain adequate data for determining what the ground motions offshore are likely to be. There are several reasons for this: 1) The technology is not yet available for economical and efficient operation of ocean bottom accelerometers and probably will not be available for several years; 2) Extrapolation of onshore measurements of ground accelerations to offshore is very difficult and requires very thorough knowledge of the subsurface geology and seismic velocity structure; and 3) accurate measurements of acceleration at the instrument site can only be made during larger events (most instruments are triggered by a magnitude 6 earthquake), requiring good spatial coverage and relatively long periods for data collections. This project will address problems 2) and 3) to improve our capability for approximating offshore ground accelerations.

Objectives:

1. To expand the coverage of the existing network of strong-motion accelerometers, as required by the BLM environmental programs, thereby increasing the areal extent of measurements of acceleration from major earthquakes.

2. To utilize available data and appropriate techniques for extrapolating measured accelerations to offshore areas.

Methods:

Additional strong-motion accelerometers will be installed in areas where there is presently no coverage, particularly in the Kodiak and Lower

Cook Inlet areas. Existing installations will be evaluated to determine whether there is adequate coupling to bedrock, and to re-install if necessary. Available data on subsurface and offshore geology, including existing seismic profiling records, will be compiled and analyzed to construct seismic velocity profiles. These will then be combined with the onshore accelerometer and seismograph data to approximate seafloor accelerations.

It is possible that part or all of the funds indicated under "Estimated Costs" may be applied to existing research units (16, 210, and 251).

Output:

1. Narrative reports: Reports will explain the design of the network and will provide a summary of the geology at each installation. A summary of acceleration data obtained each quarter will be presented in each quarterly report. The year-end report will contain interpretations of the data obtained; an explanation of the techniques used to analyze the data; an analysis of the effects of the subsurface geology; and an evaluation of estimated offshore accelerations.

2. Digital Data: None

3. Visual Data:

   a. Maps of peak accelerations determined for the land areas for which ground motion data were obtained during major earthquakes.

   b. Maps of estimated peak accelerations for offshore areas.

4. Other Non-digital Data: Copies of accelerograms will be submitted for inclusion in the data base.

4.3 DESCRIPTIONS FOR PROJECTS IN TASK D (TRANSPORT):

D-1:	RU 48	
	RU 138	
	RU 289	
D-2:	RU 48	P 093
	RU 138	
	RU 289	
	RU 367	
D-7:	RU 327	

(RU 48) CURRENT-MAPPING RADAR MEASUREMENTS

This research unit addresses subtasks D-1 and D-2 (BLM Study Type 27 - Currents and Tide).

Estimated Costs, FY 79: $50,000 Lower Cook

Schedule: October 1977 - September 1978

Performing Agency:

Agency: Wave Propagation Laboratory, ERL
P.I., Degree: Donald E. Barrick, Ph.D.
Percent time devoted to project and role: 25%; Project Supervisor.

Background:

During FY 77 the current-mapping radar system developed under RU 48 underwent field testing in the Gulf Stream off Florida. Simultaneous two-site current maps were generated during October-December 1976 by combining the data from two sites, one at Fort Lauderdale and the other at Miami. Field work for initial system calibration through direct surface current measurements made during radar operations was completed during March-April 1977.

Alaskan field testing of the current-mapping radar system was conducted in eastern Lower Cook Inlet for about a six-week period during the summer of 1977. These tests proved successful, and the prototype system was operated from additional sites in western Lower Cook Inlet to measure offshore and nearshore currents during June-July 1978. This effort was coordinated with the physical oceanographic and meteorological studies conducted under Research Units 138 and 367.

Funding of this project in FY 79 is for the purpose of analysis and interpretation of data collected during the FY 78 field season. No FY 79 field effort is planned.

Objectives:

The overall objective of this study (FY 77-79) is to produce synoptic maps depicting the spatial/temporal variability of tidal and non-tidal currents in selected regions of the Lower Cook Inlet lease area. Specific objectives are:

FY 78

1. To complete the analysis and interpretation of data collected from the eastern portion of Lower Cook Inlet during FY 77 field testing.

2. To obtain correlations between radar-observed currents and those measured by Lagrangian techniques.

3. To undertake radar field measurements within the western portion of Lower Cook Inlet in the region being studied under RU 138.

FY 79

1. To obtain correlations between radar-observed currents and those measured by Eulerian techniques (RU 138) in the same study area.

2. To obtain correlations between radar-observed currents and local meteorological disturbances observed under RU 367.

3. To provide, in collaboration with RU 138, calibration and verification data for modeling studies being conducted under Research Unit 436 (and P 093, should the results of RU 436 indicate the need for additional modeling work).

4. To produce a final report containing the analysis and interpretation of data collected during FY 77-78.

Methods:

The current-mapping radar system employs two low-power portable HF radar systems whose signals from shore are Bragg scattered from ocean waves that serve as tracers. The return signals detected by the receiving units are Doppler shifted a known amount by the waves' phase velocity. The actually observed Doppler shift will differ from that induced solely by waves in proportion to the ocean current velocity in which the wave field is imbedded. Signals from each of two geographically separated radar units, scattered from the same point on the ocean surface, are used to construct a complete current vector for that point. Vectors are constructed on a 3-km-square grid, and maps of the nearsurface current field are generated by an on-site mini-computer.

Output:

1. Narrative Reports: A final report will be provided describing the field operation and calibration procedures for the current-mapping radar system. The report will contain hardcopies of coastal radar current maps for selected times and averaging periods for data collected during FY 77 and 78. The report will also contain the results of correlations with other current measurement techniques described in Objectives above.

2. Digital Data: Digital magnetic tapes in archive formats will be produced for all current-map data.

3. Visual Data: Hardcopies of radar current maps.

(RU 138) GULF OF ALASKA STUDY OF MESOSCALE OCEANOGRAPHIC PROCESSES

This research unit addresses subtask D-1 and D-2 (BLM Study Types 27 - Currents and Tides and 32 - Trajectories of Oil Spills).

Estimated Costs, FY 79:	$ 52,600	Aleutians
	116,800	Kodiak
	122,000	Lower Cook
	$292,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Agency: NOAA/PMEL
P.I., Degree: Stanley P. Hayes, Ph.D.
Title: Oceanographer
Percent of time devoted to project and role: 50%; experimental design and analysis of pressure gauge records

P.I., Degree: James D. Schumacher, Ph.D.
Title: Oceanographer
Percent of time devoted to project and role: 45%; experimental design and analysis of current meter records.

Background:

1. Currents in the Lower Cook Inlet lease area are complicated by highly variable tidal currents, local run-off, wind driven currents, and a current which may be a branch of the Alaska Stream. The latter, if not a branch of the Alaska Stream, is known to be a result of forces and influences along the shelf, one of which is the influence of nearshore precipitation and run-off.

   The existing information base includes data from NOS-placed current meters, OCSEAP-placed meters (in FY 78), a data buoy, numerous CTD surveys and miscellaneous data from other sources.

   Analysis has shown a high variability in net flows over the lease area and complex gradients in tidal flow.

2. Currents in Shelikof Strait, on the other hand, are reasonably simple, partly because its channel is parallel to the Alaska Stream; but on the east side of Kodiak Island currents are weak and variable. There is some evidence that physical oceanographic processes influence the distribution of species associated with the shallow shelf, i.e., on Albatross Banks.

Data collected in FY 77 and 78 show a large decrease in flow as one moves from the shelf-break onto the shelf. Some historic data also indicate flow onshore in the deepest part of the shallow canyon separating North and South Albatross Banks.

3. Details of flow to the southwest of Kodiak along the shelf are unknown, although data were obtained from one or two moorings in FY 77 and 78. CTD transects have been accomplished only infrequently; therefore, any details of flow and possible spill trajectories in the area would be speculative.

Objectives:

The objectives in Lower Cook Inlet are to complete the analysis of data and to provide a map of circulation patterns in sufficient detail to allow calculation of oil spill trajectories with calculation of probabilities of impact over selected areas.

In the Kodiak lease area, the objective is to analyze data on hand and report on circulation in Kiliuda Trough and Kiliuda Bay which bisects Middle and Southern Albatross Banks. The physical oceanography will be closely coordinated with the biological studies in an effort to determine the dependency of biological events on circulation features. Specific objectives include:

1. Residence time of water in Kiliuda Trough and Bay.

2. Transit time, (preferably residence time) of water on the banks (Portlock and Albatross).

3. Examination of the hypothesis that there is restricted interchange of waters between the Middle and Southern Albatross Banks.

4. Examination of the hypothesis that significant up-channel flow occurs in Kiliuda Trough--sufficient to re-seed the nearshore area in case of biological impact from pollutants.

Objectives to be addressed in the Aleutian Lease Area are to provide analyses of 1977 and 1978 CTD and current meter data to increase understanding of large-scale circulation features.

Methods:

Standard statistical analyses of current meter and pressure gauge data during FY 79 will include extraction of tidal and non-tidal currents by means of appropriate record filtering, analysis of coherence between winds, corrected sea level and currents, spectral analysis. Non-tidal current data at selected locations will be used as additional input and calibration data for the diagnostic circulation model developed under RU 140.

Output:

1. Narrative Reports: A report will be provided containing a description of mooring locations, measurement and analysis techniques, sampling frequency and duration. The report will contain the results of statistical analyses of the current meter and pressure gauge records and, to the extent permitted by the study, a description of regional circulation patterns, specifically addressing the stated objectives. Specific data products to be provided include:

   a. Maps of circulation patterns in Kiliuda Bay and Trench.

   b. Maps of circulation patterns and water mass properties over Albatross Banks.

   c. Tabulations of tidal and net currents with objective estimates of variability in Lower Cook Inlet.

   d. Analysis of the affect of meteorological events on circulation in each area.

   e. Description of mixing processes.

2. Digital Data: All current meter and pressure gauge data will be in digital form and will be submitted to OCSEAP on magnetic tape in Formats 015, 017 and 022.

3. Visual Data: The following visual data representations will be included in the Narrative Report.

   - Time plots of filtered current meter and pressure gauge data showing both tidal and non-tidal velocity and pressure fluctuations.

   - Progressive vector diagrams.

   - Energy density spectra.

   - Plots showing coherence between wind, corrected sea level and currents.

   - Plots showing estimated return frequencies of selected extreme values of current.

(RU 289) CIRCULATION AND WATER MASSES IN THE GULF OF ALASKA AND SATELLITE IMAGERY OF MESOSCALE FLOW FEATURES IN OTHER ALASKAN OCS AREAS

This research unit addresses subtasks D-1 and D-2 (BLM Study Types 27 - Currents and Tides and 29 - Residence Time and Flushing).

Estimated Costs, FY 79:

$10,200	Aleutians
10,200	Kodiak
10,200	Lower Cook Inlet
71,400	NEGOA
$102,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

University: University of Alaska, Inst. of Marine Science
P.I., Degree: Thomas C. Royer, Ph.D.
Title: Research Associate Professor
Percent of time devoted to project and role: 50%; project supervisor

Other Principal Scientist Significantly Involved in Project:

Name, Degree: K. Ahlnas, M.S.
Title: Resident Associate
Percent of time devoted to project and role: 85%; remote sensing image enhancement, interpretation, and archiving.

Background:

Since FY 75, the Principal Investigator has studied the mean and seasonal variations of the water mass characteristics and currents in the Gulf of Alaska from observed temperature and salinity distributions and direct current measurement. Sea surface temperature measurements obtained from NOAA satellites have been used in conjunction with hydrographic data in an attempt to estimate and map the surface circulation in the entire Gulf of Alaska.

The incorporation of satellite remote sensing into this project has substantially improved its capability to define nearshore circulation features that are manifested in surface water temperature differences. This is particularly important in the Kodiak and Aleutian lease areas.

Similar satellite data for the entire Alaskan OCS coastline including Lower Cook Inlet is made available by this project for use by other OCS principal investigators.

Efforts under this project are closely coordinated with those under RU's 138, 140, 141, 217, 267, 367, 541, and 550.

Objectives:

The objectives of this project are to complete the studies of mesoscale circulation patterns in the Gulf of Alaska from hydrographic properties, direct current measurements and satellite imagery and to provide similar satellite data for the entire Alaskan OCS coastline for use by other investigators. Objectives specifically applicable to the NEGOA, Aleutian, Kodiak, and Lower Cook lease areas are:

1. To provide evidence of key circulation features, both offshore and nearshore, by use of satellite imagery.

2. To provide improved descriptions of the seasonal variability in hydrographic properties in each area, and particularly in front of Hinchinbrook Entrance.

3. To analyze moored current meter data from near Kayak Island to allow determination of the barotropic flow on the shelf and provide input and calibration data for modeling conducted under RU 140.

4. To correlate currents inferred from satellite imagery with meteorological and hydrographic conditions.

5. To estimate, to the degree the evidence allows, the frequency and lifetime of mesoscale circulation features, such as nearshore eddies and meanders with descriptions of residence time wherever possible.

6. To provide satellite data for use by other OCS principal investigators.

7. To provide archive identification of all imagery showing evidence of key circulation features.

Methods:

No field work is planned in the Aleutian, Kodiak, or Lower Cook Inlet areas. There will be limited work west of Kayak Island, but only if the modeling study in FY 78 shows a gap in data. Field measurement, calibration, and analysis techniques will be similar to those currently in use. Quasi-continuous depth profiles of temperature and salinity will be obtained on a trimesterly basis from a grid of hydrographic stations from Unimak Pass to Yakutat. Data analysis will involve standard techniques in producing maps of hydrographic properties and in performing geostrophic current calculations.

Imagery from satellites (e.g., ERTS, NOAA) transiting the Gulf of Alaska will be used to describe surface circulation features that are manifested as water temperature differences. Similar information will be provided to OCS investigators in other lease areas on a 60-day delay, with infrared enhancements to be carried out during this time period.

Output:

1. Narrative Report: A report will be provided containing discussion and interpretation of principal hydrographic features and inferred flow patterns occurring during the observation period. The report will contain surface maps and cross-shelf section contours of hydrographic parameters and surface maps of dynamic topography for each cruise. Time series plots of water properties will be provided at selected stations to describe the seasonal characteristics of the shelf hydrography.

   The report will contain discussions of satellite imagery interpretations, including criteria, for seasonal offshore and nearshore current patterns, and integration of observations with other OCSEAP and climatological data.

2. Digital Data: Digital STD, current meter and pressure gauge data will be submitted to EDS in OCSEAP-approved formats 022, 015 and 017.

3. Visual Data:

   a. Seasonal maps of hydrographic properties.

   b. Seasonal maps of dynamic topography and geostrophic currents.

   c. Images and maps of seasonal and shorter-lived surface currents features as inferred by satellite remote sensing.

4. Other Data: Both the visible and IR images from clear areas of the coastline will be retained. IR enhancements and enlargements of these data will be carried out and catalogued. Prints of these images will be made available to OCSEAP principal investigators on request. Assistance in interpreting the imagery will be provided.

(RU 367) NEARSHORE METEOROLOGY

This research unit addresses subtask D-2 (BLM study type 28 - Wind Fields)

Estimated Costs, FY 79:

$ 64,170	Kodiak
30,500	Lower Cook Inlet
20,330	NEGOA
$115,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Department: NOAA/ERL
P.I., Degree: R. Michael Reynolds, M.S.
Title: Oceanographer
Percent of time devoted to project and role: 50%; project supervisor

Background:

Nearshore winds along the Alaskan coastline can differ significantly from those determined from synoptic weather charts because of strong coastal orographic effects. These differences can lead to errors in pollutant transport predictions that are based on synoptic geostrophic winds.

The FY 79 program will consist of studies in the Lower Cook Inlet, Kodiak, and NEGOA lease areas, continuing studies dating back to FY 76 in the NEGOA lease area. During FY 77 and 78, the studies were extended into the Copper River Delta and Cook Inlet areas where shipboard and land-based instrumentation was used to obtain local wind data. In the Cook Inlet area, Alaska State ferries obtained local winds during transits of the Homer-Kodiak run.

The Principal Investigator has performed field studies between Yakutat and Icy Bay during FY 76-77 to obtain empirical data with which to drive and verify a numerical atmospheric circulation model modified in FY 77 and 78 from an existing model previously developed by Lavoie. This model predicts local wind fields that are significantly different from synoptic or geostrophic winds due to coastal orographic effects. Verified output from this model will be used to improve the wind stress input to the pollutant trajectory model used by RU 140.

Objectives:

The objectives of this study are to provide an improved understanding of mesoscale features of the surface wind field resulting from coastal orographic effects.

Specifically these objectives are:

1. To relate observed over-the-water winds to winds forecast from synoptic weather charts.
2. To relate land-based local weather observations with winds observed over the water in the lease area and to provide the relationship for each identifiable weather type.
3. To devise a procedure whereby, from a knowledge of synoptic wind data combined with local land-based data, the surface winds over the lease area may be forecast.
4. To find, for each lease area from historical records, a set of wind and weather patterns which typify the conditions that might be expected during a spill. This information will be assembled in a manner suitable for use in trajectory analysis.
5. Acquire and analyze data from Kiliuda Bay (Kodiak Island) and relate winds there to currents.

Methods:

Methods used will be similar to those employed in FY 77-78.

Study methodology will include the following:

1. Installation of instruments on drill rigs in Cook Inlet and portable land stations at Kiliuda Bay.
2. Shipboard and aircraft (if possible) meteorological observations and acquisition of coastal wind data. Correlations will be made between the long term over-the-water observations and those obtained from shipboard and from land-based stations. Data recorded aboard Alaska State ferries will be included when available.
3. To the degree that the mesoscale wind model is applicable, it will be used to obtain the forecasts in objective 3. Otherwise, empirical relationships will be resorted to.

Output:

1. Narrative Reports: A report will be provided containing:

   a. A procedure for finding over-water winds in the lease area, given land-based and synoptic data (This is a joint effort with RU 140).

b. Discussions of analysis and interpretation of the results of field experiments which integrate as fully as possible all supportive data from other research programs.

c. A description of most probable wind fields expected in each area.

d. Documentation of model development and verification, results of simulation runs, and operational procedures.

2. Digital Data: All meteorological data obtained in field work which include:

a. Wind speed and direction; time series at two or more sites.

b. Wind speed and direction at several points as synoptically as ship and aircraft allow.

c. Auxiliary meteorological information such as obtained from tethered balloons and rawinsondes.

d. Computed winds in digital format as required in trajectory models.

Data will be archived in format 101.

3. Visual Data: These will consist of:

a. Charts of synoptic wind vectors.

b. Graphical presentations of computed local winds versus observed winds.

c. Graphical presentations of surface current measurements.

(P 093) AN OIL SPILL TRAJECTORY MODEL IN LOWER COOK INLET

This unit addresses subtask D-2 (BLM Study type 32 - Oil Spill Trajectories).

Estimated Cost: $50,000 Lower Cook Inlet

Performing Agency: To be selected.

Background:

This research unit addresses subtask D-2, partly fulfilling a requirement to demonstrate capability of predicting transport in inshore areas. BLM study types 27, 29, and 30 are also addressed.

Lower Cook Inlet is an area where currents are very complex. The tidal currents vary from near zero to 1.0 knot within the lease area and net flows are affected both by local run-off and by a branch of the Alaska stream. A large part of the total variability is accounted for by non-periodic, randomly variable currents. Local conventional wisdom has it, however, that there is a net flow such that, "A skiff lost in the middle ends up in Kamishak Bay." Under some wind conditions it is also believed that oil would be blown in the opposite direction into Kachemak Bay. With this degree of complexity, a systematic means of accounting for and calculating currents is necessary.

A series of oil spill trajectories were calculated for Cook Inlet in FY 76 under RU 436, using an incomplete data set from National Ocean Survey and elsewhere. These data were greatly augmented in FY 77 by PMEL and a re-run of the model planned for late FY 78. OCSEAP will conduct a review of the model and an evaluation of the validity of the calculations.

The FY 79 plan described below is intended to provide for the eventuality that physical factors not presently accounted for by RU 436 must be invoked to calculate a current field with adequate accuracy. In that event a new model must be selected, preferably one already fully developed and ready to run. There are several to choose from, including the one developed by Dr. Laevastu under RU 235 in FY 76, which has not been reviewed or verified.

Because of the potentially serious consequences of impacts from oil-related developments in the area, particularly if a spill occurred, and because of intense public interest in the area, predictions of oil spill trajectories must be stated with precision and must include estimates of the reliability of the predictions. Therefore the planning for FY 79 includes a strong element of model and review and verification.

Objectives:

The objectives of this research are to run trajectory simulations from selected hypothetical spill sites under prescribed wind and water conditions and to make estimates of the validity of the trajectories, based on statistics of winds and currents. Intermediate objectives include:

1. An analysis of the suitability of the present data base for modeling and prediction of trajectories, with recommendations for improvement.

2. An analysis of the validity of existing models which accept time-dependent current data as inputs. As a subset, models which include stochastic processes and oil slick dynamics will be included.

3. Selections, with supporting rationale, of an existing trajectory model for use in accomplishment of the primary objective.

4. Operation, directly or by subcontract, of a suitable oil spill transport model.

Methods:

Methods of analysis will not be prescribed. Methods of calculation of trajectories will be by means of existing algorithms, unless analysis shows none are of sufficient reliability to be worthy of use. Subcontracts for performance of the trajectory calculations are acceptable but will be subject to prior approval by the Project Office.

The following sequence of events will be suggested for action and will serve to illustrate the scope of effort:

1. Summarize all data applicable to trajectories in the lease area.

2. Review statistical analyses already made on current meter records. Recommend additional analysis if appropriate.

3. Separate stochastic signals from tidal, wind-correlated, seasonal, net and other "predictable" current components at each station.

4. Compute or estimate error in each predictable component.

5. Estimate correlation between data from adjacent stations.

6. Estimate the ratio between velocities expected from stochastic processes and the velocities expected from predictable processes.

7. Analyze suitability of existing trajectory models and subroutines. These include: Dames and Moore, Galt, Laevastu, Coast Guard, etc. These should be examined for features such as (a) allowable grid size, (b) acceptance of time and space, dependent winds and currents, (c) ability to accept subroutines for spreading dynamics, weathering and stochastic processes. Overall, the models should be examined for ability to correctly utilize all pertinent information in the present data base and for economy of operation.

8. Negotiate a subcontract for running the model with data provided.

9. Assemble all available wind and current data into sets for a sequence of runs.

10.. Select (with Project Office help) hypothetical spill sites.

11. Schedule and review model runs.

12. Report results.

Output:

A narrative report will be provided which includes trajectory maps, with documentation of input data and estimates of error in prediction of the position of the pollutant control after 12, 24, 48, and 96 hours and at landfall. The error will be estimated and will be divided into two different components: error due to imperfect knowledge of tidal and other predictable currents and error due to the calculated random or stochastic components of currents.

The report will also include a description of the model used and an evaluation of its contribution to estimated errors. Rationale for selection of the model will be included.

An estimate will be made of the amount by which errors in the trajectory could be reduced with additional data.

4.4 DESCRIPTIONS FOR PROJECTS IN TASK E (BIOTA):

E-1:	RU 243
E-2:	RU 194
	RU 243
E-3:	RU 3
	RU 341
E-4:	RU 3
	RU 341
E-6:	RU 424
	RU 512
E-7:	RU 5
E-8:	RU 417
E-9:	RU 417
E-10:	RU 424
E-11:	RU 425
E-13:	RU 424
E-15:	RU 29
	RU 190

(RU 3) IDENTIFICATION, DOCUMENTATION AND DELINEATION OF COASTAL MIGRATORY BIRD HABITAT IN ALASKA

This research unit addresses subtasks E-3, E-4 (BLM study types 39 - Vulnerable Populations, 40 - Life History, 41 - Critical Habitats, 42 - Food Web Dependencies, 44 - Wetland Ecosystems.)

Estimated Costs, FY 79 :		
	$ 5,200	NEGOA
	26,000	Lower Cook Inlet
	1,560	Kodiak
	19,240	Bristol Bay
	$52,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Agency: Alaska Department of Fish and Game
P.I., Degree: Paul Arneson, Ph.D.
Percent time devoted to project and role: 100%;
Project direction, sample collection, analysis and data processing.

Background:

Collection of information on the seasonal composition, distribution, abundance, timing of migrations and coastal habitat preference by migratory birds in the Gulf of Alaska was completed during 1976. Field work in 1977 was concentrated in Bristol Bay, Lower Cook Inlet, Kodiak, and the Alaska Peninsula. In 1978 winter surveys were conducted in Lower Cook Inlet to determine distribution and abundance of marine birds in relation to ice conditions and also to limited colony studies during the summer to determine bird usage of selected small colonies on the west of Lower Cook Inlet. Field investigations will be completed at the end of FY 78. However, the project will be continued in FY 79 to allow complete analysis of data and preparation of two comprehensive final reports.

Objectives:

The objectives of this study are to determine seasonal changes in the composition, distribution, abundance, feeding and breeding ecology of birds associated with coastal habitats. Specifically, the objectives are:

1. Determine seasonal density, distribution, and use of coastal habitat by migratory bird species.

2. Determine primary feeding and staging areas.

3. Determine breeding locales for selected species.

Methods:

Data collected from previous years will be analyzed and synthesized to provide two comprehensive final reports. Marine bird coastal habitat maps produced by this research unit have been duplicated on 35mm slides and submitted to the Program Office.

Output:

1. Final Narrative Report: Seasonal changes in distribution, density, and use (feeding, breeding, etc.) of coastal habitats by migratory birds will be described and evaluated. This report will include information available on the spring migration of birds past Cape St. Elias, a winter population estimate for Kodiak Island, and winter and spring distribution and abundance estimates of birds in Lower Cook Inlet related to ice conditions and other environmental parameters. Scientific input will be provided by RU 341 (Sanger), RU 005 (Feder), RU 424 (English), RU 512 (Blackburn) and RU 059 (Hayes) in developing this report.

   A second narrative report will be developed in which the phenology, reproductive ecology, life histories, and foraging areas for selected colonies in Lower Cook Inlet and Bristol Bay will be assessed. Literature synopses of food habits for principal life stages of selected species will be included. Input will be provided by RU 341.

2. Digital Data: By FY 79 study results will have been provided in OCSEAP format under file types FY 040 - Bird Habitat and the new bird colony format presently being developed, FT135.

3. Visual Data: Narrative reports will be supported by maps, charts, figures, and tables. Specifically, these products are:

   a. Maps which identify:

      (1) Coastal area surveyed and associated habitat.
      (2) Sampling locations.

   b. Charts which illustrate:

      (1) Seasonal changes in distribution and densities of migratory birds.
      (2) Primary breeding locales for selected species.
      (3) Primary foraging areas for selected species.
      (4) Primary migratory routes.

c. Figures and tables which illustrate:

(1) Changes in bird distribution and density.
(2) Changes in seasonal use patterns.
(3) Seasonal changes in feeding habits of birds associated with coastal habitat.

(RU 5) FOOD WEB RELATIONSHIPS AND PRODUCTIVITY OF INVERTEBRATE SPECIES IN THE NEARSHORE ZONE

This research unit addresses OCSEAP subtask E-7 (BLM study types 39 - Vulnerable Populations, 40 - Life History, 42 - Food Web Dependencies).

Estimated Cost, FY 79:	$ 94,350	Lower Cook Inlet
	85,100	Kodiak
	5,550	NEGOA
	$185,000	Total

Performing Agency:

University: University of Alaska
P.I., Degree: Howard M. Feder, Ph.D.
Title: Professor of Marine Science and Zoology
Percent of time devoted to project and role: 33%; Project Director.

Background:

Exploration of the benthos on the Alaskan OCS began in 1974 in the Gulf of Alaska. In subsequent years, the geographic coverage was expanded to include the benthic populations of the Lower Cook Inlet, Kodiak Island, Chukchi Sea and the St. George Basin, Bristol Bay and Norton Sound regions of the Bering Sea. Due to recent shifts in the OCS leasing schedule, efforts to investigate these offshore epi- and infaunal populations have been focused on the Lower Cook Inlet, Kodiak, and, again, on the Northeast Gulf of Alaska. The methodology has included extensive trawl studies conducted during FY 76 and FY 77 to provide broadscale information on the composition, distribution and relative abundance of the epifaunal invertebrates. Similarly the infauna have been studied primarily through use of grab and dredge surveys except in Norton Sound where only the epifauna has been intensively investigated by trawling equipment.

The results thus obtained will yield data on the distribution, abundance, species diversity and community structure of the benthos necessary in determination of their critical habitats in offshore regions. Reports synthesizing the results from these reconnaissance level surveys are expected to be completed for each lease area during FY 78.

Investigations have also been conducted closer inshore in the Lower Cook Inlet and Kodiak Island regions. This began in FY 77 with summer trawl surveys in Alitak and Ugak Bays (Kodiak) to provide a preliminary look at the temporal and spatial distributions of epifaunal populations in these nearshore waters. The two large bays of Lower Cook Inlet and Kachemak and Kamishak Bays were sampled as early as FY 76 with equipment such as the pipe dredge. Additional data will be obtained in conjunction with the food web studies in the Kodiak region during the FY 78 field season through summer cruises in the two bays of Kodiak Island, Izhut and Kiliuda. The intensified spatial and temporal scheme will yield

the higher resolution data presently needed. A limited field effort was also conducted in the Hinchinbrook entrance area in FY 78. It consisted of a single reconnaissance survey of nearshore benthos in both protected and exposed coastal habitats. The research emphasis was also shifted in FY 78 from solely a reconnaissance level survey to inclusion of trophic relationships studies focused on commercially important members of the epibenthic invertebrate community. This project is also a component of the integrated studies on the feeding relationships of both ecologically and commercially important marine organisms in the Kodiak and Lower Cook Inlet lease areas.

Objectives:

Studies in the lease areas will continue to center upon food web relationships and supportive data. Data and information exchanges with the other research units involved will also continue to be an important part of the research efforts. Specifically the objectives for each lease area are:

NEGOA (in principal nearshore habitats, <100m in depth):

1. Describe the distributions and relative abundance of dominant epifaunal invertebrates.

2. Determine the food habits of selected benthic invertebrates and demersal fishes.

Kodiak:

1. Determine the feeding habits of the principal inshore epi faunal invertebrate species emphasizing the commercially important king crab and pink shrimp.

2. Exchange data and information with RU's 341, 551, 552, and 553 in order to develop a food web structure for selected inshore areas.

3. Synthesize information on distribution, abundance, and life histories of key species of benthic invertebrates.

Lower Cook Inlet:

1. Determine the feeding habits of the principal inshore epifaunal invertebrate species, emphasizing key commercially important species such as the snow crab.

2. Develop food webs integrating the invertebrate, fish, mammal and bird trophic relationship data in conjunction with RU's 229, 243, 341, 417, 424, and 512.

3. Synthesize available information on the distribution, abundance, and life histories of commercial invertebrates.

4. Describe and evaluate the potential for impact by OCS gas and oil exploration activities, and subsequent development and production, on those epi- and infaunal habitats of Lower Cook Inlet using data from studies conducted in FY 76 through FY 78.

Kodiak and Lower Cook Inlet:

1. Assess spatial and temporal distribution and relative abundance of epifaunal invertebrates in selected bays and inshore areas.

2. Review and analyze the existing data base to provide a comprehensive description of benthic biota and environment.

Methods:

Analyses of the trawl, dredge and grab samples will be conducted by those procedures previously utilized by this research unit and documented by a quality control memorandum. In particular the trawl analyses are comparable to those methods employed for the epibenthic samples taken in Norton Sound in 1976. Food habits of the key, commercially important species of epibenthic invertebrates will be determined through stomach analyses utilizing those standard gravimetric procedures defined in RU's 486 and 512.

Trophics work in the bays of Kodiak Island will continue in the same bays as the other food web studies. Epibenthic invertebrate populations were sampled monthly during the spring and summer of FY 78. These efforts, initiated in FY 78, will continue quarterly in the fall and winter of early FY 79 for completion of a full year of data. Samples will be obtained primarily through the use of otter trawl and diving surveys with infaunal food sources sampled by dredge and grab equipment. Site selection for intensive sampling will be based on results from studies conducted during FY 78.

Objective 3 for Lower Cook Inlet will require several additonal sources of information. These include the location of leased tracts, the location of exploratory rigs, the BLM development scenario, results of trajectory analyses for Lower Cook Inlet made by OCSEAP in FY 78, and the results of Miles Hayes' (RU 59, 1977) work on vulnerable habitats of Lower Cook and NEGOA. In addition, the existing information on sensitivity of specific components of the ecosystem must be considered. This latter information will be supplied to the investigator by the project office.

Output:

1. Narrative Reports: Reports will describe methods, temporal and spatial intensity of sampling, current status of knowledge, description of statistical treatment, results, discussion and conclusions. Recommendations for future investigations will be defined. Reports will provide an analysis of biological activity at each study site and a discussion of trophic relationships in the Kodiak and Lower Cook Inlet lease area with an identification of the critical links in the food web. A final report will be prepared for those lease areas already intensively studied which will focus on contrast and comparison of results. This effort should result in better resolution of any future studies of the benthos in these areas.

2. Digital Data: Results of this study will be submitted on OCSEAP defined formats in the File Type 032 - Benthic Organisms. Data from the analysis of stomach contents will be submitted in a new File Type developed during FY 78.

3. Visual Data: Data supporting the narrativ report will be provided in the form of maps, charts, figure nd tables. Specifically, the products will be:

   a. Maps of sampling sites.

   b. Charts illustrating:

      (1) The seasonal distribution and abundance of dominant benthic organisms.

      (2) The seasonal distribution of major predator and prey species.

   c. Figures and tables illustrating:

      (1) The benthic food web.

      (2) The major prey species.

      (3) The productivity/biomass of selected species.

      (4) Species inventories for various habitats (embayments, outer coast).

      (5) Indices of composition of phyla (numbers, weight and biomass - as allowed by the data) in various habitats.

      (6) Frequency and percent frequency of occurrence of food items in stomachs of selected invertebrates and fish species.

(RU 29) ASSESSMENT OF POTENTIAL INTERACTIONS OF MICROORGANISMS AND POLLUTANTS FROM PETROLEUM DEVELOPMENT IN LOWER COOK INLET AND THE BEAUFORT SEA

This research unit addresses subtasks E-15 (BLM study type 57 - Effects of Contaminants on Normal Microbial Activity).

Estimated Costs, FY 79:

\$ 70,500	Beaufort Sea
\$ 32,500	Lower Cook Inlet
\$ 32,500	Norton Sound
\$135,500	Total

Schedule: October 1978 - September 1979

Performing Agency:

University: University of Louisville
Department: Department of Biology
P. I., Degree: R. Atlas, Ph.D.
Title: Assistant Professor of Biology

Background

The goals of the OCSEAP microbiology program are to determine the effects of oil on the numbers and types of bacteria present in each lease area and their contribution to the productivity of the area, through carbon and nitrogen fixation and denitrification. Spatial and seasonal variation can be enormous; hence sampling should be done on a seasonal and spatial basis. In addition, the capabilities of the microbial population to degrade oil should be investigated.

These objectives have been addressed by RU 29 and 190. To date we have a good understanding of the types and numbers of bacteria and their productivity in Cook Inlet on a seasonal and geographical basis. Geographical data only on types and numbers of bacteria, biomass, and nitrogen fixation will be available in FY 78 for the Beaufort Sea.

Objectives:

RU 29 is concerned with the determination of the effects of oil on the numbers and types of bacteria present in water and sediment samples, the rates at which they carry out denitrification. In FY 79, objectives for each lease area will be as follows:

1. In the Beaufort Sea,

    a. to enhance knowledge of the geographical distribution of bacteria east of Prudhoe Bay through analyses of water and sediment samples collected in FY 78 for the potential of the microbial population for degrading hydrocarbons;

b. To determine the long-range effects on microbes of the release of oil into bottom sediments through rupture of a buried pipeline. This is a continuation of an experiment already in progress in the Beaufort Sea, in which plexiglass trays containing oil overlain with sediment collected at the experimental site are maintained on the ocean floor in Elson Lagoon. The trays are sampled three times per year for determination of the numbers of total and viable bacteria, numerical taxonomy, denitrification rates, and hydrocarbon biodegradation potential. Chemical analyses are performed to monitor changes in the composition of the oil and its breakdown products over time.

2. In Norton Sound, to determine if the presence of a natural oil seep has altered the relative abundance of microbes and in particular of hydrocarbon-utilizing bacteria. Comparisons will be made of numbers of total and viable bacteria, numerical taxonomy, denitrification rates, and hydrocarbon biodegradation potential in water and sediment samples collected inside and outside the seep area. This study will be coordinated with the chemistry research units, including 152, 153, 480, and P 902.

3. In Upper Cook Inlet, to enlarge the knowledge of the effects of oil platforms on the bacterial population by measuring total and viable bacteria, numerical taxonomy, denitrification rates, and hydrocarbon biodegradation potential. This study will be performed in connection with the chemistry research units 152, 153, 275, and 480.

Methods:

Sediment and water samples will be collected during one cruise in Norton Sound and one cruise in Cook Inlet. The plexiglass trays on the floor of the Beaufort Sea will be sampled by divers 3 times per year.

Total bacteria will be quantified by epifluorescence counting, and viable bacteria will be quantified by growth on glucose or glutamic acid-containing agar at 5 and/or 20? C. Hydrocarbon biodegradation potential (a measurement of the capability of the bacterial population to degrade hydrocarbons) will be determined by measuring the rate of CO_1 release from ^{14}C labeled hydrocarbons added to samples. Taxonomy of the bacterial population will be determined by measuring the numbers of microbes capable of growing on a large variety of substrates, including sugars, alcohols, and amino acids.

Compositional analyses of petroleum and its biodegradation products will be performed using gas chromatography and mass spectrometry. The investigator will participate in intercalibration analyses in cooperation with other OCSEAP-sponsored laboratories.

Output:

1. Reports containing:

    a. detailed descriptions of experimental methodology, including protocols for sample collection, measurements of total and viable bacteria, hydrocarbon biodegradation potential, numerical taxonomy, and chemical analyses;

    b. results, including figures and tables showing numbers of total and viable bacteria, hydrocarbons biodegradation potential, and numerical taxonomy as a function of sample type and site and of environmental parameters such as temperature and salinity. Chromatographs of petroleum components and breakdown products isolated from the plexiglass trays in the Beaufort Sea should be included;

    c. interpretation of results, conclusions, and recommendations for future studies.

2. Digital data on microbial population counts and taxonomy, deposited at NIH, available to OCSEAP and other interested parties through NODC.

(RU 190) MICROBIAL ACTIVITY AND CRUDE OIL MICROBIAL INTERACTIONS IN WATERS AND SEDIMENTS OF COOK INLET AND THE BEAUFORT SEA

This research unit addresses subtask E-15 (BLM study type 57 - Effects of Contaminants on Normal Microbial Activity).

Estimated Costs, FY 79:

$ 15,000	Beaufort Sea
15,000	Norton Sound
100,000	Lower Cook Inlet
$130,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

University: Oregon State University
P.I., Degree: R. Griffiths, Ph.D. and R. Morita, Ph.D.
Title: Research Associate; Professor of Microbiology
Percent time devoted to project and role: Griffiths: 30%; Morita, 5%; jointly plan and supervise program.

Background:

The goals of the OCSEAP microbiology program are to determine the numbers and types of bacteria present in each lease area and the potential effects of contaminants or their contribution to the productivity of the area, through carbon and nitrogen fixation and denitrification. Spatial and seasonal variation can be enormous; hence sampling should be done on a seasonal and spatial basis. The interactions of oil and microbes must be studied, including the capabilities of the microbial population to degrade oil and the effects of oil on microbial abundance, diversity, and functions.

These objectives have been addressed in the past by RU's 29 and 190. To date there is some understanding of the types and numbers of bacteria and their productivity in Cook Inlet on a seasonal and broad geographical basis. Geographical data only on types and numbers of bacteria, biomass, and nitrogen fixation will be available in FY 78 for the Beaufort Sea.

Emphasis in FY 79 will be placed on evaluating possible effects of crude oil and weathered petroleum contaminants on the nature and extent of microbial involvement in the productivity and microbial activity of selected OCS areas.

Objectives:

1. In Lower Cook Inlet, to determine the effects of petroleum on the extent and nature of microbial involvement in detrital food webs at selected nearshore study sites. More specifically this will involve:

a. Literature review and synthesis of all available information of the role microbiota in detrital food webs with emphasis on the arctic marine environments.

b. The comparison of microbial biomass, relative microbial activity, respiration ratios, microbial growth (by indirect means), and rates of nitrogen fixation and denitrification between control and petroleum impacted sediments of selected nearshore areas.

c. The determination of the rates of hydrocarbon biodegradation in control and petroleum impacted sediments of selected nearshore areas.

Measurements should also be made of the effects of oil on the following physiochemical variables, and correlations should be made with the microbial measurements listed above: pH, Eh, salinity, temperature, NO_2, NO_3, NH_4, O_2, total organic C, and total organic N.

2. In the Beaufort Sea, to determine the effects of petroleum on relative microbial activity, respiration ratios, rates of nitrogen fixation, and inorganic nutrients in bottom sediments provided by RU 29 from the plexiglass tray experiment.

3. In Norton Sound, to determine whether the presence of a natural oil seep has altered the activity of the microbial population. Relative microbial activity, respiration ratios, rates of nitrogen fixation, and inorganic nutrients will be measured in the same water and sediment samples used by RU 29 for measurements of the relative abundance of microbes.

4. To continue laboratory studies to determine the effects of crude oil on relative microbial activity, respiration ratios, and rates of nitrogen fixation.

Methods:

Samples will be collected from small boats in Cook Inlet and the Beaufort Sea and during one ship cruise in Norton Sound. Nearshore sites selected for study in Cook Inlet will include the nearshore areas that were studied in FY 78 by RU's 417 and 512. Techniques for addressing the objectives for Lower Cook Inlet will be developed at the beginning of FY 79 using information collected in FY 78 by RU's 417 and 425. Relative microbial activity will be measured by uptake of glucose and glutamic acid. Respiration ratios will be measured by the release of CO_2 from ^{14}C-labeled substrates. Nitrogen fixation will be measured by the acetylene reduction method. Procedures for determining the effects of petroleum on the microbial involvement in detrital food webs will take into consideration possible effects on nitrogen fixation and denitrification by gastro-intestinal flora as well as sediment flora. Procedures for measuring the effects of petroleum on microbial growth and biomass will also consider correction for cropping rates by protozoa.

Output:

Expected products from this research activity include:

Narrative reports: Describing the general state-of-knowledge, methodology, results and conclusions. Such narrative reports should include a seasonal documentation of the effects of oil on microbial biomass, crude oil biodegradation, respiration, growth, rates of nitrogen fixation and denitrification, and correlations of these variables with those physiochemical variables measured concomitantly. An evaluation as to the probable impacts of crude oil on the study site should be included.

Digital data: On station locations and sampling information required by the standard format; digital data on microbial biomass, microbial activity, respiration ratios, microbial growth, rates of nitrogen fixation and denitrification, and protozoan biomass and cropping rates of bacteria; digital data on physio-chemical variables measured in conjunction with the microbial studies. All data will be submitted to NIH inconjunction with RU 29 (Atlas), and RU's 371 and 391 (Krichevsky).

Visual Data: Data accompanying the narrative reports include:

a. Charts of stations locations and areas of high biodegradation, nitrogen fixation, and denitrification.

b. Graphs showing the seasonal variations of microbial variables and their relationship to those physiochemical variables measured concomitantly, rates of biodegradation of crude oil, and the effect of crude oil on these microbial processes. Supporting tables should be provided indicating the appropriate parameters and test statistics used in the analysis.

(RU 194) MORBIDITY AND MORTALITY OF MARINE MAMMALS

This research unit addresses subtasks E-2 and F-7 (BLM study types 39 - Vulnerable Populations, 40 - Life History).

<u>Estimated Costs, FY 79</u>:

$30,000	Kodiak
10,000	Lower Cook Inlet
10,000	NEGOA
4,000	Norton
2,000	Chukchi
4,000	Beaufort
$60,000	Total

<u>Schedule</u>: October 1978 - September 1979

<u>Performing Agency</u>:

University: University of Alaska
P.I., Degree: Francis H. Fay, Ph. D.
Title: Associate Professor
Percent of time devoted to project and role: 33% Project direction sample collection, and data analysis.

<u>Background</u>:

FY 76, FY 77, and FY 78 efforts consisted of aerial reconnaissance to locate stranded, dead and moribund animals and necropsy of selected individuals. A review of historical information on marine mammal morbidity and mortality was completed and an annotated bibliography prepared and cross-indexed. Research will be continued into FY 79 to provide information on annual variation in disease occurrence of stranded and beached carcasses. No further necropsy or analysis of mammal specimens obtained through selective collecting is anticipated in FY 79. A very large body of unpublished observations on many aspects of arctic fox (<u>Alopex lagopus</u>) biology is available to this P.I. As an alternative to commencing fieldwork on the problems of foxes, this RU will be asked to deliver a summary report dealing with fox biology as it relates to OCS activities.

<u>Objectives</u>:

Level of effort will be reduced in FY 79. Specifically, the objectives are:

1. To determine the number (by species, sex, and age) of stranded marine mammals along the Alaskan coast.

2. To determine the pathological conditions and agents that caused or contributed to the moribund condition or death of stranded animals.

3. To analyze and determine the major cause of natural mortality of those species of marine mammals that have been selectively collected by RU 229 (Pitcher), RU 243 (Calkins), RU 230 (Burns), and RU 232 (Burns) during the past three years.

4. To determine annual variation in the pathological agents that cause or contribute to moribund conditions or death of marine mammals.

5. To determine the occurrence of pathogenic agents in the natural populations of marine mammals.

6. To determine the source and probable drift trajectories for these areas where the highest incidence of beached mammal carcasses occur.

7. Synthesize and report on previously obtained, unpublished data (non-OCSEAP) on arctic foxes, relating their trophic dependencies to marine-derived beached carcasses, pathological conditions, and to offshore oil and gas development activities.

Methods:

The only significant change in sampling methods during FY 79 will be the concentration of sampling efforts on stranded dead mammals, rather than those collected for research purposes.

Output:

1. Narrative Reports: These will describe the distribution of stranded dead and moribund animals along the Alaskan coast, the type of pathogenic conditions that caused or contributed to the moribund condition or death of stranded animals, and of the annual variation in the incidences of selected pathogenic agents in natural populations.

2. Digital Data: These will be in OCSEAP formats File Type (FT) 011 - Histopathology, FT 025 - Mammal Specimen and FT 026 - Mammal Sighting 02.

3. Visual Data: Data supporting the narrative report will be provided in the form of maps, charts, figures, tables and, where appropriate, photographs. Specifically, the products will be:

   a. Maps of stranded, moribund, and dead marine mammals.

   b. Charts illustrating probable carcass drift based on stranding from known sources.

c. Figures and tables illustrating:

(1) The occurrence of pathogenic agents in selected species.

(2) The annual variation in the occurrence of pathogenic agents for selected species.

(3) The occurrence of pathogenic agents in principal life stages of selected marine mammals.

(RU 243) POPULATION ASSESSMENT, ECOLOGY AND TROPHIC RELATIONSHIPS OF STELLER SEA LIONS IN THE GULF OF ALASKA

This research unit addresses subtasks E-1 and E-2 (BLM Study Types 39 - Vulnerable Populations, 40 - Life History, 41 - Critical Habitats, 42 - Food Web Dependencies, and 1 - HC Baselines).

Estimated Cost, FY 79:	$51,000	Kodiak
	65,500	Lower Cook Inlet
	29,000	NEGOA
	$145,500	Total

Schedule: October 1, 1978 - September 30, 1979

Performing Agency:

Department: Alaska Department of Fish and Game
P. I., Degree: Donald Calkins, M.S.
Title: Marine Mammals Biologist
Percent of time devoted to project and role: 75%; project direction and field work

Other Principal Scientist significantly involved in project:

P.I., Degree: Kenneth Pitcher, M.S.
Title: Marine Mammals Biologist
Percent time devoted to Project and role: 25% participant in field work.

Background:

This project has produced a catalog and map of all hauling-out areas for sea lions in the general Gulf of Alaska region including information on numbers seen at each site. Results are improved understanding of the seasonal use patterns associated with hauling-out areas and, in most cases, determining areas actually used as rookeries (breeding locations). A large number of animals has been collected, yielding data on population composition, reproductive biology, food habits, and pathology. A large collection of organ and tissue samples has been accumulated. Analysis of this material for levels of hydrocarbons and metals began in FY 77 and will be completed in FY 79. Most of these analyses are being performed by investigators working with other research units. A major element of the work in FY 76 and FY 77 was the branding of young sea lions at principal rookeries. During FY 78 further specimen collection was limited and directed toward filling specific gaps. Considerable effort was spent in locating previously branded animals. A series of preliminary surveys to determine the population size, discreteness, and movements of the belukha whale population in Lower Cook Inlet was conducted in FY 78.

FY 79 studies will locate previously branded animals and further elucidate breeding population discreteness, dispersal, and movements from and to major rookeries. Completion of analyses of specimens and materials collected in previous years and a major synthesis effort of all existing data will be stressed.

Objectives:

1. To determine the seasonal distribution and abundance of Steller sea lions in the Gulf of Alaska, their reproductive ecology and food habits. More specifically this will involve:

    a. Determination of numbers and biomass in the Gulf of Alaska.

    b. Determination of age and sex composition at major rookeries and hauling grounds.

    c. Determination of population discreteness and seasonal patterns of movement.

    d. Determination of population productivity, age of sexual maturity, age specific reproductive rates, and mortality/ survival rates as a function of age and sex.

    e. Determination of food habits and important prey species.

2. To determine the distribution and abundance of belukha whales in Lower Cook Inlet.

3. To provide a complete synthesis of all ecological information on marine mammals in Lower Cook Inlet with emphasis on describing and evaluating the potential for impact by OCS oil and gas exploration, development, and production. Synthesis should consider the following information where available:

    a. Distribution and abundance
    b. Seasonal patterns of movement
    c. Location and characterization of important habitats
    d. Population productivity
    e. Food habits and foodweb relationships

Objective 3 will require several additional sources of information besides available ecological information on mammals. These additional sources include: the location of leased tracts, the location of exploratory rigs, the BLM Development Scenario, the results of the trajectory analysis which is being run by OCSEAP in FY 78, the results of Hayes' work on vulnerable habitats in Lower Cook Inlet (1977 - RU 059) and existing information on the sensitivity of specific components.

Methods:

Following systematic collection of specimens, standard laboratory procedures are used for analyses, including taking of standard marine mammal measurements, gross and microscopic examination of reproductive condition, reading of cementum annuli, and identification of stomach and intestinal contents. Aerial and vessel-based surveys are employed to determine patterns of use of hauling-out areas and to locate branded animals, supplemented by on-land observations. Animals are branded to distinguish place and year of birth, principally at the major rookeries.

Output:

1. Narrative reports providing syntheses of information on subjects and parameters listed above will be furnished in FY 80. These syntheses will be initiated in FY 79. Specific products to be furnished are:

   a. A synthesis of all available information on seasonal distribution and abundance, breeding and concentration areas, population and trophic dynamics, effects of disturbance, seasonal movement patterns and critical habitats of Steller sea lions in the Gulf of Alaska;

   b. Analyses of sea otter behavior and ecology in the Afognak-Marmot Islands area;

   c. Distribution and abundance estimates of beluga whales in Lower Cook Inlet;

   d. A complete synthesis of all information available on the marine mammals of Lower Cook Inlet. Interpretaion of data relating behavior to OCS development activities will be stressed;

   e. All of the synthesis information available on marine mammals of Lower Cook Inlet (addresses Objective 3) will be provided as a final report in FY 79.

2. Digital data as listed in appropriate marine mammal formats: 025 and 027.

3. Visual data in the form of maps showing hauling-out areas and rookeries, numbers present at various seasons, and sightings of branded animals.

4. Participation in synthesis meetings and review of synthesis reports.

(RU 341) POPULATION DYNAMICS AND TROPHIC RELATIONSHIPS OF MARINE BIRDS IN THE GULF OF ALASKA

This research unit addresses subtasks E-3 and E-4 (BLM Study Types 41 - Critical Habitats and Habitat Dependencies and 42 - Food Web Dependencies).

Estimated Costs, FY 79:		
	$120,000	Lower Cook Inlet
	81,000	NEGOA
	120,000	Kodiak
	$321,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Agency: U.S. Fish and Wildlife Service
P.I., Degree: Calvin J. Lensink, Ph.D.
Title: Activity Leader
Percent of time devoted to project and role: 25%; direction and data analysis

Other Principal Scientists significantly involved in project:

P.I., Degree: Gerald Sanger, B.S.
Title: Project Leader, Seabird Trophics
Percent of time devoted to project and role: 100%; supervision, data collection and interpretation

P.I., Degree: P. J. Gould, Ph.D.
Title: Study Leader, Seabirds and Seabird Habitat
Percent of time devoted to project and role: 60%; supervision, data collection and interpretation

This research unit originally addressed only population dynamics of marine birds, but subsequent incorporation of RU's 338, 342, and 343 enlarged its scope to include seabird colony mapping and trophics studies.

Definition of foraging areas originally took part under RU 337 as part of the work on the seasonal distribution and abundance of marine birds utilizing pelagic habitats. During FY 77 emphasis on shipboard surveys was reduced and aerial surveys emphasized to complete the reconnaissance phase of the program.

The characterization of the food habits and feeding ecology of marine birds was initiated in 1975. It consists of collections of data at breeding colonies, on the open ocean and in coastal concentration areas.

The major emphasis of the work has been on seabirds, but some data are available on shorebirds and waterfowl. In 1976-77, the bulk of the field effort was concentrated in the Kodiak area and included collections

at colonies and coastal waters in support of an integrated nearshore ecosystem study. An integrated food web study was initiated in FY 78 in Lower Cook Inlet.

Population dynamics studies at major seabird colonies and selected coastal estuaries began in 1975. This work, continued through 1978, has provided information bases ranging in length from one to four years at 14 seabird breeding colonies along the Alaskan coast between Kayak Island in NEGOA and St. Lawrence Island in the northern Bering Sea. Data on shorebirds and waterfowl have been obtained from the Yukon delta, lagoon systems on the northern Alaska Peninsula, and from the Copper River.

Seabird colony mapping was largely completed in FY 77. A small study of colonies on the southwestern side of Kodiak Island was the only work addressing that objective in FY 78.

A beached bird study was initiated as a relatively modest project in FY 78. The work, intended to produce indices of seabird mortality, was discontinued when it became apparent that the low data return would not produce conclusive results within a reasonable time period.

Most of the research unit objectives have been satisfied, thus the emphasis of FY 79 work will be on completion of the field work on population dynamics, phenology, and productivity studies at colonies not yet intensively investigated, and the acquisition of seabird trophics data on selected species, including elements of integrated foodweb investigations. These studies will be confined to the NEGOA, Lower Cook Inlet, and Kodiak lease areas. The work in the latter two areas will continue to support the integrated nearshore ecosystems investigations in progress, while work in the NEGOA will concentrate on further definition of the foraging areas around Middleton Island in conjunction with the colony studies. Field efforts in all three lease areas will be substantially reduced to a few identified colonies, aimed at selected species representative of various marine bird environments in terms of behavioral characteristics.

Objectives:

The major thrust of the research is to develop a capability to predict the rate of recovery of seabird species from impacts of petroleum spills. Recovery is largely a function of productivity, thus this aspect of seabird studies is stressed. Many factors affect productivity, so the research objectives consist of several elements. This study addresses the reproductive ecology, phenology, foraging, and trophic relationships of selected marine bird species in the Gulf of Alaska. Specifically, the objectives are:

1. To determine timing and use of major rookeries by marine birds in NEGOA, Lower Cook Inlet, and Kodiak Island areas.

2. To describe on an annual basis, species productivity, i.e., hatching, fledging, and growth rates in those rookeries.

3. To describe year-to-year variations in phenology and productivity of seabird species as a function of location, environmental conditions and other pertinent factors.

4. To define feeding habits of principal life stages of selected marine bird species in terms of prey taken, season, and location, with emphasis on the species of diving birds.

5. To locate primary seabird foraging areas in coastal waters and determine the extent and timing of use and conditions fostering concentrations of prey.

Methods:

Methods will be similar to those used in previous years. Field camps will be established at the rookeries and manned throughout the nesting season. The work at the colonies will consist of mapping rookeries, determining species composition and abundance, monitoring timing and success of egg laying, hatching and chick fledging, and making collections for food habits studies. Seabird trophics studies in the coastal waters of Lower Cook Inlet and Kodiak Island will involve periodic collections of samples of selected seabird species, and observations of feeding locations and food available. Foraging surveys in the Gulf of Alaska adjacent to Middleton Island will utilize standard shipboard transect methodology to locate and delineate the size of these areas.

Outputs:

1. Narrative Reports: Population dynamics reports will describe the phenology of major events in the nesting cycle at each colony and the reproductive ecology of species studied. They will also include, as the data allow, estimates of the number of individuals in each seabird species present at the colony.

   Seabird trophics reports will consist of discussions of the feeding ecology of selected species, including data on prey species, size and numbers with respect to season and location. Information will be included on the extent, location, and temporal changes in foraging areas as well as other aspects of feeding ecology as the data-gathering effects allow.

   Discussions of population and trophic dynamics should include evaluations of inter-year and inter-colony variability when sufficient information is available.

2. Digital Data: The results of this study will be submitted on magnetic tape for archival in EDS under the following OCSEAP

file types: 031 - Marine Bird Specimens, 033 - Bird Sighting, 034 - Bird Sighting, 135 - Bird Colony, 038 - Seawatch for Birds, and 040 - Bird Habitat.

3. Visual Data: These will consist of:

   a. Maps which show:

      (1) Location of rookeries selected for study.
      (2) Study sites, nest locations, etc.
      (3) Shipboard transect lines.

   b. Charts which show foraging areas

   c. Tables and figures which illustrate:

      (1) Timing of use of rookeries for individual species.
      (2) Timing of use of rookeries for all species combined.
      (3) Times of arrival, egg laying, egg hatching, fledging and departure from the rookery by species studied.
      (4) Hatching and fledging success and growth rates for species studied.
      (5) Food habits for species studied as functions of bird size, age, and sex, and prey species, size and numbers.
      (6) Changes in intensity of use of major foraging areas.
      (7) Changes in the range of foraging excursions by selected species for major rookeries.

(RU 417) ECOLOGICAL STUDIES OF INTERTIDAL AND SHALLOW SUBTIDAL HABITATS IN LOWER COOK INLET AND NEGOA

This research unit addresses subtasks E-8 and E-9 (BLM Study Types 39 - Vulnerable Population, 40 - Life History, 41 - Critical Habitats, and 42 - Food Web Dependencies).

Estimated Costs:		
	$ 90,000	Lower Cook Inlet
	30,000	NEGOA
	$120,000	Total

Schedule: October 1978 - September 1979.

Performing Agency:

Agency: Dames and Moore
P.I., Degree: Dennis Lees, MS
Present time devoted to project and role: 50% - Project supervisor, sample collection, and data analysis.

Background:

During the 1975 field season, Dames and Moore personnel under subcontracts to NMFS-Auke Bay Lab (RU 78) and ADF&G (RU 27) initiated subtidal habitat studies in NEGOA (RU 78) and in Lower Cook Inlet (RU 27). In FY 76, the scope of work in Lower Cook Inlet was expanded to an intertidal reconnaissance survey and the NEGOA work was de-emphasized. In FY 77, work in Lower Cook Inlet evolved into site specific intensive studies consisting of comprehensive assessment of seasonal changes in the composition of dominant intertidal organisms in representative habitats in Lower Cook Inlet. These specific sites were: Deep Creek, Homer Spit, Gull Island, Jakalof Bay and Seldovia on the eastern side of Lower Cook Inlet; Chinita Bay, Inishin Bay, Bruin Bay, Nordyke Island, Douglas River, and offshore reefs near Bruin Bay on the western side of Lower Cook Inlet; and Port Etches/Constantine Harbor and Latouche Point in NEGOA.

The work continued in FY 78, with research directed toward seasonal and shorter-term estimations of production, standing crop, and growth for major macrophyte species, trophic relationships of dominant organisms, and growth and standing crop for selected invertebrate species. Clarification of the littoral and shallow, subtidal food webs at the specific sites has required close coordination with RU's 005 (deeper water benthos), 512 (fishes, including nearshore forms), 341 (marine birds), and 424 (seasonal distribution of meroplankton).

Work during FY 79 will involve completion of field work in NEGOA, and final laboratory and data analysis, synthesis of all available information, interpretation, and final report preparation on the intertidal and shallow subtidal habitats of Lower Cook Inlet and NEGOA.

Objectives:

1. To assess the seasonal changes in composition and define the trophic relationships amoung dominant intertidal and subtidal organisms in representative habitats in Lower Cook Inlet and NEGOA.

2. To determine the seasonal patterns of primary production, growth, and standing crop for the major macrophyte species.

3. To describe and evaluate the potential for impact by OCS oil and gas exploration, development and production on those intertidal and shallow subtidal habitats studied from FY 76 through FY 78.

Methods:

In order to address objective 1 for Lower Cook Inlet, information exchange will be required with Research Units 005 (Feder), 424 (English), and 512 (Blackburn). Objective 3 will require several additional sources of information including: the location of leased tracts, the location of exploratory rigs, the BLM Development Scenario, the results of the trajectory analysis which is being run by OCSEAP in FY 78, the results of Hayes' work (059) on vulnerable habitats in Lower Cook Inlet (1977) and NEGOA (1977) and existing information on the sensitivity of specific components.

There will be no field work in Lower Cook Inlet in FY 79. Effort will instead be devoted to completion of laboratory and data analysis, synthesis, interpretation and final report preparation.

Field work in NEGOA will be restricted to two sampling periods during the first half of the fiscal year and the rest of the year devoted to data analysis interpretation, synthesis, and final report preparation. The field sampling in NEGOA in FY 79 is necessary in order to obtain a seasonal data base for those habitats studied. The final report on the NEGOA studies will also include a comparison of the habitats with those studied in Lower Cook Inlet. If extrapolations from the larger data base in Lower Cook Inlet to NEGOA appear feasible, such extrapolations and their related findings will be discussed in the NEGOA report.

Output:

1. Narrative Reports: This will describe in detail methods used, spatial and temporal intensity of sampling, frequency and duration of measurements, background data and information, statistical analysis, results discussion, and conclusions, recommendations, and graphics illustrating data synthesis and conclusions.

2. <u>Digital Data</u>: The results of this study will be provided on magnetic tape in OCSEAP defined format. The data and procedures for quality control will be submitted to OCSEAP for archival in Environmental Data Service (EDS). This study will produce digital data in File Type 030 - Intertidal Data.

3. <u>Visual Data</u>: These will include maps, charts, figures and tables.

   a. Maps that identify:

      (1) Area surveyed.
      (2) Location of sampling sites.

   b. Charts that illustrate vertical zonation at each sampling site.

   c. Figures and tables that illustrate:

      (1) Seasonal composition of subtidal biota.
      (2) Trophic hierarchy at each study site.
      (3) Seasonal growth rates, standing biomass, and production of macrophyte communities.
      (4) Size/weight regressions for selected species, with estimates of seasonal production.

(RU 424) SEASONAL COMPOSITION AND THE RELATIONSHIP OF PLANKTONIC FAUNA (HOLOPLANKTON AND MEROPLANKTON) TO THE FOOD WEB OF SELECTED COMMUNITIES IN LOWER COOK INLET

This research unit addresses subtasks E-6, E-10, and E-13 (BLM Study Types 39 - Vulnerable Population, 40 - Life History, 41 - Critical Habitats, and 42 - Food Web Dependencies).

Estimated Costs: $105,000 Lower Cook Inlet

Schedule: October 1, 1978-September 30, 1979

Performing Agency:

University: University of Washington
P.I. Degree: T. Saunders English, Ph.D.
Title: Associate Professor
Present time devoted to project role: 33%-Program direction and data analysis.

Background:

As part of the research program established in FY 78 to investigate food webs in Lower Cook Inlet, this research unit has been determining the time of appearance and quantitative distribution of meroplankton with emphasis on ichthyoplankton, fish eggs, and the planktonic larval stages of shrimps and crabs. Based on data resulting from the sampling program in FY 77, the areas of greatest abundance appeared to be Kamishak Bay and Kachemak Bay between the months of March and July.

The emphasis in FY 79 will be final analysis of the bongo and neuston samples taken in Lower Cook Inlet in FY 78 and subsequent analysis and interpretation of results, including comparison of previous years' data from applicable stations.

Objectives:

1. Identify early-life-history stages of important components of the food webs of Lower Cook Inlet and Kachemak and Kamishak Bays.

2. Describe temporal and spatial dynamics and distributions of these important ecosystem components, specifically ichthyoplankters and meroplanktonic stages of shrimp and crabs.

3. Evaluate timing and use of specific areas within Lower Cook Inlet and its bays by these early life history stages of fishes, shrimp, and crabs.

4. Exchange data and information with RU's 5, 138, 417, 425, and 512 to provide a comprehensive understanding of the dynamics of these ecosystem components.

Methods:

Analysis of bongo and neuston data from FY 78 will involve a comparison of distributional and seasonal changes in nearshore and offshore areas of Kamishak and Kachemak Bays. This information will then be available to RU's 5, 417, 425, 341, and 512 in order to provide information relative to distribuiton of prey and planktonic life history stages of fish and benthos. In addition to interpretation of all planktonic data collected by RU 424, the final report will include a synthesis of all available information on zooplankton (both holo- and meroplankton) for Cook Inlet.

Output:

1. Narrative Report: Reports will describe methods, spatial and temporal intensity of sampling, techniques employed, current status of knowledge, description of statistical treatment, results, discussion and conclusions. Recommendations of further investigation will be defined.

2. Digital Data: Data in digital form documenting results of this study according to OCSEAP defined formats and procedures will be submitted in File Types FT008-Zooplankton 01 and FT024-Zooplankton 02.

3. Visual Data: Information will be portrayed in maps, charts, figures, and tables to support the narrative reports. Specific items are:

    a. Maps identifying sampling sites.

    b. Charts illustrating:

        (1) Temporal distribution of principal planktonic life stages for each major species or species group by season.

        (2) Primary spawning areas for major species where applicable.

    c. Figures and tables illustrating:

        (1) Temporal changes in species composition at each sampling site.

        (2) Temporal changes of relative abundance of principal life stages of major species or species groups at each sampling site.

(RU 425) COMPOSITION AND SOURCES IDENTIFICATION OF ORGANIC DETRITUS IN LOWER COOK INLET

This research unit addresses subtask E-11 (BLM Study Types 30 - Effluent Dispersion, 42 - Food Web Dependencies and 56 - Ecosystem Vulnerability).

Estimated Costs, FY 79: $52,000 Lower Cook Inlet

Schedule: October 1978 - September 1979

Performing Agency:

Agency; Pacific Marine Environmental Laboratory
P.I., Degree: Jerry D. Larrance, M.S.
Title: Biological Oceanographer
Percent of time devoted to project and role: 33%; project direction, sample collection, data analysis

Background:

This research unit was established in FY 78 to define the seasonal composition and origin of organic detrital material, to determine the short- and long-term vertical fluxes of organic particles to the bottom (coordinated with RU 152), and to determine the importance of this detrital component to the benthic community (in coordination with RU 005). Emphasis in FY 78 was on the water column organic material originated in the deeper waters of Kachemak Bay, the Lower Central Zone, and Kamishak Bay. A regularly scheduled sampling program utilizing sediment traps was established at permanent stations to measure deposition of total particulates, total organic particulates, phytoplankton cells, zooplankton fecal pellets, and macrophyte debris.

The deposition of suspended material in the water column, including organic particulate material and its associated microbiota is a hypothesized mechanism for transporting spilled oil and associated contaminants from the water column to benthos. The information resulting from this research unit and the sorption/desorption data from RU 275, hydrocarbon degradation data from RU 029, measurements of effects of hydrocarbons on microbial activity from RU 190, and measurements of the transport of suspended materials by RU 152, will provide information for preliminary assessment of this transport mechanism plus provide data to be used in the design of experiments on uptake mechanisms of biota and the resulting effects.

Work in FY 79 will involve completion of laboratory and data analysis and interpretation on the composition and source identification of organic detritus in Lower Cook Inlet and final report preparation.

Objectives:

1. Define the seasonal composition and origin of organic detrital material.

2. Determine the short- and long-term vertical fluxes of organic particles to the bottom.

3. Determine phytoplankton composition, standing stock, and productivity during the biologically active period of the year.

4. Test the feasibility for determination of sources of organic detritus by application of carbon and nitrogen isotopic composition.

Methods:

The completion of objectives 1 and 2 will require information from RUs 138 (physical oceanography) and 152 (suspended sediment studies) in the analysis. Station locations and sampling times correspond for all three research units. Information input will also be required from RU 424 (microplankton studies) to address objective 3. The final report resulting from RU 425 will provide information to RU 005 (benthic community studies) in order to interpret the detrital component in the areas studied. The final report will also include an evaluation of the carbon and nitrogen isotope technique in determining detritus sources and a recommendation relative to its employment in OCSEAP studies.

Output:

1. Narrative Reports: Reports will describe in detail methods used, spatial and temporal intensity of sampling, frequency and duration of measurements, background data and information, statistical analysis, results, discussion, and conclusions, recommendations, and graphics illustrating data synthesis and conclusions.

2. Digital Data: Data documenting the results of this study will be provided in OCSEAP defined format (on magnetic tape). The data and procedures for quality control will be submitted to OCSEAP for archival in Environmental Data Service (EDS). This study will produce digital data in File Types 028 and 029.

3. Visual Data: These will include maps, charts, figures, and tables.

    a. Maps that identify:

        1. Area surveyed
        2. Location of sampling sites

b. Figures and tables that illustrate:

1. Seasonal composition and origin of organic detrital material.
2. Seasonal and shorter-term input to subtidal benthic communities.

(RU 512) SEASONAL COMPOSITION AND FOOD WEB RELATIONSHIPS OF PELAGIC AND DEMERSAL FISHES IN LOWER COOK INLET

This research unit addresses subtask E-6 (BLM Study Types 39 - Vulnerable Population, 40 - Life History, 41 - Critical Habitats, and 42 - Food Web Dependencies.)

Estimated Costs: $100,000 Lower Cook Inlet

Schedule: October 1978 - September 1979.

Performing Agency:

Agency: Alaska Department of Fish and Game
P.I., Degree: James Blackburn, M.S.
Title: Fishery Biologist
Percent time devoted to project and role: 50% - Project direction, sample collection, and data analysis.

Background:

As part of the research program established in FY 78 to investigated food webs in Lower Cook Inlet, this research unit has been determining the seasonal composition and feeding habits of principal life stages of nearshore fishes and evaluating the timing and use of specific nearshore areas by critical life stages. Coordination of sampling areas was initiated with RU's 417 (littoral and shallow, subtidal community studies), 005 (subtidal benthic studies), and 424 (meroplankton studies). A regularly scheduled sampling program involved the sampling of pelagic and demersal fish species in Kamishak and Kachemak Bay areas. Seventeen species have been selected for which stomach analyses will be emphasized.

Field work initiated in FY 78 will continue through October 1978. Effort for the remainder of FY 79 will be devoted to final analysis and synthesis of all past information on the fisheries of Lower Cook Inlet in order to define the seasonal changes in composition and feeding habits of dominant species.

Objectives:

1. Determine the feeding habits of principal life stages of dominant pelagic and demersal fish and provide an initial description of their role in the food web.

2. Describe the seasonal composition and temporal dynamics of pelagic and demersal fish at specific sites.

3. Evaluate the timing and use of specific areas by the pelagic and demersal fish.

4. Review all past information on the fisheries in Lower Cook Inlet, including commerical and sports catch statistics, in order to determine the past and future trends in the importance of these species and to define the geographical and seasonal locations of fishing areas.

5. Define the geographical locations and seasonal use of spawning areas to the highest resolution possible.

6. Identify the geographical and seasonal locations of important prey.

7. Describe and evaluate the potential for impact on commercial, potentially commercial, and sports fisheries by OCS oil and gas explorations, development, and production based on the findings of the above six objectives plus existing information on the sensitivity of various life stages of these species, and geographical areas of potential risk.

Methods:

Information to address objective 5 should be on hand within ADF&G. Additional information on shellfish will be provided by RU 005. In order to address objective 5, input will be required from RUs 417 and 424, as well as published reports on Kachemak Bay by Haynes (1976) and Sundberg and Clausen (1976). Research Units 005, 417, 424 will be directed to provide input to RU 512 in order to address objective 6. Objective 7 is extremely important and is really the basic goal of the fisheries research in Lower Cook Inlet. The identification of areas of potential risk should be derived from several sources including the location of leased tracts, the location of exploratory rigs, the BLM Development Scenarios, the results of the trajectory analysis which is being run by OCSEAP in FY 78, the results of Hayes' work on vulnerable habitats in Lower Cook Inlet (1977), and existing literature information on the sensitivity of specific components.

Output:

1. Narrative Report: Reports will describe methods, spatial and temporal intensity of sampling, current status of knowledge, description of statistical treatement, results, discussion and conclusions. Recommendations for further investigations will be defined.

   Reports will provide an integrated analysis of biological activity at each study site and a discussion of trophic relationships in the area with an additional attempt to identify critical links in the food web.

2. <u>Digital Data</u>: Data in digital form documenting results of this study according to OCSEAP defined formats and procedures will be submitted to OCSEAP for archival in EDS. Data will be submitted in File Type FT 023 - Ground Fish.

3. <u>Visual Data</u>: Information will be portrayed on maps, charts, and in figures and tables to support the narrative reports. Specific times are:

   a. Maps identifying sampling sites.

   b. Charts illustrating:

      (1) Seasonal distribution of principal life stages for each major species or species group by season.

      (2) The primary use made of an area, i.e., migration feeding and/or spawning.

      (3) Primary spawning areas or depth for major species where applicable.

   c. Figures and tables illustrating:

      (1) Seasonal changes in species composition at each sampling site.

      (2) Seasonal changes of relative abundance of principal life stages of major species or species group at each sampling site.

      (3) Seasonal use made of sampling areas, i.e., migration, feeding, and/or spawning.

      (4) Seasonal changes in food habits of principal life stages of major species or species groups.

      (5) Life history table of major species or species groups to include:

         (a) Spawning areas.
         (b) Spawning time.
         (c) Growth rates (including larval stages).
         (d) Age class composition.
         (e) Mortality rates.
         (f) Foraging areas (where applicable).
         (g) Food habits by principal life stages.
         (h) Identification of primary predators (where applicable).

4.5 DESCRIPTIONS FOR PROJECTS IN TASK F (EFFECTS):

F-6: P 918

F-7: RU 194

(P 918) ASSESSMENT OF THE EFFECTS OF AIRCRAFT DISTURBANCE ON SEABIRD NESTING COLONIES

This unit addresses subtask F-6 (BLM study types 53 - Effects of Noise, 54 - Tainting of Commercial Species, 55 - Environmental Recovery Rates of Ecosystems, and 56 - Ecosystem Vulnerability Indices).

Estimated Costs, FY 79: $15,200 Lower Cook Inlet

Schedule: October 1978 - September 1979

Performing Agency:

Agency: U.S. Fish & Wildlife Service
P.I., Degree: C. J. Lensink, Ph.D.
Title: Project Leader - Coastal Ecosystems
Percent of time devoted to project and role: 10%; project planning and coordination

Background:

Since there are limited nesting habitat areas available for cliff-nesting seabirds and because breeding pairs generally gather to nest in dense aggregations, they are potentially vulnerable to various human disturbances and reduced productivity. The adverse effects of aircraft noise on colonial seabirds has not been well documented; however, several field observations of aircraft-induced mortality of cliff-nesting seabirds have been reported. Such disturbances can ultimately result in significant reductions in final productivity. Aircraft disturbance mortality is a result of egg and chick losses during quick departures of adult birds from narrow ledges and abnormal gull predation.

Adverse effects from aircraft disturbances are likely to increase in the near future with the advent of increasing offshore petroleum development activities and concomitant increase in aircraft traffic. However, leases issued as a result of the lower Cook Inlet sale on 27 October 1977 contain a stipulation (No. 5) that creates a buffer zone around certain seabird colonies during the nesting season.

> "To reduce the impacts of human disturbance (i.e., aircraft and vessel traffic) at major seabird colonies and marine mammal rookeries, boats will be routed to stay at least ½-mile from all colonies and rookeries from May 1 to September 15. In addition, during this period, fixed-winged and rotary aircraft must maintain a ½-mile horizontal and 2500 foot vertical distance from seabird colonies and marine mammal rookeries. The list and geographic locations of major seabird colonies and marine mammal rookeries will be available from the Manager, Alaska OCS Office. The location of any major colonies or rookeries discovered in the future will be submitted to the Manager, Alaska OCS Office, for addition to the present list. Human safety will at all times take precedence over the provisions of this stipulation."

One major goal of the OCSEA program is "to acquire impact data that may result in modification of leasing regulations...to permit more efficient (petroleum) resource recovery with maximum environmental protection." In this respect it is not known if the dimensions of the buffer zone are adequate or too generous. Therefore, this study is designed to determine the adequacy and effectiveness of lower Cook Inlet lease sale stipulation No. 5.

Objectives:

1. Observe responses of cliff-nesting seabirds such as black-legged kittiwakes, murres, and cormorants to various types of aircraft at varying distances from colonies. Special attention will be given to determine the adequacy or inadequacy of LCI lease sale stipulation No. 5.

2. Assess aircraft-induced mortality, including increased predation of cliff-nesting seabirds, and determine the reduction in final productivity due to aircraft disturbances.

Methods:

Fixed-wing and rotary aircraft flights will be scheduled to fly by and/or over a selected colony or colonies at predetermined horizontal and vertical distances. Scientists will be stationed at strategic locations to observe the birds' reactions and assess mortality.

Output:

Detailed narratives of all study methods and results; tabular and graphic summaries of results with accompanying discussions, and conclusions to be provided; recommendations on the improvement of LCI lease sale stipulation No. 5 to be presented; photographs illustrating types of mortalities associated with aircraft disturbances to be provided.

5.0 TIMING SCHEDULE AND PRODUCTS OF OCS STUDIES IN THE LOWER COOK INLET

The following products list and timing schedule of OCS studies addresses the Lower Cook Inlet lease area. The list of deliverables is a shorthand approximation for a complex, interlocking set of studies that are often difficult to represent by codes only and in which many qualifiers are necessarily left out.

The Codes used to identify BLM-required temporal and spatial resolution are as tabulated below. The same code is used to indicate present and projected levels of resolution in columns headed 77, 78, and 79. Appearance of the code in the FY 79 column indicates that funding is planned for FY 79.

Temporal Resolution

N = no temporal resolution
A = annual
S = seasonal
St = short term, days to weeks
D = diurnal, diel

Spatial Resolution

0 = information in hand, literature review
1 = qualitative, area wide, cursory
2 = semi-quantitative, hundreds of square miles scale or 25 miles of coastline
3 = semi-quantitative, 3-10 tracts scale or 10 miles of coastline
4 = quantitative, tract specific (2 to 5 miles resolution)
5 = quantitative, site specific
6 = no spatial resolution (non-site specific)

Several codes are also used to indicate existing (Pre-1978) and Projected (1978 and on) status of the effort to attain the specific products in the Data Products List. The codes used are as follow:

1. The research is ongoing, i.e. funded for FY 79.

2. The research unit effort has been terminated, and there are no plans for its resumption. The available data are, or may be, sufficient to meet stated needs.

3. Data are available from non-OCSEAP sources.

4. The data are insufficient to meet stated needs but the project has been terminated due to budget restrictions or lease area priorities.

5. Proposed research units.

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
A	CONTAMINANT BASELINE																		
A-1	Distribution and concentration of hydrocarbons.	Determine existing levels of hydrocarbons, prior to initiation of petroleum-related OCS activities.	Seasonal and spatial distribution patterns of hydrocarbons:																
			. in sediment	Narrative/ Table/Map	275/ 480					S2			S4	S5		S2	S3	S3	1
			. in benthic biota	"	275					S2			S4	S5		S2	S3	S3	1
			. in pelagic biota including neuston	"	275					S2			S4	S5		S2	S3	S3	1
			. dissolved in the work column	Narrative/ Table/Map Profile	275					S2			S4	S5		S2	S3	S3	1
			. in particulate matter within water column	"						S2			S4	S5		S2	S3	S3	1
		Determine probable sources of existing levels of hydrocarbons, i.e. biogenic or petroliferous.	Comparison of ratios of C_1/C_2 t with $^{13}C/^{12}C$	Narrative/ Table	480					S2			S4	S5		S2	S3	S3	1
		Monitor hydro-levels over broad geographical areas to determine significant changes in ambient concentration patterns following OCS development.																	
A-2	Distribution and concentration of low molecular weight (LMW) hydrocarbons in the water column	Determine existing levels of LMW hydrocarbons prior to initiation of petroleum-related OCS activities	Seasonal and spatial distribution patterns of C_1-C_4 hydrocarbons																
			. in water column	Table/Map Narrative	153					S2			S4	S5		S2	S3	S3	1
			. in sediments	"						S2			S4	S5		S2	S3	S3	1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
A-2		Determine probable sources of existing levels of hydrocarbon, i.e., biogenic or petroliferous.	Comparison of methane and C_2-C_4 hydrocarbon concentrations.		153					S2			S4	S4		S2	S3	S3	1
					153					S2			S4	S5		S2	S3	S3	1
		Use LMW hydrocarbon as an indigenous tracer or detection parameter to discern accumulation of hydrocarbon during or after OCS development.																	
		Examine the dispersion and diffusion of natural LMW hydrocarbons.																	
A-3	Distribution concentration and chemical speciation of selected toxic metals	Determine the concentration and distribution of nonvolatile petroleum components, especially toxic metals, prior to OCS development.	Seasonal and spatial distribution patterns of selected metals:																
			. in sediment	Table/Map/ Narrative	162					S2			S4	S5		S2	S3	S3	1
			. in benthic biota		162/ 506					S2			S4	S5		S2	S3	S3	1
			. in pelagic biota		162					S2			S4	S5		S2	S3	S3	1
			. in water column (soluble and suspended forms)		162/ 506					S2			S4	S5		S2	S3	S3	1
		Determine the chemical speciation and tranport mechanism of selected metals and characteristics of substrates to which they are absorbed.	Elemental composition and distribution of suspended particulate matter.	Table/Map Narrative	152					S2			S4	S5		S2	S3	S3	1
			Hydrocarbon absorption characteristics of suspended matter.		152					S2			S4	S5		S2	S3	S3	1

77-469

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
A-3		Monitor selected metal concentrations over broad geographical areas to determine significant changes following OCS development.																	

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
C-1	Description of seismic and volcanic activity.	To determine the potential hazards to platforms, pipelines and other structures due to earthquakes and volcanic equptions, as input to tract de-selection and design stipulations.	Historical earthquake epicenters, focal depths, and magnitudes	Map	251	NO				D3		D4				D4	D4	D4	1
					352											D3	–	–	2
			Earthquake magnitude vs. frequency relationships for selected areas.	Map Graph	251	NO				N2					N4	N2	N2	N2	1
			Seismic activity of surface and near-surface faults identified in geologic mapping.	Map Report	251	NO				N3		N4			N5	N3	N4	N4	1
			Relationships between earthquake magnitudes and strong ground motion.		251	NO				N2						–	–	N2	1
			Description of volcanic activity and resulting phenomena such as flows and nuees ardentes.	Map Report	251	NO				N3		N4				N3	N4	N4	1
			Seismic risk map.	Map	251	NO				N3		N4				N3	N3	N4	1
			Volcanic risk map.	Map	251	NO				N3		N4				N3	N3	N4	1

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
C-2	Description of the distribution and relative ages of surface and near-surface faults.	To determine the potential hazards to platforms, pipelines, and other structures due to active faulting; serves primarily as input to tract deselection and to provide geographic focus for earthquake studies.	Locations of surface and near-surface faults classified according to apparent recency of movement (from geologic relationships).	Map Report	327	NO				N3		N4			N5	N4	N4	-	2
C-3	Description of the types and extent of natural seafloor instability.	To determine the potential hazards to platforms, pipelines, and other structures due to slumping, compaction, and liquefaction of bottom sediments; serves as input to tract deselection and siting/design stipulations.	Delineation of existing and potential slumps and other unstable sediment masses, classified according to present relative stability.	Map	327	NO				N3		N4			N5	N3	N4	N4	1
			Thickness of unconsolidated sediment.	Map	327	NO				N3		N4			N5	N3	N4	-	2
			Description of sediment physical properties.	Map Report	327	NO				N3		N4			N5	N3	N4	N4	1
			Geologic cross-sections of potentially unstable sediment masses.	Profile	327	No				N4		N4			N5	N4	N4	N4	1
			Description of the geologic history of unconsolidated sediment units.	Map Report	327					N3						N3	N3	-	2

77-469

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
			Interpretation and description of the nature and severity of sediment instability.	Report	327	N0				N3		N4				N3	N3	N4	1
C-4	Identification and description of areas of potentially hazardous seafloor erosion, deposition, and bedform movement.	To determine the potential hazards to platforms, pipelines, and other structures due to seafloor erosion, deposition, and beform movement; serves as input to tract deselection and siting/design stipulations.	Locations of areas of of severe erosion and deposition (indicating rates where possible)	Map	327	N0				N3		N4			N5	N3	N4	N4	1
			Distribution and description of large-scale mobile bedforms showing directions and rates of movement.	Map Report	327	N0				N3		N4				N3	N4	N4	1
			Interpretations regarding the nature and severity of erosion, deposition, and bedform movement.	Report	327	N0				N3		N4				N3	N4	N4	1
C-5	Identification and description of potential coastal hazards.	To determine the potential hazards to onshore development due to coastal erosion, accretion, faulting, and other onshore surface processes; serves primarily as input to siting/ design stipulations and development plan verification.	Identification of coastal areas with severe erosion or accretion, indicating rates where possible.	Map	-	N0					N2					-	-	-	0
			Description of nearshore sediment dynamics.	Map Reports	-	N0					N2				N5	-	-	-	0

77-969

DATA	PRODUCTS					Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
C-5 cont.			Description of coastal geology, including active faults and surface processes.	Map Report	-	NO					N2				N5	-	-	-	0
			Interpretation of the potential hazards to coastal facilities.	Report	-	NO					N2				N5	-	-	-	0
C-6	(Not applicable to GOA-BS)																		
C-7	Description of the geographic distribution of ice gouging, its severity, and frequency of occurrence.	To determine the potential hazards to pipelines and other seafloor installations due to ice gouging; serves as input to siting/design stipulations.	Description of ice gouging activity, distribution, frequency, and gouge depth.	Map Report	NA														
			Interpretations regarding the nature and severity of ice gouging and its relation to ice structures and behavior.	Report	NA														
C-8	Description of the distribution and nature of gas-charged sediments.	To determine the potential hazards to platforms, pipelines and other structures due to gas-charged sediments; serves primarily as input to siting/design stipulations.	Description of the distribution and depth of gas-charged sediments.	Map Profile	327	NO				N3		N4				N3	N3	N4	1
			Identification of oil and gas seeps.	Map	327	NO				N3		N4				N3	N3	N4	1
			Descriptions of the origins and characteristics of gas-charged sediments and their potential hazards	Report	327	NO				N3		N4				N3	N4	N4	1

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
C-10	Characterization of frequency, intensity and effects of extreme oceanic events	To identify hazards to OCS exploration, development, and production activities.	1. Observational and historic information on storm surges as a function of location, season, and magnitude.	Tables															
			2. Observational and historical information on coastal katabatic winds as a function of location, season, and magnitude.	Tables															
			3. Historical information on tsunamis (see Subtask C-1)	Tables															
			4. Marine and coastal climatology, including . temperature . wind . cloud cover . wave heights . storm tracks and frequencies . coastal flooding . vessel icing	Tables Graphs															

77-469

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D	TRANSPORT																		
D-1	Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	To predict or estimate trajectories of pollutants and time of impact.	1. Analyses of historic data in the literature and previously unreported data.	Narrative with maps	138			S2	S3								S3	S3	1
					289											S2	S2	S2	1
			2. Analyses of historical data on climatic systems and meteorological events for their effects on circulation.	Narrative with maps	138			S2	S3								S3	S3	1
					367												S3	S3	1
			3. Seasonal temperature and salinity distribution.	Narrative with maps	138			S2	S3								S3	S3	1
					289			S2	S3							S2	S2	S2	1
			4. Baroclinic circulation.	-	289			S2	S3			S4				S2	S2	S2	1
			5. General circulation, based on moored current meter data.	Narrative with figures	138			S2	S3			S4					S3	S4	1
			6. Trajectories of drogues.	Maps and narrative	P910			S2	S3			S4						S3	1
			7. Discussion of mixing and estimates of lagrangian dispersion coefficients.	Narrative	P910			S2	S3			S4						S3	1
			8. Estimates of sea-surface slope.	Narrative	138			S2									S2	S2	1
			9. Measurements of local wind fields.	Narrative	367			S2									S2		2
			10. Analyses of synoptic weather data to obtain local wind and temperature fields.	Narrative with maps	367			S2	S3			S4					S3	S3	1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-1	Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	To predict or estimate trajectories of pollutants and time of impact.	11. A procedure for determining local wind fields when synoptic data and local station data are available.	Narrative	367			N6									N6	N6	1
			12. Currents, calculated by diagnostic model	Narrative	P093			S2										S2	1
			13. Currents calculated by hydrodynamical model.	Map	P093			S2										S2	1
D-2	Seasonal and shorter term description of water masses and circulation patterns in near-shore	To predict or estimate trajectories of pollutants and time of impact	1. Analyses of historic data in the literature and previously unreported data.	Narrative	138			S2									S2	S2	1
					367												S2	S2	1
			2. Analyses of historical data on climatic systems and meteorological events for their effects on circulation.	Narrative with maps	367			S2									S2	S2	1
					138												S2	S2	1
			3. Seasonal temperature and salinity distribution.	Narrative with maps	289			S2								S2	S2	S2	1
			4. Baroclinic circulation.	Narrative	289			S2								S2	S2	S2	1
			5. Near-shore circulation, based on moored current meter data.	Narrative	138			S2								S2	S2	S2	1
			6. Trajectories of drogues.	Maps and Narrative	P910				S2									S2	1

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-2	Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	To predict or estimate trajectories of pollutants and time if impact.	7. Discussion of mixing and estimates of Lagrangian dispersion coefficients.	Narrative	P910				S2									S2	1
			8. Estimates of sea surface slope.	Narrative	138				S2								S2		2
			9. Near shore currents by means of a current mapping radar.	Narrative	048				S4							S2		S4	1
			10. Analyses of satellite photos for oceanographic data.	Narrative	267				S2							S2	S2		2
					289											S2	S2	S2	1
			11. Surf zone dynamics; wave refraction diagrams, rip-current distributions.	Narrative with maps					S2										0
			12. Storm surge probability and intensity.	Narrative	347				S2							S2	S2		2
			13. Measurements of local wind fields near shore.	Narrative	367				S3								S3		2
			14. Analyses of synoptic weather data to obtain local wind and temperature fields.	Narrative with maps	367				S2								S2	S2	1
			15. A procedure for determining local wind fields when synoptic data and local station data are available.	Narrative	367				S2								S2	S2	1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-2	Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	Used to assess potential for air pollution by onshore development offshore facilities	16. Measurements of the stability of the surface (air) boundary layer and ice nuclei baseline.	Narrative	N/A				S3										
			17. Results of analysis by models.	Narrative	P093		S2	S3				S4						S4	1
			a. General circulation.	Maps															
			b. Tidal current (hydro dynamical).	Maps															
			c. Trajectory.	Maps															
			d. Trajectory with plume dynamics.	Maps															
D-3	Description of oil spill plume behavior and oil weathering processes.	Evaluation of degree of impact, areal scale of impact and contingency requirements.	1. Oil spill weathering mechanisms and estimated rates.	Narrative	499 P935														4 5
			2. Laboratory determined weathering rates	Tables	499														4
			3. Field studies to determine weathering rates.	Tables	499 P935														4 5
			4. Description of mechanisms which cause dispersal of oil plumes.	Narrative	499														4
			5. Pollutant dynamics model general.	Computer code and documentation															0
			6. Pollutant dynamics model subroutine accounting for weathering).	Computer code and report															0

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-4	Description of the types and characteristics of bottom sediments and their probable interaction with oil and biota.	To determine the probable fate of oil in association with bottom sediments, its longevity, cleanup difficulty, and possible effects on intertidal and benthic biota; serves as input to tract deselection.	Description of sediment grain size properties.	Map	490					N2	N3					N2	N3	N3	1
					275											N2	N3	N3	1
					430											N2	N3	N3	1
			Description of coast-morphology, beach materials, and relative vulnerability of the coast to spilled oil.	Map Report	059					N2	N3					N2			2
			Interpretation regarding the interaction between oil and bottom sediment, oil retention capability of the substrate, and implications regarding possible effects on intertidal and benthic biota.	Report	152					N2	N3						N2	N3	1
					275												N2	N3	1
D-5	Description of bottom sediment dynamics.	To determine the transport trajectory of oil in association with bottom sediments. Serves as input to tract deselection and to hazards studies.	Description of the directions and rates of bottom sediment movement.	Map Report	327					N2	N3					N2	N2	N3	1
					430											N2	N2	N3	1
			Interpretation regarding the mechanisms of entrainment and transport of bottom sediment and their relationship to physical oceanographic processes.	Report	430					N2	N3					N2	N2	N3	1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-6	Character of suspended particulates and their effectiveness as transporters of oil.	Assessment of the impact potential of oil spills.	1. Sediment and suspended sediment distributions.	Narrative with maps	152					S2	S3						S2	S3	1
			2. Sediment movements.	Narrative with maps	152					S2	S3						S2	S3	1
			3. Tabular data, indicating extent of oil/sediment interaction under varying environmental condition.	Narrative with maps	152 275					S2	S3						S2 S2	S2 S2	1 1
			4. Relation of suspended particulate matter to terrestrial and marine sources.	Narrative	152					S2	S3						S2	S3	1
D-7	Description of sea-floor topography.	To provide input to circulation studies and hazards studies	Description of sea-floor topographic features.	Map	327			N4								N3	N4		2
D-8	Characterization of sea ice morphology including under-ice morphology.	Assessment of role of ice cover as a habitat and in transport of spilled oil.	Analysis of the historical records of ice conditions.	Report	N/A														
			Description of ice conditions, seasonally and areally from contemporary data; position of ice-front, ex.	Report seasonal maps	N/A														
			Under-ice morphology, and its potential as a trap for oil.	Report	NA														

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-9	Description of ice dynamics and their effects on transport of oil and safety of structures.	As input data to transport models and in evaluation of construction plans for safety.	Oil trajectories in over and under ice of various types.		N/A			S2	S3			S4							
			Model of ice motion under various environmental conditions.		N/A			S2	S3			S4							
D-10	Description of interaction between sea ice and oil and movement of oil in a ice field.	As input to transport models.	Model of behavior of oil incorporated in ice matrix.		N/A			Resolution scale not applicable.											
			Measurements of oil movement in the presence of ice in field.		N/A			Resolution scale not applicable.											
			Comparison of model results with field results.					Resolution scale not applicable.											
D-11	Susceptibility of marshlands near the coast to inundation by oil transported by storm tides.	To assess the probability of insult to critical habitats.	Calculated probability of storm surge.	Narrative	-			S2											
			Verification of probability of storm surge by field studies	Narrative	059			S2											
			Analysis of historical storm surge records.	Narrative	347			S2											

77-969

150

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E1	Description of seasonal distribution and abundance of marine mammals.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available marine mammal data and literature.	Narrative	068	NO										NO			2
			2. Review of available literature and data on marine mammals.	Narrative	068	NO										NO			2
				Charts	ADF&(											NO			2
			3. Seasonal distributions and relative abundance of marine mammals.	Charts	229					S1	S2	S3				S2	S3		2
				Tables	240											S3			2
					243											S2	S3	S3	1
			4. Locations of marine mammal migration routes.	Charts	229	NO				S2	S2	S3				S2	S3		2
					243											S2	S3	S3	1
			5. Locations of breeding and concentration areas.	Charts	229	NO				S3	S4	S4				S3	S4		2
					243					S3		S4				S3	S4	S4	1
E-2	Description of population dynamics and trophic relations of marine mammals.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	1. Population dynamics of marine mammals, including: . reproductive biology . growth . population composition . habitat dependencies	Tables Graphs Figures	229					S2				S3		S2	S3		2
					243	NO										S2	S3	S3	1
			2. Trophics of marine mammals, including: . major prey species . foraging areas	Tables	229	NO				S2				S3		S2	S3		2
				Charts	243											S2	S3	S3	1
			3. Behavioral aspects of marine mammals relative to OCS activities.			NO				S0									0

77-469

151

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
										T	E	FS							
E-3	Description of seasonal distribution and abundance of marine birds.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of marine bird data and literature.	Narrative	339	NO										NO	NO		2
					340											NO	NO		2
			2. Literature review of marine bird data and literature.	Narrative	003											NO	NO		2
				Charts	339											NO	NO		2
				Tables	340											NO	NO		2
			3. Seasonal distribution and abundance of marine birds.	Charts	003					S2						S2	S2		
				Tables	337											S2	S2		2
			4. Locations of marine bird breeding colonies.	Charts	003	NO				S5						S5	S5		2
					338											S5	S5		2
					343											S5	S5		2
			5. Locations of marine bird concentration areas.	Charts	003	NO				S2		S3				S3	S3		2
					337											S3	S3		2
					338											S3	S3		2
					343											S3	S3		2
			6. Locations of bird migration routes.	Charts	003					S2						S2	S2		2
					337											S2	S2		2
					338											S2	S2		2
					343											2	S2		2
E-4	Description of population dynamics and trophic relations of marine birds.	To evaluate the potential effects of OCS activities on the stability of of populations within a considered critical habitat.	1. Population dynamics of marine birds, including: . breeding phenology . reproductive ecology . growth . habitat dependencies	Tables Graphs Figures	341	NO				S2		S_t1		S_t1			St1	St1	1
			2. Trophics of marine . major prey species . foraging areas	Tables Charts	341	0				S2				S3			S3	S3	1

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-4	Description of seasonal distribution and abundance of marine birds.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	3. Behavioral aspects of marine birds relative to OCS activities.			NO				SO									0
E-5	Description of the seasonal distribution and abundance of marine fish.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available marine fish data and literature.	Narrative	064					NO		NO				NO	NO		0
					174											NO	NO		2
					353											NO			2
			2. Review of available marine fish data and literature.	Narrative	174	NO				NO						NO	NO		2
				Graphs	284											NO	NO		2
			3. Seasonal distributions and relative abundance of marine fishes.	Charts	353	NO				S2						S2			2
					512											S2	S2		2
			4. Locations of spawning and concentration areas, and migration routes.	Charts	353	NO				S2		S3				S2	S3	S3	2
					424											S2	S3	S3	1
					512											S2	S3	S3	1
			5. Locations of important commercial fishing areas.	Tables		NO				S2		S3							0
E-6	Description of population dynamics and trophic relations of marine fish.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	1. Trophics of marine fishes, including: . identification of major prey species . foraging areas	Tables	424	NO				N1		S2					N1	S2	1
				Charts	512												N1	S2	1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-6	Description of population dynamics and trophic relations of marine fish.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	2. Population dynamics of marine fishes including: . reproductive biology . growth . habitat dependencies	Tables	424					N1		S2					N1	S2	1
				Charts	512												N1	S2	1
E-7	Description of seasonal distribution and abundance of benthic biota.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available literature and data on benthic biota.	Narrative	282	NO										NO			2
			2. Review of available literature and data on benthic biota.	Narrative	005	NO										NO	NO	NO	1
					417											NO	NO	NO	1
			3. Distribution and abundance of dominant benthic organisms.	Charts	005	NO				N2		S3				S1	S2	S3	1
					282											S2			2
	Description of population dynamics and trophic relations of benthic biota.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	4. Population dynamics of benthic organisms, including: . Seasonal community structure . Seasonal abundance of dominant organisms . Productivity estimates	Tables Graphs Figures	005											S1	S2	S3	1
					417											S1	S2	S3	1
			5. Trophic relations of selected benthic organisms including: . food webs . identification of major prey species	Tables Figures	005					N1		S1		S3		N1	S1	S3	1
					417											N1	S1	S3	1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-8	Description of distribution and abundance of biota in littoral communities.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available data and literature on littoral biota.	Narrative	417	NO				NO									1
			2. Review of available data and literature on littoral biota.	Narrative	417	NO													1
			3. Regional characterization of littoral habitat, including: . Substrate . Littoral community structure . Population density distributions	Charts	024	NO				S2		S3		S4		S4			2
				Figures	078											S2			2
				Tables	417											S2	S3	S4	1
E-9	Description of the ecosystem dynamics and relative abundance of biota in littoral communities.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat	1. Population dynamics of intertidal biota, including: . Seasonal community structure . Productivity	Tables Figures Graphs	417	NO				S2				S3		S3	S3		1
			2. Trophic relations of littoral fauna, including: . Food webs . Identification of major predator prey relations	Tables	417	NO				S2				S3			S3	S3	1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-10	Seasonal density distributions of principal species of plankton.	To identify critical habitats and to determine the likelihood of impact based on transport data and probable sources.	1. Time of appearance							S1		S2							
				Tables/ Graphs	424	NO										S1	S2	S2	1
				Maps/ Graphs	424	NO										S1	S2	S2	1
			2. Quantitative distributions	Graphs/ Maps	424	NO										S1	S2	S2	1
E-11	Seasonal indices of phytoplankton standing crop and production.	To identify critical habitats and to determine the likelihood of impact based on transport data and probable sources.	1. Composition	Tables/ Graphs	425	NO				N1		S2				S3			2
			2. Standing crop	Maps/ Graphs	425	NO				N1		S2		S3		S3			2
			3. Productivity	Maps/ Tables/ Graphs	425	NO				N1		S2		S3		S3			2
			4. Ecology of sea ice flora.	Narrative	N/A					N1		S2							
E-12	Non-population dependent physiological and population parameters of plankton communities.																		
E-13	Identification and seasonal characterization of critical habitats for egg and larval stages of fish and shellfish species.	To identify critical habitats and to determine the likelihood of impact based on transport data and probable sources.	1. Time of appearance	Tables/ Graphs	424	NO				S1		S2		S3		S2	S3	S3	1
			2. Quantitative distributions.	Maps/ Graphs	424	NO				S3				S6		S2	S3	S3	1
E-14	Ichthyoplankton key for Alaskan waters.	OCSEA Program development.	Ichthyoplankton key.	Key	349	NO			N6							N6			2

15.6

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-15	Characterize marine microbial communities with regard to quantitative levels of indigenous heterotrophs, chemotrophs and pathogens.	To identify critical habitats and determine likelihood of impingements based on transport data and probable sources.	1. Geographical density distributions of physiological groups in: . Water . Sediments	Maps/ Tables/ Graphs	029	NO				N2		S2				N2	S2		2
		To define the potential for petroleum degradation in specific habitats and, therefore, likelihood of impact.	2. Hydrocarbon degradation rates.	Tables/ Graphs	029	NO				N1		S1		S2		S1	S1	S2	1
			3. Evaluation of techniques used to determine oil degradation in sediments.	Narrative	190	NO				N6						NO	NO	NO	1
E-16	Response of microorganisms to normal environmental stresses.	To obtain the range of variation in microbial activity in order to provide a basis for evaluating the effect of hydrocarbon contamination.	1. Microbial activity and respiration ratios.	Tables/ Graphs	190	NO				S1		S2				S1	S2	S2	1
			2. Nitrogen fixation rates in: . Sediment . Animal guts		190	NO				S1		S2				S1	S2	S2	1
E-17	Relationship of ice movements and types to distributions and abundance of various living resources.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	Species abundance and distributions relative to: . Ice characteristics . Ice movements.	Maps/ Tables/ Graphs	003	NO											S2		2
					417												S2	S2	1

77-569

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
F-1	Review of available literature and data on toxicity of crude oils as related to species, life stage and source of oil.	To provide a basis of information on which to set priorities for research exploring the effects of oil development of the Alaskan OCS.	Summary of available information on effects of oil on Alaskan marine organisms and ecosystems.	Report	075		N6									N6			2
F-2	Acute and chronic effects of crude oil and other petroleum associated chemicals on selected organisms.	To provide a basis for assessment of the potential impact of oil development of the Alaskan OCS to the shelf areas and adjacent shorelines	1. Toxicity of oil to	Graphs Tables Charts	071		NO				N6					N6			1
			. marine mammals																
			. marine birds													NO			0
			. fish		072		NO									N6			1
			. plankton		-						N6					NO			0
			. benthos		454						N6					N6			1
			. bacteria		029 190						N6 S2					N2 S2			1 1
			2. Sublethal effects on:	Graphs Charts Tables															
			. marine mammals		071						N6					N6			1
			. marine birds		423						N6					N6			1
			. fish		073						N6					N6			1
			. plankton		-						N6					NO			0
			. benthos		454						N6					N6			1
			. bacteria		190						N6					S2			1

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
F-3	Effects of petroleum contaminants on metabolic and reproductive functions	To evaluate the potential for a petroleum contaminant to alter the stability of a population by affecting a key metabolic process in a way which increases the possibility of the organisms death before it reproduces.	1. Evaluation of effects of crude oil on carbon and nitrogen fixation in: . sediments . guts of animals	Graphs	190	NO				S1		S2					S2	S2	1
			2. Evaluation of effects of crude oil on hatching success of bird eggs.	Graphs	096 083	NO NO						S_t6 S_t6				S_t6 S_t6	S_t6 S_t6	S_t6	1 2
			3. Evaluation of effects of crude oil on thermoregulation of marine mammals		083							S_t6				S_t6	S_t6	S_t6	2
F-4	Characterization of release of toxic metals from oil impacted sediments and relative importance of metals uptake and effects on biota	To evaluate negative effects of metals associated with OCS activities on biota, to assist in siting stipulations for development.	1. Uptake/depuration of metals in benthic organisms.	Graphs Charts Tables	-											N6			0
			2. Metabolic an other sublethal effects in benthos.		454							N6				N6			1
F-5	Bioaccumulation and effects of hydrocarbons, and other contaminants through various exposure pathways.	To determine areas of greatest sensitivity in marine organisms.	1. Evaluate accumulation of hydrocarbons through experimental food chains.	Charts Graphs Tables	073 275 389							N6 N6 N6				N6 NO N6	 N6 	 N6	1 1 4
			2. Evaluate accumulation through sediment-sorbed contaminants.		454 029							N6 S3				N6 S3			1 1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
F-6	Characterization of responses of selected organisms and ecosystems to perturbations induced by contaminants or disturbances associated with OCS activities.	To identify ecosystems or organisms that are potentially susceptible to adverse cimpact from OCS activities.	1. Characterization of perturbations due to OCS activities on selected organisms and ecosystems.	Maps Tables Graphs										S5					
			2. Recovery rate of selected communities in terms of: . composition and density . productivity	Maps Tables Graphs										S5					
F-7	Types and incidences of diseases present in marine organisms.	Development of a baseline of information with which to evaluate future mortality and/or morbidity relative to OCS activities. Identify species highly susceptible to impact from OCS activities.	1. Incidence of pathological conditions in: . marine mammals . marine birds . marine fish	Tables Graphs	194 332					N1				N2		N1	N2	N1 N2	1 2
			2. Identifications of pathological agents and causes in: . marine mammals . marine birds . marine fish	Tables Graphs	194 332					N6						N1	N2	N1 N2	1 2
			3. Incidence of mortality or morbidity in natural populations of: . marine mammals . marine birds	Tables, Graphs	194 332					N1				N2		N1	N2	N1 N2	1 2

160

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
			4. Effect of oil on disease susceptibility in:	Charts Tables															
			. marine mammals		071									N6		N6			1
			. marine birds		096									N6		N6			4
			. marine fish		073									N6		N6			1
F-8	Ecological effects of oil spill countermeasures.	To provide data to be used in determining preferred countermeasures to oil spill.	1. Toxicity of dispersants to:	Charts Tables Graphs															
			. marine birds		072							S6				N0		N6	0
			. marine fish		–							S6				N0			–
			. marine mammals		–							S6				N0			0
			2. Sublethal effects of dispersants in:																
			. marine fish	073								S_t6				N0	N6		1
			. marine birds	–								S_t6				N0			0
			. marine mammals.	–								S_t6				N0			0
F-9	Characterization of structure and function of select-coastal ecosystems with respect to potential impacts of OCS development.	Identification of critical links in the food web relative to fish, benthos, birds, and mammals.	Descriptions of: . seasonal community structure . trophic relations of key species in various habitats at selected study sites.	Charts Tables Graphs	–							S1		S2	S5	N1			0

77-969

161

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
F-10	Characterization of structure and function of ice front ecosystem with respect to potential impacts of OCS development	Identification of critical links in the food web relative to fish benthos birds and mammals.	Descriptions of: . community structure . trophic relations of key species . primary and secondary production in the vicinity of the ice front.	Charts Tables Figures Graphs	N/A											-	-	-	-
F-11	Descriptions of coastal detritus systems with respect to OCS development.	Identification of critical links in the food web relative to fish, benthos, birds and mammals.	1. Definition of seasonal composition and origin of organic detrital materials.	Charts Tables Graphs	425					S1			S2				S1	S2	1
			2. Role of detritus in ecosystem energetics.	Narrative	425					S1			S2		S5			S2	1

77-969

3.0 RATIONALE FOR KODIAK RESEARCH PROGRAM

3.1 SCOPE AND DIRECTION

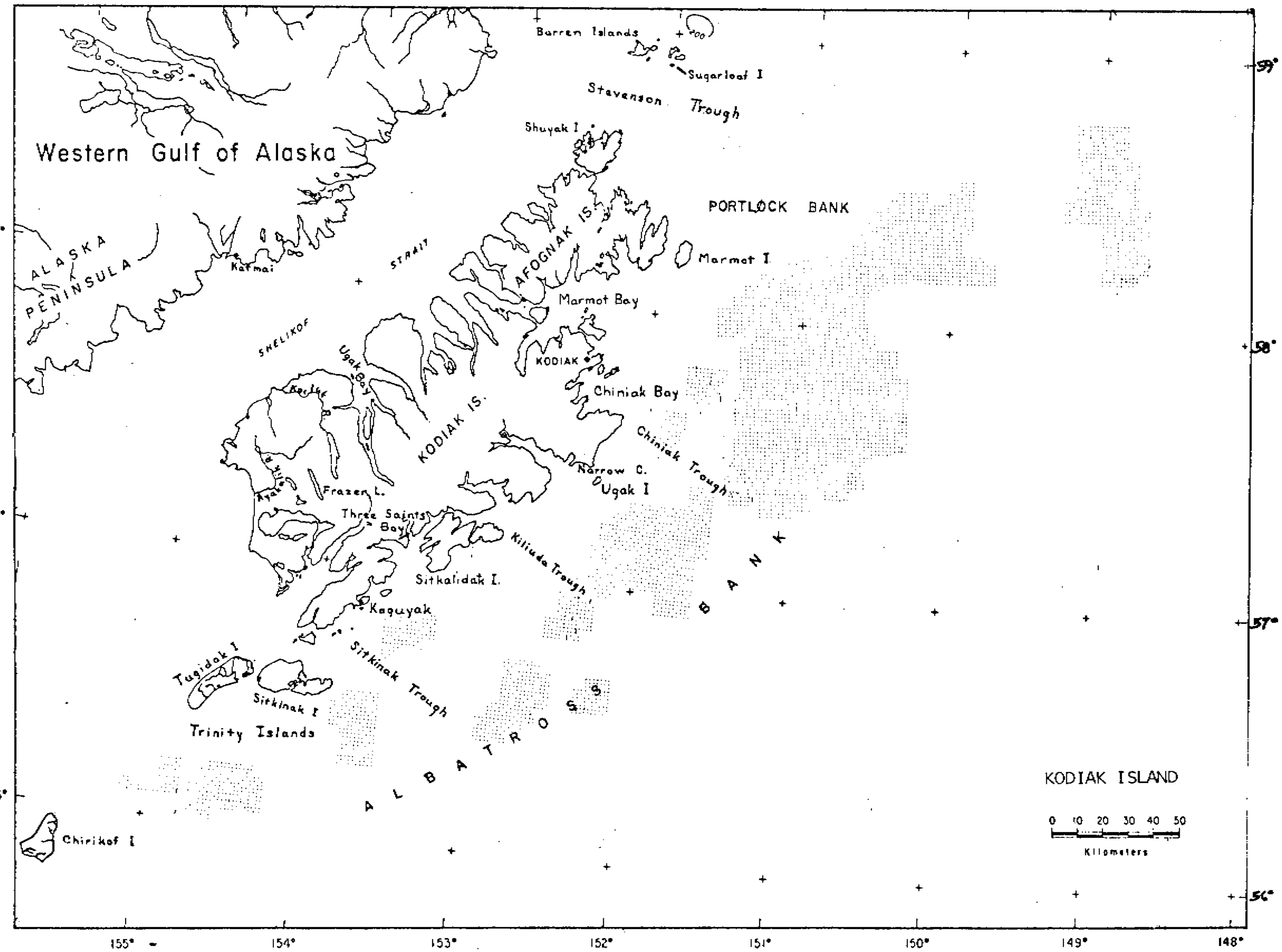
3.1.1 Premise

The assessment of marine environmental quality and biotic resources in the Kodiak region is viewed as an interdisciplinary one, involving studies in biology, chemistry, geology and physics as related to OCS development and synthesizing the resulting information into a cohesive whole. OCSEAP studies in this oil and gas lease area, initiated in FY 76, follow the Program Development Plan (PDP) in developing and managing scientific studies and providing specific products and deliverables. Research activities have evolved around the OCS Planning Schedule, information needs and objectives of BLM, and specific regional environmental characteristics. These studies are being supplemented by extensive literature searches and compilation and review of available scientific data and results as they pertain to the description of the environment and possible effects of OCS development.

The evaluation of potential adverse impacts and risks of biota and ecosystems, habitat disturbances, characterization of environmental hazards, identification of most probable landfalls and potential pathways of contaminants released in the lease area or in areas related to OCS development are some of the most important features that must be adequately addressed and understood to insure environmental safety and conservation. The relevance and needs for such studies and information products needed for decision-making are outlined in Section 2.0.

In the Kodiak lease area, OCSEAP studies have addressed the following objectives:

- Establish background levels of petroleum related contaminants in water, sediment, and selected biota. These studies address PDP Task A (Contaminant Baselines).
- Characterize vulnerability of the region to environmental hazards, including geologic (seismicity, volcanism, faulting, sediment instability, and coastal configuration and processes), meteorologic (storm winds), and oceanographic (storm waves, tsunamis). These studies address PDP Task C (Hazards).


Western Gulf of Alaska
KODIAK ISLAND
ALASKA PENINSULA
Katmai
SHELIKOF STRAIT
Barren Islands
Sugarloaf I
Stevenson Trough
Shuyak I
AFOGNAK IS.
PORTLOCK BANK
Marmot I
Marmot Bay
KODIAK
Chiniak Bay
Chiniak Trough
KODIAK IS.
Ugak Bay
Karluk
Narrow C.
Ugak I
Frazer L.
Ayakulik
Three Saints Bay
Kiliuda Trough
Sitkalidak I.
Kaguyak
Sitkinak Trough
Tugidak I
Sitkinak I
Trinity Islands
ALBATROSS BANK
Chirikof I
0 10 20 30 40 50
Kilometers
155°
154°
153°
152°
151°
150°
149°
148°
56°
57°
58°
59°

- o Determine water property distributions, mean flow characteristics and circulation regime in the water column and over the seabed, and probable contaminant trajectories. Shelf and nearshore studies are conducted in relation to the southwest moving Alaska Stream, and outflows from the Copper River and Cook Inlet. These studies address PDP Task D (Transport).
- o Evaluate extensive fish resources, both shellfish and finfish, which constitute a major source of local employment and regional economy. A part of this study relates to PDP Task E (Biota).
- o Study the distribution and abundance of the extensive and varied regional biota, evaluate factors responsible for the observed high but non-uniform productivity over the shelf, identify major bird and marine mammal colonies and delineate important foraging and hauling areas. Also included in this objective is the identification and assessment of coastal areas and embayments which are critical to feeding, spawning, rearing, and migration of fish, bird, or mammals. These studies address PDP Task E (Biota).
- o Conduct site-specific studies on trophic dynamics and evaluate potential contaminant transport through food webs. In addition, describe selected areas with regard to population density distribution, feeding and reproductive niches, and phenology of biological events. These studies address PDP Tasks E (Biota) and F (Effects).

Studies of sea ice as a potential hazard to structures and facilities offshore, as a platform for biotic dispersion, or as to its effect on contaminant transport or overall biological productivity are not relevant in this area. Effects of landfast ice on coastal geomorphology and intertidal benthic distribution will be studied by appropriate research units.

Information related to the nature and magnitude of potential contaminant input as a result of OCS activities and necessary for OCSEAP planning, establishing priorities and timing of other research tasks, will be provided by BLM as it becomes available. This information relates to PDP Task B (Sources).

Data and information generated by these studies are used in the development of a Draft Environmental Impact Statement (DEIS) and final Environmental Impact Statement (EIS) for the proposed action, lease tract selection, recommendations for platform design, pipeline permitting and routing, onshore facility design and location, and formulation of stipulations and operating procedures.

The timing and sequence of Kodiak research in FY 79 are geared toward the OCS Planning Schedule (August 1977) for Kodiak sale #46. This schedule calls for DEIS in November 1979, EIS in March 1980, proposed notice of sale in July 1980, and sale in October 1980.

3.1.2 Long-Term Needs

Concentrated OCSEAP investigations in the Kodiak lease area were initiated during FY 76 after a major expansion of the OCS environmental assessment program was requested by BLM. Prior to this expansion, Kodiak shelf and offshelf areas were investigated as part of regional circulation, biological reconnaissance and geological hazard assessment studies of the NEGOA lease area.

The level of research during FYs 76, 77, and 78 has remained relatively uniform: 27 Research Units were engaged in FY 76, 27 in FY 77, and 22 in FY 78. As expected, major emphasis to date has been placed on identifying significant biological populations, assessing geological hazards, and describing the circulation regime. So far OCSEAP studies have provided reconnaissance data on biological populations and communities at nominal and, in some cases, ordinal level of resolution, a very generalized distribution pattern of petroleum-related contaminants, an adequate knowledge of mesoscale circulation and distribution of properties, and preliminary assessment of some geological hazards at tract-scale spatial resolution. Studies on assessment of environmental hazards, process-oriented biological studies, interaction between biotic and abiotic factors, probable contaminant trajectories under different test conditions, nearshore circulation and meteorological conditions are now underway.

Due to the high productivity and complexity of biological systems of the Kodiak shelf (richness and diversity of species, varied trophic structure, synergism of biological and physical factors resulting in high biological productivity in some areas, etc.), large orographic influence on coastal meteorology, effects on circulation of local freshwater runoff and the presence of several trough and shallow banks, many of the ongoing or proposed research projects will require extensive and repetitive field sampling. Specifically, studies on seasonal species density distribution and food web relationships in the nearshore areas will require widespread and, in some localities, intensive sampling. Sample collection, the use of a variety of nets, trawls and other devices to insure a representative spectrum of size classes in collected samples, identification and enumeration of taxa, analysis of stomach contents, and synthesis of information will require allocation of adequate time, resources and facilities through FY 81. Studies on geological hazard assessment and predictability are expected to continue through the duration of OCSEAP and provide increasingly finer spatial resolution, i.e., site-specific assessment, required for exploration and production phases of OCS development. Appropriate site-specific, multidisciplinary studies will be initiated once estimates of the nature and amount of potential contaminants and habitat disturbance due to OCS development are made available. Monitoring studies over wide geographical areas will be implemented, when appropriate, to detect significant changes in ambient hydrocarbon concentrations, population distribution and productivity parameters, and water quality indicators during and after OCS development.

3.2 KEY ISSUES AND STATUS OF KNOWLEDGE

3.2.1 Key Issues

Water Circulation and Transport

Hydrographic and current meter data and diagnostic modeling studies indicate a much less energetic flow over the shelf dominated by tides and eddies. Flow direction and strength are characterized by a high degree of perturbations. The shelf circulation regime is separated by a southwesterly offshore flow near the shelf-break that is swift and consistent in direction. It is surmised that shelf circulation, espe- ially northeast of Kodiak Island, is such that the residence time of water might be considerable. Any released contaminants would remain over the shelf for much longer periods of time than in the offshore environment.

Mesoscale wind stress patterns are believed to be a dominant mechanism in driving the shelf circulation; the effect is especially marked over the banks. The role of wind stress in controlling the circulation regime may be different in different parts of the Gulf, e.g., coastal sea level and nearshore dynamic topography have good correlation at Seward but not at Yakutat. This aspect has not yet been adequately addressed for the Kodiak Shelf by OCSEAP. Data on local winds (speed and direction) and the relationship between local and synoptic scale wind fields are also not available.

Biological Productivity and Trophic Webs

The relatively long residence time of water combined with extensive macrophyte populations and detrital abundance nearshore provide additional mechanisms to support substantial secondary productivity and maintain high population densities of the commercially important species. It is speculated that the detritus-based component of the food web is significant. Many benthic forms can utilize detrital components for their energy requirements. King crab reportedly feeds on detritivorous forms and, to an extent, also on detritus. Only fragmentary and incomplete data are currently available on the mode and mechanisms of energy transfer through the food webs in this area.

Preliminary outlines for trophic structure are available for Alitak and Ugak Bays. These food webs are based on stomach content analysis of a few fish and commercial shellfish species, especially king crab, juvenile pink and chum salmon, capelin, sand lance and sculpins. Increased understanding of the structure and function of regional ecosystem dynamics can be accomplished only after temporal and spatial population changes and feeding ecology of principal life stages of important marine organisms have been quantitatively assessed. In specific locations, emphasis should be placed on meroplankton, ichthyoplankton, fish eggs, macrozooplankton/micronekton, and forage fish. Both the nearshore pelagic and benthic food webs need to be studied, preferably as a coupled system. Marine birds and mammals are dependent either directly or through trophic transfer on small pelagic (e.g., baleen whales, shearwaters, tufted puffins, etc.) and benthic (e.g., sea otter, diving ducks, etc.) communities.

Shellfish

The commercial shellfish harvest from the Kodiak area represents one-third of the total Alaskan catch (1976-77 estimate). Principal species of commercial significance include: Dungeness crab, snow crab, king crab, pink shrimp and weathervane scallop. Kodiak shelf environment is utilized seasonally by adult, juvenile, and larval forms of these species (see Table 3-1 below).

Table 3-1: Use of Kodiak Shelf by Commercially Important Invertebrates (Annual Technical Summary 1977, OCSEAP/SAI)

	SEASON			
Species	Winter	Spring	Summer	Fall
King Crab	AEJ	AEJL	AEJL	AEJ
Dungeness Crab	AEJ	AJL	AJL	AEJ
Tanner Crab	AEJ	AEJ	AELJ	AEJ
Pink Shrimp	AEJ	AEJL	AJL	AEJ
Coonstripe Shrimp	AEJ	AEJL	AJL	AEJ
Sidestripe Shrimp	AEJ	AEJL	AJL	AEJ
Humpy Shrimp	AEJ	AEJL	AJL	AEJ
Spot Shrimp	AEJ	AEJL	AJL	AEJ
Weathervane Scallop	AJ	AJ	AELJ	AJ

E = Eggs L = Larvae J = Juvenile A = Adult

Spawning areas and seasons for the ecologically and commercially important shellfish need to be delineated. Eggs, larval and juvenile aggregations may be vulnerable to environmental perturbations.

Mammals

Many of the 1.2 million fur seals that breed on the Pribilof Islands migrate by Kodiak Island in spring and fall. During migration, concentrations of fur seals occur off the east coast of Kodiak Island, particularly over Portlock Bank and southern Albatross Bank. The migratory animals apparently pause in this area to feed, mainly on capelin and sand lance.

Geologic Hazards

Kodiak lease area is located in a seismically active area, extending from Prince William Sound to the Aleutian Islands. Much of the proposed lease area experienced regional uplift that reached a maximum of 9m as a result of tectonic movement associated with the 1964 Alaska earthquake. Several active faults have been identified within and near the proposed lease area and others have been indicated.

3.2.2 Status of Knowledge

Ambient Contaminant Levels

Only limited studies on hydrocarbon and heavy metal concentrations in seawater, sediment and biota have been conducted in the western Gulf of Alaska. No data are available on the concentration and distribution of low molecular weight hydrocarbons (LMWH) in the Kodiak lease area. Water samples collected southwest of Kodiak Island contained hydrocarbon concentrations of less than 1 ppb. Concentration of total hydrocarbon in the sediments ranged from less than 1 to 26.7 μg/g dry sediment. These concentrations are as low as or lower than values reported for uncontaminated open ocean regions (Kaplan, RU 480).

Concentrations of soluble fractions of heavy metals were less than 0.02 (cadmium), 0.039 (lead), 0.155 (copper), 0.33 (zinc), 0.006 (mercury), and 1.50 (vanadium) $\mu g/\ell$. These values are lower than mean "oceanic" values. The soluble fraction was fairly uniform throughout the water column. In particular the heavy metal fraction was concentrated in the nearshore and near-bottom suspended sediments (Burrell, RU 162). Heavy metal concentrations (cadmium, copper, nickel, and zinc) have also been reported for the clam, Mytilus (Burrell, RU 162).

Hazards

Seismicity and Volcanism

In both the Kodiak and Aleutian lease areas the most serious environmental hazards are those associated with earthquakes and volcanism. Secondarily, these events may also result in mudflows, landslides, corrosive rains, and local tsunamis. A catalog of tsunamis (Cox et al., 1976) and an analysis of earthquake intensities and recurrence rates Meyers, RU 352) have been compiled for the Kodiak Shelf area. Historical earthquake recurrence rates exhibit considerably higher frequencies in this area than those noted for the adjacent Cook Inlet and NEGOA regions. Recurrence rates with a 75 km radius from 57° N, 153° W indicate an annual average of 20.9 events of magnitude 4 or greater; 4.9 events of magnitude 5.0 or greater, and 0.3 events of magnitude of 6.0 or greater. Historical data are being supplemented with new data along a regional network by Pulpan and Kienle (RU 251) on both the seismic and volcanic hazards. These data are being obtained with upgraded seismic and volcanic monitoring with better location accuracy and lower magnitude detection levels. Equipment failure in FY 76 curtailed the amount of data collected; however, it is expected that a preliminary seismic catalog and epicenter map will be produced shortly. Because of the susceptibility of the Kodiak lease area to geologic hazards, research activities of RU 251 are planned to continue through OCSEAP investigations.

Plots of epicenter locations and aftershock zones show a gap in seismic activity located between the Shumagin Islands and Kodiak Island. This area, identified as "Shumagin Gap," is believed to be of accumulative tectonic strain but has been seismically quiet since 1938. It is postulated that this strain would be released in the form of a major earthquake or is being dissipated in very small quakes. Calculations by Davies et al. (RU 16) support that a major earthquake, magnitude >7.9, may occur in this area before the year 2288, with the most probable period between 1998 and 2025.

Faulting and Sediment Stability

Hampton and Bouma (RU 327) have identified several apparently active faults near the edge of the continental slope off South Albatross, Middle Albatross and Portlock Banks. Small sediment slides (10-20m thick) have been noted all along the Kodiak shelf break and are probably triggered by seismic shocks. Continued studies by this research unit in FY 79 would provide a better resolution in the data and information on the location, geometry, offset and age of the last movement.

Sediments over the Kodiak shelf are semi-relict and their distribution directly reflects the interacting effects of bottom topography and water transport. No substantial present-day sediment source exists; clay mineral analyses suggest that at least some of the finer fraction sediments reaching Kodiak shelf originate in the Copper River Delta (Hampton and Bouma, RU 327).

Water Circulation and Transport

Oceanographic investigations in the Gulf of Alaska have been carried out intermittently for several decades. A substantial number of temperature, salinity, current meter and meteorological data were available for oceanic waters in this region prior to OCSEAP. Available knowledge of physical oceanography of the Western Gulf of Alaska and Kodiak Shelf prior to 1974 has been summarized by Ingraham, Bakun, and Favorite (RU 357). Earlier studies were either of a generalized nature (to evaluate mesoscale oceanic features) or were concentrated primarily in the NEGOA lease area. Systematic OCSEAP investigations over the Kodiak Shelf and in adjoining waters were initiated in FY 77, although seasonal temperature-salinity data along Seward, Cook Inlet, and Wide Bay transects have been collected periodically since July 1974. So far, data from temperature-salinity surveys (Royer, RU 289), moored current meters and pressure gauges (Hayes and Schumacher, RU 138), Lagrangian drifters (Hansen, RU 217), nearshore meteorology (Reynolds and Walter, RU 367) and remote sensing (Royer, RU 289) have been obtained and reported. In addition, a diagnostic circulation model has been developed by Galt (RU 140) for Kodiak shelf and slope waters.

The nature of the shelf flow in the region between Kodiak Island and the Kenai Peninsula is extremely complex and still poorly understood. There is also the tendency of flow to follow bathymetric contours. The nature of the bathymetry over the Kodiak Shelf, marked by numerous rises, valleys and banks results in a highly irregular flow. The reported data and results indicate a swift, narrow and southwesterly flow is separated from a much less energetic flow over the shelf, dominated by tides and eddies. The baroclinic current estimates show variable and inconsistent direction and speed and occasionally flow reversals northeast of Kodiak Island (Royer, RU 289). Satellite imagery data show a bifurcation of the westward flowing current in the northern Gulf of Alaska in the area south of Middleton Island. A part of this water remains on the shelf and the rest moves southwesterly offshelf parallel to the Kodiak shelf (Royer, RU 289). There is also evidence from coarse grained sediments and bedforms in Stevenson Trough that outflowing water from Cook Inlet moves across the Kodiak Shelf via Stevenson Entrance and Trough (Hampton and Bouma, RU 327).

Data from two current meter locations, WGC-2 (57^{o} 27' N, 150^{o} 29' W) and Station 9 along Seward line (58^{o} 45' N, 148^{o} 25'W), have provided the only relatively long-time series of observations of mean currents in this area. These data have shown that currents near the shelf break off North Albatross Bank are consistently longshelf and the velocity field is dominated by mean flow with a net drift of 22 cm/sec at 20m. However, only 10 km inshore from this position, over the shelf in water about 100m deep net flow was only 3 cm/sec and currents were characterized by a considerable number of perturbations and direction changes. Over the shelf northeast of Kodiak Island, currents showed a general south-southwest direction; however, reversals in flow direction and weak and inconsistent currents were observed continuously for as long as 80 days. Five additional current meter moorings, K_1 - K_5, were placed around Kodiak Island. These moorings were recovered in spring 1977; no useful data were obtained from K_3 and K_4 mooring records, but data from the other moorings are being processed. Limited drift buoy trajectories over the shelf northeast of Kodiak Island also manifest a shelf current regime characterized by perturbations and eddy motions.

Preliminary results from diagnostic modeling studies have depicted surface and near-bottom current patterns over the Kodiak Shelf and in Shelikof Strait under different wind-stress conditions. The swift, southward moving Alaska Stream does not appear to be dependent on wind. Flow direction and strength southwest of Kodiak Island show a high degree of perturbation. Over the shelf northeast of Kodiak Island, currents are generally weak and inconsistent in direction. The effect of increased wind stress is more pronounced over the shelf in general and over the banks in particular.

Physical oceanography and transport studies are being conducted in FY 78 by Hayes and Schumacher (RU 138). Royer (RU 289), Hansen (RU 217) and Galt (RU 140). In addition, Hayes (RU 59) is studying coastal geomorphology and sediment distribution especially as they relate to contaminant retention, and Reynolds and Walter (RU 367) are evaluating mesoscale features of the surface wind field resulting from coastal orographic effects.

Biological Productivity, Communities and Populations

Plankton

No systematic OCSEAP studies have yet been conducted in the Kodiak lease area. A review of historic data on nutrients, primary productivity and chlorophyll concentration in the Gulf of Alaska has shown that no measurements were available for the Kodiak Shelf waters (Anderson and Lam, RU 58). OCSEAP plankton studies conducted in the NEGOA and Lower Cook Inlet lease area also included two stations in the vicinity of Kodiak Shelf, one station northeast of Afognak Island and the other east and offshore of Afognak-Kodiak Islands. Primary productivity levels at these two stations varied from 400 to 2400 mgc/m^2/day. Chlorophyll a concentration in the photic zone varied from 23 to 155 mg/m^2 in the upper 50 m. Nutrient availability does not appear to be a limiting factor to primary productivity. Phytoplankton taxonomic data for these two stations indicate that microflagellate are abundant in offshore waters, whereas, diatoms such as *Thalassiosira* sp. and *Chaetoceros* sp. are dominant in the nearshore.

Zooplankton of the western Gulf of Alaska are presumed to represent populations and communities continuous with those of NEGOA. Under this assumption, the neritic waters will be characterized by the presence of *Acartia* sp., *Pseudocalanus* sp., *Oithona* spp. and larval plankton. In deeper, offshore waters *Calanua cristatus*, *Calanus plumchrus*, *Ecalanus bungii bungii*, *Eukrohnia hamata*, *Aglantha digitale* and euphausiids are likely to be dominant seasonally. Earlier zooplankton data assembled in the NORPAC atlas indicated that zooplankton density in the Kodiak-Shumagin Islands region exceeded 400 mℓ/1000m^3 but was characterized by high degree of seasonal and yearly variability. No OCSEAP phytoplankton or zooplankton population distribution or productivity studies are underway in FY 78.

Fish egg and ichthyoplankton data from spring 1972 have shown that highest concentrations of fish eggs and larvae occurred on the shelf between Chirikof Island and the Trinity Islands (Dunn and Naplin, 1974). It was also noted that the highest concentration of larvae was usually offshore and to the south of the maximum egg densities. Walleye pollock eggs accounted for 97% of the total egg catch and 62% of the total larvae catch. Other species represented in the samples included: flathead sole, Alaska plaice, and rex sole for eggs and Pacific sand-lance, sculpins and rex sole for larvae. Earlier investigations have shown that fish larval abundance was generally associated with calanoid copepod populations (Lisovenko, 1960, cited in AEIDC 1974). English (RU 349) has developed an illustrated taxonomic key for marine icthyo-plankton in the Gulf of Alaska.

Preliminary, and mostly incidental, data on the abundance and distribution of juvenile fish in nearshore (Harris and Hartt, RU 485) and shelf waters (Blackburn, RU 486) were reported in FY 77 as part of biological reconnaissance surveys around Kodiak Island. Studies on offshore meroplankton (Hayes, RU 551) and nearshore meroplankton and trophic relationships (Rogers, RU 553) were initiated in FY 78 to determine seasonal composition and food web relationships in the nearshore and shelf environments.

Benthos

Aerial photographic surveys of the Kodiak coastline and intertidal area have been conducted by Zimmerman et al. (RU 78). The resulting data and photographs show major substrate types and macrophyte cover. Precipitous, wave-swept shores dominate Kodiak and adjacent islands. Outcrops of exposed bedrock, boulder beaches and coarse gravels make up almost 92% of the nearly 4000 km coastline. Sandy beaches are rare on Kodiak (3.6% of the coastline) but more common (about 50%) in the Trinity and Chirikof Islands. Several rocky intertidal sites have been sampled for biological communities and zonation. Three physical zones based on tidal amplitude (supralittoral fringe, littoral zone and infralittoral fringe) and six biological zones based on characteristic communities (Porphyra zone, barnacle zone, Fucus zone, Rhodymenia zone, Alaria zone, and Laminaria zone) have been characterized. Extensive beds of eel-grass, Phyllospadix sp., subtidal brown alga, Laminaria sp., bull kelp, Nereocysts sp., and floating kelp, Alaria sp. are found in different areas. These algae provide important substrate and cover for associated intertidal organisms and enter the food web by direct consumption (10%

of annual production) or as detrital organic matter (up to 37% of annual production). During the Kodiak Synthesis meeting (March 1977), a correspondence between areas of high macrophyte cover and productive shellfish regions was noted. Zimmerman et al. (RU 78) is continuing intertidal surveys and studying littoral zone ecology and dynamics in FY 78.

Sandy intertidal invertebrates have been studies at twelve sites on Kodiak Island and the adjacent Alaska Peninsula with emphasis on razor clam, Siliqua patula population distribution and abundance (Kaiser and Konigsberg, RU 24). Razor clams were found over a broad tidal range, from -1.2 to +1.5m, and in beach sands of fine to medium grain size. Sandy beach habitats were most extensively utilized in summer when in addition to those of razor clams, eggs, larvae, juveniles and adults of basket cockle, Clinocardium sp., and pinkneck clam, Spisula sp., are also abundant.

Russian scientists have documented both the distribution of average benthic biomass and identified trophic groups along the Kodiak Shelf. A list of 128 benthic species are identified from the Gulf of Alaska. Sessile filter feeders predominate on the Albatross banks which are characterized by coarser sediments and stronger current action. Mobile filter feeders are more abundant on the finer grained sediments of Portlock Bank. The deeper waters of Shelikof Strait contain a benthic fauna dominated by nonselective feeders. OCSEAP-sponsored data are sparse. A reconnaissance survey of epifauna of Alitak and Ugak Bays was conducted by Feder (RU 517). Ten phyla and 89 species were recognized from the samples collected with a 400 mesh Eastern otter trawl in summer 1976. No OCSEAP data on infaunal benthos are available for the Kodiak shelf. Nearshore subtidal benthic assemblages and community structures are being studied by Feder (RU 5) in FY 78.

Commercial facilities catch statistics data have recently been summarized by the Alaska Department of Fish and Game (ADF&G, 1976) and a major resource survey has been compiled by the Northwest Fisheries Service (Ronholt, Shippen and Brown, RU 174). The principal commercial shellfish are: Cancer magister (Dungeness crab), Chionoecetes bairdi (snow crab), Paralithodes camtschatica (king crab), Pandalus borealis (pink shrimp), Pandalopsis dispar (sidestripe shrimp), Patinopecten caurinus (weathervane scallop). The mating season and areas, incubation period, and spawning areas for king crab and other shellfish were discussed and delineated at the Kodiak Synthesis meeting (March 1977). Mating migrations of king crab into shallow waters begin around Kodiak Island in December and continue into spring months. Inshore areas, in general, are important mating grounds but shallow areas between the Chirikof and Trinity Islands are particularly significant. Marmot Flats, Portlock Bank and Albatross Bank are also important. King crab move back into deeper water after mating, reaching 100-150m depths by July. Eggs are incubated until the following mating season.

Snow crab inhabit the entire Kodiak area to depths greater than 400m and exhibit a preference for muddy substratum. Their migratory behavior is much less marked than in the king crab. Molting, egg deposition and hatching extend from January through July with peaks in April and May.

Dungeness crab occur in shallow water (<100m) with sandy substratum. Life history data are incomplete. Mating season is from July to September and eggs hatch in April and May. Commercial catch is relatively small and presently declining.

Shrimp are widespread around Kodiak and support a major, multi-species fishery. Mating generally takes place in September, the females incubating the eggs until they hatch in March and April. Critical spawning areas include embayments, particularly along the eastern shore and offshore gulleys such as Kiliuda Trough and Horsehead Basin. Larvae are free swimming for approximately two and one-half months before they settle to the bottom. Large concentrations are found over sand, silt or mud substrates; exploration conducted in more difficult trawling areas has been too limited to assess populations. Weathervane scallops are generally found along the east side, north to Portlock Bank.

Fish

Extensive OCSEAP studies conducted in FY 76 and 77 have supplemented the previously existing data on the distribution of commercially important fish species. During FY 77, these studies were conducted by Blackburn (RU 486) on trawling surveys over the shelf; Harris and Hartt (RU 485) on nearshore fish (both pelagic and demersal) distribution;

Stern and Rogers (RU 353) on salmon catch statistics; Ronholt et al. (RU 174) on commercial fish resource assessment; and by Macy and Wall (RU 64/354) on literature review of non-salmonid fishes.

So far, 106 species of finfish belonging to 26 families have been identified in the Kodiak area. Twenty-six species are recognized as key species on the basis of their numerical abundance, commercial value, spawning in specialized habitats, and position in the food web. These species include: Pacific herring, pink salmon, Dolly Varden, capelin, walleye pollock, Pacific cod, Pacific ocean perch, greenling, Atka mackerel, sablefish, great sculpin, yellow Irish lord, Pacific sandfish, Pacific sandlance, arrowtooth flounder, flathead sole, halibut and yellowfin sole. General information on seasonal occurrence and regional utilization of the Kodiak area (i.e., for spawning, feeding and migration) by adult, juvenile and larval forms were described and discussed at the Kodiak Synthesis meeting (March 1977). The resulting data and information have been summarized for the epipelagic and littoral zone for 35 fish species and the benthic zone for 41 species. Tentative information on the principal habitat, areas and seasons of peak occurrence and probable effect of oil has also provided for major species or species groups in the Interim Kodiak Synthesis Report (SAI/OCSEAP 1978).

Based on historical records, the mean salmon spawning run is estimated to be 11.6 million fish, with a peak of 28.9 million (Stern and Rogers, RU 353). The average number of juvenile fish leaving the Kodiak region is estimated at 330 million. The primary juvenile salmonid outmigration route is around the periphery of the northern Gulf of Alaska, rarely extending over 37 km from the shore, then southward past Kodiak. Migratory patterns and routes for different salmon species have also been described.

Harris and Hartt (RU 485) have shown that Pacific sandfish and capelin are most dominant species nearshore, especially in Ugak, Kaiugnak and Alitak Bays in summer. In the intertidal areas of the three bays, the Pacific sandlance was most abundant but showed patchy distribution. Greenlings were abundant in rocky coastal areas and in kelp beds.

Data and other information on commercial exploration of fish resources have been summarized by Ronholt et al. (RU 174). Halibut, salmon, Pacific ocean perch, walleye pollock and sablefish account for over 90% of the commercial catch. Major fishing grounds for halibut and geographical distributions of salmon catch have been delineated by the Alaska Department of Fish and Games. Those two species comprise the predominant catch by U.S. fishermen.

In view of the large amount of data on fish occurrence, distribution, and use of the Kodiak shelf environment, research in FY 78 is concentrated on offshore meroplankton and fish abundance (Hayes, RU 551); continued studies on nearshore fish distribution and abundance, both pelagic and demersal (Jackson, RU 552) and meroplankton distribution in nearshore waters and studies on trophic structure (Rogers, RU 553). Three studies are aimed to address the spatial temporal changes in the composition and feeding habits for principal life stages of fish, especially in the nearshore regime.

Birds and Mammals

Bird reconnaissance studies and population surveys have continued in the western Gulf of Alaska since FY 76. About 130 species of birds are associated with the marine environment of the Kodiak and adjacent islands for at least part of their life cycle. In addition to seabirds, shorebirds, and waterfowl, these include several species of land birds that feed or breed in coastal and beach habitats. U.S. Fish and Wildlife Service (Bartonek et al., RU 337) has identified 251 seabird nesting colonies on Kodiak with a total of more than 400,000 birds. Major colonies are located at Cathedral Island (88,000 birds) and Boulder Bay (100,000 birds). In addition, 450,000 birds nest in 14 colonies on the Barren Islands.

Relative densities and seasonal distribution of 55 bird species for the Kodiak Basin and 32 species for Shelikof Strait area have been tabulated. These data are only semi-quantitative (OCSEAP/SAI, April 1977).

From May to August, shearwaters are the most abundant birds. They are widespread around Alaska, their population concentration ranges up to 100 birds/km^2 in spring and early summer (Bartonek et al., RU 337). Large numbers of shearwaters are present throughout the summer in Chiniak and Marmot Bays. In addition to those of shearwaters, monthly population densities of 50 bird species from May to November were summarized at the Kodiak Synthesis meeting. The relative abundance of major bird families, their principal habitat areas and seasons of peak abundance and utilization of the region have also been tentatively summarized (NOAA/SAI 1977).

A large number of marine birds, belonging to more than 30 species, are known to winter along the coast and in protected bays around Kodiak Island (Arneson, RU 3). Some particularly important wintering areas are Chiniak Bay (seaducks), the Kiliuda Bay-Sitkalidak Strait area (murres), Ugak Bay (murres), and the Ugak Bay-Spiridon Bay regions (crested auklets).

Endoparasites of 138 seabirds of nine species have been analyzed (Bartonek et al., RU 341). Helminths were the predominant parasite group. Glaucous-winged gulls were most frequently parasitized, followed by the horned puffin, thick-billed murre, black-legged kittiwake, tufted puffin, and common murre.

In FY 78, OCSEAP bird studies are focused on the population dynamics, reproductive ecology, phenology, and trophic relationships of selected bird species. These studies are being conducted by RU's 337 and 341.

OCSEAP-sponsored studies in FY 77 on harbor seals (Pitcher and Calkins, RU 229), Steller sea lions (Calkins and Pitcher, RU 243), sea otters (Schneider, RU 240), and sea lions and cetaceans (Mercer, Braham, and Fiscus, RU 68) have provided substantial additional data on the distribution and ecology of marine mammals in the Kodiak area. Preliminary maps of population aggregation areas and estimates of population densities have been prepared (SAI/OCSEAP 1978; and Annual Technical Summary Report, FY 77). The largest single concentration of harbor seals, estimated at 13 to 20 thousand animals, inhabits Tugidak

Island; other smaller concentrations are noted on Ugak Island, Sitkinak Island, the Geese Islands, and Aiaktalik Island. Steller sea lions are abundant in all areas of the Kodiak Archipelago with two large rookeries located on Sugarloaf and Marmot Islands. Areas critical to sea lion populations include the Barren Islands, Marmot Island, Two-headed Island and Chirikof Island. Over 12,000 pups are born at these four locations each year. Important feeding areas include Portlock Bank, and Albatross Bank as well as Marmot Flats.

Many of th 1.2 million fur seals that breed on the Pribilof Islands migrate past Kodiak in spring and fall. They pause in the Portlock Bank and southern Albatross Bank, apparently to feed mainly on capelin and sandlance.

Three apparently discrete sea otter population areas have been recognized: Barren Islands, Shuyak-Afognak and Trinity-Chirikof Islands. As the populations are increasing, it is anticipated that northern and southern populations will become continuous.

Cetaceans, whose sightings have been recorded in the Kodiak region, include dall, white-sided and harbor porpoises and gray, minke, sei, blue, fin, humpback, killer and sperm whales. These records indicate that all of these, except possibly the killer whale, visit the area only seasonally, with peak occurrence in May-June. The eastern shelf of Kodiak is one of the three main habitats of humpback whales in the Gulf of Alaska and is also an area of major occurrence for minke, sei, and fin whales in the Gulf.

Studies on population dynamics, reproduction ecology on harbor seals (Pitcher and Calkins, RU 229) and Steller sea lion (Calkins and Pitcher, RU 243) are continued in FY 78. Braham (RU 68) is collecting cetacean population distribution data and Fay (RU 194) is surveying the general area for stranded marine mammals, their mortality and morbidity and diagnosis of pathology.

Microbiology

Only a limited amount of microbiological data have been collected in the Kodiak lease area. Heterotrophic population in surface waters and sediment are generally low, comparable to mid-ocean waters. Hydrocarbon utilizing bacteria are in lower concentrations than in other areas of the Gulf, i.e., Cook Inlet and NEGOA (Atlas, RU 30).

Microbial isolates from tissues of snow and Dungeness crabs collected from Chiniak Bay showed human pathogens, resulting from sewage contamination. Specimens collected from Ugak Bay, which does not receive sewage, were not contaminated (Atlas, RU 30). Studies on the incidence and frequency of pathology in the Kodiak marine environment in FY 78 are being conducted by McCain (RU 332).

3.3 APPROACH

3.3.1 General Program Emphasis

Preliminary, but only limited, data on hydrocarbon and trace metal concentrations in the Kodiak lease area and adjoining waters and sediments have shown generally very low values with only modest areal variability. It is also recognized that any significant external input of hydrocarbon and toxic metals can be detected against current ambient concentrations. So far there has been no evidence to suggest that low molecular weight hydrocarbons originated from petroleum seepage. Therefore, it does not seem necessary to obtain new data on hydrocarbons and trace metals with extensive areal coverage in this area. Site-specific studies prior to, during, and following development activities will be initiated, as required, in the future.

Several potential environmental hazards to OCS oil and gas development in the Kodiak lease area have been identified. These include seismicity, volcanism, faulting and unstable sediments, and severe storm events. A knowledge of the nature, frequency, and intensity of these hazards is an essential objective of OCSEAP research in this area. Studies to address potential hazards and identify vulnerable areas have been underway since FY 76. These studies are also intended to determine which lease tracts are less environmentally hazardous than others and thus contribute to a risk/benefit analysis of a particular tract and also to provide data to develop appropriate OCS orders, regulations and stipulations that would control the safety of energy development on the shelf. After a broad, regional understanding of the environmental hazards has been obtained, site-specific hazard studies will be initiated along the coast and offshore and at designated areas where continuous data collection/monitoring is warranted.

OCSEAP data reported so far and discussions at the Kodiak Synthesis Meeting (March 1977) have demonstrated that the Trinity and Chirikof Islands and the entire eastern coast and shelf of Kodiak Archipelago, from Shuyak Island to Sitkinak Strait support important biological populations and communities and may also be subject to impingement during OCS oil and gas development. Preliminary results from a USGS/BLM oil spill trajectory analysis, based on the limited current data available, have shown that the entire east side of Kodiak Archipelago is vulnerable to oil spills. According to simulated trajectories, 12% of the spills from the lease area would move ashore on or near Afognak Island, 11% on northern Kodiak Island, 4% on southern Kodiak Island, 6% on Trinity Islands, and 7% on Chirikof Island. Only 2% of the simulated trajectories remained in the vicinity of lease area, and about 56% left the area traveling south and southwest from the lease area. Many of the trajectories beach in areas of vital importance for shellfish (especially crab and shrimp) mating, rearing and catching, intertidal spawning of fish, mammal aggregations and feeding, or those representing significant bird assemblages and rich intertidal biomass. These analyses are based on the transport of surface oil by winds and currents and do not involve any consideration of dispersion and weathering of oil.

The Alaska Department of Fish and Game has identified major portions of the Trinity-Shirikof shelf as vital to the reproduction, rearing, and catch of king and snow crab. King crab catches in this area are presently amongst the highest of all Kodiak stocks.

It is also known that shelf northeast of Kodiak Island is characterized by weak, variable and inconsistent currents. Flow direction and strength southwest of Kodiak Island, in the vicinity of Trinity and Chirikof Islands, are also noted for high degree of perturbation and some meandering. Available data suggest, although not conclusively, a flow regime over the shelf in which water could remain in shallow areas for considerable periods of time, possibly for over two months. Such long residence times can promote localized high productivity, limit wide dispersal of shellfish larvae and other plankton and favor their settlement over geographically restricted areas. In case of contaminant discharges, the same features would promote longer contaminant exposure and contact with the environment and biota. There is also evidence from coarse-grained sediments and bedforms in Stevenson Trough that outflowing water from Cook Inlet moves across the Kodiak Shelf via Stevenson Entrance and Trough. This indicates that a portion of contaminants released in Cook

Inlet may spread over the eastern Kodiak Shelf. As progress in the research program continues and more field coverage and seasonal data become available, the mode, magnitude and mechanism of water transport downstream to and from the Kodiak lease area will be assessed.

It is clear that the Kodiak shelf area is characterized by a high degree of interaction among the biotic and abiotic factors. Whereas specific disciplinary studies are still required for certain tasks (for example, coastal meteorology or geological hazards), a thorough study plan for coordinated, cross-disciplinary and an ultimately holistic approach will be required to describe the environment and understand the dynamics of the Kodiak lease area and adjoining regions. In addition, site-specific studies will be required to study regional ecosystems/ biocenoses to evaluate factors responsible for localized aggregations and population abundances of commercially/ecologically/aesthetically important species.

As would be evident from the status of knowledge section, a large part of data required on population sizes of important or characteristic species and their variability, critical communities and special habitats have been or are being obtained (in FY 78). Data analyses are now required to define and discern cause and effect relationships among environmental variables and interactions implicit in assessing or predicting potential environmental or ecological damage as a result of OCS development. In view of the current status of knowledge and anticipated new data during FY 78, it is planned that future research in this lease area be focused on the following objectives:

- Calculations of contaminant trajectories and distribution of plumes to assess the nature and extent of exposure to the environment along and at the end of transport pathways.
- Identification and delineation of seasons and areas of release, aggregation and settlement of meroplankton, especially those of commercially important species.
- Identification, delineation and description of nearshore biological communities, with emphasis on forage fish.

- Food, feeding ecology, and food selectivity of major species of fish, birds and mammals.
- Determination of potential contaminant pathways through biological systems in selected areas, especially nearshore and the extent of impact on ecosystem.
- Description and prediction of the frequency and intensity of extreme and severe events in the environment.
- Compilation and analysis of existing data base and multidisciplinary synthesis of moulting information in relation to offshore oil and gas development.

3.3.2 Integrated Biological Studies

These studies were initiated in FY78 to address significant data gaps in environmental knowledge of the Kodiak lease area, especially those relating to high population densities and biological productivity ·oted for various embayments and specific regions over the shelf. Most of the data gaps were identified by OCSEAP investigators participating in the Kodiak synthesis meeting, held in March 1977, and by BLM in their statement of research needs for FY79.

Research units involved in these studies are expected to participate in joint field sampling programs, exchange resulting data and information with other investigators and coordinate progress in individual research projects. This would help insure analysis and synthesis of data in the manner, format and timing most useful to decision makers. The overall direction for obtaining specific research products and synthesis methodology, as required, will be provided by the Kodiak lease area coordinator and other affiliated OCSEAP staff.

As these studies are expected to continue through FY80, and possibly beyond FY80, and would utilize considerable amount of OCSEAP resources and logistic support, the following account is intended to provide an overview of research plans and objectives. A schedule for specific deliverables and end products from these studies will be provided after results from preliminary survey of regional biota (currently underway) become available.

The overall objective of these studies is to describe, analyze and verify the ecological community structure and productivity of selected coastal ecosystems with respect to potential impacts of oil and gas development (PDP Task F-9). In realizing this objective, several other subtasks, especially those of Task E, will also be addressed and their objectives accomplished. A limited amount of related data are already available from previous OCSEAP studies, including results from previous trawl surveys (RU 486), nearshore fish distribution (RU 485), food and food requirements of marine mammals (RU's 229, 243) and birds (RU 341), trophic relationships of snow crab, king crab, and Pacific cod (RU 517) and preliminary outline of food web structure in Alitak and Ugak Bays (RU 517). Data from these research units and literature will be utilized in achieving the objective of these studies.

Specifically, objectives of individual components of these studies include:

- Determine seasonal composition, distribution and relative abundance of major life-stages of selected planktonic taxa including fish eggs and larvae, euphausiids, copepods, and larvae of shrimps and crabs.

- Determine seasonal composition, distribution and relative abundance of major life stages of selected subtidal benthic invertebrates and demersal/pelagic fishes nearshore and in selected areas offshore.

- Determine changes in the food and feeding habits of selected species of nearshore subtidal invertebrates, fish, birds, and mammals.

- Determine the relationship between seasonal variation in oceanographic conditions and the timing of occurrence, distribution, and food habits of selected marine organisms.

- o Synthesize resulting data and results into a comprehensive description of the biological environment and trophic dynamics over the Kodiak Shelf and in selected areas.

A gradual and progressive shift in emphasis in data collection and analysis is envisioned during the course of these studies. During the first year of studies, key species and habitats will be identified. Due to the extreme variety of biota and diversity in community structure, complex interactions among various species, and interdependence of biological-chemical-physical components of the system, inclusion of all factors and entities is not only impractical but also unnecessary to accomplish OCSEAP objectives (adaptation of the resulting systems model/description to resolve practical or management problems would be nearly impossible). Therefore, a set of species, factors and entities will be selected for comprehensive study and data analysis/interpretation on the basis of results obtained from reconnaissance study, preliminary data analysis and literature review (FY 78).

Currently planned studies are expected to follow the listed steps (note that in this context the term "system" represents all associated biological/environmental entities and processes):

- o System Measurement: Obtain accurate and precise measurements or estimates of the dependent and independent variables or entities under study (FY 78, 79).

- o System Analysis: Determine, by appropriate data reduction and analysis, which variables/entities of those measured are most important in regulating the system (FY 79).

- o System Description: Take those variables/entities shown to be important and incorporate them into a coherent whole (FY 79, 80).

- System Simulation: Explore the behavior of the system model to evaluate the consequences of various strategies and policies for managing the system or determine the effects of external input to the system (FY 80, 81).

Ideally at the conclusion of these studies and synthesis of resulting information into an operational model, simulation studies to address effects of various stresses and strains on biota can be initiated. Systems simulation is an important technique to study effects of perturbations in the pelagic zone where environment or biota cannot be delineated or controlled for experimental manipulation in the field. However, it is very important to have an environmental description (systems model) that is consistent with nature, and exhibits sensitivity and response to natural variation in its constituents, i.e. variables and coefficients. Data obtained during the course of these studies are expected to address these requirements.

Major emphasis in these studies is placed on faunal assemblages, both pelagic and benthic, over the Kodiak shelf. Several commercially or ecologically significant species are involved. Spatial distribution, feeding relations, growth, migration and seasonal use of selected habitats will be determined or inferred from data in the literature for selected species. It is expected that the following information will be generated from field data and literature review.

I. Distribution and Feeding Ecology.

1. Distribution: Seasonal distribution and abundance of principal life stages of selected species, including patterns and seasonality of migration.
2. Prey Selection and Available Food: Explicit trophic levels will not be emphasized. A multispecies interactive trophic structure is envisioned presently. The realism of the study will depend to a large extent upon the realism of rules according to which one entity in this system selects its food among all entities including its own. For example, cod must eat herring, of course, but herring must also eat cod or cod-like fish when its individuals are sufficiently small in size. The following factors will be investigated:

- Prey size -- size frequency distribution of food items.

- Vulnerability to predation -- moving prey are easily taken by certain species whereas certain less mobile forms are eaten by others (cod vs haddock).

- Feeding level -- amount of food determined by metabolic requirements (assimilation efficiency, feeding history).

- Prey selection -- two animals may get the same amount of food if one moves little but eats almost everything in its way and the other is very active but eats only particular food items. Selectivity criteria are important in assessing food requirements as related to growth.

3. Efficiency of Food Conversion: Assimilation or growth conversion of ingested food.
4. Spawning: Occurs at discrete time intervals. Growth includes gonad development, after spawning growth is resumed at a reduced body weight.
5. Seasonal Growth Variation: Growth within the year depends on the variation in food supply, ultimately to levels of primary productivity. Other factors, such as temperature and daylight hours, will also be considered.
6. Stock-Recruitment Relationship: Seasonality in stock recruitment and area-specific description. High mortality on the larval, post-larval stages.
7. Mortality Induced by Fishery: Also in relation to other causes of mortality and morbidity (spawning strain, starvation, pollution, adverse physical impact).

II. Dynamics of Non-Faunal Entities

1. Nutrients
2. Phytoplankton
3. Detritus

Systematic studies on primary productivity have not been conducted in the Kodiak lease area although sporadic data are available from NEGOA and Lower Cook Inlet research units. The relative significance of detritus, bacteria, phytoplankton, and macrophytes as primary food source in the Kodiak nearshore waters and embayments is not known. This aspect of trophic dynamics is being addressed in Lower Cook Inlet (LCI) trophic studies. It is expected that pertinent data from LCI studies will be evaluated for their applicability in Kodiak and for planning similar studies in Kodiak, if needed, in the future.

III. Dynamics of Physical Environment

1. Temperature-Salinity Distribution
2. Mixing Rates
3. Water Exchange and Transport Rates
4. Circulation Regime (Tidal, Nontidal)

Correlation and interdependence of physical environmental characteristics and processes with biological population distributions and productivity will be an important component of these studies. Some of the abiotic factors, such as temperature-salinity distributions, circulation pattern, and freshwater and sediment input from land play significant and possibly controlling roles in the area-specific and time-specific distribution of species, especially the larval forms. Some populations and age-groups are also known to be demarcated by topographic features i.e., banks and troughs over the shelf.

Much of the relevant information on physical features and processes has been or will be obtained in FY78 through studies related to Tasks C (Hazards) and D (Transport), principally involving research units 138, 140, 217, 289 and 327. Information from these research units will be incorporated by individual biological research units during the course of their studies. If found necessary due to the complexity of accumulated data base, a new multidisciplinary research unit will be proposed in the future (FY 80) to integrate all relevant and available data and provide regional description of the environment and biota as they relate to planned OCS oil and gas development.

E. <u>Relevance to Oil and Gas Development</u>

- o Description of seasonal distribution and abundance of principal life stages of selected species, including migratory pathways and seasonality. Identification of critical links in the food web.

- o Evaluation of consequences of significant reduction in population or removal of food organisms. Effect on yield of commercial or sport fishery.

- o Accumulation of toxic substances in biota and its consequences (through "Effects" studies). These substances may include sediment, toxic metals, petroleum hydrocarbons, etc.

- o "Biomagnification" through food web - its consequences on coastal/nearshore biotic environment (through "Effects" studies).

- o Possible effects of altered habitats due to coastal development (i.e., structures, facilities, municipal sewage).

3.3.3. <u>Research Program in FY 79</u>

Hazards

Geologic hazards in the form of seismicity and volcanism pose potential threats to structures, platforms and other facilities. Historic records and continued observation along a regional seismic network by Pulpan and Kienle (RU 251) have shown that earthquake recurrence rates are much higher in the Kodiak lease area than in the NEGOA and Cook Inlet areas. Because of high seismic risks involved and the long-term usefulness of the information obtained, this research will continue at current level of effort and funding in FY 79. The results will include continually updated data with better location, accuracy and lower magnitude detection levels.

A serious drawback of OCSEAP seismic data is that observations are limited to events that can be detected onshore. As a result, detection threshold is high and low magnitude seismic events are not accurately recorded. A new research unit (P 925) is proposed to acquire better seismic data offshore from ocean bottom seismometers (OBS's) deployed at specific locations, e.g., near active faults. A portable instrument array will be developed to be easily deployed and recovered. A field test of this unit and data evaluation are proposed for FY 79. This task is included in non-site specific studies program.

The currently available data base on ground motion associated with major earthquakes is inadequate to assess the extent of damage resulting from a major earthquake. The need for such data was reiterated by participants of the recently concluded review of the OCSEAP geology program. An increase in the number of strong-motion instruments around the Gulf of Alaska is proposed for FY 79. Pertinent data will be obtained and analyzed by a new research unit (P 927). Proposed research efforts of this research unit will be divided in NEGOA, Kodiak, Lower Cook Inlet and Aleutian areas.

Studies to identify and describe areas of faulting and sediment slides and slumps are being continued by Hampton and Bouma (RU 327). This research unit is planned to continue studies in FY 79 as additional data are required on the location of surface and nearsurface faults, actual or potential sediment slump and slide area, distribution and dispersal of sediment especially in various troughs on the shelf. It is also proposed that the level of effort by this research unit be increased in FY 79 and funding appropriately increased.

Data reported by RU 327 have shown that troughs and banks over the Kodiak shelf are markedly different in terms of sediment accumulation and flux. Kiliuda, Chiniak and Amatuli Troughs are relatively quiet areas of sedimentation and may accumulate or retain contaminants for long periods of time. Stevenson Trough, on the other hand, is noted for strong bottom currents and apparently low rates of sediment accumulation.

No actual current meter data or sediment transport rates have been obtained for near-bottom water off Kodiak. A new research unit is proposed to determine ocean bottom morphological features, long-term changes in bedforms and correlate bottom sediment flux with general hydrography and current regime (P 430). Studies of similar nature and scope have been conducted in other OCS lease areas.

Physical Oceanography and Transport

It is planned that in FY 79 OCSEAP physical transport studies will continue to emphasize nearshore and shelf circulation. A substantial amount of data from moored current meter arrays and pressure gauges has been obtained around the Kodiak Archipelago to determine the variability in the mean flow and to elucidate temporal changes in the flow regime (Hayes, RU 138). During the FY 78 field program particular attention will be given to areas that are highly productive or where active sediment transport occurs. Data obtained through FY 78 will be compiled, analyzed, interpreted and reported during FY 79 to provide a description of reasonal variation in the current field over the shelf. Long-term current meter records obtained in offshore waters will also be examined. STD surveys, conducted by Royer (RU 289), will not be emphasized in FY 79, as sufficient salinity and density distribution data are currently available and will be supplemented by observations made in FY 78. These data will be compiled, interpreted and reported by Royer (RU 289) in FY 79. Royer (RU 289) will also continue to maintain a file and catalog of satellite imagery data and distribute these data to other investigators upon request.

Lagrangian drift buoy trajectories available for this area are only of short duration (about one week in September 1976) and cover a small area northeast of Kodiak Island (Hansen, RU 217). These data have provided additional evidence for perturbed and inconsistent flow over the Kodiak Shelf. In coastal and nearshore waters, drift buoy trajectories do not necessarily repesent nearsurface flow. The deep drogue is about 20-30m below the surface and may be drifting beneath the seasonal pycnocline. There is a possibility that buoys entering estuarine environments, as has been noted for Prince William Sound, may have followed inflowing deeper water (a manifestation of positive estuarine circulation). There might well have been an outflow of surface water. Therefore, a new research unit is proposed to obtain surface and near-surface current measurements in shelf and nearshore waters using drogues tracked by precision navigational equipment and radar (P 910). The drogues will be constructed so that they penetrate the upper one meter or less of the water column. Data obtained from these drogues will also be used to correlate local wind patterns (RU 367) with surface currents.

Presently only a modest number of data are available on local wind fields and meteorological conditions in nearshore areas of the Kodiak Shelf. Nearshore winds can differ significantly from synoptic weather charts because of strong coastal orographic effects. These differences can lead to errors in contaminant transport calculations that are usually based on synoptic geostrophic winds. It is planned in FY 79, coastal and nearshore meteorological studies will be intensified (Reynolds, RU 367). These studies will also involve refinements of the mesoscale wind model (developed for the Icy Bay region) and continued field observation program for the Kodiak Shelf.

Modeling studies by Galt (RU 140) are planned to continue in FY 79 at previous year's level. The modeling task is being accomplished by formulating three models: a diagnostic circulation model, a pollution trajectory model, and a meteorological model. Results of the diagnostic model can now be coupled to a pollutant trajectory model to obtain simulated trajectories and approximate landfalls under different test conditions. Several changes are being implemented into earlier versions and formulations of these models to obtain better outputs, improve documentation and minimize boundary condition problems. New routines to handle time-series data and to solve the distribution of variables equation are also being incorporated. It is expected that in FY 79, this research unit will synthesize the submodels describing the flow regime, pollutant trajectories and pollutant concentrations near landfalls using available input and verification data from field observations and laboratory experiments.

Biological Productivity, Communities, Populations

A shift in emphasis in biological research from population abundance estimates to feeding and reproductive ecology was initiated in FY 78. It is planned that reconnaissance level surveys of intertidal and subtidal benthos and for certain species of birds and marine mammals which are continuing in FY 78 will be discontinued in FY 79. Emphasis will be placed on environmental factors affecting biological populations and communities and on the phenology and ecology of selected species. A sound knowledge of the spatial and temporal distribution of major organisms, their migratory pathways, habitat dependence and potential susceptibility to impact is a prerequisite for a thorough understanding of the highly productive Kodiak Shelf ecosystem with detail and realism appropriate to assess implication of OCS development. In addition, meroplankton distribution patterns (especially those of commercially important shellfish), the role of forage fish in trophic structure, and feeding habits of life stages of selected species need to be addressed as part of a coordinated study on Kodiak food web structure.

OCSEAP studies have provided a forum for addressing various aspects of regional ecosystem and trophic dynamics studies, as well as opportunities to collect pertinent data and obtain background information on ambient contaminant levels and resources at risk. Studies on regional ecosystems and trophic dynamics were initiated in FY 78 and are planned to continue in FY 79. These studies involve the assessment of meroplankton and macroplankton abundance and distribution in offshore waters (Hayes, RU 551), nearshore fish distribution and abundance, both pelagic and demersal species (Jackson, RU 552), study of food relations and prey selectivity by major fish species (Rogers, RU 553), and community structure and feeding ecology of selected subtidal benthic species (Feder, RU 5). Once the necessary data base has been acquired these studies will be integrated to formulate nearshore trophic dynamics structure at selected areas. Biological data will also be correlated with major physical factors and processes to describe areas of vulnerable biological assemblages and estimate the extent of habitat dependency by principal species. Continued studies on higher forms, seabirds and marine mammals, in FY 78 will provide new data on feeding relationships, reproductive ecology and phenology that would also supplement the information bases for biocenoses/synecology of selected regions.

A large amount of avian data has been obtained and reported by several research units. Broad-scale reconnaissance studies were completed in FY 77, while foraging excursions from major rookeries (RU 337) and reproductive ecology and phenology of certain bird species (RU 341) are being addressed during FY 78. It is planned that these data be used to identify effects of large-scale environmental changes on bird communities and to estimate population density fluxes, biomass changes and bioenergetic demands of important bird species. This task will be addressed by Wien (RU 108). Additional data on feeding ecology and food requirements of selected species will be obtained by Lensink (RU 341) in FY 79.

It is also planned that studies on seasonal distribution and abundance, population dynamics and reproductive ecology of Steller sea lions (Calkins, RU 243) and harbor seals (Pitcher, RU 229) be continued in FY 79. The major objective of these RUs will be to provide comprehensive, interpretive reports based on existing data base. Studies to determine pathological conditions and major causes of morbidity and mortality in marine mammals were initiated in this area in FY 78 (Fay, RU 194). It is planned that these studies also be continued in FY 79.

3.4 SELECTED PROJECTS

Kodiak research studies planned for FY 79 reflect information needs and priorities related to BLM requirements, the present OCS Planning Schedule, and important scientific data gaps identified in Annual Research Reports submitted to date and discussed at the Kodiak Synthesis Meeting held in March 1977 (see Table 3.2). The planned research addresses Tasks C (Hazards), D (Transport, E (Biota), and F (Effects). This year emphasis is placed on studies related to nearshore biological community structure and trophic dynamics with respect to potential impacts of OCS development. Selected projects for FY 79 are listed below (proposed research studies for FY 79 (P units) are not included).

RU 251 Seismic and Tectonic Hazards (Subtask C-1)

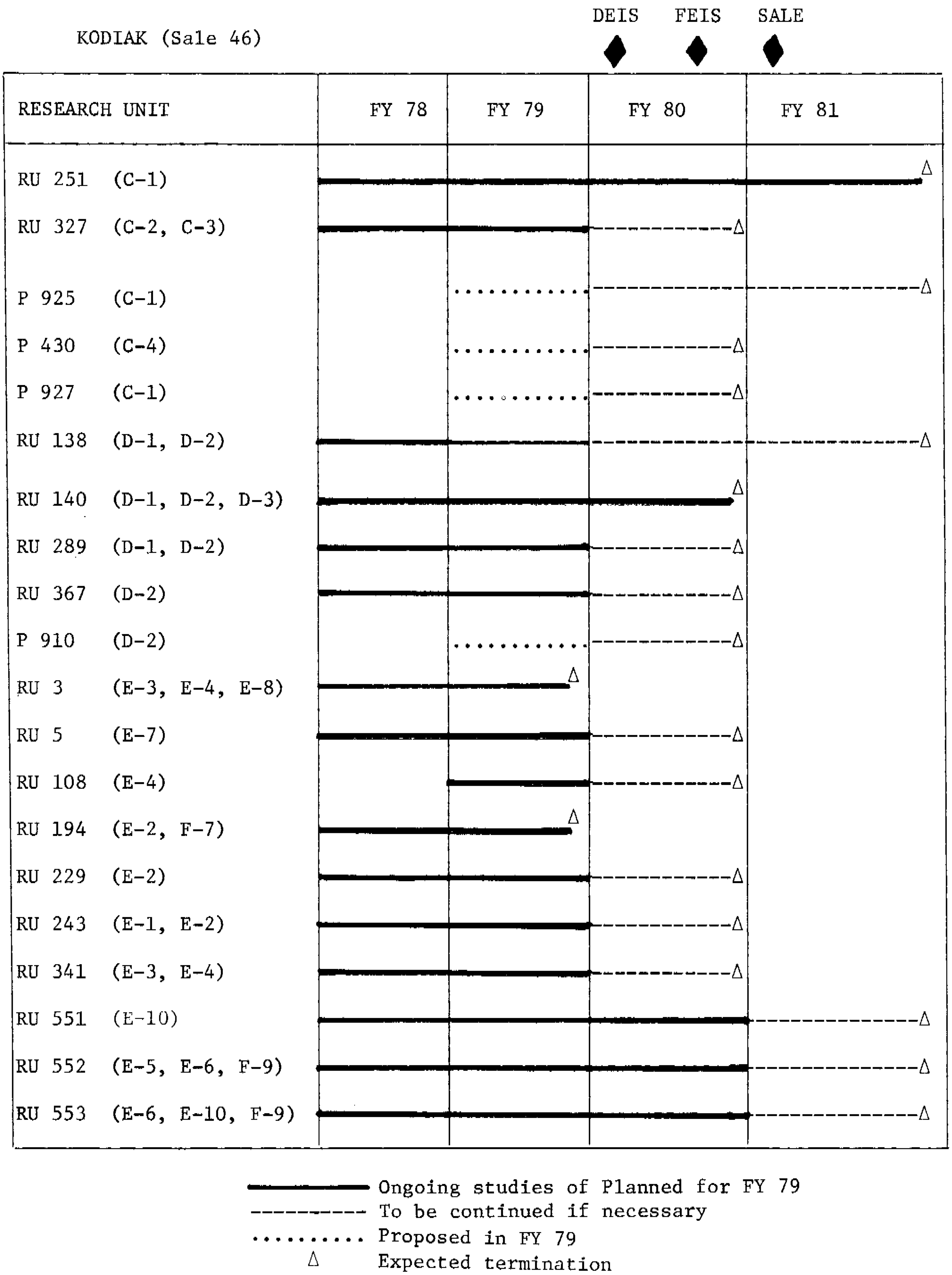
This research unit is engaged in studies on seismicity and its relationship to identifiable tectonic features such as faults. In FY 79, continued emphasis will be placed upon risk analysis as opposed to previous efforts which were largely devoted to bringing the regional monitoring system to a reliable level of performance. Tectonic risk maps are presently under preparation. Continued maintenance of the seismic network will greatly improve the existing data base. Successful completion of risk studies would imply that fundamental seismological input parameters for seismic zoning and microzoning are available and can be used for decision-making purposes.

This research unit is also monitoring microtectonic activity of active volcanoes in the region and combining these data with historic records to determine eruption potential and associated risks.

RU 327 Near Surface Geologic Hazards (Subtasks C-2, C-3)

This research unit will continue to obtain data and information to identify general areas of active surface faulting, slope instability, sediment erosion and deposition as well as to classify the surface and nearsurface sediment types. In addition, the length, orientation and displacement of shallow faults and the geometry and boundaries of major

Table 3.2 Schedule of Research Units Selected for FY 79. Appropriate PDP Tasks and Subtasks are given in parentheses.



slumps will be determined. A few key sedimentary, structural or physiographic provinces will be chosen for detailed surveying and intensive sampling to represent other equivalent areas that can be identified but not studied in detail. This research unit will also provide an analysis and interpretation of the present day geological conditions as they relate to OCS development.

RU 138 Mesoscale and Shelf Circulation (Subtasks D-1, D-2)

This research unit will analyze and synthesize CTD, current meters and pressure gauge data obtained through FY 78. Several sets of current meters and pressure gauges are currently moored on the Kodiak shelf. Recovery of data and their analysis and interpretation during the current year and in FY 79 will greatly enhance the knowledge of water transport in the water column and over the seabed. It is expected that in FY 79 both the spatial and seasonal variabilities in the flow field will be resolved and the influence of bathymetry and meteorological conditions assessed. The resulting information will also be utilized by other research units, for example, to identify and evaluate hydrocarbon factors responsible for observed biological distribution and separation of populations.

RU 289 Distribution of Water Properties and Circulation (Subtasks D-1, D-2)

This research unit has conducted surveys for temperature-salinity profiles along the Gulf of Alaska station grid and a regional Kodiak Island-Shelikof Strait grid. These data have been used to determine property distributions, water mass characteristics, and to infer baroclinic currents fields and transport. STD data collection will not be emphasized in FY 79 but previously obtained data will be analyzed, interpreted and reported. A catalog and file of satellite imagery data will continue to be maintained by this research unit and resulting photographs distributed to other investigators.

RU 140 Circulation and Oil Spill Trajectory Modeling (Subtasks D-1, D-2, D-3)

The primary objective of continued studies by this research unit is to describe, synthesize, and communicate observational and theoretical studies on the distribution and movement of hydrocarbon contaminants on the sea. Currently, this objective is being addressed by formulating three models: a diagnostic circulation model, an oil spill trajectory model, and a meteorological model. Results of the diagnostic model can now be coupled to an oil spill trajectory model to obtain simulated trajectories and approximate landfalls under different test conditions. Several changes and refinements will be implemented into earlier versions and formulations of these models to obtain graphics and outputs compatible with OCSEAP and BLM needs, to improve documentation with additional field data and to minimize boundary conditions. Additionally, routines for weathering advection and diffusion of oil slicks in the sea will be incorporated to show both oil density and the distribution in time of Lagrangian elements.

RU 367 Coastal Meteorology (Subtask D-2)

This research unit will continue studies of coastal meteorology and describe local wind patterns as related to synoptic field. Nearshore winds in this area can differ significantly from synoptic weather charts because of strong orographic effects. This research unit will continue to obtain coastal wind data as well as measurements from a continuously recording meteorological buoy, shipboard and aircraft. The resulting data will also be used to verify results of a meteorological model, being developed by RU 140, under different test and field conditions. Reliable estimates of nearshore winds are also required in contaminant transport calculations.

RU 194 Natural Mortality and Morbidity of Mammals (Subtask E-2, F-7)

This research unit is investigating the causes of natural mortality and morbidity in marine mammals with emphasis on determining the kinds and incidences of pathological conditions and identification of causative agents.

RU 229 Biology, Population Dynamics, and Trophic Relationships of Harbor Seals (Subtask E-2)

This research unit will continue studies on the biology and life history of harbor seals. In FY 79 emphasis will be placed on seasonal changes in food habits, reproduction and growth. In addition, trend count locations will be established to monitor population changes. Studies on population segregations and movements will also be conducted, especially on Tugidak Island where a very large population resides. A comprehensive, narrative report based on existing data base is expected at the end of this contract period.

RU 243 Biology, Population Dynamics and Trophic Relationships of Steller Sea Lions (Subtask E-1, E-2)

This research unit is engaged in studies on the distribution, abundance, and trophic relationships of Steller sea lions. Population dynamics and stock separation are being studied by a mark-recapture technique. Earlier data have indicated considerable movement of populations from exposed summer rookeries to more protected wintering areas. However, population aggregation patterns based on sex or age structure have not been established. As these animals are tertiary consumers, their food habits and requirements as well as selectivity of prey species play an important role in community energetics and biological productivity of regional environments. Compilation and analysis of all existing data will be initiated in FY 79.

RU 3 Coastal Migratory Bird Habitats (Subtasks E-3, E-4, E-8)

This research unit is currently analyzing existing data base on coastal migratory birds in the Gulf of Alaska and eastern Bering Sea to determine their distribution patterns, feeding and staging areas and breeding locales. This work is expected to be completed soon and final narrative reports, supplemented by maps, diagrams, charts and photographs, will be submitted in FY 79.

RU 108 Bird Population Energetics (Subtask E-4)

Patterns of seasonal density distribution of avian fauna of the Kodiak Archipelago have been studied by several research units. Numerous nesting colonies and foraging areas have been identified. This and other information on bird flock dimensions and characteristics, time-specific species behavior and their food habits and requirements will be used to determine population energetics of marine birds in this area. A computer simulation model will be formulated that can be used to assess energetic consequences of potential habitat disturbances and changes in community structure associated with OCS development.

RU 341 Trophic Relationships of Selected Bird Species (Subtask E-4)

This research unit will conduct studies on feeding habits and food requirements, including the amount, variety, and selectivity of seabird species and will describe their feeding cycle and behavior. Colony, feeding and beached bird surveys will also continue in order to obtain better size estimates of colonies, demarcation of nesting and foraging areas, and population dynamics. These studies will be focused on selected species inhabiting coastal and nearshore areas and open water.

RU's 005,551 Integrated Biological Studies (Subtasks E-5, E-6, E-7, E-
552,553 10, E-15, and F-9).

The following research units will be involved in joint field sampling programs and/or data analysis in FY79.

RU 005 Subtidal Benthic Invertebrate

Seasonal distribution, feeding ecology of commercially or ecologically important epibenthic invertebrates, mass/energy transfer from sediment-detrital system to infaunal deposit feeders.

RU 551 Meroplankton and Macroplankton

Seasonal distribution, migration, and habitat use by larvae of key fish and shellfish species, taxonomic composition and abundance of neuston, abundance and distribution of key food species taken by birds and fish, distribution of fish eggs. Distribution and abundance data will be correlated with water column stratification, currents, temperature profiles and other physical factors.

RU 552 Pelagic and Demersal Fishes, Including Forage Fish

Distribution of juvenile and adult fishes with emphasis on non-salmonid pelagic species and those important as food for higher forms i.e., capelin, herring, etc., seasonality in habitat use, stock-recruitment relationship, times and areas of spawning, correlation of distribution and abundance with substratum type, physical features, and availability of food organisms. This RU will also determine the timing and localities of spawning by pelagic, demersal and coastal fishes, including life history characteristics of spawning populations.

RU 553 Food Web Relations

Analysis of stomach contents of fish (specimens provided by RU 552), prey selectivity and feeding levels, seasonal variation in feeding and growth, trophic structure and dynamics for Kodiak Shelf in general and for specific regions/embayments in particular. The resulting data will also be used to formulate a preliminary food web structure and identify critical trophic links.

Information obtained by RU's 229, 243 (population dynamics and feeding ecology of seals and sealion) 341 (trophic relations of principal bird species) will also be utilized by the above research units to provide comprehensive accounts of their study objectives.

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4.0 RU AND P UNIT DESCRIPTIONS

Research and P Units are shown in the order of the tasks to which they relate. Some RU's are associated with more than one task. The following index will assist in locating particular P and RU descriptions.

4.1 DESCRIPTIONS FOR PROJECTS IN TASK C (HAZARDS):

C-1:	RU 251	P 925
		P 927
C-2	RU 327	
C-3:	RU 327	
C-4:	RU 327	P 430
C-8:	RU 327	

(RU 251) SEISMIC AND VOLCANIC RISK STUDIES -- WESTERN GULF OF ALASKA

This research unit addresses subtask C-1 (BLM Study Types 10-Seismic Hazards, 11-Volcanic Hazards, and 12-Surface and Near Surface Faulting).

Estimated Costs, FY 79:		
	$81,640	Kodiak
	75,360	Lower Cook Inlet
	$157,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

University: University of Alaska
P.I., Degree: Hans Pulpan, Ph.D.
Title: Assistant Professor of Geophysics
Percent of time devoted to project and role: 50%; co-principal investigator for seismology

Other Principal Scientist significantly involved in Project:

P.I., Degree: Juergen Kienle, Ph.D.
Title: Associate Professor of Geophysics
Percent of time devoted to project and role: 50%; co-principal investigator for volcanology

Background:

A regional network of short-period seismic stations is being operated to cover the Lower Cook Inlet, Kodiak Island, and the Alaska Peninsula offshore area between the west coast of Kodiak Island and the Semidi Islands. A large portion of this seismic network has been installed under the current program. The operation of the Alaska Peninsula portion of the system is largely funded through a contract with the United States Department of Energy (DOE).

Hypocenter data files and epicenter maps have been generated routinely since January, 1976. Besides providing seismicity data with greatly improved accuracy and lower magnitude level, the system monitors the seismic activity associated with several active Cook Inlet volcanoes. Preliminary results of the 1976 eruption of Augustine Volcano have been presented. During 1977, the entire seismic network was redesigned, telemeter links were upgraded, and every field unit was replaced with a laboratory tested and calibrated unit. This has resulted in a significant improvement in data quality and successful continuous operation of the network during the past winter (1977-78). Three strong motion instruments were installed in the southern portion of the study area to allow recording of ground accelerations during major earthquakes.

Tentative risk maps are presently in preparation. Continued maintenance of the seismic network will greatly improve the data base for evaluation of the seismic and volcanic risk and may contribute to ability to predict eruptions.

Objectives:

1. To record the locations and magnitudes of all detectable earthquakes within the study area and to evaluate frequency of occurrence versus magnitude relationships.

2. To determine the seismic activity of surface and nearsurface faults identified by geologic mapping.

3. To evaluate the observed seismicity in cooperation with Research Units 210 and 16 towards development of an earthquake prediction capability in the Gulf of Alaska.

4. To report magnitude/frequency relationships of seismicity in Cook Inlet.

5. To monitor activity of volcanoes within the study area to evaluate volcanic hazards and to contribute to an understanding of the regional tectonics.

6. To complete preliminary seismic and volcanic risk analyses for Lower Cook Inlet.

Methods:

The present regional network of seismographs and the stations on Augustine and Redoubt volcanoes will be maintained and updated to provide data coverage over as continuous a period as possible. Data from these networks will be processed and combined with historical data to assess the seismicity and volcanic activity of the area. Close coordination with other investigators will be maintained to maximize the use of available data on the seismicity of nearby areas, offshore features such as faults and submarine volcanic flows, etc.

Output:

1. Narrative Reports: Reports will provide a detailed description of the operation of the seismic network, including number and spatial density of instruments and resulting accuracy of derived earthquake parameters. A summary of seismic and volcanic events recorded during the survey will be presented and interpreted. Reports will include an evaluation of frequency versus magnitude relationships, activity of surface and nearsurface faults, and conclusions regarding implications for OCS exploration and development activities.

2. Digital Data: Derived earthquake parameters (e.g., date, time, location, depth, magnitude) will be submitted on punch cards or magnetic tape in the standard Hypocenter Data File format.

3. Visual Data:

1) Maps of hypocenter locations and magnitudes.

2) Maps and graphs of earthquake magnitude versus frequency relationships for selected areas.

3) Maps with supportive text summarizing seismic activity of surface and nearsurface faults identified in geologic mapping.

4) Maps and reports summarizing volcanic activity.

5) Seismic and volcanic risk maps.

(RU 327) SHALLOW FAULTING, BOTTOM INSTABILITY, AND MOVEMENT OF SEDIMENTS IN LOWER COOK INLET AND WESTERN GULF OF ALASKA

This research unit addresses subtasks C-2, C-3, C-4, and D-7 (BLM Study Types 12 - Surface and Near Surface Faulting, 13 - Seafloor Instability, 14 - Erosion and Deposition, 34 - Bottom Sediment Characteristics and 35 - Basin Morphology).

Estimated Costs, FY 79:	$79,200	Kodiak
	40,800	Lower Cook Inlet
	$120,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Department: U.S. Geological Survey
P.I., Degree: Monty A. Hampton, Ph.D.
Title: Geologist
Percent of time devoted to project and role: 75%; co-principal investigator

P.I., Degree: Arnold H. Bouma, Ph.D.
Title: Geologist
Percent of time devoted to project and role: 75%; co-principal investigator.

Background:

Reconnaissance geological and geophysical surveys were conducted in 1976 over the outer continental shelves of Lower Cook Inlet and Kodiak Island. These surveys identified, on a regional scale, potential seafloor hazards due to faulting, slumping, erosion, deposition, and large scale bedform movement. Detailed studies of specific problems, such as large fault zones on the Kodiak Shelf, possible weak volcanic sediments in the troughs that cut the Kodiak shelf, and large-scale bedforms in Lower Cook Inlet, were begun in 1977 and continue into 1978. Results from the 1977 cruise were limited because of adverse weather. These studies will continue into FY 79, with the focus on improved mapping and age determinations on surface and nearsurface faults on the Kodiak shelf and areas of sediment instability on both the Kodiak and Lower Cook Inlet shelves.

Objectives:

This study addresses the overall objective of evaluating geologic hazards associated with seafloor instability, erosion and deposition in the Lower Cook Inlet and Kodiak lease areas. Specific objectives for FY 79 are:

Lower Cook Inlet

1. To determine the rate of migration of large scale bedforms by re-surveying tracklines run previously under this project and by industry.

2. To determine what processes (e.g. tides, winter storm waves, etc.) exert the most influence over large-scale bedform movement.

3. To coordinate with Dr. Juergen Kienle (RU 251) in a pilot study toward determining the offshore extent and frequency of pyroclastic flows from Augustine volcano.

Kodiak Shelf

1. To complete collection and analysis of data begun in 1978 to determine the recency of movement of major shallow faults. Close coordination will be maintained with Pulpan and Kienle (RU 251) in assessing the possible recent activity of these faults.

2. To identify and map areas of potential seafloor instability associated with weak, fine-grained or ash-bearing sediments and oversteepened slopes.

3. To determine the area distribution, depth, and thickness of gas-charged sediment masses, their gas contents, origins, and potential severity as a hazard to offshore petroleum exploration and production.

Methods:

Seismic profiling surveys, including side-scan sonar, will be used to identify and map seafloor features. Previous tracklines run in Lower Cook Inlet will be re-run to determine the extent that large scale bedforms are migratory. Sediment samples will be collected for analysis of physical properties. Close coordination will be maintained with RU 430 (Cacchione and Drake) in order to relate estimates of bottom sediment flux to the distribution of sediment types, movement of bedforms, and patterns of erosion and deposition.

Studies by Juergen Kienle (RU 251) show the possibility exists that volcanic flows from eruptions of Augustine Volcano extend far enough onto the shelf to indicate potential hazards from future eruptions. Coordination between these two research units will establish whether offshore sampling and profiling in this area are needed to better address this problem.

Output:

1. Narrative Reports: Reports will provide a detailed description of profiling and sampling methods, spatial density of the survey, analytical and interpretive methods, background information, results of the field and laboratory work (including graphic illustrations), interpretation of the nature and severity of potential seafloor hazards on the Kodiak shelf and in Lower Cook Inlet, and recommendations for future work.

2. Digital Data: Grain size analysis data will be submitted on punch cards or magnetic tape in OCSEAP standard archive format file type 073.

3. Visual Data:

   Maps:

   a. Location, geometry, offset, and apparent age of last movement of surface and nearsurface faults.

   b. Delineation of existing and potential slumps and other unstable sediment masses, indicating present stability.

   c. Isopach maps of unconsolidated sediments

   d. Sediment grain size properties

   e. Locations of areas of severe erosion, deposition, and bedform movement.

   f. Location of gas charged sediments and oil and gas seeps, if present.

   g. Seafloor topography

   Figures: Geologic cross-section of potentially unstable sediment masses.

4. Other Data: High-resolution seismic profiles, fathograms, side-scan sonar records, and associated navigation will be submitted for inclusion in the OCSEAP data base.

(P 430) BOTTOM AND NEAR-BOTTOM SEDIMENT DYNAMICS ON THE KODIAK SHELF

This research unit addresses subtask C-4 (BLM Study Type 14 - Erosion and Deposition).

Estimated Cost, FY 79: $150,000 Kodiak

Schedule: October 1978 - September 1979

Performing Agency:

Department: U.S. Geological Survey
P.I., Degree: David A. Cacchione, Ph.D.
Title: Geologist
Percent of time devoted to project and role: 75%; co-principal investigator.

P.I., Degree: David A. Drake, Ph.D.
Title: Geologist
Percent of time devoted to project and role: 50%; co-principal investigator

Background:

Near-bottom currents and sediment transport on the Kodiak Shelf are poorly understood at present and may have important implications with regard to transport of sediment-borne contaminants and hazards due to erosion and deposition. From studies performed by RU 327 (Hampton and Bouma), it appears that Kiliuda, Chiniak, and Amatuli Troughs, which cut the shelf offshore of Kodiak Island, are quiet areas of sedimentation which may act as long-term storage sites for pollutants. Stevenson Trough, however, which cuts the shelf trending southeasterly from Stevenson Entrance, contains coarse, well-sorted sediment and sand waves which suggest the presence of strong bottom currents and large-scale bottom sediment transport. In addition to being a possible pathway for contaminants, this magnitude of sediment motion could present hazards to structures from rapid scour and fill.

Objectives:

1. To provide a temporal and spatial description of bottom sediment dynamics in and near major seafloor troughs which dissect the Kodiak shelf.

2. To relate the initiation of sediment movement, sediment flux, and changes in surface character of the seafloor to hydrodynamic conditions.

3. To compare the results of the study to similar BLM-sponsored shelf studies of the North Atlantic Shelf or other OCS regions.

Methods:

Specially designed ocean bottom instruments (GEOPROBES) will be deployed to measure current velocities near the seafloor, pressure variations related to sea surface activity, temperature (for water mass identification), and suspended sediment concentrations. Bottom cameras attached to the GEOPROBES will record bottom sediment activity, bedforms, and long term bed changes. Close coordination will be maintained with RU 327 to identify appropriate areas of study and to obtain sediment samples and other data.

Output:

1. Narrative Reports: Reports will provide detailed descriptions of the field methods and instrumentation, analytical and interpretive methods, background information, and results of the field and laboratory work addressing each of the stated objectives.

2. Digital Data: None

3. Visual Data: Maps showing bottom sediment dynamics, including transport flux and direction for selected time periods and during high-energy events such as storms and tides.

(P 925) PORTABLE ARRAY OF OCEAN BOTTOM SEISMOMETERS

This unit addresses subtask C-1 (BLM Study Type 10 - Seismic Hazards).

Estimated Costs, FY 79: $160,000 Kodiak

Schedule: October 1978 - September 1979

Performing Agency: To be determined

Background:

Capabilities for monitoring earthquake activity on the Alaskan continental shelf are currently limited to seismic events that can be detected and located with onshore seismographs. Since most of the shelf areas lie outside the existing networks, the detection threshold magnitude is high and location accuracy is poor. In some areas, offshore mapping has revealed faults which appear to have had "recent" displacement and therefore present a major potential hazard to offshore explora ion and development if they are indeed active. It is often impossible determine the activity of these faults using onshore seismographs, due to the limitations noted above, particularly if the activity over long periods of time is at a low magnitude level. Deployment of ocean bottom seismometers (OBS's) very near these faults for short periods (weeks to months) will provide valuable information about their activity (or inactivity).

Objectives:

The objectives of this effort will be to assemble portable arrays of OBS units which can be deployed on demand where it is necessary to acquire better data on offshore seismicity and activity of selected faults. Deployments will be made in FY 79 in areas to be selected in cooperation with BLM, after which an evaluation will be made of the system's success before further deployments are attempted.

Methods:

Instrument designs selected for this study will be state-of-the-art and have demonstrated reliability from previous field use. Environmental extremes and expected ocean bottom conditions will be taken into account. Site selection will be a cooperative effort among the developer of the array, the principal investigator conducting ongoing earthquake hazard studies in the areas of interest, investigators performing offshore fault mapping and OCSEAP management. Data synthesis and performance evaluation of the OBS arrays will be the responsibility of the performing agency.

Copies of offshore seismic data and interpretive reports will be provided to principal investigators conducting earthquake hazard studies in order to supplement information derived from onshore seismometers. This will result in a much improved understanding of seismic activity for each area.

Output:

1. Narrative reports: Reports will contain a discussion of offshore seismic activity which will include a summary of seismic events recorded during OBS emplacement, an interpretation of offshore seismic hazards, and an evaluation of the activity of surface and near-surface faults.

2. Digital Data: Earthquake parameters recorded by the OBS arrays, including date, time, location, depth, and magnitude will be submitted on punch cards or magnetic tape on the Hypocenter Data Tide Format.

3. Visual Data:

    1) Maps of offshore hypocenter locations and magnitudes.

    2) Maps with supportive text summarizing seismic activity of surface and near-surface faults.

(P 927) GROUND ACCELERATIONS ASSOCIATED WITH MAJOR EARTHQUAKES IN ALASKAN OCS AREAS

This unit addresses subtask C-1 (BLM Study Types 10 - Seismic Hazards and 12 - Surface and Near Surface Faulting).

Estimated Costs, FY79:

$25,000	Aleutians
25,000	Kodiak
25,000	Lower Cook Inlet
25,000	NEGOA
$100,000	Total

Schedule: October 1978 - September 1979

Performing Agency: To be determined

Background:

Knowledge of the probable offshore ground accelerations associated with major earthquakes is important in tract deselection and in setting design stipulations for seafloor-mounted structures. Although OCSEAP currently supports limited onshore networks of strong motion accelerographs, it has not been possible to obtain adequate data for determining what the ground motions offshore are likely to be. There are several reasons for this: 1) The technology is not yet available for economical and efficient operation of ocean bottom accelerometers and probably will not be available for several years; 2) Extrapolation of onshore measurements of ground accelerations to offshore is very difficult and requires very thorough knowledge of the subsurface geology and seismic velocity structure; and 3) accurate measurements of acceleration at the instrument site can only be made during larger events (most instruments are triggered by a magnitude 6 earthquake), requiring good spatial coverage and relatively long periods for data collections. This project will address problems 2) and 3) to improve our capability for approximating offshore ground accelerations.

Objectives:

1. To expand the coverage of the existing network of strong-motion accelerometers, as required by the BLM environmental programs, thereby increasing the areal extent of measurements of acceleration from major earthquakes.

2. To utilize available data and appropriate techniques for extrapolating measured accelerations to offshore areas.

Methods:

Additional strong-motion accelerometers will be installed in areas where there is presently no coverage, particularly in the Kodiak and Lower

Cook Inlet areas. Existing installations will be evaluated to determine whether there is adequate coupling to bedrock, and to re-install if necessary. Available data on subsurface and offshore geology, including existing seismic profiling records, will be compiled and analyzed to construct seismic velocity profiles. These will then be combined with the onshore accelerometer and seismograph data to approximate seafloor accelerations.

It is possible that part or all of the funds indicated under "Estimated Costs" may be applied to existing research units (16, 210, and 251).

Output:

1. Narrative reports: Reports will explain the design of the network and will provide a summary of the geology at each installation. A summary of acceleration data obtained each quarter will be presented in each quarterly report. The year-end report will contain interpretations of the data obtained; an explanation of the techniques used to analyze the data; an analysis of the effects of the subsurface geology; and an evaluation of estimated offshore accelerations.

2. Digital Data: None

3. Visual Data:

   a. Maps of peak accelerations determined for the land areas for which ground motion data were obtained during major earthquakes.

   b. Maps of estimated peak accelerations for offshore areas.

4. Other Non-digital Data: Copies of accelerograms will be submitted for inclusion in the data base.

4.2 DESCRIPTIONS FOR PROJECTS IN TASK D (TRANSPORT):

D-1:	RU 138	
	RU 140	
	RU 289	
D-2	RU 138	P 910
	RU 140	
	RU 289	
	RU 367	
D-7	RU 140	
	RU 327	

(RU 138) GULF OF ALASKA STUDY OF MESOSCALE OCEANOGRAPHIC PROCESSES

This research unit addresses subtask D-1 and D-2 (BLM Study Types 27 - Currents and Tides and 32 - Trajectories of Oil Spills).

Estimated Costs, FY 79:	$ 52,600	Aleutians
	116,800	Kodiak
	122,000	Lower Cook
	$292,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Agency: NOAA/PMEL
P.I., Degree: Stanley P. Hayes, Ph.D.
Title: Oceanographer
Percent of time devoted to project and role: 50%; experimental design and analysis of pressure gauge records

P.I., Degree: James D. Schumacher, Ph.D.
Title: Oceanographer
Percent of time devoted to project and role: 45%; experimental design and analysis of current meter records.

Background:

1. Currents in the Lower Cook Inlet lease area are complicated by highly variable tidal currents, local run-off, wind driven currents, and a current which may be a branch of the Alaska Stream. The latter, if not a branch of the Alaska Stream, is known to be a result of forces and influences along the shelf, one of which is the influence of nearshore precipitation and run-off.

   The existing information base includes data from NOS-placed current meters, OCSEAP-placed meters (in FY 78), a data buoy, numerous CTD surveys and miscellaneous data from other sources.

   Analysis has shown a high variability in net flows over the lease area and complex gradients in tidal flow.

2. Currents in Shelikof Strait, on the other hand, are reasonably simple, partly because its channel is parallel to the Alaska Stream; but on the east side of Kodiak Island currents are weak and variable. There is some evidence that physical oceanographic processes influence the distribution of species associated with the shallow shelf, i.e., on Albatross Banks.

Data collected in FY 77 and 78 show a large decrease in flow as one moves from the shelf-break onto the shelf. Some historic data also indicate flow onshore in the deepest part of the shallow canyon separating North and South Albatross Banks.

3. Details of flow to the southwest of Kodiak along the shelf are unknown, although data were obtained from one or two moorings in FY 77 and 78. CTD transects have been accomplished only infrequently; therefore, any details of flow and possible spill trajectories in the area would be speculative.

Objectives:

The objectives in Lower Cook Inlet are to complete the analysis of data and to provide a map of circulation patterns in sufficient detail to allow calculation of oil spill trajectories with calculation of probabilities of impact over selected areas.

In the Kodiak lease area, the objective is to analyze data on hand and report on circulation in Kiliuda Trough and Kiliuda Bay which bisects Middle and Southern Albatross Banks. The physical oceanography will be closely coordinated with the biological studies in an effort to determine the dependency of biological events on circulation features. Specific objectives include:

1. Residence time of water in Kiliuda Trough and Bay.

2. Transit time, (preferably residence time) of water on the banks (Portlock and Albatross).

3. Examination of the hypothesis that there is restricted interchange of waters between the Middle and Southern Albatross Banks.

4. Examination of the hypothesis that significant up-channel flow occurs in Kiliuda Trough--sufficient to re-seed the nearshore area in case of biological impact from pollutants.

Objectives to be addressed in the Aleutian Lease Area are to provide analyses of 1977 and 1978 CTD and current meter data to increase understanding of large-scale circulation features.

Methods:

Standard statistical analyses of current meter and pressure gauge data during FY 79 will include extraction of tidal and non-tidal currents by means of appropriate record filtering, analysis of coherence between winds, corrected sea level and currents, spectral analysis. Non-tidal current data at selected locations will be used as additional input and calibration data for the diagnostic circulation model developed under RU 140.

Output:

1. Narrative Reports: A report will be provided containing a description of mooring locations, measurement and analysis techniques, sampling frequency and duration. The report will contain the results of statistical analyses of the current meter and pressure gauge records and, to the extent permitted by the study, a description of regional circulation patterns, specifically addressing the stated objectives. Specific data products to be provided include:

   a. Maps of circulation patterns in Kiliuda Bay and Trench.

   b. Maps of circulation patterns and water mass properties over Albatross Banks.

   c. Tabulations of tidal and net currents with objective estimates of variability in Lower Cook Inlet.

   d. Analysis of the affect of meteorological events on circulation in each area.

   e. Description of mixing processes.

2. Digital Data: All current meter and pressure gauge data will be in digital form and will be submitted to OCSEAP on magnetic tape in Formats 015, 017 and 022.

3. Visual Data: The following visual data representations will be included in the Narrative Report.

   - Time plots of filtered current meter and pressure gauge data showing both tidal and non-tidal velocity and pressure fluctuations.

   - Progressive vector diagrams.

   - Energy density spectra.

   - Plots showing coherence between wind, corrected sea level and currents.

   - Plots showing estimated return frequencies of selected extreme values of current.

(RU 140) NUMERICAL STUDIES OF THE ALASKAN REGION

This research unit addresses subtasks D-1, D-2, D-7 (BLM Study Types 27 - Currents and Tides, 28 - Wind Fields and 37 - Trajectories of Oil Spills).

Estimated Costs, FY 79:	\$ 65,000	Kodiak
	\$ 35,000	NEGOA
	\$100,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Agency: NOAA/ERL
P.I., Degree: Jerry Galt, Ph.D.
Title: Project Supervisor, Modeling and Simulation Studies
Percent of time devoted to project and role: 25%; project supervisor

Background:

A diagnostic circulation model has been developed to calculate currents over an area from density data and data from strategically located current meter moorings. The calculated currents are used to determine trajectories which include the effect of stochastic processes derived from the statistics of the empirically determined currents.

Results of the diagnostic model can now be coupled to a pollutant trajectory model to obtain trajectories and approximate landfalls under various environmental conditions.

Objectives:

The objectives of the modeling studies are to complete the model development effort and to calculate pollutant transport scenarios around each lease area under conditions not accounted for in the FY 78 development effort. In addition, larval transport simulations over Albatross Bank will be used in an attempt to quantify interchange across the Kiliuda Trough. Weathering process and spreading algorithms will be selected from among the many already reported in literature and incorporated in trajectory calculation.

Specific objectives are:

1. To predict current patterns over Albatross Bank and around Kodiak Island where current meter data are limited but where density in the water column and estimates of sea level slope are known.

2. To predict pollutant trajectories and landfalls by application of observed wind fields to the flows derived from the diagnostic model and other sources.

3. To predict pollutant trajectories and landfalls in areas where current meter, Lagrangian drifter or derived geostrophic currents are available.

4. To include turbulent mixing and weathering explicitly as transport processes.

5. To evaluate the success of the model by comparison of computed current fields and trajectories with currents and trajectories found empirically from other studies (RU's 138, 289, and 217).

6. To demonstrate the effect of errors in winds and currents by showing changes in landfall under conditions of assumed error.

Methods:

The existing suite of model sub-units will be optimized and used to synthesize most-probable current fields; pollutant trajectories, and pollutant concentrations using all available input and verification data.

Coordination will be effected with U.S.G.S. trajectory modelers. Coordination with RU 289 and RU 367 for data, will be effected.

Output:

1. Narrative Reports: The final report in FY 79 will include operational descriptions of the model, documentation of computer programs, and analyses and interpretations of currents and trajectories based on various scenarios and inputs to the model. Strategy of Model-verification methods will be planned and reported prior to computer runs made under Objective 5.

2. Visual Data: These will include computer graphics showing study area coastlines, current vectors, and pollutant trajectories under a variety of environmental conditions. These graphics include:

   a. Maps of nearshore surface currents, seasonally.

   b. Maps of probable oil trajectories under the suite of mesoscale wind conditions characteristic of the lease area, as obtained from RU 367.

(RU 289) CIRCULATION AND WATER MASSES IN THE GULF OF ALASKA AND SATELLITE IMAGERY OF MESOSCALE FLOW FEATURES IN OTHER ALASKAN OCS AREAS

This research unit addresses subtasks D-1 and D-2 (BLM Study Types 27 - Currents and Tides and 29 - Residence Time and Flushing).

Estimated Costs, FY 79:	$10,200	Aleutians
	10,200	Kodiak
	10,200	Lower Cook Inlet
	71,400	NEGOA
	$102,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

University: University of Alaska, Inst. of Marine Science
P.I., Degree: Thomas C. Royer, Ph.D.
Title: Research Associate Professor
Percent of time devoted to project and role: 50%; project supervisor

Other Principal Scientist Significantly Involved in Project:

Name, Degree: K. Ahlnas, M.S.
Title: Resident Associate
Percent of time devoted to project and role: 85%; remote sensing image enhancement, interpretation, and archiving.

Background:

Since FY 75, the Principal Investigator has studied the mean and seasonal variations of the water mass characteristics and currents in the Gulf of Alaska from observed temperature and salinity distributions and direct current measurement. Sea surface temperature measurements obtained from NOAA satellites have been used in conjunction with hydrographic data in an attempt to estimate and map the surface circulation in the entire Gulf of Alaska.

The incorporation of satellite remote sensing into this project has substantially improved its capability to define nearshore circulation features that are manifested in surface water temperature differences. This is particularly important in the Kodiak and Aleutian lease areas.

Similar satellite data for the entire Alaskan OCS coastline including Lower Cook Inlet is made available by this project for use by other OCS principal investigators.

Efforts under this project are closely coordinated with those under RU's 138, 140, 141, 217, 267, 367, 541, and 550.

Objectives:

The objectives of this project are to complete the studies of mesoscale circulation patterns in the Gulf of Alaska from hydrographic properties, direct current measurements and satellite imagery and to provide similar satellite data for the entire Alaskan OCS coastline for use by other investigators. Objectives specifically applicable to the NEGOA, Aleutian, Kodiak, and Lower Cook lease areas are:

1. To provide evidence of key circulation features, both offshore and nearshore, by use of satellite imagery.

2. To provide improved descriptions of the seasonal variability in hydrographic properties in each area, and particularly in front of Hinchinbrook Entrance.

3. To analyze moored current meter data from near Kayak Island to allow determination of the barotropic flow on the shelf and provide input and calibration data for modeling conducted under RU 140.

4. To correlate currents inferred from satellite imagery with meteorological and hydrographic conditions.

5. To estimate, to the degree the evidence allows, the frequency and lifetime of mesoscale circulation features, such as nearshore eddies and meanders with descriptions of residence time wherever possible.

6. To provide satellite data for use by other OCS principal investigators.

7. To provide archive identification of all imagery showing evidence of key circulation features.

Methods:

No field work is planned in the Aleutian, Kodiak, or Lower Cook Inlet areas. There will be limited work west of Kayak Island, but only if the modeling study in FY 78 shows a gap in data. Field measurement, calibration, and analysis techniques will be similar to those currently in use. Quasi-continuous depth profiles of temperature and salinity will be obtained on a trimesterly basis from a grid of hydrographic stations from Unimak Pass to Yakutat. Data analysis will involve standard techniques in producing maps of hydrographic properties and in performing geostrophic current calculations.

Imagery from satellites (e.g., ERTS, NOAA) transiting the Gulf of Alaska will be used to describe surface circulation features that are manifested as water temperature differences. Similar information will be provided to OCS investigators in other lease areas on a 60-day delay, with infrared enhancements to be carried out during this time period.

Output:

1. Narrative Report: A report will be provided containing discussion and interpretation of principal hydrographic features and inferred flow patterns occurring during the observation period. The report will contain surface maps and cross-shelf section contours of hydrographic parameters and surface maps of dynamic topography for each cruise. Time series plots of water properties will be provided at selected stations to describe the seasonal characteristics of the shelf hydrography.

   The report will contain discussions of satellite imagery interpretations, including criteria, for seasonal offshore and nearshore current patterns, and integration of observations with other OCSEAP and climatological data.

2. Digital Data: Digital STD, current meter and pressure gauge data will be submitted to EDS in OCSEAP-approved formats 022, 015 and 017.

3. Visual Data:

   a. Seasonal maps of hydrographic properties.

   b. Seasonal maps of dynamic topography and geostrophic currents.

   c. Images and maps of seasonal and shorter-lived surface currents features as inferred by satellite remote sensing.

4. Other Data: Both the visible and IR images from clear areas of the coastline will be retained. IR enhancements and enlargements of these data will be carried out and catalogued. Prints of these images will be made available to OCSEAP principal investigators on request. Assistance in interpreting the imagery will be provided.

(RU 367) NEARSHORE METEOROLOGY

This research unit addresses subtask D-2 (BLM study type 28 - Wind Fields)

Estimated Costs, FY 79:	$ 64,170	Kodiak
	30,500	Lower Cook Inlet
	20,330	NEGOA
	$115,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Department: NOAA/ERL
P.I., Degree: R. Michael Reynolds, M.S.
Title: Oceanographer
Percent of time devoted to project and role: 50%; project supervisor

Background:

Nearshore winds along the Alaskan coastline can differ significantly from those determined from synoptic weather charts because of strong coastal orographic effects. These differences can lead to errors in pollutant transport predictions that are based on synoptic geostrophic winds.

The FY 79 program will consist of studies in the Lower Cook Inlet, Kodiak, and NEGOA lease areas, continuing studies dating back to FY 76 in the NEGOA lease area. During FY 77 and 78, the studies were extended into the Copper River Delta and Cook Inlet areas where shipboard and land-based instrumentation was used to obtain local wind data. In the Cook Inlet area, Alaska State ferries obtained local winds during transits of the Homer-Kodiak run.

The Principal Investigator has performed field studies between Yakutat and Icy Bay during FY 76-77 to obtain empirical data with which to drive and verify a numerical atmospheric circulation model modified in FY 77 and 78 from an existing model previously developed by Lavoie. This model predicts local wind fields that are significantly different from synoptic or geostrophic winds due to coastal orographic effects. Verified output from this model will be used to improve the wind stress input to the pollutant trajectory model used by RU 140.

Objectives:

The objectives of this study are to provide an improved understanding of mesoscale features of the surface wind field resulting from coastal orographic effects.

Specifically these objectives are:

1. To relate observed over-the-water winds to winds forecast from synoptic weather charts.
2. To relate land-based local weather observations with winds observed over the water in the lease area and to provide the relationship for each identifiable weather type.
3. To devise a procedure whereby, from a knowledge of synoptic wind data combined with local land-based data, the surface winds over the lease area may be forecast.
4. To find, for each lease area from historical records, a set of wind and weather patterns which typify the conditions that might be expected during a spill. This information will be assembled in a manner suitable for use in trajectory analysis.
5. Acquire and analyze data from Kiliuda Bay (Kodiak Island) and relate winds there to currents.

Methods:

Methods used will be similar to those employed in FY 77-78.

Study methodology will include the following:

1. Installation of instruments on drill rigs in Cook Inlet and portable land stations at Kiliuda Bay.
2. Shipboard and aircraft (if possible) meteorological observations and acquisition of coastal wind data. Correlations will be made between the long term over-the-water observations and those obtained from shipboard and from land-based stations. Data recorded aboard Alaska State ferries will be included when available.
3. To the degree that the mesoscale wind model is applicable, it will be used to obtain the forecasts in objective 3. Otherwise, empirical relationships will be resorted to.

Output:

1. Narrative Reports: A report will be provided containing:

    a. A procedure for finding over-water winds in the lease area, given land-based and synoptic data (This is a joint effort with RU 140).

   b. Discussions of analysis and interpretation of the results of field experiments which integrate as fully as possible all supportive data from other research programs.

   c. A description of most probable wind fields expected in each area.

   d. Documentation of model development and verification, results of simulation runs, and operational procedures.

2. Digital Data: All meteorological data obtained in field work which include:

   a. Wind speed and direction; time series at two or more sites.

   b. Wind speed and direction at several points as synoptically as ship and aircraft allow.

   c. Auxiliary meteorological information such as obtained from tethered balloons and rawinsondes.

   d. Computed winds in digital format as required in trajectory models.

   Data will be archived in format 101.

3. Visual Data: These will consist of:

   a. Charts of synoptic wind vectors.

   b. Graphical presentations of computed local winds versus observed winds.

   c. Graphical presentations of surface current measurements.

(P 910) NEARSHORE SURFACE CURRENTS

This unit addresses subtask D-2 (BLM Study Types 27 - Currents and Tides and 29 - Residence Time and Flushing).

Estimated Costs, FY 79: $105,000 Kodiak

Performing Agency: To be determined

Background:

In the Kodiak lease area, near Kiliuda Bay, a nearshore meteorology program (RU 369) will be carried out. Surface current drogues will be used to correlate local winds with changes in surface currents. Characteristics of bays will be addressed.

Objectives:

The objective is to provide a direct measurement of surface currents under known wind and water conditions. This will allow the data to be used for verification of models to connect winds, surface currents and flushing in Kiliuda Bay in support of biological studies there.

Methods:

It is proposed to use drogues to measure the currents. Drogues will be constructed so they penetrate only the uppermost part of the water column. Transponders will be used to increase the range of operation and they will be tracked by similar charter NOAA- vessels using a combination of precision navigation, such as miniranger or raydist with radar location. Simultaneous wind recordings will be made.

Output:

A narrative report will include a full description of methods used, meteorological and oceanographic conditions extant, and maps of drogue motions. Interpretations of the current regimes of Kodiak fiords will be made on the basis of observed wind and current patterns.

4.3 DESCRIPTIONS FOR PROJECTS IN TASK E (BIOTA):

E-1:	RU 229
	RU 243
E-2:	RU 194
	RU 229
	RU 243
E-3:	RU 3
	RU 108
	RU 341
E-4:	RU 3
	RU 108
	RU 341
E-5:	RU 552
E-6:	RU 552
	RU 553
E-7:	RU 5
E-10	RU 551
	RU 553

(RU 3) IDENTIFICATION, DOCUMENTATION AND DELINEATION OF COASTAL MIGRATORY BIRD HABITAT IN ALASKA

This research unit addresses subtasks E-3, E-4 (BLM study types 39 - Vulnerable Populations, 40 - Life History, 41 - Critical Habitats, 42 - Food Web Dependencies, 44 - Wetland Ecosystems.)

Estimated Costs, FY 79 :		
	$ 5,200	NEGOA
	26,000	Lower Cook Inlet
	1,560	Kodiak
	19,240	Bristol Bay
	$52,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Agency: Alaska Department of Fish and Game
P.I., Degree: Paul Arneson, Ph.D.
Percent time devoted to project and role: 100%;
Project direction, sample collection, analysis and data processing.

Background:

Collection of information on the seasonal composition, distribution, abundance, timing of migrations and coastal habitat preference by migratory birds in the Gulf of Alaska was completed during 1976. Field work in 1977 was concentrated in Bristol Bay, Lower Cook Inlet, Kodiak, and the Alaska Peninsula. In 1978 winter surveys were conducted in Lower Cook Inlet to determine distribution and abundance of marine birds in relation to ice conditions and also to limited colony studies during the summer to determine bird usage of selected small colonies on the west of Lower Cook Inlet. Field investigations will be completed at the end of FY 78. However, the project will be continued in FY 79 to allow complete analysis of data and preparation of two comprehensive final reports.

Objectives:

The objectives of this study are to determine seasonal changes in the composition, distribution, abundance, feeding and breeding ecology of birds associated with coastal habitats. Specifically, the objectives are:

1. Determine seasonal density, distribution, and use of coastal habitat by migratory bird species.

2. Determine primary feeding and staging areas.

3. Determine breeding locales for selected species.

Methods:

Data collected from previous years will be analyzed and synthesized to provide two comprehensive final reports. Marine bird coastal habitat maps produced by this research unit have been duplicated on 35mm slides and submitted to the Program Office.

Output:

1. Final Narrative Report: Seasonal changes in distribution, density, and use (feeding, breeding, etc.) of coastal habitats by migratory birds will be described and evaluated. This report will include information available on the spring migration of birds past Cape St. Elias, a winter population estimate for Kodiak Island, and winter and spring distribution and abundance estimates of birds in Lower Cook Inlet related to ice conditions and other environmental parameters. Scientific input will be provided by RU 341 (Sanger), RU 005 (Feder), RU 424 (English), RU 512 (Blackburn) and RU 059 (Hayes) in developing this report.

   A second narrative report will be developed in which the phenology, reproductive ecology, life histories, and foraging areas for selected colonies in Lower Cook Inlet and Bristol Bay will be assessed. Literature synopses of food habits for principal life stages of selected species will be included. Input will be provided by RU 341.

2. Digital Data: By FY 79 study results will have been provided in OCSEAP format under file types FY 040 - Bird Habitat and the new bird colony format presently being developed, FT135.

3. Visual Data: Narrative reports will be supported by maps, charts, figures, and tables. Specifically, these products are:

   a. Maps which identify:

      (1) Coastal area surveyed and associated habitat.
      (2) Sampling locations.

   b. Charts which illustrate:

      (1) Seasonal changes in distribution and densities of migratory birds.
      (2) Primary breeding locales for selected species.
      (3) Primary foraging areas for selected species.
      (4) Primary migratory routes.

c. Figures and tables which illustrate:

(1) Changes in bird distribution and density.
(2) Changes in seasonal use patterns.
(3) Seasonal changes in feeding habits of birds associated with coastal habitat.

(RU 5) FOOD WEB RELATIONSHIPS AND PRODUCTIVITY OF INVERTEBRATE SPECIES IN THE NEARSHORE ZONE

This research unit addresses OCSEAP subtask E-7 (BLM study types 39 - Vulnerable Populations, 40 - Life History, 42 - Food Web Dependencies).

Estimated Cost, FY 79:		
	$ 94,350	Lower Cook Inlet
	85,100	Kodiak
	5,550	NEGOA
	$185,000	Total

Performing Agency:

University: University of Alaska
P.I., Degree: Howard M. Feder, Ph.D.
Title: Professor of Marine Science and Zoology
Percent of time devoted to project and role: 33%; Project Director.

Background:

Exploration of the benthos on the Alaskan OCS began in 1974 in the Gulf of Alaska. In subsequent years, the geographic coverage was expanded to include the benthic populations of the Lower Cook Inlet, Kodiak Island, Chukchi Sea and the St. George Basin, Bristol Bay and Norton Sound regions of the Bering Sea. Due to recent shifts in the OCS leasing schedule, efforts to investigate these offshore epi- and infaunal populations have been focused on the Lower Cook Inlet, Kodiak, and, again, on the Northeast Gulf of Alaska. The methodology has included extensive trawl studies conducted during FY 76 and FY 77 to provide broadscale information on the composition, distribution and relative abundance of the epifaunal invertebrates. Similarly the infauna have been studied primarily through use of grab and dredge surveys except in Norton Sound where only the epifauna has been intensively investigated by trawling equipment.

The results thus obtained will yield data on the distribution, abundance, species diversity and community structure of the benthos necessary in determination of their critical habitats in offshore regions. Reports synthesizing the results from these reconnaissance level surveys are expected to be completed for each lease area during FY 78.

Investigations have also been conducted closer inshore in the Lower Cook Inlet and Kodiak Island regions. This began in FY 77 with summer trawl surveys in Alitak and Ugak Bays (Kodiak) to provide a preliminary look at the temporal and spatial distributions of epifaunal populations in these nearshore waters. The two large bays of Lower Cook Inlet and Kachemak and Kamishak Bays were sampled as early as FY 76 with equipment such as the pipe dredge. Additional data will be obtained in conjunction with the food web studies in the Kodiak region during the FY 78 field season through summer cruises in the two bays of Kodiak Island, Izhut and Kiliuda. The intensified spatial and temporal scheme will yield

the higher resolution data presently needed. A limited field effort was also conducted in the Hinchinbrook entrance area in FY 78. It consisted of a single reconnaissance survey of nearshore benthos in both protected and exposed coastal habitats. The research emphasis was also shifted in FY 78 from solely a reconnaissance level survey to inclusion of trophic relationships studies focused on commercially important members of the epibenthic invertebrate community. This project is also a component of the integrated studies on the feeding relationships of both ecologically and commercially important marine organisms in the Kodiak and Lower Cook Inlet lease areas.

Objectives:

Studies in the lease areas will continue to center upon food web relationships and supportive data. Data and information exchanges with the other research units involved will also continue to be an important part of the research efforts. Specifically the objectives for each lease area are:

NEGOA (in principal nearshore habitats, <100m in depth):

1. Describe the distributions and relative abundance of dominant epifaunal invertebrates.

2. Determine the food habits of selected benthic invertebrates and demersal fishes.

Kodiak:

1. Determine the feeding habits of the principal inshore epi faunal invertebrate species emphasizing the commercially important king crab and pink shrimp.

2. Exchange data and information with RU's 341, 551, 552, and 553 in order to develop a food web structure for selected inshore areas.

3. Synthesize information on distribution, abundance, and life histories of key species of benthic invertebrates.

Lower Cook Inlet:

1. Determine the feeding habits of the principal inshore epifaunal invertebrate species, emphasizing key commercially important species such as the snow crab.

2. Develop food webs integrating the invertebrate, fish, mammal and bird trophic relationship data in conjunction with RU's 229, 243, 341, 417, 424, and 512.

3. Synthesize available information on the distribution, abundance, and life histories of commercial invertebrates.

4. Describe and evaluate the potential for impact by OCS gas and oil exploration activities, and subsequent development and production, on those epi- and infaunal habitats of Lower Cook Inlet using data from studies conducted in FY 76 through FY 78.

Kodiak and Lower Cook Inlet:

1. Assess spatial and temporal distribution and relative abundance of epifaunal invertebrates in selected bays and inshore areas.

2. Review and analyze the existing data base to provide a comprehensive description of benthic biota and environment.

Methods:

Analyses of the trawl, dredge and grab samples will be conducted by those procedures previously utilized by this research unit and documented by a quality control memorandum. In particular the trawl analyses are comparable to those methods employed for the epibenthic samples taken in Norton Sound in 1976. Food habits of the key, commercially important species of epibenthic invertebrates will be determined through stomach analyses utilizing those standard gravimetric procedures defined in RU's 486 and 512.

Trophics work in the bays of Kodiak Island will continue in the same bays as the other food web studies. Epibenthic invertebrate populations were sampled monthly during the spring and summer of FY 78. These efforts, initiated in FY 78, will continue quarterly in the fall and winter of early FY 79 for completion of a full year of data. Samples will be obtained primarily through the use of otter trawl and diving surveys with infaunal food sources sampled by dredge and grab equipment. Site selection for intensive sampling will be based on results from studies conducted during FY 78.

Objective 3 for Lower Cook Inlet will require several additonal sources of information. These include the location of leased tracts, the location of exploratory rigs, the BLM development scenario, results of trajectory analyses for Lower Cook Inlet made by OCSEAP in FY 78, and the results of Miles Hayes' (RU 59, 1977) work on vulnerable habitats of Lower Cook and NEGOA. In addition, the existing information on sensitivity of specific components of the ecosystem must be considered. This latter information will be supplied to the investigator by the project office.

Output:

1. Narrative Reports: Reports will describe methods, temporal and spatial intensity of sampling, current status of knowledge, description of statistical treatment, results, discussion and conclusions. Recommendations for future investigations will be defined. Reports will provide an analysis of biological activity at each study site and a discussion of trophic relationships in the Kodiak and Lower Cook Inlet lease area with an identification of the critical links in the food web. A final report will be prepared for those lease areas already intensively studied which will focus on contrast and comparison of results. This effort should result in better resolution of any future studies of the benthos in these areas.

2. Digital Data: Results of this study will be submitted on OCSEAP defined formats in the File Type 032 - Benthic Organisms. Data from the analysis of stomach contents will be submitted in a new File Type developed during FY 78.

3. Visual Data: Data supporting the narrative report will be provided in the form of maps, charts, figures and tables. Specifically, the products will be:

    a. Maps of sampling sites.

    b. Charts illustrating:

        (1) The seasonal distribution and abundance of dominant benthic organisms.

        (2) The seasonal distribution of major predator and prey species.

    c. Figures and tables illustrating:

        (1) The benthic food web.

        (2) The major prey species.

        (3) The productivity/biomass of selected species.

        (4) Species inventories for various habitats (embayments, outer coast).

        (5) Indices of composition of phyla (numbers, weight and biomass - as allowed by the data) in various habitats.

        (6) Frequency and percent frequency of occurrence of food items in stomachs of selected invertebrates and fish species.

(RU 108) SIMULATION MODELING OF MARINE BIRD POPULATION ENERGETICS, FOOD CONSUMPTION AND SENSITIVITY TO PERTURBATION

This research unit addresses subtasks E-3 and E-4 (BLM Study Type 42 - Food Web Dependencies and Energetics).

Estimated Costs, FY 79: $50,000 Kodiak

Schedule: October 1978 - September 1979

Performing Agency:

Agency: Oregon State University
P.I., Degree: John A. Wiens, Ph.D.
Percent of time devoted to project and role: 33%; Project Supervisor.

Background:

This project has evolved from a field program studying the distribution and abundance of marine birds in the offshore waters of the Gulf of Alaska during FY 76 with an evaluation of species interactions in feeding flocks to simulation modeling on the energetics, food consumption and sensitivity to perturbation of the sea bird colonies on the Pribilof Islands during FY 78. An existing model (see Wiens and Innis, 1974. Estimation of energy flow in bird communities: a population bioenergetics model. Ecology 55: 730-746) was expanded during FY 78 to permit evaluation of spatial variations in energy and food consumption for marine birds. Thus, sensitivity analysis allows an identification of the species, time periods, or areas within a lease area that may be especially vulnerable to environmental perturbations from oil development.

During FY 79, efforts in the modeling study will be shifted from the eastern Bering Sea to the Kodiak lease area to integrate and synthesize the extensive data on seabirds that have been developed by the U. S. Fish and Wildlife Service. Model results will be used to identify major information gaps and estimate the effects of large-scale environmental changes on the Kodiak avian community.

Objectives:

The modeling study will seek to:

1. Estimate the energy demands and food consumption patterns of marine bird populations in the Kodiak lease area.

2. Identify major information gaps in the BLM/OCSEAP marine bird program in the Kodiak lease area.

3. Identify species, time periods or areas within the lease area that may be especially sensitive to oil development.

4. Develop estimates on the effect of environmental preturbation on population density and bioenergetic requirements of marine bird populations.

5. Submit final report on Bering Sea seabird modeling work.

Methods:

The expanded simulation model will be used to synthesize and provide sensitivity analyses of the existing data on sea birds developed by the U.S. Fish and Wildlife Service under RU's 337 and 341.

Output:

1. Narrative Reports: Reports will provide detailed descriptions of the model, documentation of new computer programs developed, and analysis and interpretation of results based on various inputs to the model. Major information gaps and sensitivity of populations to environmental changes or oil spills will be discussed. A special report identifying major information gaps (Objective #2) in the OCSEAP marine bird research program for the Kodiak lease area should be submitted to the Juneau Project Office before 1 July 1979.

2. Digital Data: New data will not be generated.

3. Visual Data: Visual displays or computer graphics will show:

    a. Areal and temporal changes in population densities and energy demands for major life stages of selected species or species groups.

    b. Daily energy demands for major life stages of selected species.

    c. Effects of altering model constants or input variables on estimates of energy demands and population densities.

(RU 194) MORBIDITY AND MORTALITY OF MARINE MAMMALS

This research unit addresses subtasks E-2 and F-7 (BLM study types 39 - Vulnerable Populations, 40 - Life History).

Estimated Costs, FY 79:		
	$30,000	Kodiak
	10,000	Lower Cook Inlet
	10,000	NEGOA
	4,000	Norton
	2,000	Chukchi
	4,000	Beaufort
	$60,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

University: University of Alaska
P.I., Degree: Francis H. Fay, Ph. D.
Title: Associate Professor
Percent of time devoted to project and role: 33% Project direction sample collection, and data analysis.

Background:

FY 76, FY 77, and FY 78 efforts consisted of aerial reconnaissance to locate stranded, dead and moribund animals and necropsy of selected individuals. A review of historical information on marine mammal morbidity and mortality was completed and an annotated bibliography prepared and cross-indexed. Research will be continued into FY 79 to provide information on annual variation in disease occurrence of stranded and beached carcasses. No further necropsy or analysis of mammal specimens obtained through selective collecting is anticipated in FY 79. A very large body of unpublished observations on many aspects of arctic fox (*Alopex lagopus*) biology is available to this P.I. As an alternative to commencing fieldwork on the problems of foxes, this RU will be asked to deliver a summary report dealing with fox biology as it relates to OCS activities.

Objectives:

Level of effort will be reduced in FY 79. Specifically, the objectives are:

1. To determine the number (by species, sex, and age) of stranded marine mammals along the Alaskan coast.

2. To determine the pathological conditions and agents that caused or contributed to the moribund condition or death of stranded animals.

3. To analyze and determine the major cause of natural mortality of those species of marine mammals that have been selectively collected by RU 229 (Pitcher), RU 243 (Calkins), RU 230 (Burns), and RU 232 (Burns) during the past three years.

4. To determine annual variation in the pathological agents that cause or contribute to moribund conditions or death of marine mammals.

5. To determine the occurrence of pathogenic agents in the natural populations of marine mammals.

6. To determine the source and probable drift trajectories for these areas where the highest incidence of beached mammal carcasses occur.

7. Synthesize and report on previously obtained, unpublished data (non-OCSEAP) on arctic foxes, relating their trophic dependencies to marine-derived beached carcasses, pathological conditions, and to offshore oil and gas development activities.

Methods:

The only significant change in sampling methods during FY 79 will be the concentration of sampling efforts on stranded dead mammals, rather than those collected for research purposes.

Output:

1. Narrative Reports: These will describe the distribution of stranded dead and moribund animals along the Alaskan coast, the type of pathogenic conditions that caused or contributed to the moribund condition or death of stranded animals, and of the annual variation in the incidences of selected pathogenic agents in natural populations.

2. Digital Data: These will be in OCSEAP formats File Type (FT) 011 - Histopathology, FT 025 - Mammal Specimen and FT 026 - Mammal Sighting 02.

3. Visual Data: Data supporting the narrative report will be provided in the form of maps, charts, figures, tables and, where appropriate, photographs. Specifically, the products will be:

   a. Maps of stranded, moribund, and dead marine mammals.

   b. Charts illustrating probable carcass drift based on stranding from known sources.

c. Figures and tables illustrating:

(1) The occurrence of pathogenic agents in selected species.

(2) The annual variation in the occurrence of pathogenic agents for selected species.

(3) The occurrence of pathogenic agents in principal life stages of selected marine mammals.

(RU 229) BIOLOGY OF THE HARBOR SEAL IN THE GULF OF ALASKA

This research unit addresses subtasks E-1 and E-2 (BLM study types 39 - Vulnerable Populations, 40 - Life History, 41 - Critical Habitats, 42 - Food Web Dependencies, and 53 - Effects of Noise).

Estimated Cost, FY 79:		
	$34,500	Kodiak
	17,000	NEGOA
	$51,500	Total

Schedule: October 1978 - September 1979

Performing Agency:

Department: Alaska Department of Fish & Game
P.I., Degree: Kenneth Pitcher, M.S.
Title: Marine Mammals Biologist
Percent time devoted to Project and role: 75% Project Director

Other Principal Scientist significantly involved in Project:

P.I., Degree: Donald Calkins, M.S.
Title: Marine Mammals Biologist
Percent time devoted to project and role: 25%, Participant in field work.

Background:

During FY 77 and FY 78 a large number of animals were collected, yielding data on population composition, reproductive biology, food habits, and pathology. A large collection of organ and tissue samples have been accumulated for analysis of baseline levels of hydrocarbons and metals. During FY 78, specimen collection was limited and directed toward filling seasonal and geographical gaps and preliminary work was done in development of radio-tracking techniques for monitoring population status. FY 79 efforts will be directed toward the final synthesis and analysis of the preceding years' field data and the preparation of a comprehensive final report on the studies.

Objectives:

Objectives of this study will provide information on population dynamics, reproductive ecology, and food habits of the harbor seal in the Gulf of Alaska. Specifically, these objectives are:

1. To determine food habits and identify important prey species.

2. To determine seasonal distributions and abundance estimates and identify critical habitats.

3. To determine age of sexual maturity, age specific reproductive rates, growth rates, and seasonal changes in mean body condition by life stage and area.

4. To determine the effects of disturbance on harbor seal populations.

5. To complete the analyses of tissue samples and specimen materials for hydrocarbons and trace metals. No additional hydrocarbon and tissue sample analysis (beyond what is presently being conducted) is anticipated in FY 79.

6. To determine activity patterns, haul out behavior and seasonal use patterns for harbor seals at Tugidak Island.

Methods:

Data collected from previous years will be analyzed and a comprehensive final report will be submitted in FY 79. Distribution information will receive further interpretive analysis based on the results of intensive fish studies conducted by other research units.

Output:

1. A final narrative report describing growth rates, reproductive biology, population discreteness and patterns of movement, abundance estimates, food habits, behavioral aspects, critical habitats and seasonal use patterns, radio tracking techniques and methods, and effect of disturbance with recommendation for OCS activity stipulations which will protect populations.

2. Maps showing areas of concentration, seasonal movements, and critical habitats.

3. Digitized data will be in OCSEAP File Type 025 for information outputs listed in (1) and (2) above.

4. Specimen materials, including appropriate tissues for establishing baseline levels of hydrocarbons and metals.

5. Participation in Synthesis meetings and report review, as requested.

(RU 243) POPULATION ASSESSMENT, ECOLOGY AND TROPHIC RELATIONSHIPS OF STELLER SEA LIONS IN THE GULF OF ALASKA

This research unit addresses subtasks E-1 and E-2 (BLM Study Types 39 - Vulnerable Populations, 40 - Life History, 41 - Critical Habitats, 42 - Food Web Dependencies, and 1 - HC Baselines).

Estimated Cost, FY 79:		
	$51,000	Kodiak
	65,500	Lower Cook Inlet
	29,000	NEGOA
	$145,500	Total

Schedule: October 1, 1978 - September 30, 1979

Performing Agency:

Department: Alaska Department of Fish and Game
P. I., Degree: Donald Calkins, M.S.
Title: Marine Mammals Biologist
Percent of time devoted to project and role: 75%; project direction and field work

Other Principal Scientist significantly involved in project:

P.I., Degree: Kenneth Pitcher, M.S.
Title: Marine Mammals Biologist
Percent time devoted to Project and role: 25% participant in field work.

Background:

This project has produced a catalog and map of all hauling-out areas for sea lions in the general Gulf of Alaska region including information on numbers seen at each site. Results are improved understanding of the seasonal use patterns associated with hauling-out areas and, in most cases, determining areas actually used as rookeries (breeding locations). A large number of animals has been collected, yielding data on population composition, reproductive biology, food habits, and pathology. A large collection of organ and tissue samples has been accumulated. Analysis of this material for levels of hydrocarbons and metals began in FY 77 and will be completed in FY 79. Most of these analyses are being performed by investigators working with other research units. A major element of the work in FY 76 and FY 77 was the branding of young sea lions at principal rookeries. During FY 78 further specimen collection was limited and directed toward filling specific gaps. Considerable effort was spent in locating previously branded animals. A series of preliminary surveys to determine the population size, discreteness, and movements of the belukha whale population in Lower Cook Inlet was conducted in FY 78.

FY 79 studies will locate previously branded animals and further elucidate breeding population discreteness, dispersal, and movements from and to major rookeries. Completion of analyses of specimens and materials collected in previous years and a major synthesis effort of all existing data will be stressed.

Objectives:

1. To determine the seasonal distribution and abundance of Steller sea lions in the Gulf of Alaska, their reproductive ecology and food habits. More specifically this will involve:

    a. Determination of numbers and biomass in the Gulf of Alaska.

    b. Determination of age and sex composition at major rookeries and hauling grounds.

    c. Determination of population discreteness and seasonal patterns of movement.

    d. Determination of population productivity, age of sexual maturity, age specific reproductive rates, and mortality/ survival rates as a function of age and sex.

    e. Determination of food habits and important prey species.

2. To determine the distribution and abundance of belukha whales in Lower Cook Inlet.

3. To provide a complete synthesis of all ecological information on marine mammals in Lower Cook Inlet with emphasis on describing and evaluating the potential for impact by OCS oil and gas exploration, development, and production. Synthesis should consider the following information where available:

    a. Distribution and abundance
    b. Seasonal patterns of movement
    c. Location and characterization of important habitats
    d. Population productivity
    e. Food habits and foodweb relationships

Objective 3 will require several additional sources of information besides available ecological information on mammals. These additional sources include: the location of leased tracts, the location of exploratory rigs, the BLM Development Scenario, the results of the trajectory analysis which is being run by OCSEAP in FY 78, the results of Hayes' work on vulnerable habitats in Lower Cook Inlet (1977 - RU 059) and existing information on the sensitivity of specific components.

Methods:

Following systematic collection of specimens, standard laboratory procedures are used for analyses, including taking of standard marine mammal measurements, gross and microscopic examination of reproductive condition, reading of cementum annuli, and identification of stomach and intestinal contents. Aerial and vessel-based surveys are employed to determine patterns of use of hauling-out areas and to locate branded animals, supplemented by on-land observations. Animals are branded to distinguish place and year of birth, principally at the major rookeries.

Output:

1. Narrative reports providing syntheses of information on subjects and parameters listed above will be furnished in FY 80. These syntheses will be initiated in FY 79. Specific products to be furnished are:

    a. A synthesis of all available information on seasonal distribution and abundance, breeding and concentration areas, population and trophic dynamics, effects of disturbance, seasonal movement patterns and critical habitats of Steller sea lions in the Gulf of Alaska;

    b. Analyses of sea otter behavior and ecology in the Afognak-Marmot Islands area;

    c. Distribution and abundance estimates of beluga whales in Lower Cook Inlet;

    d. A complete synthesis of all information available on the marine mammals of Lower Cook Inlet. Interpretaion of data relating behavior to OCS development activities will be stressed;

    e. All of the synthesis information available on marine mammals of Lower Cook Inlet (addresses Objective 3) will be provided as a final report in FY 79.

2. Digital data as listed in appropriate marine mammal formats: 025 and 027.

3. Visual data in the form of maps showing hauling-out areas and rookeries, numbers present at various seasons, and sightings of branded animals.

4. Participation in synthesis meetings and review of synthesis reports.

(RU 341) POPULATION DYNAMICS AND TROPHIC RELATIONSHIPS OF MARINE BIRDS IN THE GULF OF ALASKA

This research unit addresses subtasks E-3 and E-4 (BLM Study Types 41 - Critical Habitats and Habitat Dependencies and 42 - Food Web Dependencies).

Estimated Costs, FY 79:	$120,000	Lower Cook Inlet
	81,000	NEGOA
	120,000	Kodiak
	$321,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Agency: U.S. Fish and Wildlife Service
P.I., Degree: Calvin J. Lensink, Ph.D.
Title: Activity Leader
Percent of time devoted to project and role: 25%; direction and data analysis

Other Principal Scientists significantly involved in project:

P.I., Degree: Gerald Sanger, B.S.
Title: Project Leader, Seabird Trophics
Percent of time devoted to project and role: 100%; supervision, data collection and interpretation

P.I., Degree: P. J. Gould, Ph.D.
Title: Study Leader, Seabirds and Seabird Habitat
Percent of time devoted to project and role: 60%; supervision, data collection and interpretation

This research unit originally addressed only population dynamics of marine birds, but subsequent incorporation of RU's 338, 342, and 343 enlarged its scope to include seabird colony mapping and trophics studies.

Definition of foraging areas originally took part under RU 337 as part of the work on the seasonal distribution and abundance of marine birds utilizing pelagic habitats. During FY 77 emphasis on shipboard surveys was reduced and aerial surveys emphasized to complete the reconnaissance phase of the program.

The characterization of the food habits and feeding ecology of marine birds was initiated in 1975. It consists of collections of data at breeding colonies, on the open ocean and in coastal concentration areas.

The major emphasis of the work has been on seabirds, but some data are available on shorebirds and waterfowl. In 1976-77, the bulk of the field effort was concentrated in the Kodiak area and included collections

at colonies and coastal waters in support of an integrated nearshore ecosystem study. An integrated food web study was initiated in FY 78 in Lower Cook Inlet.

Population dynamics studies at major seabird colonies and selected coastal estuaries began in 1975. This work, continued through 1978, has provided information bases ranging in length from one to four years at 14 seabird breeding colonies along the Alaskan coast between Kayak Island in NEGOA and St. Lawrence Island in the northern Bering Sea. Data on shorebirds and waterfowl have been obtained from the Yukon delta, lagoon systems on the northern Alaska Peninsula, and from the Copper River.

Seabird colony mapping was largely completed in FY 77. A small study of colonies on the southwestern side of Kodiak Island was the only work addressing that objective in FY 78.

A beached bird study was initiated as a relatively modest project in FY 78. The work, intended to produce indices of seabird mortality, was discontinued when it became apparent that the low data return would not produce conclusive results within a reasonable time period.

Most of the research unit objectives have been satisfied, thus the emphasis of FY 79 work will be on completion of the field work on population dynamics, phenology, and productivity studies at colonies not yet intensively investigated, and the acquisition of seabird trophics data on selected species, including elements of integrated foodweb investigations. These studies will be confined to the NEGOA, Lower Cook Inlet, and Kodiak lease areas. The work in the latter two areas will continue to support the integrated nearshore ecosystems investigations in progress, while work in the NEGOA will concentrate on further definition of the foraging areas around Middleton Island in conjunction with the colony studies. Field efforts in all three lease areas will be substantially reduced to a few identified colonies, aimed at selected species representative of various marine bird environments in terms of behavioral characteristics.

Objectives:

The major thrust of the research is to develop a capability to predict the rate of recovery of seabird species from impacts of petroleum spills. Recovery is largely a function of productivity, thus this aspect of seabird studies is stressed. Many factors affect productivity, so the research objectives consist of several elements. This study addresses the reproductive ecology, phenology, foraging, and trophic relationships of selected marine bird species in the Gulf of Alaska. Specifically, the objectives are:

1. To determine timing and use of major rookeries by marine birds in NEGOA, Lower Cook Inlet, and Kodiak Island areas.

2. To describe on an annual basis, species productivity, i.e., hatching, fledging, and growth rates in those rookeries.

3. To describe year-to-year variations in phenology and productivity of seabird species as a function of location, environmental conditions and other pertinent factors.

4. To define feeding habits of principal life stages of selected marine bird species in terms of prey taken, season, and location, with emphasis on the species of diving birds.

5. To locate primary seabird foraging areas in coastal waters and determine the extent and timing of use and conditions fostering concentrations of prey.

Methods:

Methods will be similar to those used in previous years. Field camps will be established at the rookeries and manned throughout the nesting season. The work at the colonies will consist of mapping rookeries, determining species composition and abundance, monitoring timing and success of egg laying, hatching and chick fledging, and making collections for food habits studies. Seabird trophics studies in the coastal waters of Lower Cook Inlet and Kodiak Island will involve periodic collections of samples of selected seabird species, and observations of feeding locations and food available. Foraging surveys in the Gulf of Alaska adjacent to Middleton Island will utilize standard shipboard transect methodology to locate and delineate the size of these areas.

Outputs:

1. Narrative Reports: Population dynamics reports will describe the phenology of major events in the nesting cycle at each colony and the reproductive ecology of species studied. They will also include, as the data allow, estimates of the number of individuals in each seabird species present at the colony.

   Seabird trophics reports will consist of discussions of the feeding ecology of selected species, including data on prey species, size and numbers with respect to season and location. Information will be included on the extent, location, and temporal changes in foraging areas as well as other aspects of feeding ecology as the data-gathering effects allow.

   Discussions of population and trophic dynamics should include evaluations of inter-year and inter-colony variability when sufficient information is available.

2. Digital Data: The results of this study will be submitted on magnetic tape for archival in EDS under the following OCSEAP

file types: 031 - Marine Bird Specimens, 033 - Bird Sighting, 034 - Bird Sighting, 135 - Bird Colony, 038 - Seawatch for Birds, and 040 - Bird Habitat.

3. Visual Data: These will consist of:

   a. Maps which show:

      (1) Location of rookeries selected for study.
      (2) Study sites, nest locations, etc.
      (3) Shipboard transect lines.

   b. Charts which show foraging areas

   c. Tables and figures which illustrate:

      (1) Timing of use of rookeries for individual species.
      (2) Timing of use of rookeries for all species combined.
      (3) Times of arrival, egg laying, egg hatching, fledging and departure from the rookery by species studied.
      (4) Hatching and fledging success and growth rates for species studied.
      (5) Food habits for species studied as functions of bird size, age, and sex, and prey species, size and numbers.
      (6) Changes in intensity of use of major foraging areas.
      (7) Changes in the range of foraging excursions by selected species for major rookeries.

(RU 551) DESCRIPTION OF PLANKTON POPULATIONS OF THE BANKS OFF KODIAK ISLAND

This research unit addresses subtask E-10 (BLM Study Types 39-Vulnerable Populations and 42-Food Web Dependencies).

Estimated Cost, FY 79: $190,000 Kodiak (100%)

Schedule: October 1978 - September 1979

Performing Agency:

Agency: National Marine Fisheries Service
P.I., Degree: Jean Dunn, M.S.
Title: Fishery Biologist
Percent of time devoted to project and role: 50%; Project Leader

P.I., Degree: Felix Favorite, Ph.D.
Title: Oceanographer
Percent of time devoted to project and role: 15%; Supervisor as Principal Investigator

Background:

The continental shelf around Kodiak Island is biologically highly productive and maintains extensive populations of fish, shellfish, birds and mammals, some of which are commercially harvested. Previous OCSEAP studies conducted in this area have supplemented existing data on the distribution, abundance and catch statistics of commercially important species. Data on other species in the pelagic, demersal and coastal environments are fragmentary and incomplete. In field sampling conducted so far, seasonal coverage has generally been limited to one season, regional coverage to small areas, and biological coverage to adult forms. As a result, the currently available data base is inadequate for environmental assessment of the Kodiak lease area.

A substantial number of data gaps remain to be addressed by OCSEAP before an understanding of the biological environment and associated processes is achieved. Most significantly, data are needed on the abundance and distribution of meroplankton, non-salmonid pelagic fish, sublittoral and nearshore forage fish, and zooplankton which constitute principal sources of food for higher forms. Analyses to establish relationships between observed distribution of key species and abiotic factors (hydrographic factors, bathymetry) are also required to understand the apparent season-specific and area-specific biotic assemblages. These data and results will be used to determine key species/life stages and biologically important localities that might be impinged by OCS development. Data on trophic dynamics are needed to identify critical links in the food web, evaluate consequences of removal or significant reduction in the population of predominant prey species (to fish, birds and mammals), and select key species to study population dynamics, habitat dependency or effect of contaminants.

An Integrated Biological Studies project was initiated in FY 78 to obtain additional data and provide a regional description of the biological environment, major population assemblages and ecological communities and trophic dynamics over the Kodiak shelf, especially nearshore, research emphasis to be placed on key species as identified by BLM. These species include those with commercial/subsistence/ sport significance, those designated as unique, rare or endangered, and those with preeminent or essential roles in an ecosystem. The field sampling program of this project is being supplemented by cooperative shellfish surveys by the Alaska Department of Fish and Game.

Research Units 551, 552 and 553 are principal components of the Integrated Biological Studies project. Besides utilizing data available in the literature and from previous OCSEAP studies, these research units will participate in joint field sampling programs, and exchange data with each other and with other appropriate research units active in FY 79, i.e., RU's 138, 140, 5, 229, 243 and 341. This would help insure analysis and synthesis of data in the manner, format and timing most useful to decision makers.

Objectives:

The overall objective of Integrated Biological Studies in Kodiak is to describe, analyze and verify the ecological community structure and productivity of selected coastal ecosystems with respect to potential impacts of oil and gas development. Specifically, objectives of RU 551 are:

1. Describe seasonal composition, distribution and relative abundance of major life stages of key planktonic taxa, including fish eggs and larvae, euphausiids, copepods, amphipods, and larvae of shrimps and crabs.

2. Correlate observed biological distributions of key species with local hydrographic regime and bathymetry.

3. Determine the extent of seasonal population recruitment for key species in plankton from offshore to inshore waters.

4. Develop a report synthesizing available literature data on key species in meroplankton and total plankton distribution on the Kodiak shelf.

Methods:

Field sampling programs, started in March 1978, will be continued through February 1979 to complete a one-year sample collection. Thereafter, sampling will be limited to specific sites and in support of research on trophic relations and dynamics over the Kodiak shelf.

At each station a CTD cast will be made to determine the position of the thermocline and pycnocline. A neuston tow will be made to sample surface ichthyoplankton. A double oblique tow of Bongo nets, from near bottom to the surface, will be made to sample zooplankton. A multiple net Tucker trawl will be used to sample meroplankton in three discrete layers: from near bottom to the bottom of the thermocline, through the mixed layer, and from the mixed layer to the surface.

Macroplankton will be sampled with a 6-foot Isaacs-Kidd midwater trawl at stations over South Albatross Bank and in Kiliuda Trough. Plankton which may reside near the bottom will be sampled with an epibenthic sled equipped with opening-closing Tucker trawls.

Output:

1. Narrative Reports: Reports will describe methods, spatial and temporal intensity of sampling, current status of knowledge, description of statistical treatment, results, discussion and conclusions. Recommendations for further investigation will be defined. Reports will include relationships of distribution of organisms to results of physical oceanographic studies (RU's 138, 140) to determine residence time over the Banks and apparent separation of populations by the Kiliuda Trough.

2. Digital Data: Results of this study will be submitted according to OCSEAP defined format in the following File Types: 008 - Zooplankton 01, 024 - Zooplankton 02.

3. Visual Data: Information will be portrayed on maps, charts, figures and tables to support the narrative reports. Specific items are:

    a. Diagrams showing the total and relative abundance of ichthyoplankton and meroplankton by seasons.

    b. Listing by season in rank order of abundance, possibly subdivided into coastal and offshore regimes.

    c. Contour maps of the distribution of biomass of principal taxa by means of overlays.

    d. Contour maps of the distributions of selected species by means of overlays.

    e. Figures and tables showing patterns of seasonal abundance with depth and timing of migration, i.e., diel, seasonal.

(RU 552) SEASONAL DISTRIBUTION AND POPULATION CHARACTERISTICS OF NEARSHORE FISHES

This research unit addresses subtasks E-5, E-6, and F-9 (BLM Study Types 39 - Vulnerable Populations, 40 - Life Histories, 41 - Critical Habitats and 42 - Food Web Dependencies).

Estimated Costs, FY 79: $155,000 Kodiak (100%)

Schedule: October 1978 - September 1979

Performing Agency:

Agency: Alaska Department of Fish & Game
P.I., Degree: Peter Jackson, B.S.
Title: OCS Coordinator
Percent of time devoted to project and role: 15%; Project Supervisor

P.I., Degree: James Blackburn, M.S.
Title: Fisheries Biologist
Percent of time devoted to project and role: 50%; Field Sampling and Data Analysis

Background: (See Background for research unit 551.)

Objectives:

The overall objective of Integrated Biological Studies in Kodiak is to describe, analyze and verify the ecological community structure and productivity of selected coastal ecosystems with respect to potential impacts of oil and gas development. Specifically, objectives of RU 552 are:

1. Determine the seasonal composition of juvenile and adult key fish populations over the Kodiak shelf, especially nearshore.

2. Describe the temporal dynamics (diel, seasonal, ontogenetic) and habitat use by key fish species, including their juvenile stages.

3. Determine the timing and localities of spawning by key pelagic, demersal and coastal fishes, including life history characteristics (age, size) of spawning populations.

4. Provide specimens of key species for stomach content analysis and food web description to RU 553.

Methods:

The stated objectives will be addressed through the use of a wide spectrum of sampling devices and survey techniques.

Sites: Permanent sampling sites will be established in specific localities, to be selected on the basis of results obtained from FY 78 field sampling program.

Equipment and Procedures: Juvenile and adult fishes will be sampled using tow nets, mid-water trawls, otter trawls, gillnets, and seines.

Sampling Intensity: Sampling will be conducted on a quarterly basis throughout the year. However, sampling intensity will be increased during the spring and summer (monthly) to coincide with expected intensification of biological activity.

Analytical Procedures: Fish samples will be processed according to the methodology described under RU's 486 and 512. Specimens for stomach analysis will be collected as specified by RU 553.

Output:

1. Narrative Reports: Reports will describe methods, spatial and temporal intensity of sampling current status of knowledge description of statistical treatment, results, discussion, and conclusions. Recommendations for further investigation will be defined.

   The reports will provide an integrated analysis of biological activity at each study site and a discussion of habitat preference for key ecologically important fishes in the Kodiak lease area.

2. Digital Data: Results of this study will be submitted according to OCSEAP defined format in the following File Types: 023 - Ground Fish, 057 - Nearshore Fish Spawning.

3. Visual Data: Information will be portrayed on maps, charts, figures and tables to support the narrative reports. Specific items are:

   a. Maps identifying sampling sites.

   b. Charts illustrating:

      (1) Distribution and abundance of principal life stages for each major species or species group by season.

(2) The primary use made of selected locations, i.e., migration, feeding and/or spawning.

c. Figures and tables illustrating:

(1) Spawning areas.
(2) Spawning time.
(3) Growth rates (including larval stages).
(4) Age class composition.
(5) Mortality rate.
(6) Foraging areas (where applicable).
(7) Nursery areas.

(RU 553) SEASONAL CHARACTERISTICS OF MEROPLANKTON AND FOOD WEB STRUCTURE IN THE NEARSHORE WATERS OF KODIAK ISLAND

This research unit addresses subtasks E-6, E-10, and F-9 (BLM Study Types 39 - Vulnerable Populations, 42 - Food Web Dependencies, and 46 - Ecosystems).

Estimated Costs, FY 79: $200,000 Kodiak (100%)

Schedule: October 1978 - September 1979

Performing Agency:

University: Fisheries Research Institute, University of Washington, Seattle
P.I., Degree: Donald Rogers, Ph.D.
Percent of time devoted to project and role: 33%; Project Supervisor

Background: (See Background for research unit 551)

Objectives:

The overall objective of Integrated Biological Studies in Kodiak is to describe, analyze and verify the ecological community structure and productivity of selected coastal ecosystems with respect to potential impacts of oil and gas development. Specifically, objectives of RU 553 are:

1. Complete one-year sampling program (initiated in FY 78) and analysis to determine seasonal plankton distribution nearshore.

2. Describe the relative variety and amount of major prey organisms taken by key fish species.

3. Determine the extent of prey selectivity (relative to what is abundant) by key fish species.

4. Determine seasonal changes in the food and feeding habits of key fish species.

5. Provide a semi-quantitative model of food web structure and identify critical biological links in selected study areas.

Methods:

In FY 78, this research unit was engaged in plankton (including meroplankton) distribution studies nearshore comlementing RU 551 studies offshore. Field sampling, started in March 1978, will be continued through the early part of FY 79 to cover fall and winter seasons, October to February 1979.

Field work will be conducted by personnel from the Fisheries Research Institute (FRI). Samples will be sorted by a subcontractor; final sorting and data analysis of fish eggs and larvae will be accomplished by personnel from the FRI, with final sorting and data analysis of shrimp and crab larvae as the responsibility of personnel from the Northwest and Alaska Fisheries Center (NWAFC).

Principal objective of RU 553 in FY 79 will be stomach content analysis and description of trophic structure in selected areas. If additional nearshore plankton data are required, field sampling will be conducted by RU 551 and data made available to RU 553.

Detailed analysis of fish stomach contents will be conducted to provide species and size frequency distribution of food items. Numerical and statistical methods will be used to determine:

1. Food selectivity (or Electivity Index) by key fish species.

2. Daily ration, metabolic requirements, and seasonal trends in food consumption by key fish species.

Data on seasonal distribution and abundance of plankton (RU's 551, 553), fish (RU 552), food and feeding ecology of fish (RU's 552, 553), birds (RU 341), and mammals (RU's 229, 243) and literature will be utilized to formulate a semi-quantitative model of trophic structure and dynamics for selected areas. Critical links in the food web will be identified on the basis of uniqueness of a species role (its utilization as food by different species and taxa, its seasonal pattern of abundance and migration) and its vulnerability to OCS development.

Output:

1. Narrative Reports: Reports will describe methods, spatial and temporal intensity of sampling, current status of knowledge, description of statistical treatment, results, discussion, and conclusions. Recommendations for further investigation will be made.

2. Digital Data: Results of this study will be submitted according to OCSEAP defined format in the following File Types: 008 - Zooplankton 01, 024 - Zooplankton 02.

3. Visual Data: Information will be portrayed on maps, charts, and in figures and tables to support the narrative reports. Specific items are:

    a. Diagrams showing total and relative abundance of plankton and meroplankton by seasons in nearshore waters.

b. Tables and figures showing species and size frequency distribution of food items in fish stomachs by seasons.

c. Tables showing feeding selectivity (or Electivity Index) of key fish species.

d. Tables showing estimates of daily ration and relationship between food consumption and size and growth rate.

e. Diagramatic, schematic, or mathematical formulation of trophic web structure at selected localities, with estimates of biomass in its different components and mass transfer coefficients.

4.4 DESCRIPTION FOR PROJECTS IN TASK F (EFFECTS):

F-7	RU 194
F-9	RU 552
	RU 553

5.0 TIMING SCHEDULE AND PRODUCTS OF OCS STUDIES IN THE KODIAK AREA

The following products list and timing schedule of OCS studies addresses the Kodiak lease area. The list of deliverables is a shorthand approximation for a complex, interlocking set of studies that are often difficult to represent by codes only and in which many qualifiers are of necessity left out.

The Codes used to identify BLM-required temporal and spatial resolution are as tabulated below. The same code is used to indicate present and projected levels of resolution in columns headed 77, 78, and 79. Appearance of the code in the FY 79 column indicates that funding is planned for FY 79.

Temporal Resolution

N = no temporal resolution
A = annual
S = seasonal
St = short term, days to weeks
D = diurnal, diel

Spatial Resolution

0 = information in hand, literature review
1 = qualitative, area wide, cursory
2 = semi-quantitative, hundreds of square miles scale
    or 25 miles of coastline
3 = semi-quantitative, 3-10 tracts scale or
    10 miles of coastline
4 = quantitative, tract specific (2 to 5 miles resolution)
5 = quantitative, site specific
6 = no spatial resolution (non-site specific)

Several codes are also used to indicate existing (Pre-1978) and Projected (1978 and on) status of the effort to attain the specific products in the Data Products List. The codes used are as follow:

1. The research is ongoing, i.e. funded for FY 79.
2. The research unit effort has been terminated, and there are no plans for its resumption. The available data are, or may be, sufficient to meet stated needs.
3. Data are available from Non-OCSEAP sources.
4. The data are insufficient to meet stated needs but the project has been terminated due to budget restrictions or lease area priorities.
5. Proposed research units.

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5				
										T	E	FS				77	78	79	
A	CONTAMINANT BASELINE																		
A-1	Distribution and concentration of hydrocarbons	Determine existing levels of hydrocarbons, prior to initiation of petroleum-related OCS activities.	Seasonal and spatial distribution patterns of hydrocarbons:							S2	S3								
			. in sediment	Table/Maps	275 480											N1			4
			. in benthic biota	Table/Maps	275											N1			4
			. in pelagic biota including neuston	Table/Maps	275											N1			4
			. dissolved in the water column	Table/Maps	275											N1			4
			. in particulate matter within water column	Table/Maps															0
		Determine probable sources of existing levels of hydrocarbons, i.e. biogenic or petroliferous.	Comparison of ratios of C_1/C_2+ with $^{13}C/^{12}C$	Tables	480					N2	N3					N1			4
		Monitor hydro-levels over broad geographical areas to determine significant changes in ambient concentration patterns following OCS development.																	
A-2	Distribution and concentration of low molecular weight (LMW) hydrocarbons in the water column	Determine existing levels of LMW hydrocarbons prior to initiation of petroleum-related OCS activities	Seasonal and spatial distribution patterns of C_1-C_4 hydrocarbons							S2	S3								
			. in water column	Maps Figures	153											N1			4
			. in sediments	Maps Figures	153											N1			4

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5				
										T	E	FS				77	78	79	
A-2		Determine probable sources of existing levels of hydrocarbon, i.e., biogenic or petroliferous. Use LMW hydrocarbon as an indigenous tracer or detection parameter to discern accumulation of hydrocarbon during or after OCS development. Examine the dispersion and diffusion of natural LMW hydrocarbons.	**Comparison of methane and C_2-C_4 hydrocarbon concentrations.**	Tables Figures	153					S2	S3					N2			4
A-3	Distribution concentration and chemical speciation **of selected toxic metals**	Determine the concentration and distribution of nonvolatile petroleum components, especially toxic metals, prior to OCS development.	Seasonal and spatial distribution patterns selected metals:							S2	S3								
			. in sediment	Maps	162											N1			4
			. in benthic biota	Maps	162/ 506											N1			4
			. in pelagic biota	Maps	162											N1			4
			. in water column (soluble and suspended forms)	Figures	162/ 506											N1			4
		Determine chemical speciation and transport mechanism of selected metals and characteristics of substrates to which they are adsorbed.	Elemental composition and distribution of suspended particulate matter.	Tables	152					S2	S3					N1			4
			Hydrocarbon adsorption characteristics of suspended matter.	Tables	152					N6						N6			4

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5				
										T	E	FS				77	78	79	
A-3		Monitor selected metal concentrations over broad geographical areas to determine significant changes during and following OCS development																	

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
										T	E	FS							
C	ENVIRONMENTAL HAZARDS																		
C-1	Description of seismic and volcanic activity.	To determine the potential hazards to platforms, pipelines and other structures due to earthquakes and volcanic equptions, as input to tract de-selection and design stipulations.	Historical earthquake epicenters, focal depths, and magnitudes	Map	251 352			N2				N4				N2 N2	N2 -	N2 -	1 2
			Earthquake magnitude vs. frequency relationships for selected areas.	Map	251 352			N2				N4				N1 N1	N2 -	N2 -	1 2
			Seismic activity of surface and near-surface faults identified in geologic mapping.	Map	251			N2				N4				N3	N3	N4	1
			Relationships between earthquake magnitudes and strong ground motion.	Map	251			N2				N4				-	-	N2	1
			Description of volcanic activity and resulting phenomena such as flows and nuees ardentes.	Maps	251			N2				N4				N2	N2	N2	1
			Seismic risk map.	Map	251			N2				N4				-	N2	N2	1
			Volcanic risk map.	Map	251			N2				N4				-	-	N2	1

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
C-2	Description of the distribution and relative ages of surface and near-surface faults.	To determine the potential hazards to platforms, pipelines, and other structures due to active faulting; serves primarily as input to tract deselection and to provide geographic focus for earthquake studies.	Locations of surface and near-surface faults classified according to apparent recency of movement (from geologic relationships).	Map	327			N3				N4				N3	N3	N4	1
C-3	Description of the types and extent of natural seafloor instability.	To determine the potential hazards to platforms, pipelines, and other structures due to slumping, compaction, and liquefaction of bottom sediments; serves as input to tract deselection and siting/design stipulations.	Delineation of existing and potential slumps and other unstable sediment masses, classified according to present relative stability.	Map	327			N3				N4				N3	N3	N4	1
			Thickness of unconsolidated sediment.	Map	327			N3				N4				N3	N3	N4	1
			Description of sediment physical properties.	Map Report	327			N3				N4				N2	N2	N2	1
			Geologic cross-sections of potentially unstable sediment masses.	Prof[illegible]	327			N3				N4				N2	N3	N3	1
			Description of the geologic history of unconsolidated sediment units.	Map	327			N3				N4				N3	N3	N3	1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
						-4	-3	-2	-1	0	+1	+2	+3	+4	+5				
Task	Product	Intended Use	Specific Product	Format	R.U.					T	E	FS				77	78	79	
C-3 cont.			Interpretation and description of the nature and severity of sediment instability.	Report	327			N3				N4				N2	N3	N4	1
C-4	Identification and description of areas of potentially hazardous seafloor erosion, deposition, and bedform movement.	To determine the potential hazards to platforms, pipelines, and other structures due to seafloor erosion, deposition, and beform movement; serves as input to tract deselection and siting/design stipulations.	Locations of areas of of severe erosion and deposition (indicating rates where possible).	Map	327			N3				N4				N3	N3	N3	1
			Distribution and description of large-scale mobile bedforms showing directions and rates of movement.	Map Report	327			N3				N3				N3	N3	N3	1
			Interpretations regarding the nature and severity of erosion, deposition, and bedform movement.	Report	327			N3				N3				N3	N3	N3	1
C-5	Identification and description of potential coastal hazards.	To determine the potential hazards to onshore development due to coastal erosion, accretion, faulting, and other onshore surface processes; serves primarily as input to siting/ design stipulations and development plan verification.	Identification of coastal areas with severe erosion or accretion, indicating rates where possible.	Map				N2				N3	N4						0
			Description of nearshore sediment dynamics.	Map Report				N2				N3	N4						0

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
C-5			Description of coastal geology, including active faults and surface processes.	Map Report				N2			N3	N4							
			Interpretation of the potential hazards to coastal facilities.	Report				N2			N3	N4							0
C-6	Description of the extent and characteristics of sub-sea permafrost.	Not applicable to Kodiak																	
C-7	Description of the geographic distribution of ice-gouging, its severity, and frequency of occurrence.	Not applicable to Kodiak																	
C-8	Description of the distribution and nature of gas-charged sediments.	To determine the potential hazards to platforms, pipelines and other structures due to gas-charged sediments; serves primarily as input to siting/design stipulations.	Description of the distribution and depth of gas-charged sediments.	Map Profile	327			N2	N3		N4					–	N3	N4	1
			Identification of oil and gas seeps.	Map	327			N2	N3		N4					N2	N3	N3	1
			Descriptions of the origins and characteristics of gas-charged sediments and their potential hazards.	Report	327			Resolution not applicable.											

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
C-9	Stress - strain relationships in ice.	Not applicable to Kodiak																	
C-10	Characterization of frequency, intensity and effects of extreme oceanic events	To identify hazards to OCS exploration, development, and production activities.	1. Observational and historic information on storm surges as a function of location, season, and magnitude.	Tables		NO				S3									
			2. Observational and historical information on coastal katabatic winds as a function of location, season, and magnitude.	Tables Figures Graphs	347	NO				S3						S2			2
			3. Historical information on tsunamis (see Subtask C-1)	Tables	352	NO				S3						S2	-	-	2

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D D-1	TRANSPORT Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	To predict or estimate trajectories of pollutants and time of impact.	1. Analyses of historic data in the literature and previously unreported data.	Narrative with maps, tables	357			S2	S3							S2			2
			2. Analyses of historical data on climatic systems and meteorological events for their effects on circulation.	Narrative with maps	347			S2	S3							S2			2
			3. Seasonal temperature and salinity distribution.	Narrative with maps	289			S2	S3			S4				S2	S2	S3	1
			4. Baroclinic circulation.		289			S2	S3			S4				S2	S2	S3	1
			5. General circulation, based on moored current meter data.	Narrative with figures	138			S2	S3			S4				S2	S2	S3	1
			6. Trajectories of drogues.	Maps and narratives	217			S2	S3			S4				A2	S2	-	4
			7. Discussion of mixing and estimates of lagrangian dispersion coefficients.	Narrative	217			S2	S3			S4				A2	A2	-	4
			8. Estimates of sea-surface slope.	Narrative Tables	138			S2								S1	S1	-	1
			9. Measurements of local wind fields.	Narrative	367			S2									S2	S2	1
			10. Analyses of synoptic weather data to obtain local wind and temperature fields.	Narrative	367			S2	S3			S4					S1	S2	1

77-969

95

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-1	Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	To predict or estimate trajectories of pollutants and time of impact.	11. A procedure for determining local wind fields when synoptic data and local station data are available.	Narrative	367		Resolution scale not appropriate									-	-	N6	1
			12. Currents, calculated by diagnostic model.	Narrative	140					Not applicable						-	N6	N6	1
			13. Currents calculated by hydrodynamical model.	Map	235			S2								D3	-	-	4
D-2	Seasonal and shorter term description of water masses and circulation patterns in near-shore	To predict or estimate trajectories of pollutants and time of impact	1. Analyses of historic data in the literature and previously unreported data.	Narrative with maps	357			S2								S2	-	-	2
			2. Analyses of historical data on climatic systems and meteorological events for their effects on circulation.	Narrative with maps	-			S2								-	-	-	0
			3. Seasonal temperature and salinity distribution.	Narrative with maps	289			S2								S2	S2	S3	1
			4. Baroclinic circulation.	-	289			S2								S2	S2	S3	1
			5. Near-shore circulation, based on moored current meter data.	Narrative with figures	138			S2								S2	S2	S3	1
			6. Trajectories of drogues.	Maps and Narrative	217				S2							A2	S2	-	4

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-2	Seasonal and shorter term description of water masses and circulation patterns in nearshore regimes.	To predict or estimate trajectories of pollutants and time if impact.	7. Discussion of mixing and estimates of Lagrangian dispersion coefficients.	Narrative	217				S2									-	4
			8. Estimates of sea surface slope.	Narrative	138				S2							S1	S1	-	1
			9. Near shore currents by means of a current mapping radar.	Map	-				S4							-	-	-	0
			10. Analyses of satellite photos for oceanographic data.	Narrative	289				S2							S2	S2	S2	1
			11. Surf zone dynamics; wave refraction diagrams, rip-current distributions.	Narrative with maps	-				S2							-	-	-	0
			12. Storm surge probability and intensity.	Narrative					S2							-	-	-	0
			13. Measurements of local wind fields near shore.	Narrative	367				S3							-	-	S3	1
			14. Analyses of synoptic weather data to obtain local wind and temperature fields.	Narrative with maps	367				S2	S3			S4			-	-	S2	1
			15. A procedure for determining local wind fields when synoptic data and local station data are available.	Narrative	367													N6	1

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-2	Seasonal and shorter term description of water masses and circulation patterns in nearshore regimes.	Used to assess potential for air pollution by onshore development offshore facilities	16. Measurements of the stability of the surface (air) boundary layer and ice nuclei baseline.	Narrative	N/A				S3							-	-	-	0
			17. Results of analysis by models.	Narrative with:															
			a. General circulation.	Maps	160			S2	S3			S4				S2	S2	S3	1
			b. Tidal current (hydro dynamical).	Maps	235			S2	S3			S4				D3	-	-	4
			c. Trajectory.	Maps	140			S2	S3			S4				S3	S3	S3	1
			d. Trajectory with plume dynamics.	Maps				S2	S3			S4				-	-	-	0
D-3	Description of oil spill plume behavior and oil weathering processes.	Evaluation of degree of impact, areal scale of impact and contingency requirements.	1. Oil spill weathering mechanisms and estimated rates.	Narrative	499			Resolution: Not Applicable								-	N6	-	4
			2. Laboratory determined weathering rates.	Tables				Resolution: Not Applicable								-	-	-	0
			3. Field studies to determine weathering rates.	Tables				Resolution: Not Applicable								-	-	-	0
			4. Description of mechanisms which cause dispersal of oil plumes.	Narrative	-			Resolution: Not Applicable								-	-	-	0
			5. Pollutant dynamics model general.	Computer	-			Resolution: Not Applicable								-	-	-	0
			6. Pollutant dynamics model subroutine accounting for weathering).																

510

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-4	Description of the types and characteristics of bottom sediments and their probable interaction with oil and biota.	To determine the probable fate of oil in association with bottom sediments, its longevity, cleanup difficulty, and possible effects on intertidal and benthic biota; serves as input to tract deselection.	Description of sediment grain size properties.	Map	290 327					N2	N3					N2 N3	N2 N3	- N4	2 1
			Description of coast-morphology, beach materials, and relative vulnerability of the coast to spilled oil.	Map Report	59					N2	N3					-	N2	-	2
			Interpretation regarding the interaction between oil and bottom sediment, oil retention capability of the substrate, and implications regarding possible effects on intertidal and benthic biota.	Report	59					N2	N3					-	N2	-	2
D-5	Description of bottom sediment dynamics.	To determine the transport trajectory of oil in association with bottom sediments. Serves as input to tract deselection and to hazards studies.	Description of the directions and rates of bottom sediment movement.	Map Report	327					N2	N3					N2	N2	N2	1
			Intrepation regarding the mechanisms of entrainment and transport of bottom sediment and their relationship to physical oceanographic processes.	Report						N2	N3								

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-6	Character of suspended particulates and their effectiveness as transporters of oil.	**Assessment of the impact potential of oil spills.**	1. Sediment and suspended sediment distributions.	Narrative with maps						S2	S3					-	-	-	0
			2. Sediment movements.	Narrative with maps						S2	S3					-	-	-	0
			3. Tabular data, indicating extent of oil/sediment interaction under varying environmental condition.	Narrative with maps						S2	S3					-	-	-	0
			4. Relation of suspended particulate matter to terrestrial and marine sources.	Narrative with maps						S2	S3					-	-	-	0
D-7	Description of seafloor topography.	To provide input to circulation studies and hazards studies	Description of seafloor topographic features.	Map Report	327			N4								N3	N3	N4	1
D-8	Characterization of sea ice morphology including under-ice morphology.	Not applicable to Kodiak																	
D-9	Description of ice dynamics and their effects on transport of oil and safety of structures.	Not applicable to Kodiak																	
D-10	Description of interaction between sea ice and oil and movement of oil in a ice field.	Not applicable to Kodiak																	

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-11	Susceptibility of marshlands near the coast to inundation by oil transported by storm tides.	To assess the probability of insult to critical habitats.	Calculated probability of storm surge.	Narrative				S2								-	-	-	0
			Verification of probability of storm surge by field studies	Narrative				S2								-	-	-	0
			Analysis of historical storm surge records.	Narrative with tables				S2								-	-	-	0

77-969

513

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-1	Description of seasonal distribution and abundance of marine mammals.	To identify critcial habitats and determine the likelihood of impinge ment based on transport data and probable sources.	1. Annotated bibliography of available marine mammal data and literature.	Narrative	068											NO			2
			2. Review of available literature and data on marine mammals.	Narrative	068											NO			2
				Charts												NO			3
			3. Seasonal distributions and relative abundance of marine mammals.	Charts Tables	068					S1		S3				S2			2
					229											S2	S3	S3	1
					240											S2	-	-	2
					243											S2	S3	S3	1
			4. Locations of marine mammal migration routes.	Charts	68					S2		S3				S2	S3		2
			5. Locations of breeding and concentration areas.	Charts	229					S3		S4				S3	S4	S4	1
					240					S3		S4				S3	-	-	2
					243					S3		S4				S3	S4	S4	1
E-2	Description of population dynamics and trophic relations of marine mammals.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	1. Population dynamics of marine mammals, including: . reproductive biology . growth . population composition . habitat dependencies	Tables Graphs Figures	229					S2				S3		S2	S3	S3	1
					240											S2	-	-	2
					243											S2	S3	S3	1
			2. Trophics of marine mammals, including: . major prey species . foraging areas	Tables Charts	229					S2				S3		S2	S3	S3	1
					240											S2	-	-	2
					243											S2	S3	S3	1
			3. Behavioral aspects of marine mammals relative to OCS activities.		243					S0								-	1
					240											S1	-	-	2
					229												S1	S2	1

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-3	Description of seasonal distribution and abundance of marine birds.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of marine bird data and literature.	Narrative	339												NO		2
					340												NO		2
			2. Review of marine bird data and literature.	Narrative	003												NO	-	2
				Charts	339												NO		2
				Tables	340												NO		2
			3. Seasonal distribution and abundance of marine birds.	Charts	003					S2						S2	S2	S2	1
				Tables	108												S2	S2	1
					239											S2	-	-	2
					337											S1	S2	-	2
			4. Locations of marine bird breeding colonies.	Charts	003					S5						S3	S4	S4	1
					338											S3	S5	-	2
					343											S3	S5	-	2
			5. Locations of marine bird concentration areas.	Charts	003					S2		S3				S3	S3	S3	1
					337											S3	S3	-	2
					338											S3	S3	-	2
			6. Locations of bird migration routes.	Charts	003					S2						S2	S2	S2	1
					337											S2	S2		2
					340											S2	S2		2
E-4	Description of population dynamics and trophic relations of marine birds.	To evaluate the potential effects of OCS activities on the stability of of populations within a considered critical habitat.	1. Population dynamics of marine birds, including: . breeding phenology . reproductive ecology . growth . habitat dependencies	Tables Graphs Figures	341					S2		S_t^1		S_t^1			S2	S_t^1	1
					108													S_t^1	1
			2. Trophics of marine birds, including: . Major prey species . foraging areas	Tables Charts	341					S2				S4		S1	S2	S2	1
					108													S3	1

77-969

Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	Projected 77	Projected 78	Projected 79	Status
	DATA PRODUCTS					Resolution Schedule for OCS Studies by Fiscal Year — Required										Projected			
E-4 cont.	Description of seasonal distribution and abundance of marine birds.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	3. Behavioral aspects of marine birds relative to OCS activities.		108					N1								S_t 1	1
E-5	Description of the seasonal distribution and abundance of marine fish.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available marine fish data and literature.	Narrative	064					NO		NO					NO		2
					174											NO			2
					353											NO			2
										NO						NO	NO		2
																NO			2
			2. Review of available marine fish data and literature.	Narrative Graphs	64												NO		2
					174														
					353														
			3. Seasonal distributions and relative abundance of marine fishes.	Charts	174					S2							NO		2
					353											NO			2
					552													S 3	1
					553													S 2	1
					485												S2		2
					486												S2		2
			4. Locations of spawning and concentration areas, and migration routes.	Charts	353					S2		S3					N1		2
					552													S3	1
					553													S2	1
																			1
					174												NO	-	2
			5. Locations of important commercial fishing areas.	Tables	174					S2		S3					NO		2
					353											NO			2
E-6	Description of population dynamics and trophic relations of marine fish.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	1. Trophics of marine fishes, including: . identification of major prey species . foraging areas	Tables Charts	284	NO				N1		S2				NO	N1		2
					285											N6			2
					553												S2	S2	1

77-969

E-6 Description of pop- To evaluate the 2. Population

109

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-6 cont.	Description of population dynamics and trophic relations of marine fish.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	2. Population dynamics of marine fishes including: . reproductive biology . growth . habitat dependencies	Tables Charts	551 552 553					N1		S2						S2 S 2 S 2	1 1 1
E-7	Description of seasonal distribution and abundance of benthic biota.	To identify criti- habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available literature and data on benthic biota.	Narrative	282											NO			2
			2. Review of available literature and data on benthic biota.	Narrative	282											NO			2
			3. Distribution and abundance of dominant benthic organisms.	Charts Tables	005 517 282					N2		S3				- N2 N2	S 2	S 2	1 2 2
	Description of population dynamics and trophic relations of benthic biota.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	4. Population dynamics of benthic organisms, including: . Seasonal community structure . Seasonal abundance of dominant organisms . Productivity estimates	Tables Graphs Figures	005												N2	N2	1
			5. Trophic relations of selected benthic organisms including: . food webs . identification of major prey species	Tables	005 517					N1		S1		S3			S 2	S2 N2	1 2

77-969

105

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5				
										T	E	FS				77	78	79	
E-8	Description of distribution and abundance of biota in littoral communities.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available data and literature on littoral biota.	Narrative						NO									0
			2. Review of available data and literature on littoral biota.	Narrative	078											NO	NO		2
			3. Regional characterization of littoral habitat, including: . Substrate . Littoral community structure . Population density distributions	Charts Figures Tables	024 078					S2		S3		S4		S2 N2	N3		2 2
E-9	Description of the ecosystem dynamics and relative abundance of biota in littoral communities.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat	1. Population dynamics of intertidal biota, including: . Seasonal community structure . Productivity	Tables Figures	024 078					S2				S3		N2 -	N1	-	2 2
			2. Trophic relations of littoral fauna, including: . Food webs . Identification of major predator prey relations	Tables						S2				S3					

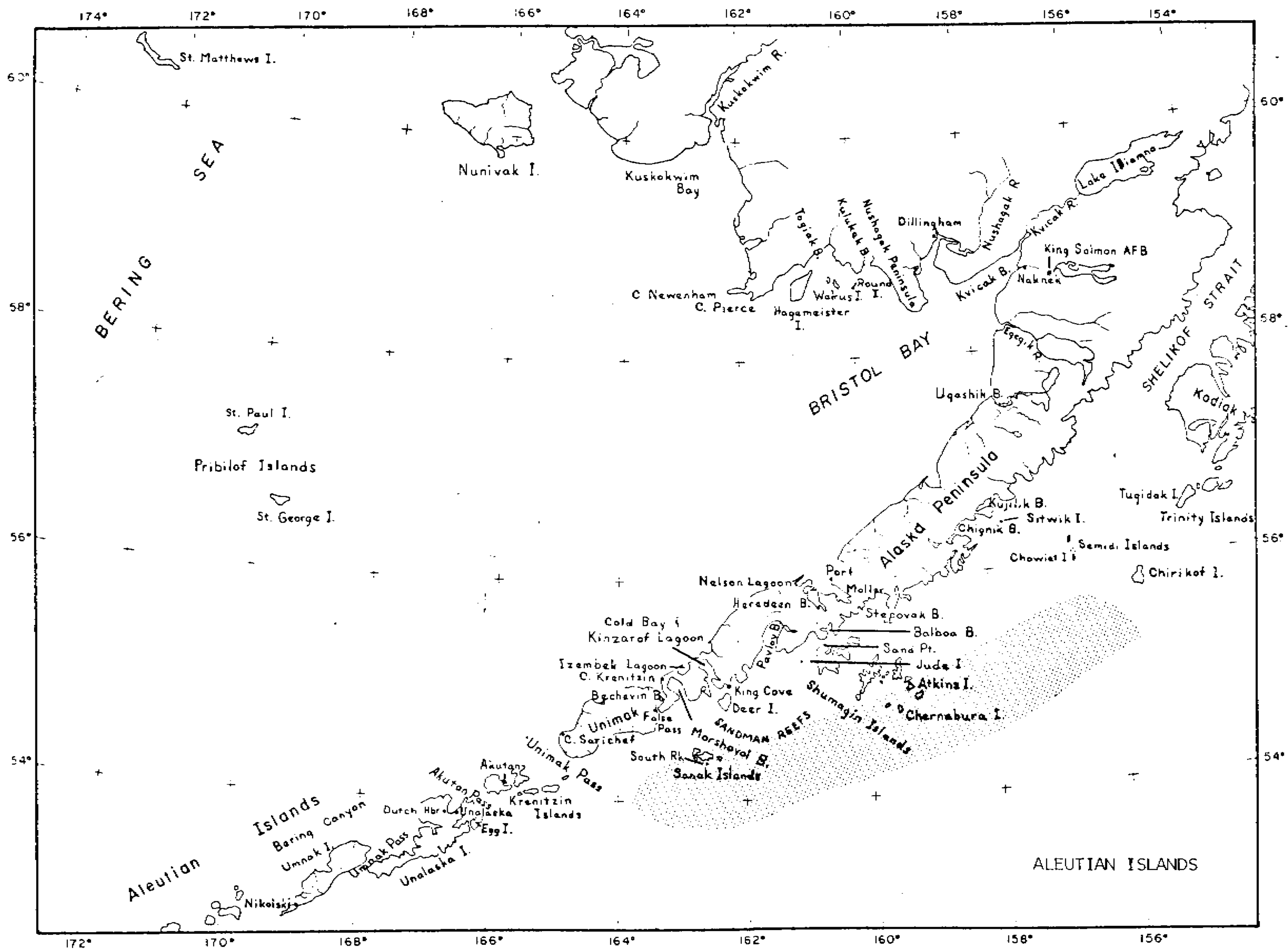
77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	Status
E-10	Seasonal density distributions of principal species of plankton.	To identify critical habitats and to determine the likelihood of impact based on transport data and probable sources.	1. Time of appearance	Tables Graphs	058					S1		S2				S1			2
					156b/											S1			2
					156c/											S1			2
					156d											S1			2
					551												N2	S2	1
					553												N2	S2	1
			2. Quantitative distributions							S1		S2							
E-11	Seasonal indices of phytoplankton standing crop and production.	To identify critical habitats and to determine the likelihood of impact based on transport data and probable sources.	1. Composition	Graphs Tables	058					N1		S2				S1			2
					156c/											S1			2
					425b														
			2. Standing crop	Graphs Tables	058					N1		S2		S3		S1			2
					156c/											S1			2
			3. Productivity	Graphs Tables	058					N1		S2		S3					2
					156c/											S1			2
			4. Ecology of sea ice flora.		N/A					N1		S2							
E-12	Non-population dependent physiological and population parameters of plankton communities.	To recognize gross seasonal and spatial trends in distribution of plankton communities	1. Pigment ratios. 2. ATP content. 3. Carbon assimilation ratio.	Narrative Tables Figurs															
E-13	Identification and seasonal characterization of critical habitats for egg and larval stages of fish and shellfish species.	To identify critical habitats and to determine the likelihood of impact based on transport data and probable sources.	1. Time of appearance	Charts Tables Graphs	551					S1		S2		S3				S2	1
					5[illegible]													S2	1
			2. Quantitative distributions.	Charts Figures Tables	551					S3				S6				S2	1
					553													S2	1
E-14	Ichthyoplankton key for Alaskan waters.	OCSEA Program development.	Ichthyoplankton key.	Key	349				N6							N6			2

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
										T	E	FS							
E-15	Characterize marine microbial communities with regard to quantitative levels of indigenous heterotrophs, chemotrophs and pathogens.	To identify critical habitats and determine likelihood of impingements based on transport data and probable sources	1. Geographical density distributions of physiological groups in: . Water . Sediments . Biota	Tables Graphs Charts	030 190 332					N2		S2					N2 N2 N2		4 4 2
		To define the potential for petroleum degradation in specific habitats and, therefore, likelihood of impact.	2. Hydrocarbon degradation rates	Tables Graphs	030					N1		S1		S2			N6		4
			3. Evaluation of techniques used to determine oil degradation in sediments.	Narrative						N6									3
E-16	Response of microorganisms to normal environmental stresses.	To obtain the range of variation in microbial activity in order to provide a basis for evaluating the effect of hydrocarbon contamination.	1. Microbial activity and respiration ratios.	Tables Graphs						S1		S2							
			2. Nitorgen fixation rates in: . Sediment . Animal guts	Tables Graphs						S1		S2							
E-17	Relationship of ice movements and types to distributions and abundance of various living resources.	Not applicable to Kodiak		N/A															

77-969


St. Matthews I.
BERING
SEA
Nunivak I.
Kuskokwim Bay
Kuskokwim R.
Togiak B.
Kulukak B.
Nushagak Peninsula
Dillingham
Nushagak R.
Kvichak R.
Lake Iliamna
King Salmon AFB
Naknek
Kvichak B.
C. Newenham
C. Pierce
Hagemeister I.
Walrus I.
Round I.
Egegik R.
BRISTOL BAY
SHELIKOF STRAIT
Kodiak
Ugashik B.
St. Paul I.
Pribilof Islands
St. George I.
Alaska Peninsula
Chignik B.
Semidi Islands
Tugidak I.
Trinity Islands
Chirikof I.
Nelson Lagoon
Port Moller
Herendeen B.
Stepovak B.
Balboa B.
Sand Pt.
Jude I.
Atkins I.
Chernabura I.
Shumagin Islands
Pavlof B.
Cold Bay & Kinzarof Lagoon
Izembek Lagoon
C. Krenitzin
Bechevin B.
King Cove
Deer I.
Unimak
False Pass
C. Sarichef
Unimak Pass
SANDMAN REEFS
Morzhovoi B.
South Rk.
Sanak Islands
Akutan
Akutan Pass
Krenitzin Islands
Dutch Hbr.
Unalaska
Egg I.
Aleutian Islands
Bering Canyon
Umnak I.
Umnak Pass
Unalaska I.
Nikolski
ALEUTIAN ISLANDS

3.0 RATIONALE FOR ALEUTIAN RESEARCH PROGRAM

3.1 SCOPE AND DIRECTION

A major change in OCSEAP research scope and direction was necessitated in FY 78 in view of a budget reduction and a new OCS Planning Schedule dated August 1977, which does not include the Aleutian lease area. Studies conducted in FY's 76 and 77 were both regional and area-specific in nature and addressed several PDP subtasks. However, in FY78 the level of effort declined and only studies with long-term applicability and regional significance were funded. It is assumed that this lease area will be included in later OCS Planning Schedules. Therefore, to the extent the budget allows, research studies requiring long lead time and those needed for future planning will be continued at modest levels. Since the Aleutian area is downstream from the Gulf of Alaska lease areas, it may be adversely affected by OCS development and receive contaminants released elsewhere. Therefore, it is imperative that special site-specific studies be conducted in this lease area once development activities are initiated in the Kodiak lease area "upstream."

3.1.1 Premise

The assessment of marine environmental quality and biotic resources in the Aleutian region is viewed as an interdisciplinary one, involving studies in biology, chemistry, geology and physics as related to OCS development and synthesizing the resulting information into a cohesive whole. OCSEAP studies in this area follow the Program Development Plan (PDP) in developing and managing scientific studies and providing specific products and deliverables. Research activities have evolved around OCS Planning Schedule, information needs and objectives of BLM, and specific regional environmental characteristics. These studies are being supplemented by extensive literature searches and compilation and review of available scientific data and results as they pertain to the description of the environment and possible effects of OCS development.

The evaluation of potential adverse impacts and risks of biota and ecosystems, habitat disturbances, characterization of environmental hazards, identification of most probably landfalls and potential pathways of contaminants released in the lease area or in areas related to OCS development are some of the most important features that must be adequately addressed and understood to insure environmental safety and conservation. The relevance and needs for such studies and information products needed for decision-making are outlines in Section 2.0.

Earlier studies in this area were conducted in conjunction with projects of similar scope and objectives in the Gulf of Alaska, primarily to insure continuity of observations within the oceanographic regime. The level of resolution in the data obtained and intensity of sampling by most research units in this lease area, except on geological hazards assessment, have remained low. So far the following objectives have been addressed.

- Establish background levels of petroleum-related contaminants in water, sediment, and selected biota. These studies address PDP Task A (Contaminants).
- Characterize vulnerability of the region to environmental hazards, including geologic (seismicity, volcanism, faulting and sediment instability) meteorologic (severe climatological events), and oceanographic (storm waves, tsunamis). These studies address PDP Task C (Hazards).
- Determine water property distributions, mean flow characteristics and circulation regime in the water column and over the seabed, and probable contaminant trajectories. Shelf and nearshore studies are conducted in relation to the southwest moving Alaska Stream, and outflows from the Shelikof Strait. These studies address PDP Task D (Transport).
- Evaluate extensive fish resources, which constitute a major source of local employment and regional economy. A part of this study (nonsocioeconomic) relates to PDP Task E (Biota).
- Study the distribution and abundance of the extensive and varied regional biota, evaluate factors responsible for the observed high but non-uniform population density distributions over the shelf, identify major bird and marine mammal colonies and delineate important foraging and hauling areas. Also included in this objective is the identification and

assessment of coastal areas and embayment which are critical to feeding, spawning, rearing, and migration of fish, bird, or mammals. These studies address PDP Task E (Biota).

Studies of sea ice as a potential hazard to structure and facilities offshore, as a platform for biotic dispersion, or as to its effect on contaminant transport or overall biological productivity are not relevant in this area. Effects of landfast ice on coastal geomorphology and intertidal benthic distribution will be studied by appropriate research units.

Information related to the nature and magnitude of potential contaminant input as a result of OCS activities, necessary for OCSEAP planning and establishing priorities and timing of other research tasks, will be provided by BLM as it becomes available. Such information relates to PDP Task B (Sources).

3.1.2 Long-Term Needs

Concentrated OCSEAP investigations in the Aleutian lease area were initiated after a major expansion of OCS environmental assessment program was requested by BLM? Prior to this expansion, Aleutian Shelf and offshore areas were investigated as part of regional circulation, biological reconnaissance and geological hazard assessment studies of the NEGOA and Kodiak lease areas. As stated earlier, this area is not currently included in the OCS Planning Schedule (August 1977), although a previous schedule (January 1977) called for a proposed first generation sale during FY 81. As a result, data collection and flow of information have not been uniform. Only two research units, one assessing the geological hazards and the other describing the flow pattern and variability as part of the Gulf of Alaska mesoscale circulation, have continued studies on a uniform and sustained basis.

Major OCSEAP research emphasis was placed in this lease area in FY 77 when 17 research units conducted studies addressing PDP Tasks A (Contaminants), C (Hazards), D (Transport) and E (Receptors). During FY 78, in response to the revised OCS Planning Schedule, only seven research units were engaged in studies emphasizing geological hazard assessment, mesoscale circulation and compilation of seabird and marine mammal data. So far, OCSEAP studies have provided reconnaissance data on biological populations and communities at a nominal level of resolution, a very generalized distribution of petroleum-related contaminants, an inadequate knowledge of mesoscale circulation and distribution of properties in the water column, and preliminary assessments of seismic and volcanic hazards. Studies on assessment of environmental, mostly geologic, hazards and mesoscale circulation are currently underway and planned for FY 79. Preliminary assessment of marine mammal, bird and selected fish populations is expected to be completed in FY 78.

A very modest research program with limited objectives, long-term usefulness of data and broad regional applicability of resulting information, is anticipated in the next few years unless a further change in priorities in the Aleutian leasing schedule occurs.

3.2 KEY ISSUES AND STATUS OF KNOWLEDGE

3.2.1 Key Issues

Geologic Hazards

The general Kodiak-Aleutian area is seismically very active. Historic records have shown that hundreds of seismic events have occurred in this area over the past 75 years, several with magnitude 6.0 or greater. Maximum historical earthquake recurrences rates have been recorded south of Unimak Island.

Plots of epicenter locations and aftershock zones have shown a gap between Shumagin Islands and the Kodiak Island. This area, identified as "Shumagin Gap," is believed to be one of accumulative tectonic strain. It is likely that this strain would be released in the form of a major earthquake, possibly during the projected oil and gas production phase in the Kodiak (and probably Aleutian) lease areas.

Biological Populations on Semidi Islands

The Semidi Islands group and surrounding waters are designated as a National Wildlife Refuge. This general area is also situated downstream from the Western Gulf of Alaska lease areas and adjacent to the Bristol Bay area (not on the current lease schedule) and may be impacted by oil and gas development activities elsewhere.

Over 50 resident and migrant bird species have been identified in this area. Extensive and large populations of shearwaters, northern fulmars, and thick-billed murres, comprising nearly one-half million individuals, are located here. Possibly the world's largest population of Steller sea lions reside on Chowiet Island, with other smaller assemblages found on neighboring islands and the Alaska Peninsula. Any significant impact on environmental factors that affect or govern population size and distribution or possible removal or reduction in population size of key prey/food species may have deleterious consequences for both the biota and regional environmental quality.

3.2.2 Status of Knowledge

Ambient Contaminant Levels

Only limited studies on hydrocarbon and heavy metal concentration in seawater, sediment and biota have been conducted in the western Gulf of Alaska. No data have been obtained on the concentration and distribution of hydrocarbons in the water column. Currently available data show that concentration of total hydrocarbon (sum of hexane and benzene fractions) in sediments in the Aleutian area is between 2 to 27 μg/g dry sediment; methane concentration in sediments varies between 0.7 to 5.8 μg/g dry sediment. There is no indication that hydrocarbons are petroliferous (Shaw, RU 275).

Concentration of soluble fractions of heavy metals in seawater in this area is generally very low, usually lower than mean values for open oceanic waters. Values reported so far are: 0.03 μg/l for cadmium, 0.2 for copper, 0.65 for nickel, 0.007 for mercury and 1.5 for vanadium. Limited data on concentrations of manganese, vanadium, arsenic, barium, cobalt, chromium, iron, antimony and aluminum on the sediments have also been reported. No systematic vertical distribution patterns in sediments have been recognized (Burrell, RU 162).

Hazards

The general Kodiak-Aleutian area lies within an active seismic belt and is extremely susceptible to earthquake damage. Underthrusting of the Pacific Plate beneath the North American Plate provides the mechanism for the seismicity. Hundreds of seismic events have been recorded in this area since 1899, including approximately 30 earthquakes of magnitude 6.0 or greater (Meyers, RU 352). Maximum historical earthquake recurrence rates are recorded south of Unimak Island (54^{O}N, 164^{O}W).

As expected, a major portion of seismic/tectonic energy is released during large earthquakes. Such events probably represent rupture along major crustal blocks whose shapes can be defined by the distribution of aftershocks. A plot of these aftershock zones suggests a regular space-time pattern for earthquakes and also identifies major gaps in seismic activity. These gaps are regarded as likely sites for future large earthquakes. The Kodiak-Shumagin seismic gap, located in the vicinity of the previously proposed Aleutian lease area, has been seismically quiet since the 1938 Shumagin Islands earthquake and could experience another major earthquake in the near future. According to available estimates, seismic events of magnitude 7.9 can be expected to recur at 60 to 87 year intervals (extreme case 26 to 360 year intervals), with the next major event occurring in this area before 2288 and possibly between 1998-2025 (Davies et al., RU 16).

Continued studies by RU 16 in the Aleutian-St. George Basin area are providing new data with upgraded monitoring systems, better location accuracy and lower magnitude detection levels. An existing array of 20 seismic stations is being maintained in this area; additional stations are proposed in the Pribilof region. A close cooperation on data exchange and analysis among RU's 16, 210 (NEGOA) and 251 (Kodiak) is being maintained for maximum dissemination of information and development of an earthquake prediction capability in the Gulf of Alaska.

Water Circulation and Transport

Currently available data and results on water transport and mixing processes, as related to probable contaminant distribution and landfalls in this area, are very sparse and insufficient to adequately address Task D objectives. Only two research units (RU's 289, 138) have provided new information on water property distribution and flow regime in this area. Physical oceanography and meteorology for the Gulf of Alaska data prior to OCSEAP have been compiled by Ingraham, Bakun and Favorite (RU 357), and Wise and Brower (RU 347).

General Hydrography

The western hydrographic station grid in the Gulf of Alaska extends over the continental shelf and slope south of Alaska Peninsula westward to Unimak Pass. Three station transects, Mitrofania, Pavlof Bay and Unimak Pass, have been sampled irregularly since fall 1975. A total of six cruises has been conducted along the western grid in the past three years but complete occupation of the grid has occurred only once because of higher priority placed on data from the Kodiak Island region. The collected data show that the shelf water properties and circulation in this area are greatly influenced by the Alaska Stream offshore and local freshwater runoff along the coast (Royer, RU 289). Local effects are probably less prominent in this region than, for example, over the Kodiak Shelf. On the basis of inferred swift and southwesterly currents alongshore, it is expected that water/contaminant residence time would be relatively short.

Current Meter Data

Hayes and Schumacher (RU 138) have obtained current meter data from two locations in the lease area since FY 76. Data obtained and reported so far from the first location have shown that the mean net flow at 20 m is between 11 and 25 cm/sec and directed at 255°TN (west-southwest), approximately parallel to the regional topography. Current meter records from the second location are fewer. The average net flow is 22 cm/sec at 20 m directed toward 256°TN and 16 cm/sec at 50 m directed toward 261°TN. This difference in direction is thought to be related to the complex and variable bathymetry of the region.

Biological Productivity, Communities and Populations

Plankton

No OCSEAP plankton studies have been conducted in the Aleutian lease area. A review of historic data, 1958-74, on nutrients, phytoplankton and primary productivity in the Gulf of Alaska and northern North Pacific has shown that data applicable to this lease area are scarce (Anderson and Lam, RU 58). The combined data from Kodiak and Aleutian areas show that chlorophyll *a* concentration in spring and summer in the upper 25 m is probably about 2-3 mg/m^3. Primary productivity values are about 15 mgC/m^3hr in spring (one observation) and 7 mgC/m^3hr in summer (four observations).

Benthos

Aerial photographic surveys of the Alaska Peninsula coastline and intertidal areas have been conducted by Zimmerman et al. (RU 78). The resulting data and photographs show major substrate types and macrophyte cover. Nearly all of the surveyed coastline is either characterized by exposed bedrock (56%) or boulder beaches (30%). Intertidal sampling conducted at Chirikof Island showed extensive population of Balanus cariosus (barnacle) covered with sponge, coralline algae, smallbladed red algae, and fertile Alaria plants. In addition, Henricia leviuscula (sea star), Katharina tunicata (chiton), Collisella pelta (limpet), littorine snails, and other species were found in substantial numbers. A brief description of tidal zonation of flora and fauna is also provided.

The few sandy intertidal areas have been surveyed by Kaiser and Konigsberg (RU 24) to determine population density distribution of razor clam, Siliqua patula and relative abundance of other invertebrates. Three beaches on bays at the southeast end of the Alaska Peninsula are recognized to have large razor clam populations: Imuya Bay, Yantarni Bay, and Aniakchak Bay.

Major field sampling effort was restricted to Kodiak Island and surrounding areas. Razor clams were found over a broad tidal range, from -1.2 to +1.5m, and in beach sands of fine to medium grain size. Sandy beach habitats were most extensively utilized in summer when, in addition, to those of razor clams, eggs, larvae, juveniles and adults of basket cockle, Clinocardium sp., and pinkneck clam, Spisula sp. are also abundant (RU 24).

Fish

OCSEAP studies on fish distribution and abundance are limited to compilation and review of data from exploratory surveys and fish catch statistics on demersal (Ronholt et al. RU 174) and salmonid (Stern and Rogers, RU 353) fishes. Much of the compiled data are from resource assessment surveys conducted by International Pacific Halibut Commission and National Marine Fisheries Service, and from Japanese catch statistics.

Major species of groundfish in this area includehalibut, sablefish, walleye pollock, Pacific cod, arrowtooth founder, flathead sole, rock sole, sculpin, and Pacific Ocean perch. Currently available information indicates that the area between Cape Spencer and Unimak Pass ranks second, after the Kodiak area, in numbers of fish produced. The areas of particular significance in the Aleutians are near Unimak Island, the Shumagin Islands and west of Kodiak Island. The greatest availability of groundfish is during the summer and fall when most of the fish are in the shallower part of their depth range.

The total number of individuals in the salmon spawning runs averaged 9.2 million fish for the period 1925-72. The estimated peak abundance in this lease area is 28.7 million fish (Stern and Rogers, RU 353). Commercial catch statistics show that the average catch is 6.6 million; however, in 1975 less than 1 million salmon were caught. This reduction in numbers is indicative of all salmon catches in the Gulf of Alaska where salmon stocks have decreased. Pink salmon (*Oncorhynchus gorbuscha*) are the most numerous of all the salmonids in the area, comprising 53% of the commercial catch and total spawning run. Following pinks, sockeye (*O. nerka*) and chum (*O. keta*), constitute respectively 26 and 20% of the salmon abundance. It is also noteworthy that pink salmon make up about 60% of the run in the area from Unimak Pass to Bluff Point, whereas sockeye salmon account for 51% of the run east of Bluff Point to the Trinity Islands. Hartt (RU 353) has also described seasons and areas of peak spawning runs and juvenile salmon outmigration patterns.

Birds

Studies of marine birds in this area have and are being conducted by Arneson (RU 3), Lensink (RU 337), Bartonek and Lensink (RU 338) and Bartonek (RU 341). Descriptions and maps of coastal bird habitats (RU 3) and major colonies and nesting areas (RU 338) are now being completed for the Gulf of Alaska. Guzman (RU 239) determined shearwater population densities in FY 76.

Relative abundance of birds on open waters of the Aleutian area from March to October 1976 is described by Lensink et al. (RU 337). Fulmars, glaucous-winged gulls, black-legged kittiwakes and murres were present at densities of 1-9 birds/km^2 during every month surveyed. Shearwaters were observed from May to October and were consistently very abundant (7100/km^2) from May to July. Between June and August 1976, Guzman (RU 239) also observed thousands of shearwaters in this region.

Intensive studies on the breeding ecology of northern fulmar and other birds were conducted on the Semidi Islands in summer 1976 (Bartonek, RU 341). It was noted that the preferred nesting habitat for fulmar is the upper, vegetated portion of cliffs. An estimated minimum of 500,000 fulmars utilize such habitat in the Semidis. Egg laying occurred from late May to late June, peaking in the first week of June. According to estimates, reproductive (fledging) success was only 15%, probably not sufficient to maintain observed population densities. Bartonek (RU 341) concludes that reproduction success may have been below average in 1976.

Glaucous-winged gulls took over 70% of about 60,000 fulmar eggs that were laid in one of the study areas (Chowiet Island). Bartonek (RU 341) points out that any activities favoring expansion of the gull population would threaten the fulmars. Such activities include the establishment of garbage dumps or fish processing plants that provide supplementary food for gulls.

Bartonek (RU 341) also identified a total of 54 species of birds on Semidi Islands, including 36 that breed on the islands and 18 that were present as migrants. The most abundant of these were common and thick-billed murres, with a population estimate of 458,000, about equally abundant with fulmars.

Data on hatching and fledging success were obtained for several other species including black-legged kittiwakes, pelagic and red-faced cormorants, black oystercatchers, common eider, horned puffin, and auklets. Kittiwakes and cormorants were notably unsuccessful, with only 18-19% of eggs laid producing fledged young. A set of maps showing breeding distribution of individual species of seabirds is also provided by RU 341.

Mammals

OCSEAP studies of marine mammals include compilation and review of literature and sighting records on cetaceans and other mammals in open water (Mercer et al., RU 68), biology and population dynamics of harbor seals (Pitcher and Calkins, RU 229), and population assessment and ecology of Steller sea lions (Calkins and Pitcher, RU 243).

A dozen species of whales and porpoises commonly occur in the western Gulf of Alaska. Observers on Semidi Islands in summer 1976 occasionally saw the following species feeding around the islands: killer whale, finback whale, sei whale, minke whale and humpback whale. Gray whales migrate through this lease area in spring and fall (Mercer et al., RU 68).

The largest concentration of marine mammals detected in this region is a population of about 5,000 Steller sea lions observed on the southern end of Chowiet Island in the Semidi Island group. It is estimated that about 2,000 pups are born in this rookery annually (Calkins and Pitcher, RU 243). Several other sea lion rookeries are located in this region, from the Shumagin Islands to Unimak Pass, including those at Castle, Rock, Atkins Island, Pinnacle Rock, South Rock, and Bird Island. Harbor seals were observed on all of the Semidi Islands, with major hauling areas located on the northwest side of Chowiet Island, the southeast side of Kateekuk Island and the east side of Aghiyuk Island. Sea otters were also present in the Semidis, in low numbers, and a pup was seen near Suklik Island on 10 August (Pitcher and Calkins, RU 229).

Microbiology

Only a limited amount of microbiological data have been collected in the Aleutian area. The concentration of heterotrophs in the water column increase from Kodiak Island to Unimak Pass (Atlas, RU 30). Due to the limited number of sediment samples, the spatial distribution of heterotrophs in sediments has not been defined.

3.3 APPROACH

3.3.1 General Program Emphasis

Although the Aleutian lease area is currently not included in the OCS Planning Schedule (August 1977), a previous schedule (January 1977) called for a proposed first generation lease sale during FY 81. Coordinated OCSEAP studies in this area were initiated in FY 76. As a result, a very modest research program with limited objectives is anticipated in this area in the next few years unless a change in priorities in the leasing schedule occurs. It is planned that only studies with long-term applicability and regional significance be conducted at this time. Studies on the assessment and prediction of hazards and on water and contaminant transport are included in this context.

It is well known that the Aleutian-Kodiak area is seismically very active. During the period 1899-1974, the Aleutian Shelf between 156°W and 170°W longitudes experienced approximately 30 earthquakes of magnitude 6.5 or greater, including three exceeding magnitude 8.0. Recent estimates suggest that a major earthquake (magnitude greater than or equal to 7.9) will occur before the year 2288, with most probable period between 1998 and 2025. An earthquake of such high intensity might cause widespread damage, including structures and facilities associated with Kodiak OCS development. Continued studies of seismic hazards with better resolution in data and more accurate position locations will offer better understanding of seismotectonics of the Alaska Peninsula, Aleutian Islands and the surrounding marine environment and, therefore, will be useful on a long-term basis. These studies will be integrated with similar studies being conducted in and planned for the Kodiak region for complete regional coverage.

Currently available data suggest that the Alaska Stream influences shelf water properties and circulation markedly. Such an influence is characteristic of the area between Icy Bay and Kayak Island but is not significant over the Kodiak Shelf. Although data from Aleutian area are sparse and inconclusive, it is expected that water/contaminant residence time over the shelf would be relatively short and contaminants widely dispersed. This area is also downstream from the Kodiak lease area and might receive contaminants released elsewhere in the Gulf of Alaska. Continued research on water transport processes and data analysis by existing research units at modest funding level for the next few years will provide the needed information on local and advected contaminant dispersal and water transport in this area.

Biological studies on fish, marine mammals and birds that were initiated in FY 76 have either been concluded after preliminary findings on population distribution and abundance or will be concluded during FY FY 78. However, possible habitat disturbances and contamination of regional biota remain a major OCSEAP concern, particularly to the bird and mammal populations on Semidi Islands and other special habitats. Semidi Islands and the surrounding water are designated as a National Wildlife Refuge and are inhabited by a variety of species in large numbers. One of the largest Steller (northern) sea lion populations, possibly the largest, resides on Chowiet Island. Large concentrations of other pinnipeds, occurrences of cetaceans, and numerous avian species representing thousands of birds are also known from this area. The world population of Emperor geese winter in the Aleutians and southwest Gulf of Alaska where they frequent coastal lagoons and bays, feeding on algae, kelp and eelgrass. In addition, coastal and lagoon food resources of the Alaska Peninsula are heavily utilized by black brant, duck, fulmars, and shearwaters, among others. Unimak Pass, between the north Pacific Ocean and the Bering Sea, is of special significance to migratory bird and mammal species. In view of the above, particular attention will continue to be paid to potential dangers to this biologically rich and varied area, part of which is only a short distance downstream from the Kodiak and Cook Inlet lease areas. Although no new studies are currently planned, special studies may be conducted in selected areas once developmental activities are initiated in the Kodiak lease area.

3.4 RESEARCH PROGRAM IN FY-79

3.4.1 Environmental Hazards

Geologic hazards in the Aleutian area, in the form of seismicity and volcanism and possible related events such as tsunamis, local floods and corrosive rains, pose risks to the environment not only locally but also to OCS lease areas such as Kodiak. Davies (RU 16) has been engaged in seismicity studies of this region for several years, originally with NSF support and subsequently as a combined OCSEAP-ERDA (now Department of Energy) program to address volcanism and geothermal potential of the region and to assess earthquake hazards on the shelf. It is planned that this research continue in FY 79 at the current level of effort. Coordination of data collection along a regional network with similar studies in Kodiak lease area (Pulpan and Kienle, RU 251) and compilation of observations from the two research units will provide synthesis and interpretation of the regional seismotectonic pattern and hazard assessment.

The currently available data base on ground motion associated with major earthquakes is inadequate to assess the extent of damage possibly resulting from a major earthquake. The need for such data was reiterated by participants in a recent review of the OCSEAP geology program. An increase in the number of strong-motion instrumen[illegible] around the Gulf of Alaska is proposed for FY 79. Pertinent data will b[illegible]ined and analyzed by a new research unit (P 927). Proposed resea[illegible] efforts wil[illegible] be divided in NEGOA, Kodiak, Lower Cook Inlet and Aleutian areas.

Physical Oceanography and Transport

OCSEAP physical oceanography and transport studies in this area have been limited. Historic data from the Gulf of Alaska have been compiled and analyzed by Ingraham, Bakun and Favorite (RU 357). Three hydrographic station transects, Mitrofania, Pavlof Bay and Unimak Pass, have been sampled irregularly (salinity, temperature profiles) since FY 75 by Royer (RU 289) as part of mesoscale Gulf of Alaska circulation. The only relatively long time-series current meter data are from two locations, one east-southeast of Unimak Pass near the 200 m isobath and the other about 250 km southwest of Kodiak Island at the 100 m isobath (Hayes, RU 138). Additional STD and current meter data are expected from FY78 field program. It is planned that in FY79 both RU 138 and RU 289 analyze and interpret previously obtained data. No new data collection is envisioned presently.

Marine Birds

The large amount of data on population distributions, abundance, and nesting and foraging areas of major bird species have been collected in the past two years. Much of these data are expected to be analyzed, interpreted and reported in FY78 (RU 3, RU 338). Lensink (RU 337) has a much larger data base to digitize, analyze, interpret and report. This task is expected to be completed during FY79. It is proposed that necessary funds be allocated for this research unit to complete the proposed work expeditiously.

Data and information generated by these studies are used by BLM in the development of Draft Environmental Impact Statement (DEIS) and final Environmental Impact Statement (EIS) for the proposed action, lease tract selection, recommending platform design, pipeline permitting and routing, onshore facility design and location, and formulation of stipulations and operating procedures. Current information requirement of BLM are minimal in this area in view of the most recent OCS Planning Schedule, August 1977, which does not include the Aleutian lease area. The limited number of selected projects for FY 79 reflect a program of research with long-term usefulness and wide-range applicability of resulting information. Selected projects for FY 79 (P units not included) are listed below:

RU 16 Seismic and Tectonic Hazards (Subtask C-1)

This research unit is engaged in studies of seismicity and its relationship to identifiable tectonic features such as faults. Because of the relatively high seismic and volcanic activities in the general area from Kayak Island to the Aleutian Chain and probability of the occurrence of a major earthquake in the Shumagin area in the near future, careful seismic, volcanic and geodetic monitoring is required. Upgraded data collection and monitoring and a program for long-term earthquake prediction are planned for FY79. In particular, relatively high risk areas will be identified and will be surveyed with increased frequency and detail. Data and information exchange with RU 251 (Kodiak lease area) will help establish an earthquake predictability system for the western Gulf of Alaska.

RU 138 Mesoscale and Shelf Circulation (Subtasks D-1, D-2)

This research unit is continuing studies to characterize circulation pattern with emphasis on determining the probable distribution and dispersion patterns of released contaminants in the Cook Inlet, NEGOA, Kodiak and Aleutian lease areas. Currently available hydrography and current meter data indicate that the flow field south of the Alaska Peninsula is influenced by local winds, the Alaska Stream, local bathymetry and complex circulation associated with Shelikof Strait. Only analysis and interpretation of the large amount of compiled data are planned for FY79 in order to describe nearshore and offshore circulation regimes and temporal variability in the mean flow. This study will also utilize results and data from RU's 217 (Lagrangian drifters), 140 (diagnostic circulation modeling), and 367 (nearshore meteorology) from the Kodiak lease area. Future field sampling programs will depend on the results obtained in FY 78, OCSEAP/BLM information requirements, and the OCS Planning Schedule.

RU 289 Distribution of Water Properties and Circulation (Subtasks D-1, D-2)

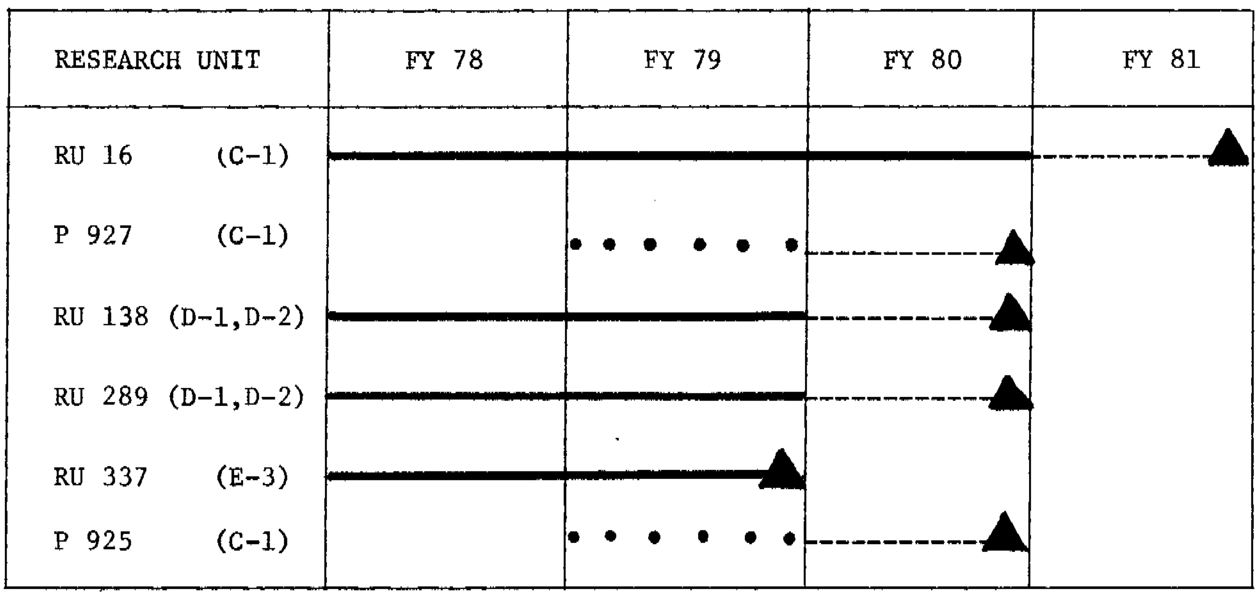
This research unit has conducted surveys for temperature-salinity profiles along the Gulf of Alaska station gird which includes station transects across the shelf from Mitrofania Island, Pavlof Bay and Unimak Island. These data have been used to determine property distributions, water mass characteristics and to infer baroclinic currents and water transport. New data collection is not planned for FY79 but previously obtained data will be analyzed, interpreted and reported. A catalog and file of satellite imagery data will continue to be maintained by this research unit and will be provided to other investigators upon request.

RU 337 Seasonal Distribution and Abundance of Marine Birds (Subtask E-3)

A large amount of data have been obtained in this area from shipboard surveys and aerial reconnaissance in the past two years. These data represent a very substantial and useful information resource to determine seasonal and temporal changes in population densities of major bird species, primary foraging areas and location of major nesting areas and breeding colonies. These data will be compiled, analyzed and interpreted in the form of narrative reports, graphs, tables and other pertinent products. No new data collection is planned for FY 79.

Table 3.1 Schedule of Research Units Selected for FY 79. Appropriate PDP Taska and Subtasks are given in parentheses.

ALEUTIAN (currently not on lease schedule)



———— Ongoing studies or planned for FY 79

---------- To be continued if necessary

• • • • Proposed in FY 79

▲ Expected termination

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4.0 RU AND P UNIT DESCRIPTIONS

Research and P Units are shown in the order of the tasks to which they relate. Some RU's are associated with more than one task. The following index will assist in locating particular P and RU descriptions.

4.1 DESCRIPTIONS FOR PROJECTS IN TASK C (HAZARDS)

C-1: RU 016 P 927

(RU 16) A SEISMOTECTONIC ANALYSIS OF THE SEISMIC AND VOLCANIC HAZARDS IN THE PRIBILOF ISLANDS--EASTERN ALEUTIAN ISLANDS REGION OF THE BERING SEA

This research unit addresses subtask C-1 (BLM Study Types 10-Seismic Hazards, 11-Volcanic Hazards, and 12-Surface and Near Surface Faulting).

Estimated Costs, FY 79:		
	$72,100	Aleutians
	30,900	St. George
	$103,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

University: Columbia University
P.I., Degree: John N. Davies, Ph.D.
Title: Research Associate
Percent of time devoted to project and role: 50%; directs and participates in all research.

Other Principal Scientist significantly involved in project:

P.I., Degree: Klaus H. Jacob, Ph.D.
Title: Senior Research Associate
Percent of time devoted to project and role: 40%; data synthesis and tectonic analysis.

Background:

This project is part of a combined DOE-OCSEAP study on the seismotectonics of the Alaska Peninsula and Aleutian chain; OCSEAP funds have permitted the extension of the seismic network to give better coverage of the Bering Sea and Gulf of Alaska Continental Shelf. This project is itself a continuation of a University of Alaska and Columbia University study (originally with NSF support) of the seismicity of the Aleutian Arc area that has been active since 1964. The DOE research concentrates upon the volcanism and geothermal energy potential of the region, while OCSEAP efforts are focused upon potential earthquake hazards on the continental shelf.

Objectives:

1. To record the locations and magnitudes of all detectable earthquakes within the study area and develop frequency of occurrence versus magnitude relationships.

2. To determine the seismic activity of surface and nearsurface faults identified by geologic mapping.

3. To develop acceleration/velocity versus distance relations for major earthquakes.

4. To evaluate the observed seismicity in cooperation with Research Units 210 and 251 towards development of an earthquake prediction capability in the Gulf of Alaska.

5. To monitor seismic activity of volcanoes within the study area, to evaluate volcanic hazards and to contribute to an understanding of the regional tectonics.

Methods:

The existing array of approximately 20 seismic stations will be maintained and upgraded to provide the necessary geographic coverage over as continuous a period as possible. In particular, FY 79 efforts will be devoted to:

1. Installation of three new stations in the Pribilof Islands to provide the minimum capability necessary for monitoring and locating earthquakes in the southern Bering Sea.

2. Conversion of the event-recording equipment at Dutch Harbor and Sand Point to more reliable digital systems.

3. Installation of one more short-period seismograph and two strong motion accelerometers near Dutch Harbor to take advantage of frequent strong earthquakes in this area to provide ground response information.

Output:

1. Narrative Reports: Reports will provide a detailed description of the operation of the seismic network, including number and spatial density of instruments and resulting accuracy of derived earthquake parameters. A summary of seismic and volcanic events recorded during the survey will be presented and interpreted. Reports will include an evaluation of frequency versus magnitude relationships, activity of surface and near-surface faults, and acceleration versus distance relationships.

2. Digital Data: Derived earthquake parameters (e.g., date, time, location, depth, magnitude) will be submitted on punch cards or magnetic tape in standard archive format.

3. Visual Data:

    1) Maps of hypocenter locations and magnitudes.

    2) Maps and graphs of earthquake magnitude versus frequency relationships for selected areas.

3) Maps with supportive text summarizing seismic activity of surface and nearsurface faults identified in geologic mapping.

4) Maps and figures with supportive text summarizing ground acceleration versus distance relationships.

5) Maps and reports summarizing volcanic activity.

6) Seismic and volcanic risk maps.

(P 927) GROUND ACCELERATIONS ASSOCIATED WITH MAJOR EARTHQUAKES IN ALASKAN OCS AREAS

This unit addresses subtask C-1 (BLM Study Types 10 - Seismic Hazards and 12 - Surface and Near Surface Faulting).

Estimated Costs, FY79:		
	\$25,000	Aleutians
	25,000	Kodiak
	25,000	Lower Cook Inlet
	25,000	NEGOA
	\$100,000	Total

Schedule: October 1978 - September 1979

Performing Agency: To be determined

Background:

Knowledge of the probable offshore ground accelerations associated with major earthquakes is important in tract deselection and in setting design stipulations for seafloor-mounted structures. Although OCSEAP currently supports limited onshore networks of strong motion accelerographs, it has not been possible to obtain adequate data for determining what the ground motions offshore are likely to be. There are several reasons for this: 1) The technology is not yet available for economical and efficient operation of ocean bottom accelerometers and probably will not be available for several years; 2) Extrapolation of onshore measurements of ground accelerations to offshore is very difficult and requires very thorough knowledge of the subsurface geology and seismic velocity structure; and 3) accurate measurements of acceleration at the instrument site can only be made during larger events (most instruments are triggered by a magnitude 6 earthquake), requiring good spatial coverage and relatively long periods for data collections. This project will address problems 2) and 3) to improve our capability for approximating offshore ground accelerations.

Objectives:

1. To expand the coverage of the existing network of strong-motion accelerometers, as required by the BLM environmental programs, thereby increasing the areal extent of measurements of acceleration from major earthquakes.

2. To utilize available data and appropriate techniques for extrapolating measured accelerations to offshore areas.

Methods:

Additional strong-motion accelerometers will be installed in areas where there is presently no coverage, particularly in the Kodiak and Lower

Cook Inlet areas. Existing installations will be evaluated to determine whether there is adequate coupling to bedrock, and to re-install if necessary. Available data on subsurface and offshore geology, including existing seismic profiling records, will be compiled and analyzed to construct seismic velocity profiles. These will then be combined with the onshore accelerometer and seismograph data to approximate seafloor accelerations.

It is possible that part or all of the funds indicated under "Estimated Costs" may be applied to existing research units (16, 210, and 251).

Output:

1. Narrative reports: Reports will explain the design of the network and will provide a summary of the geology at each installation. A summary of acceleration data obtained each quarter will be presented in each quarterly report. The year-end report will contain interpretations of the data obtained; an explanation of the techniques used to analyze the data; an analysis of the effects of the subsurface geology; and an evaluation of estimated offshore accelerations.

2. Digital Data: None

3. Visual Data:

   a. Maps of peak accelerations determined for the land areas for which ground motion data were obtained during major earthquakes.

   b. Maps of estimated peak accelerations for offshore areas.

4. Other Non-digital Data: Copies of accelerograms will be submitted for inclusion in the data base.

4.2 DESCRIPTIONS FOR PROJECTS IN TASK D (TRANSPORT):

D-1: RU 138

RU 289

D-2: RU 138

RU 289

(RU 138) GULF OF ALASKA STUDY OF MESOSCALE OCEANOGRAPHIC PROCESSES

This research unit addresses subtask D-1 and D-2 (BLM Study Types 27 - Currents and Tides and 32 - Trajectories of Oil Spills).

Estimated Costs, FY 79:		
	$ 52,600	Aleutians
	116,800	Kodiak
	122,000	Lower Cook
	$292,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

Agency: NOAA/PMEL
P.I., Degree: Stanley P. Hayes, Ph.D.
Title: Oceanographer
Percent of time devoted to project and role: 50%; experimental design and analysis of pressure gauge records

P.I., Degree: James D. Schumacher, Ph.D.
Title: Oceanographer
Percent of time devoted to project and role: 45%; experimental design and analysis of current meter records.

Background:

1. Currents in the Lower Cook Inlet lease area are complicated by highly variable tidal currents, local run-off, wind driven currents, and a current which may be a branch of the Alaska Stream. The latter, if not a branch of the Alaska Stream, is known to be a result of forces and influences along the shelf, one of which is the influence of nearshore precipitation and run-off.

   The existing information base includes data from NOS-placed current meters, OCSEAP-placed meters (in FY 78), a data buoy, numerous CTD surveys and miscellaneous data from other sources.

   Analysis has shown a high variability in net flows over the lease area and complex gradients in tidal flow.

2. Currents in Shelikof Strait, on the other hand, are reasonably simple, partly because its channel is parallel to the Alaska Stream; but on the east side of Kodiak Island currents are weak and variable. There is some evidence that physical oceanographic processes influence the distribution of species associated with the shallow shelf, i.e., on Albatross Banks.

Data collected in FY 77 and 78 show a large decrease in flow as one moves from the shelf-break onto the shelf. Some historic data also indicate flow onshore in the deepest part of the shallow canyon separating North and South Albatross Banks.

3. Details of flow to the southwest of Kodiak along the shelf are unknown, although data were obtained from one or two moorings in FY 77 and 78. CTD transects have been accomplished only infrequently; therefore, any details of flow and possible spill trajectories in the area would be speculative.

Objectives:

The objectives in Lower Cook Inlet are to complete the analysis of data and to provide a map of circulation patterns in sufficient detail to allow calculation of oil spill trajectories with calculation of probabilities of impact over selected areas.

In the Kodiak lease area, the objective is to analyze data on hand and report on circulation in Kiliuda Trough and Kiliuda Bay which bisects Middle and Southern Albatross Banks. The physical oceanography will be closely coordinated with the biological studies in an effort to determine the dependency of biological events on circulation features. Specific objectives include:

1. Residence time of water in Kiliuda Trough and Bay.

2. Transit time, (preferably residence time) of water on the banks (Portlock and Albatross).

3. Examination of the hypothesis that there is restricted interchange of waters between the Middle and Southern Albatross Banks.

4. Examination of the hypothesis that significant up-channel flow occurs in Kiliuda Trough--sufficient to re-seed the nearshore area in case of biological impact from pollutants.

Objectives to be addressed in the Aleutian Lease Area are to provide analyses of 1977 and 1978 CTD and current meter data to increase understanding of large-scale circulation features.

Methods:

Standard statistical analyses of current meter and pressure gauge data during FY 79 will include extraction of tidal and non-tidal currents by means of appropriate record filtering, analysis of coherence between winds, corrected sea level and currents, spectral analysis. Non-tidal current data at selected locations will be used as additional input and calibration data for the diagnostic circulation model developed under RU 140.

Output:

1. Narrative Reports: A report will be provided containing a description of mooring locations, measurement and analysis techniques, sampling frequency and duration. The report will contain the results of statistical analyses of the current meter and pressure gauge records and, to the extent permitted by the study, a description of regional circulation patterns, specifically addressing the stated objectives. Specific data products to be provided include:

    a. Maps of circulation patterns in Kiliuda Bay and Trench.

    b. Maps of circulation patterns and water mass properties over Albatross Banks.

    c. Tabulations of tidal and net currents with objective estimates of variability in Lower Cook Inlet.

    d. Analysis of the affect of meteorological events on circulation in each area.

    e. Description of mixing processes.

2. Digital Data: All current meter and pressure gauge data will be in digital form and will be submitted to OCSEAP on magnetic tape in Formats 015, 017 and 022.

3. Visual Data: The following visual data representations will be included in the Narrative Report.

    - Time plots of filtered current meter and pressure gauge data showing both tidal and non-tidal velocity and pressure fluctuations.
    - Progressive vector diagrams.
    - Energy density spectra.
    - Plots showing coherence between wind, corrected sea level and currents.
    - Plots showing estimated return frequencies of selected extreme values of current.

(RU 289) CIRCULATION AND WATER MASSES IN THE GULF OF ALASKA AND SATELLITE IMAGERY OF MESOSCALE FLOW FEATURES IN OTHER ALASKAN OCS AREAS

This research unit addresses subtasks D-1 and D-2 (BLM Study Types 27 - Currents and Tides and 29 - Residence Time and Flushing).

Estimated Costs, FY 79:	$10,200	Aleutians
	10,200	Kodiak
	10,200	Lower Cook Inlet
	71,400	NEGOA
	$102,000	Total

Schedule: October 1978 - September 1979

Performing Agency:

University: University of Alaska, Inst. of Marine Science
P.I., Degree: Thomas C. Royer, Ph.D.
Title: Research Associate Professor
Percent of time devoted to project and role: 50%; project supervisor

Other Principal Scientist Significantly Involved in Project:

Name, Degree: K. Ahlnas, M.S.
Title: Resident Associate
Percent of time devoted to project and role: 85%; remote sensing image enhancement, interpretation, and archiving.

Background:

Since FY 75, the Principal Investigator has studied the mean and seasonal variations of the water mass characteristics and currents in the Gulf of Alaska from observed temperature and salinity distributions and direct current measurement. Sea surface temperature measurements obtained from NOAA satellites have been used in conjunction with hydrographic data in an attempt to estimate and map the surface circulation in the entire Gulf of Alaska.

The incorporation of satellite remote sensing into this project has substantially improved its capability to define nearshore circulation features that are manifested in surface water temperature differences. This is particularly important in the Kodiak and Aleutian lease areas.

Similar satellite data for the entire Alaskan OCS coastline including Lower Cook Inlet is made available by this project for use by other OCS principal investigators.

Efforts under this project are closely coordinated with those under RU's 138, 140, 141, 217, 267, 367, 541, and 550.

Objectives:

The objectives of this project are to complete the studies of mesoscale circulation patterns in the Gulf of Alaska from hydrographic properties, direct current measurements and satellite imagery and to provide similar satellite data for the entire Alaskan OCS coastline for use by other investigators. Objectives specifically applicable to the NEGOA, Aleutian, Kodiak, and Lower Cook lease areas are:

1. To provide evidence of key circulation features, both offshore and nearshore, by use of satellite imagery.

2. To provide improved descriptions of the seasonal variability in hydrographic properties in each area, and particularly in front of Hinchinbrook Entrance.

3. To analyze moored current meter data from near Kayak Island to allow determination of the barotropic flow on the shelf and provide input and calibration data for modeling conducted under RU 140.

4. To correlate currents inferred from satellite imagery with meteorological and hydrographic conditions.

5. To estimate, to the degree the evidence allows, the frequency and lifetime of mesoscale circulation features, such as nearshore eddies and meanders with descriptions of residence time wherever possible.

6. To provide satellite data for use by other OCS principal investigators.

7. To provide archive identification of all imagery showing evidence of key circulation features.

Methods:

No field work is planned in the Aleutian, Kodiak, or Lower Cook Inlet areas. There will be limited work west of Kayak Island, but only if the modeling study in FY 78 shows a gap in data. Field measurement, calibration, and analysis techniques will be similar to those currently in use. Quasi-continuous depth profiles of temperature and salinity will be obtained on a trimesterly basis from a grid of hydrographic stations from Unimak Pass to Yakutat. Data analysis will involve standard techniques in producing maps of hydrographic properties and in performing geostrophic current calculations.

Imagery from satellites (e.g., ERTS, NOAA) transiting the Gulf of Alaska will be used to describe surface circulation features that are manifested as water temperature differences. Similar information will be provided to OCS investigators in other lease areas on a 60-day delay, with infrared enhancements to be carried out during this time period.

Output:

1. Narrative Report: A report will be provided containing discussion and interpretation of principal hydrographic features and inferred flow patterns occurring during the observation period. The report will contain surface maps and cross-shelf section contours of hydrographic parameters and surface maps of dynamic topography for each cruise. Time series plots of water properties will be provided at selected stations to describe the seasonal characteristics of the shelf hydrography.

   The report will contain discussions of satellite imagery interpretations, including criteria, for seasonal offshore and nearshore current patterns, and integration of observations with other OCSEAP and climatological data.

2. Digital Data: Digital STD, current meter and pressure gauge data will be submitted to EDS in OCSEAP-approved formats 022, 015 and 017.

3. Visual Data:

   a. Seasonal maps of hydrographic properties.

   b. Seasonal maps of dynamic topography and geostrophic currents.

   c. Images and maps of seasonal and shorter-lived surface currents features as inferred by satellite remote sensing.

4. Other Data: Both the visible and IR images from clear areas of the coastline will be retained. IR enhancements and enlargements of these data will be carried out and catalogued. Prints of these images will be made available to OCSEAP principal investigators on request. Assistance in interpreting the imagery will be provided.

4.3 DESCRIPTIONS FOR PROJECTS IN TASK E (BIOTA):

E-3: RU 337

(RU 337) SEASONAL DISTRIBUTION AND ABUNDANCE OF MARINE BIRDS

This research unit addresses subtask E-3 (BLM Study Type 41 - Critical Habitat and Habitat Dependencies).

Estimated Costs, FY 79: $30,000 Aleutians

Schedule: October 1978 - March 1979

Performing Agency:

Agency: U.S. Fish and Wildlife Service
P.I., Degree: Calvin Lensink, Ph.D.
Title: Activity Leader, Coastal Ecosystems, Alaska
Percent of time devoted to project and role: 10%; project director and coordinator for all FWS-OCSEAP studies in Alaska.

Other Principal Scientist significantly involved in project:

P.I., Degree: Patrick Gould, Ph.D.
Title: Wildlife Biologist and Study Leader (shipboard)
Percent of time devoted to project and role: 38% supervision, data interpretation and report writing.

Background:

OCSEAP initiated aerial and shipboard censusing of marine birds in 1975. The USFWS, through work that continued through FY 1977, amassed a large amount of information on the seasonal distributions and abundance of marine birds utilizing pelagic habitats. No field work was performed in support of this study in FY 78. The investigators applied all of their efforts to data compilation, reduction and analyses, submission of processed data to the Project Office, and preparation of a final report.

The large volume of data on hand will necessitate a continuation of these efforts into FY 79 in order to complete the final report.

Objectives:

1. Determine seasonal density distributions of marine birds in pelagic habitats of the western Gulf of Alaska, eastern Bering Sea and Chukchi Sea.

2. Determine temporal and spatial changes in primary foraging areas in the vicinity of selected major seabird rookeries.

Methods:

These will consist of laboratory analyses of data and preparation of the final report.

Output:

1. Narrative Report: This will be a comprehensive document containing separate presentations on the results of shipboard and aerial transect observations and synthetic overview presenting general conclusions derived from both methodologies. The report will include discussions of seasonal distribution and abundance of major seabird species, the results of studies of seabird foraging from major colonies, evaluations of the two sampling methods and their comparability, and the identification of gaps in knowledge.

2. Digital Data: It is anticipated that none will remain to be submitted in FY 79. In the event that some are submitted, they will be under file type 033-Bird Sighting.

3. Visual Data: These will consist of:

    a. Maps which show:

        (1). Aerial and shipboard transect lines (pelagic distribution and foraging studies)

    b. Charts which show:

        (1) Seasonal distributions and densities (birds/km^2 for:

            (a) all seabird species combined
            (b) major seabird species

        (2) Locations of major foraging areas in the vicinity of selected seabird colonies showing, as the data allow:

            (a) changes in intensity of use
            (b) variations in the range of foraging excursions by different species from those colonies

5.0 TIMING SCHEDULE AND PRODUCTS OF OCS STUDIES IN THE ALEUTIANS

The following products list and timing schedule of OCS studies addresses the Aleutian lease area. The list of deliverables is a shorthand approximation for a complex, interlocking set of studies that are often difficult to represent by codes only and in which many qualifiers are necessarily left out.

The Codes used to identify BLM-required temporal and spatial resolution are as tabulated below. The same code is used to indicate present and projected levels of resolution in columns headed 77, 78, and 79. Appearance of the code in the FY 79 column indicates that funding is planned for FY 79.

Temporal Resolution

N = no temporal resolution
A = annual
S = seasonal
St = short term, days to weeks
D = diurnal, diel

Spatial Resolution

0 = information in hand, literature review
1 = qualitative, area wide, cursory
2 = semi-quantitative, hundreds of square miles scale or 25 miles of coastline
3 = semi-quantitative, 3-10 tracts scale or 10 miles of coastline
4 = quantitative, tract specific (2 to 5 miles resolution)
5 = quantitative, site specific
6 = no spatial resolution (non-site specific)

Several codes are also used to indicate existing (Pre-1978) and Projected (1978 and on) status of the effort to attain the specific products in the Data Products List. The codes used are as follow:

1. The research is ongoing, i.e. funded for FY 79.

2. The research unit effort has been terminated, and there are no plans for its resumption. The available data are, or may be, sufficient to meet stated needs.

3. Data are available from non-OCSEAP sources.

4. The data are insufficient to meet stated needs but the project has been terminated due to budget restrictions or lease area priorities.

5. Proposed research units.

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
A	CONTAMINANT BASELINE									S2	S3								
A-1	Distribution and concentration of hydrocarbons	Determine existing levels of hydrocarbons, prior to initiation of petroleum-related OCS activities.	Seasonal and spatial distribution patterns of hydrocarbons:																
			. in sediment	Table/maps	275											N1			4
			. in benthic biota	Table/Maps															
			. in pelagic biota including neuston	Table/Maps	275											N1			4
			. dissolved in the water column	Table/Maps															
			. in particulate matter within water column	Table/Maps															
		Determine probable sources of existing levels of hydrocarbons, i.e. biogenic or petroliferous.	Comparison of ratios of C_1/C_2+ with $^{13}C/^{12}C$	Tables						N2	N3								
		Monitor hydro-levels over broad geographical areas to determine significant changes in ambient concentration patterns following OCS development.																	
A-2	Distribution and concentration of low molecular weight (LMW) hydrocarbons in the water column	Determine existing levels of LMW hydrocarbons prior to initiation of petroleum-related OCS activities	Seasonal and spatial distribution patterns of C_1-C_4 hydrocarbons							S2	S3								
			. in water column	Maps Figures	275											N1			4
			. in sediments	Maps Figures	275											N1			4

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
A-2		Determine probable sources of existing levels of hydrocarbon, i.e., biogenic or petroliferous. Use LMW hydrocarbon as an indigenous tracer or detection parameter to discern accumulation of hydrocarbon during or after OCS development. Examine the dispersion and diffusion of natural LMW hydrocarbons.	**Comparison of methane and C_2-C_4 hydrocarbon concentrations.**	Tables Figures						S2	S3								
A-3	**Distribution concentration and chemical speciation of selected toxic metals**	Determine the concentration and distribution of nonvolatile petroleum components, especially toxic metals, prior to OCS development.	Seasonal and spatial distribution patterns selected metals:							S2	S3								
			. in sediment	Maps	162											N1			4
			. in benthic biota	Maps															
			. in pelagic biota	Maps															
			. in water column (soluble and suspended forms)	Figures	162											N1			4
		Determine chemical speciation and transport mechanism of selected metals and characteristics of substrates to which they are adsorbed.	Elemental composition and distribution of suspended particulate matter.	Tables	152					S2	S3					N1			4
			Hydrocarbon adsorption characteristics of suspended matter.	Tables	152					N6						N6			4

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5				
										T	E	FS				77	78	79	
A-3		Monitor selected metal concentrations over broad geographical areas to determine significant changes during and following OCS development.																	

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
C	ENVIRONMENTAL HAZARDS																		
C-1	Description of seismic and volcanic activity.	To determine the potential hazards to platforms, pipelines and other structures due to earthquakes and volcanic equptions, as input to tract de-selection and design stipulations.	Historical earthquake epicenters, focal depths, and magnitudes	Map	16 352			N2				N4				N2 N2	N2 -	N2 -	1 2
			Earthquake magnitude vs. frequency relationships for selected areas.	Map	16 352			N2				N4				N1 N1	N2 -	N2 -	1 2
			Seismic activity of surface and near-surface faults identified in geologic mapping.	Map	16			N2				N4				N3	N3	N3	1
			Relationships between earthquake magnitudes and strong ground motion.	Map	16			N2				N4				-	-	N2	1
			Description of volcanic activity and resulting phenomena such as flows and nuees ardentes.	Maps	16			N2				N4				N2	N2	N3	1
			Seismic risk map.	Map	16			N2				N4				-	N2	N2	1
			Volcanic risk map.	Map	16			N2				N4				-	N2	N2	1

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5				
										T	E	FS				77	78	79	
C-2	Description of the distribution and relative ages of surface and near-surface faults.	To determine the potential hazards to platforms, pipelines, and other structures due to active faulting; serves primarily as input to tract deselection and to provide geographic focus for earthquake studies.	Locations of surface and near-surface faults classified according to apparent recency of movement (from geologic relationships).	Map				N3				N4							
C-3	Description of the types and extent of natural seafloor instability.	To determine the potential hazards to platforms, pipelines, and other structures due to slumping, compaction, and liquefaction of bottom sediments; serves as input to tract deselection and siting/design stipulations.	Delineation of existing and potential slumps and other unstable sediment masses, classified according to present relative stability.	Map				N3				N4							
			Thickness of unconsolidated sediment.	Map				N3				N4							
			Description of sediment physical properties.	Map Report				N3				N4							
			Geologic cross-sections of potentially unstable sediment masses.	Profile				N3				N4							
			Description of the geologic history of unconsolidated sediment units.	Map				N3				N3							

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
			Interpretation and description of the nature and severity of sediment instability.	Report				N3				N4							
C-4	Identification and description of areas of potentially hazardous seafloor erosion, deposition, and bedform movement.	To determine the potential hazards to platforms, pipelines, and other structures due to seafloor erosion, deposition, and beform movement; serves as input to tract deselection and siting/design stipulations.	Locations of areas of of severe erosion and deposition (indicating rates where possible).	Map				N3				N4							
			Distribution and description of large-scale mobile bedforms showing directions and rates of movement.	Map Report				N3				N3							
			Interpretations regarding the nature and severity of erosion, deposition, and bedform movement.	Report				N3				N3							
C-5	Identification and description of potential coastal hazards.	To determine the potential hazards to onshore development due to coastal erosion, accretion, faulting, and other onshore surface processes; serves primarily as input to siting/ design stipulations and development plan verification.	Identification of coastal areas with severe erosion or accretion, indicating rates where possible.	Map				N2				N3	N4						
			Description of near-shore sediment dynamics.	Map Report				N2				N3	N4						

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
C-5			Description of coastal geology, including active faults and surface processes.	Map Report				N2			N3	N4							
			Interpretation of the potential hazards to coastal facilities.	Report				N2			N3	N4							
C-6	Description of the extent and characteristics of sub-sea permafrost.	Not applicable to Aleutian																	
C-7	Description of the geographic distribution of ice-gouging, its severity, and frequency of occurrence.	Not applicable to Aleutian																	
C-8	Description of the distribution and nature of gas-charged sediments.	To determine the potential hazards to platforms, pipelines and other structures due to gas-charged sediments; serves primarily as input to siting/design stipulations.	Description of the distribution and depth of gas-charged sediments.	Map Profile				N2	N3		N4								
			Identification of oil and gas seeps.	Map				N2	N3		N4								
			Descriptions of the origins and characteristics of gas-charged sediments and their potential hazards.	Report				Resolution not applicable.											

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
C-9	Stress - strain relationships in ice.	Not applicable to Aleutian																	
C-10	Characterization of frequency, intensity and effects of extreme oceanic events	To identify hazards to OCS exploration, development, and production activities.	1. Observational and historic information on storm surges as a function of location, season, and magnitude.	Tables		NO				S3									
			2. Observational and historical information on coastal katabatic winds as a function of location, season, and magnitude.	Tables Figures Graphs	347	NO				S3						S2			2
			3. Historical information on tsunamis (see Subtask C-1)	Tables	352	NO				S3						S2	-	-	2

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D D-1	TRANSPORT Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	To predict or estimate trajectories of pollutants and time of impact.	1. Analyses of historic data in the literature and previously unreported data.	Narrative with maps, tables	357			S2	S3							S2			2
			2. Analyses of historical data on climatic systems and meteorological events for their effects on circulation.	Narrative with maps	347			S2	S3							S2			2
			3. Seasonal temperature and salinity distribution.	Narrative with maps	289			S2	S3			S4				S1	S2	S2	1
			4. Baroclinic circulation.	-	289			S2	S3			S4				S1	S2	S2	1
			5. General circulation, based on moored current meter data.	Narrative with figures	138			S2	S3			S4				S1	S2	S2	1
			6. Trajectories of drogues.	Maps and narratives				S2	S3			S4							
			7. Discussion of mixing and estimates of lagrangian dispersion coefficients.	Narrative				S2	S3			S4							
			8. Estimates of sea-surface slope.	Narrative Tables	138			S2								S1	S1	S1	1
			9. Measurements of local wind fields.	Narrative				S2											
			10. Analyses of synoptic weather data to obtain local wind and temperature fields.	Narrative				S2	S3			S4							

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-1	Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	To predict or estimate trajectories of pollutants and time of impact.	11. A procedure for determining local wind fields when synoptic data and local station data are available.	Narrative			Resolution scale not appropriate									-	-		
			12. Currents, calculated by diagnostic model.	Narrative						Not applicable						-			
			13. Currents calculated by hydrodynamical model.	Map				S2											
D-2	Seasonal and shorter term description of water masses and circulation patterns in near-shore	To predict or estimate trajectories of pollutants and time of impact	1. Analyses of historic data in the literature and previously unreported data.	Narrative with maps	357			S2								S2	-	-	2
			2. Analyses of historical data on climatic systems and meteorological events for their effects on circulation.	Narrative with maps	347			S2								S2	-	-	2
			3. Seasonal temperature and salinity distribution.	Narrative with maps	289			S2								S1	S2	S2	1
			4. Baroclinic circulation.		289			S2								S1	S2	S2	1
			5. Near-shore circulation, based on moored current meter data.	Narrative with figures	138			S2								S1	S1	S2	1
			6. Trajectories of drogues.	Maps and Narrative					S2										

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-2	Seasonal and shorter term description of water masses and circulation patterns in offshore regimes.	To predict or estimate trajectories of pollutants and time if impact.	7. Discussion of mixing and estimates of Lagrangian dispersion coefficients.	Narrative					S2									–	
			8. Estimates of sea surface slope.	Narrative	138				S2							S1	S1	S1	1
			9. Near shore currents by means of a current mapping radar.	Map	–				S4										
			10. Analyses of satellite photos for oceanographic data.	Narrative	289				S2							S2	S2	S2	1
			11. Surf zone dynamics; wave refraction diagrams, rip-current distributions.	Narrative with maps	–				S2										
			12. Storm surge probability and intensity.	Narrative					S2										
			13. Measurements of local wind fields near shore.	Narrative					S3										
			14. Analyses of synoptic weather data to obtain local wind and temperature fields.	Narrative with maps					S2	S3			S4						
			15. A procedure for determining local wind fields when synoptic data and local station data are available.	Narrative															

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-2	Seasonal and shorter term description of water masses and circulation patterns in nearshore regimes.	Used to assess potential for air pollution by onshore development offshore facilities.	16. Measurements of the stability of the surface (air) boundary layer and ice nuclei baseline.	Narrative					S3										
			17. Results of analysis by models.	Narrative with:															
			a. General circulation.	Maps				S2	S3			S4							
			b. Tidal current (hydro dynamical).	Maps				S2	S3			S4							
			c. Trajectory.	Maps				S2	S3			S4							
			d. Trajectory with plume dynamics.	Maps				S2	S3			S4							
D-3	Description of oil spill plume behavior and oil weathering processes.	Evaluation of degree of impact, areal scale of impact and contingency requirements.	1. Oil spill weathering mechanisms and estimated rates.	Narrative				Resolution: Not Applicable											
			2. Laboratory determined weathering rates.	Tables				Resolution: Not Applicable											
			3. Field studies to determine weathering rates.	Tables				Resolution: Not Applicable											
			4. Description of mechanisms which cause dispersal of oil plumes.	Narrative				Resolution: Not Applicable											
			5. Pollutant dynamics model general.	Computer				Resolution: Not Applicable											
			6. Pollutant dynamics model subroutine accounting for weathering).																

574

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-4	Description of the types and characteristics of bottom sediments and their probable interaction with oil and biota.	To determine the probable fate of oil in association with bottom sediments, its longevity, cleanup difficulty, and possible effects on intertidal and benthic biota; serves as input to tract deselection.	Description of sediment grain size properties.	Map						N2	N3								
			Description of coast-morphology, beach materials, and relative vulnerability of the coast to spilled oil.	Map Report						N2	N3								
			Interpretation regarding the interaction between oil and bottom sediment, oil retention capability of the substrate, and implications regarding possible effects on intertidal and benthic biota.	Report						N2	N3								
D-5	Description of bottom sediment dynamics.	To determine the transport trajectory of oil in association with bottom sediments. Serves as input to tract deselection and to hazards studies.	Description of the directions and rates of bottom sediment movement.	Map Report						N2	N3								
			Interpretation regarding the mechanisms of entrainment and transport of bottom sediment and their relationship to physical oceanographic processes.	Report						N2	N3								

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-6	Character of suspended particulates and their effectiveness as transporters of oil.	Assessment of the impact potential of oil spills.	1. Sediment and suspended sediment distributions.	Narrative with maps						S2	S3								
			2. Sediment movements.	Narrative with maps						S2	S3								
			3. Tabular data, indicating extent of oil/sediment interaction under varying environmental condition.	Narrative with maps						S2	S3								
			4. Relation of suspended particulate matter to terrestrial and marine sources.	Narrative with maps						S2	S3								
D-7	Description of seafloor topography.	To provide input to circulation studies and hazards studies	Description of seafloor topographic features.	Map Report				N4											
D-8	Characterization of sea ice morphology including under-ice morphology.	Not applicable to Aleutian																	
D-9	Description of ice dynamics and their effects on transport of oil and safety of structures.	Not applicable to Aleutian																	
D-10	Description of interaction between sea ice and oil and movement of oil in a ice field.	Not applicable to Aleutian																	

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
D-11	Susceptibility of marshlands near the coast to inundation by oil transported by storm tides.	To assess the probability of insult to critical habitats.	Calculated probability of storm surge.	Narrative				S2											
			Verification of probability of storm surge by field studies	Narrative				S2											
			Analysis of historical storm surge records.	Narrative with Tables				S2											

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-1	Description of seasonal distribution and abundance of marine mammals.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available marine mammal data and literature.	Narrative	068											NO			2
			2. Review of available literature and data on marine mammals.	Narrative Charts	068											No			2
			3. Seasonal distributions and relative abundance of marine mammals.	Charts Tables	068					S1		S3				S2			2
					229											S2	S3		4
					243											S2	S3		4
			4. Locations of marine mammal migration routes.	Charts	068					S2		S3				S2	S3		2
			5. Locations of breeding and concentration areas.	Charts	229					S3		S4				S3	S3		4
					243					S3		S4				S3	S3		4
E-2	Description of population dynamics and trophic relations of marine mammals.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	1. Population dynamics of marine mammals, including: . reproductive biology . growth . population composition . habitat dependencies	Tables Graphs Figures	229					S2				S3		S2	S2		4
																	-	-	
					243											S2	S2		4
			2. Trophics of marine mammals, including: . major prey species . foraging areas	Tables Charts	229					S2				S3		S2	S2		4
																	-	-	
					243											S2	S2		4
			3. Behavioral aspects of marine mammals relative to OCS activities.		243					SO									
					229														

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-3	Description of seasonal distribution and abundance of marine birds.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of marine bird data and literature.	Narrative	339												NO		2
					340												NO		2
			2. Review of marine bird data and literature.	Narrative Charts Tables	003												NO	-	2
					339												NO		2
			3. Seasonal distribution and abundance of marine birds.	Charts Tables	003					S2						S2	S2		2
					239											S2	-	-	2
					337											S1	S2	S2	1
			4. Locations of marine bird breeding colonies.	Charts	003					S5						S3	S5		2
					338											S3	S5		2
			5. Locations of marine bird concentration areas.	Charts	003					S2		S3				S3	S3		2
					337											S3	S3	S3	1
					338											S3	S3		2
			6. Locations of bird migration routes.	Charts	003					S2						S2	S2		2
					337											S2	S2	S2	1
E-4	Description of population dynamics and trophic relations of marine birds.	To evaluate the potential effects of OCS activities on the stability of of populations within a considered critical habitat.	1. Population dynamics of marine birds, including: . breeding phenology . reproductive ecology . growth . habitat dependencies	Tables Graphs Figures	341					S2		$S_t 1$		$S_t 1$			S 1		4
			2. Trophics of marine birds, including: . Major prey species . foraging areas	Tables Charts						S2				S4					

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
						-4	-3	-2	-1	0	+1	+2	+3	+4	+5				
Task	Product	Intended Use	Specific Product	Format	R.U.					T	E	FS				77	78	79	
E-4	Description of seasonal distribution and abundance of marine birds.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	3. Behavioral aspects of marine birds relative to OCS activities.							N1									
E-5	Description of the seasonal distribution and abundance of marine fish.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available marine fish data and literature.	Narrative	064 174 353					NO		NO				 NO NO	NO		2 2 2
			2. Review of available marine fish data and literature.	Narrative Graphs	174 353 64					NO						NO NO	NO NO		2 2 2
			3. Seasonal distributions and relative abundance of marine fishes.	Charts	174 353					S2						 NO	NO		2 2
			4. Locations of spawning and concentration areas, and migration routes.	Charts	353					S2		S3							2
			5. Locations of important commercial fishing areas.	Tables	174 353					S2		S3				 NO	NO		2 2
E-6	Description of population dynamics and trophic relations of marine fish.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	1. Trophics of marine fishes, including: . identification of major prey species . foraging areas	Tables Charts						NI		S2							

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
										T	E	FS							
E-6	Description of population dynamics and trophic relations of marine fish.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	2. Population dynamics of marine fishes including: . reproductive biology . growth . habitat dependencies	Tables Charts						N1		S2							
E-7	Description of seasonal distribution and abundance of benthic biota.	To identify criti- habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available literature and data on benthic biota.	Narrative	282											NO			2
			2. Review of available literature and data on benthic biota.	Narrative	282											NO			2
			3. Distribution and abundance of dominant benthic organisms	Charts Tables						N2		S3				- N2			
	Description of population dynamics and trophic relations of benthic biota.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat.	4. Population dynamics of benthic organisms, including: . Seasonal community structure . Seasonal abundance of dominant organisms . Productivity estimates	Tables Graphs Figures															
			5. Trophic relations of selected benthic organisms including: . food webs . identification of major prey species	Tables						N1		S1		S3					

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0 T	+1 E	+2 FS	+3	+4	+5	77	78	79	
E-8	Description of distribution and abundance of biota in littoral communities.	To identify critical habitats and determine the likelihood of impingement based on transport data and probable sources.	1. Annotated bibliography of available data and literature on littoral biota.	Narrative						NO									0
			2. Review of available data and literature on littoral biota.	Narrative	078											NO	NO		2
			3. Regional characterization of littoral habitat, including: . Substrate . Littoral community structure . Population density distributions	Charts Figures Tables	024 078					S2		S3		S4		S2 N2			2 4
E-9	Description of the ecosystem dynamics and relative abundance of biota in littoral communities.	To evaluate the potential effects of OCS activities on the stability of populations within a considered critical habitat	1. Population dynamics of intertidal biota, including: . Seasonal community structure . Productivity	Tables Figures	024 078					S2				S3		N2 -	N1	-	2 4
			2. Trophic relations of littoral fauna, including: . Food webs . Identification of major predator prey relations	Tables						S2				S3					

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
E-10	Seasonal density distributions of principal species of plankton.	To identify critical habitats and to determine the likelihood of impact based on transport data and probable sources.	1. Time of appearance	Tables Graphs	058					S1		S2				S1			2
			2. Quantitative distributions							S1		S2							
E-11	Seasonal indices of phytoplankton standing crop and production.	To identify critical habitats and to determine the likelihood of impact based on transport data and probable sources.	1. Composition	Graphs Tables	058					N1		S2				S1			2
			2. Standing crop	Graphs Tables	058					N1		S2		S3		S1			2
			3. Productivity	Graphs Tables	058					N1		S2		S3		S1			2
			4. Ecology of sea ice flora.		N/A					N1		S2							
E-12	Non-population dependent physiological and population parameters of plankton communities.	To recognize gross seasonal and spatial trends in distribution of plankton communities.	1. Pigment ratios 2. ATP content 3. Carbon assimilation ratios	Narrative Tables Figures															
E-13	Identification and seasonal characterization of critical habitats for egg and larval stages of fish and shellfish species.	To identify critical habitats and to determine the likelihood of impact based on transport data and probable sources.	1. Time of appearance	Charts Tables Graphs						S1		S2		S3					
			2. Quantitative distributions.	Charts Figures Tables						S3				S6					
E-14	Ichthyoplankton key for Alaskan waters.	OCSEA Program development.	Ichthyoplankton key.	Key	349				N6							N6			2

77-969

DATA PRODUCTS						Resolution Schedule for OCS Studies by Fiscal Year													Status
						Required										Projected			
Task	Product	Intended Use	Specific Product	Format	R.U.	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	77	78	79	
										T	E	FS							
E-15	Characterize marine microbial communities with regard to quantitative levels of indigenous heterotrophs, chemotrophs and pathogens.	To identify critical habitats and determine likelihood of impingements based on transport data and probable sources.	1. Geographical density distributions of physiological groups in: . Water . Sediments	Tables Graphs Charts	030					N2		S2					N1		4
		To define the potential for petroleum degradation in specific habitats and, therefore, likelihood of impact.	2. Hydrocarbon degradation rates.	Tables Graphs						N1		S1		S2					
			3. Evaluation of techniques used to determine oil degradation in sediments.	Narrative						N6									
E-16	Response of microorganisms to normal environmental stresses.	To obtain the range of variation in microbial activity in order to provide a basis for evaluating the effect of hydrocarbon contamination.	1. Microbial activity and respiration ratios.	Tables Graphs						S1		S2							
			2. Nitrogen fixation rates in: . Sediment . Animal guts	Tables Graphs						S1		S2							
E-17	Relationship of ice movements and types to distributions and abundance of various living resources.	Not applicable to Aleutian		N/A															

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77-969