Program Work Statements

Environmental Assessment of the Alaskan Continental Shelf

3 – Fish, Plankton, Benthos, and Littoral

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

U. S. DEPARTMENT OF INTERIOR
Bureau of Land Management

CONTENTS - FISH, PLANKTON, BENTHOS, LITTORAL

RU#	Proposer	Title	Page
5/303	H. M. Feder IMS/Univ. of Alaska	The Distribution, Abundance, Diversity, and Productivity of Benthic Organisms in the Bering Sea	1
6	A. G. Carey Oregon State University H. M. Feder IMS/Univ. of Alaska	The Distribution, Abundance, Diversity, and Productivity of the Western Beaufort Sea Benthos	5
7	A. G. Carey Oregon State University	Summarization of Existing Literature and Unpublished Data on the Distribution, Abundance, and Life Histories of Benthic Organisms of the Beaufort Sea	13
19	Ronald Regnart ADF&G	Herring Spawning Surveys - Southern Bering Sea	18
23	ADF&G	Yakutat Bay Benthos Study	23
24	ADF&G	Razor Clam Density and Distribution	29
27	ADF&G	Kenai Peninsula Study of Littoral Zone	34
58	G. C. Anderson Ronald K. Lam Dept. of Oceanography Univ. of Washington	A Description and Numerical Analysis of the Factors Affecting the Processes of Production in the Gulf of Alaska	42
64	W. T. Pereyra M. O. Nelson NMFS/NWFC	Review and Evaluation of Historical Data Base on Non-Salmonid Pelagic Resources of the Gulf of Alaska Shelf and Slope	48
78	S. T. Zimmerman T. R. Merrell NMFS/Auke Bay Fisheries	Baseline Characterization: Littoral Biota, Gulf of Alaska	50
79	S. T. Zimmerman T. R. Merrell NMFS/Auke Bay Fisheries	Baseline Characterization: Littoral Biota, Bering Sea	56

RU#	Proposer	Title	Page
156/ 164	T. S. English (a) Dept. of Oceanography Univ. of Washington	Plankton of the Gulf of Alaska - Ichthyoplankton	61
	D. M. Damkaer (b) PMEL	Plankton of the Gulf of Alaska - Initial Zooplankton Investigations	63
	J. D. Larrance (c) PMEL	Phytoplankton of the Gulf of Alaska	74
	R. T. Cooney (d) IMS/Univ. of Alaska	Zooplankton and Micronekton in the Bering - Chukchi/Beaufort Seas	89
	Vera Alexander (e) IMS/Univ. of Alaska	Phytoplankton Studies - Bering Sea	104
174	W. T. Pereyra L. Ronholt S. Hughes NMFS/NWFC	Baseline Studies of Demersal Resources of the Northern Gulf of Alaska Shelf and Slope	110
175	W. T. Pereyra J. E. Reeves R. G. Bakkala NMFS/NWFC	Baseline Studies of Demersal Resources of the Eastern Bering Sea Shelf and Slope	120
233	Rick Furniss ADF&G	Beaufort Sea Estuarine Fishery Study	136
281	H. M. Feder IMS/Univ. of Alaska	The Distribution, Abundance, Diversity and Productivity of Benthic Organisms in the Gulf of Alaska	141
282/ 301	H. M. Feder IMS/Univ. of Alaska	A Summarization of Existing Literature and Unpublished Data on the Distribution, Abundance and Productivity of Benthic Organisms of the Gulf of Alaska and Bering Sea	145
284	Ronald Smith IMS/Univ. of Alaska	Food and Feeding Relationships in the Benthic and Demersal Fishes of the Gulf of Alaska and Bering Sea	148
285	J. E. Morrow Dept. of Biological Sci. Univ. of Alaska	Preparation of Illustrated Keys to Skeletal Remains and Otoliths of Forage Fishes - Gulf of Alaska and Bering Sea	152

RU#	Proposer	Title	Page
318	J. E. Morrow Dept. of Biological Sci. Univ. of Alaska	Preparation of Illustrated Keys to Skeletal Remains and Otoliths of Forage Fishes - Beaufort Sea	155
348	J. E. Morrow Dept. of Biological Sci. Univ. of Alaska	Literature Search and Data Conversion on Density Distribution of Fishes of Beaufort Sea	158
349	T. S. English Dept. of Oceanography Univ. of Washington	Ichthyoplankton	161
354	W. T. Pereyra Paul T. Macy NMFS/Seattle	Review of Literature and Archive Data for Non-Salmonid Pelagic Fishes of the Eastern Bering Sea	163
356	A. C. Broad Western WA State Coll. Bellingham, WA	Littoral Survey of the Beaufort Sea	166
359	T. S. English Dept. of Oceanography Univ. of Washington	Beaufort Sea Plankton Studies	178

ALASKA MARINE ENVIRONMENTAL ASSESSMENT PROGRAM
WORK STATEMENT (Research Unit #5/303)

I. Title:

The distribution, abundance, diversity, and productivity of benthic organisms in the Bering Sea.

II. Principal Investigator:

Howard M. Feder, Professor
Institute of Marine Science
University of Alaska
Fairbanks, Alaska 99701
SS#: 548-38-8943

III. Geographic Area and Inclusive Dates:

Bering Sea April 1, 1975 - September 30, 1976

IV. Cost Summary:

FY1975 through June 30, 1975	FY1976 July 1, 1975 - Sept 30, 1976
$13,571	$142,707

V. Proposed Research:

A. Background and objectives

This proposal addresses itself to Task A-18.

The benthic macrofauna of the Bering Sea is relatively well-known toxonomically, and some data on distribution, abundance and feeding mechanisms are reported in the literature. The relationship of specific infaunal feeding types to certain substrate conditions has a limited documentation as well. However, detailed information on the temporal and spatial variability of the benthic fauna is sparse, and the relationship of benthic species to the overlying seasonal ice cover is not known.

The objectives of this study are:

1) A qualitative and quantitative inventory census of dominant benthic species within the identified oil-lease sites.

2) A description of spatial and seasonal distribution patterns of selected species in the designated study areas, with emphasis on assessing patchiness and correlation with microhabitat.

3) A preliminary comparison of the distribution of dominant species with physical, chemical and geological features with emphasis on the latter parameter.

4) Preliminary observations of biological interrelationships between selected segments of the benthic biota in the designated study areas.

B. Methods

As many stations as possible will be occupied over the entire southern Bering shelf in the early summer cruises. All of the stations occupied in the early cruises will be reoccupied on subsequent cruises whenever time and ship position makes this possible. Additional stations will be chosen, as necessary, to provide better spatial coverage within the entire study area and also to examine specific details of distribution of particular species relative to environmental parameters (e.g. sediment distribution or bathymetric irregularities). Fifty to sixty stations will be occupied over the time period of the project. Five van Veen grab samples ($0.1m^2$) are planned for each station occupied, with at least 5 stations planned for statistical testing by way of approximately 10 grabs. The results from these stations will be used to determine the optimum numbers of grabs needed per station in further studies in the area. Appropriate analyses of variance will be used to test the validity of the numbers of replicates taken.

Data collected by the Trawl Survey team of the National Marine Fisheries Service will be used to relate to the grab-sample program. The stomach data analyzed by Dr. Smith will be used to initiate basic understanding of the food webs involved on the shelf, and will point to the importance of certain bottom invertebrates as key food organisms. Widely distributed benthic invertebrate data of Mr. Stoker will be used extensively to further comprehend distributions over the shelf.

In the first two years of the survey it will be possible to identify, count and weigh all species taken by way of the quantitative grab program. In addition, it is hoped that the most abundant species will be examined from the trawls taken by the National Marine Fishery Service cruises; this will be primarily the result of time and space constraints on the vessels used in the survey -- i.e. not all species can be examined. Biologically important species will be chosen for examination in detail (see Feder and Mueller, 1972 for criteria of Biologically Important Species). Important invertebrate food species will be selected for special treatment. Evidence from work of Stoker and others in the Bering Sea indicates that Annelida, Mollusca and Echinodermata will be of prime interest.

An evaluation of the information obtained in grab and trawl samples will provide a continuing and expanding list of infaunal and epifaunal species, the distribution of these species in space and

time, diversity indices for the stations in the grid, and a preliminary statistical analysis of the species taken in the quantitative samples (e.g. a multivariate analysis and other appropriate types of analysis of assemblages of species in selected stations). The data will also result in an understanding of various aspects of the general biology of selected, biologically important species (criteria to be selected according to Feder and Mueller, 1972); features to be examined will be recuitment, feeding biology and food-web interactions, growth and reproductive biology. Candidates for continued monitoring will be selected on the basis of a preliminary screening at the end of the second year, and will be based on the biological information obtained in laboratory results.

VI. Information Products:

1. Data representing the seasonal density, distribution and ecology of benthos life history stages. Data to be gained from sampling by trawl and bottom grab. Data where possible will be provided on magnetic tape.

2. Narrative, tables and figures describing the ecology, growth and life history of the principal benthos.

3. Conclusions and recommendations regarding research gaps and recommendations for corrective research.

VII. Data or Sample Exchange Interfaces:

1. Data from Dr. Smith on food habits of demersal fishes will be needed to initiate basic understanding of the food webs.

2. Sediment data from Dr. Hoskin will be necessary to make correlations between distribution of species and substrate characteristics.

3. Data collected by the trawl survey of the National Marine Fisheries Service will be required to supplement the grab-sample program.

VIII. Sample Archival Requirements:

Samples will be stored in the Marine Sorting Center. No provisions have been made in the work statement for long term storage of the samples.

IX. Schedule:

Cruises are required three times per year, mid-summer, late fall, mid-spring. Four months will be required to work up samples.

X. Equipment Requirements:

Replacement grabs.

XI. Logistics Requirements:

Vessel capable of working in Bering Sea. Require three cruises per year as per above, X. Schedule. Ship must be capable of sampling with van Veen grab. Laboratory space with fume hood aboard vessel is required.

WORK STATEMENT (Research Unit #6)

I. TITLE: The distribution, abundance, diversity, and productivity of the western Beaufort Sea benthos.

II. PRINCIPAL INVESTIGATOR:

Andrew G. Carey, Jr.
Associate Professor
School of Oceanography
Oregon State University
Corvallis, Oregon 97331
(503)754-2525

Andrew G. Carey, Jr.

II. GEOGRAPHIC AREA AND INCLUSIVE DATES

Western Beaufort Sea

through 30 September 1976

IV. COST SUMMARY

	FY 1975 through 30 June 1975	FY 1976 1 July 1975-30 Sept. 1976
Salaries and Wages	-0-	42,710
Benefits	-0-	6,410
Equipment	47,617	-0-
Materials and Services	-0-	14,990
Travel	-0-	6,500
Indirect Costs	-0-	19,310
TOTAL	47,617	89,920

V. PROPOSED RESEARCH

A. Background and objectives

(1) Field studies will be conducted throughout the year to estimate the distribution, abundance, diversity and productivity of benthic organisms. (Task A-18)

(2) Very little research has been accomplished on the benthic fauna of the Beaufort Sea. Extensive sampling was undertaken off Point Barrow (G.E. MacGinitie, 1955 and N. MacGinitie, 1959) and recently on the continental shelf and slope of the western Beaufort Sea (Carey, et al., 1974; Carey and Ruff, in press). Research on shallow water benthos is being undertaken in Canadian waters near the Mackenzie River. Broad outlines of faunal composition and abundances are known, only for the central portion of the Alaskan shelf, details of variability in space and time are much less well known.

(3) The information needed to complete the task objectives include extensive surveys by quantitative grab, otter trawl, and bottom camera during the summer season, and quantitative grab, trapping and camera work at selected standard seasonal stations during the fall, winter and spring (initially 4 field trips on the ice per year).

Extensive and time-consuming laboratory research will then be necessary to pick and sort the samples, identify and enumerate the fauna.

(4) By 30 September 1976 reports detailing dominant species distributions and abundance on the continental shelf in regions of prime interest will be produced.

Field work should include summer survey sampling of infauna and epifauna in regions of prime interest, and winter sampling of infauna at a small series of standard seasonal stations arranged on 3 north-south transects across the continental shelf.

(5) Related research in the Beaufort Sea include all environmental studies that pertain to the Beaufort Sea ecosystem as well as studies concerned specifically with biota. Planned geological and physical oceanographic research are of particular interest. Primary production, nutrient chemistry, and zooplankton are areas of prime interest which should be included for an understanding of the marine ecosystem.

B. Methods

Sampling

(1) A broad range of sizes and ecological types of the benthic fauna will be sampled by 0.1 m^2 Smith-McIntyre grab, 0.1 m^2 and or 0.25 m^2 box corer, 3.5 cm^2 multiple-corer, and bottom traps, and when ice conditions permit by a 3-meter beam trawl and/or 4-meter otter trawl. The visible mega-epifauna will also be quantitatively studied by stereo bottom photography particularly when sea ice or bottom topography may prevent trawling.

(2) (a) Summer survey stations will be located on north-south transects from the 10-meter contour to the shelf edge and down to the upper slope where feasible and important for the interpretation of faunal patterns and relationships. In regions of particular interest, e.g., oil lease areas, the sampling station pattern will be increased to a more detailed grid pattern. The data derived from earlier studies (Carey, et al., 1974; Carey and Ruff, in press) will be utilized to locate many of the stations.

Approximately 20 stations will be sampled for benthos on the outer continental shelf from a U.S. Coast Guard icebreaker during the summer of 1976 (weather, equipment, ice conditions, and logistics permitting).

Five grab samples will be taken at each station during summer cruises. Twenty grab samples will be obtained from a selected characteristic station to determine sampling variability and efficiency. Box core samples (5-10) will be obtained when possible to determine the depth of fauna within the sediments. Otter trawls will be taken when summer ice conditions are exceptionally open to provide specimens for identification and for distributional studies. Bottom photographs will be taken at each appropriate station to determine trends in distribution and abundance of the larger epifauna across the Alaskan continental shelf.

These estimates of the number of samples to be obtained are tentative because of the necessary dependence on weather, ice conditions, equipment, and logistics.

(b) Seasonal stations on three north-south transects across the continental shelf will be re-occupied four times per year, logistics and weather permitting. Three to five stations are planned on each transect with five 0.1 m^2 grab samples to be taken at each station. Field expeditions supported logistically by helicopter and ship will be undertaken during fall, spring, early summer, and late summer months to obtain data on life histories and perhaps growth, of dominant benthic invertebrates.

Sampling Summary (through September 1976):

(1) Smith-McIntyre Grab

	Stations	Samples (5/station)
(a) Summer survey		
10-20 m	20	100
20-100 m	20	100
(b) Seasonal stations (4 times/year)		
Barrow Transect	3-5	60-100
Prudhoe Bay Transect	3-5	60-100
Barter Island Transect	3-5	60-100
TOTALS	49-55	380-500

(2) Otter Trawl (4 meter)

(a) Summer Survey		
10-100 m	10-20	10-20

(3) Bottom Photography

10-100 m	10-20	2000-4000 photos

Samples to be studied by Oregon State University will be picked and sorted and the fauna identified as far as possible in the Benthos Laboratory at OSU. It should be noted that this is a particularly long and laborous process for the very specious fauna living within and associated with the sediments. Picking the fauna from the larger sediment particles and debris and sorting them into major taxonomic categories for counting and weighing is a major task in itself. Assistance from taxonomic specialists and taxonomic collections will be utilized when necessary. Dominant species will be evaluated for feasibility for study of life histories. Quantitative estimates of the numerical density and biomass will be undertaken.

Research undertaken on later contracts will include appropriate statistical analyses to define communities, variability, diversity, and other bio-indices and to determine the degree of correlation of the ecological patterns with features of the environment.

(3) A wide range of appropriate taxonomic forms will be included in the infaunal and epifaunal analyses. Particular emphasis will be placed on the abundant groups - molluscs, polychaetes, and crustaceans for the infauna, and echinoderms for the mega-epifauna (>1.3 cm). Animal groups will be included that are abundant, are quantitatively collected by the sampling gear, and for which there is appropriate taxonomic expertise. Dominant species that can effectively be sized will be used in the year-round studies on growth and life history.

(4) Samples collected by grab or box-corer will be processed on board ship, or at the ice transect base station by washing through 1.0 and 0.42 mm screens (Carey et al., 1974; Holme and McIntyre, 1971). In the laboratory, organisms will be picked from the samples with the aid of Rose Bengal vital stain and will be sorted into major groups for counting and weighing. Identifications will be undertaken as far as possible in the OSU Benthos laboratory and the aid of specialists will be sought when necessary and when possible.

Analysis of data will include appropriate summarization of bioindices with analyses of sample variability. Appropriate statistical techniques for delineation of benthic communities will be undertaken when enough data have been accumulated.

VI. INFORMATION PRODUCTS

A. Final report including:

1 - digitized data on occurrences of benthic invertebrates on the Alaskan Beaufort Sea continental shelf, and when appropriate and available, numerical densities and biomass.

2 - digitized data on seasonal occurrences and abundance of the benthic invertebrate fauna at selected stations across the continental shelf.

3 - narrative including tables and figures on the ecology, life histories, and growth of selected benthic species when appropriate data are available.

4 - tentative conclusions and recommendations for further research with comments on critical benthic environmental areas and on critical aspects of the ecology of the benthos.

B. Quarterly reports and periodic data reports, including transfer of data in appropriate ADP format (digitized data on appropriate Fortran Coding Forms).

VII. DATA OR SAMPLE EXCHANGE INTERFACES

A. Data required from other programs include seasonal information on:

1 - sediment characteristics
particle size
organic carbon

2 - hydrography
water mass positions
temperature
salinity
O_2

3 - currents and mass transport

4 - plankton
primary production
zooplankton abundance and distribution

5 - coastal benthos
species composition
abundance

6 - demersal fish
abundance
distribution

7 - other biological aspects
food web

B. Benthic data and samples required by other research efforts.

1 - Benthic species composition and abundance within and adjacent to ice scours. Repopulation rates of ice scours by benthos. (Geology-USGS).

2 - Distribution and abundance of inner shelf benthos (Marine Mammal group; Marine Birds).

3 - Life history and spawning activity of Benthos (Zooplankton).

4 - Large, abundant benthic specimens (Chemical Baselines).

Note - Biological data cannot be made available within 120 days of collection because of logistics and the time lag caused by sample processing, identification, and enumeration. Basic sampling data and certain other data can be made available within the prescribed time, but detailed benthic biological information will be more difficult to transmit promptly. Every effort will be made, however, to communicate data as rapidly as possible as they become available. Data will be transmitted 120 days after identification and final work-up of the fauna.

We request that the Environmental Data Service (EDS) provide bibliographic, computer card key punching, data printout, correlative retrieval, and plotting (histograms, x-y, and contouring). It is requested that these services be supplied at no cost to the contractor.

Data will be codified (species in the VIMS format) and logged onto appropriate computer compatable data sheets (Fortran Coding Forms) from which

EDS can punch IBM computer cards. A duplicate set of punched cards is requested to be returned to OSU Benthos. Approximately 7.1 x 10^4 IBM cards will be generated from this project during the first 13 months of operation (we prefer to have each species on a single card). In terms of the number of 80 column lines, approximately 150,000 lines would be necessary for the total accumulated data.

Each grab station would require:
1 card - general collection data
1 card - environmental parameters
1 card - substrate (sediment)
100 cards - Bio deck - 1 card/sp
103 cards

200 existing grab samples
380-500 potential grab samples (year No. 1)
(580-700 samples)(103 cards) = 59,740

Otter Trawl Stations

25 existing trawls x 103 cards/trawl = 2,575 cards

Deep Sea Stereo Camera Stations

1 card - general collection data
1 card/frame - Bio deck

2500 existing frames
2100 potential frames
4600 x 2(stereo) = 9,200 cards.

VIII. SAMPLE ARCHIVAL REQUIREMENTS

Samples will be archived at Oregon State University with appropriate preservation and labelling until identification of specimens, reproductive and growth analyses of dominant species, and quantification of the sample are complete. A well-labelled and well-indexed reference collection will be stored in the OSU Benthos Invertebrate Reference Museum.

IX. SCHEDULE

A. Sampling

July-August 1975 - Sampling across Alaskan shelf including standard seasonal stations.
(a) ice breaker (20-500 m)
(b) coastal vessel (10-20 m)] logistics doubtful
(c) helicopter

October 1975 - Sampling across Alaskan shelf on three seasonal transects.
(a) through-th-ice sampling with helicopter support.

March 1976 - Sampling across Alaskan shelf on three seasonal transects.
(a) through-the-ice sampling with helicopter support.

June 1976 - Sampling across Alaskan shelf on three seasonal transects.
(a) through-the-ice sampling with helicopter support.

August-September 1976 - Sampling across Alaskan shelf, including standard seasonal stations
(a) icebreaker (20-500 m), 6 weeks
(b) coastal vessel (10-20 m), 2-4 weeks.

B. Sample processing and data analysis

October 1975 - Reporting of sampling and initial benthic data.
December 1975 - Reporting of sampling and initial benthic data.
May 1976 - Reporting of sampling and initial benthic data.
August 1976 - Reporting of sampling and initial benthic data.
September 1976 - Reporting of sampling and initial benthic data.

C. Interfaces

1. Seasonal through-the-ice sampling

2. Summer coastal and ice breaker sampling operations.

3. Exchange of preliminary and final data directly with geology, phytoplankton, and zooplankton research groups.

X. EQUIPMENT REQUIREMENTS

A. Precision navigation system (Del Norte) for all field expeditions and cruises. Essential for seasonal studies and ice scour studies (complementary NSF research).

B. Ice sampling, support equipment, and hydrographic winch capable of lifting 0.1 m^2 Smith-McIntyre grab, small corer, small underwater camera system, and a one meter net.

Smith-McIntyre grab weight information

Basic grab with lead weights and cocking bar	135 lbs
Sample weight (15 liters sand)	70
Pull-out tension (max)	1000
Wire weight (3/16" hydro wire) for 200 meters wire.	50
Winch lifting capacity.	1255 lbs.
Sample weight/transect flight (25 samples)	1750 lbs.

XI. LOGISTIC REQUIREMENTS

A. Logistics support to be requested from NOAA

1. Large vessel (with boat for inshore work)
   U.S. Coast Guard icebreaker for 6 weeks August-September 1975-76 for offshore sampling

2. Coastal vessel (offshore of barrier islands, 10-20 m depth)
   Ice-strengthened vessel to operate under light ice conditions with power, size, and winches capable of handling trawls, box-corers, cameras and grabs.

3. Helicopter support for Oct., Mar., and June field expeditions on the ice. Needed to move personnel, gear, and samples on ice across continental shelf. Should include all support gear plus ice hole cutting equipment (4 foot square hole).

4. Per diem at shore facilities (Naval Arctic Research Lab, Point Barrow, Alaska and Prudhoe Bay, Alaska) for 3 people.

5. Per diem on ships and ice field trips for 3 people.

B. Oregon State University will only provide travel from Corvallis, Oregon to ship or shore facility.

WORK STATEMENT

(Research Unit #7)

I. TITLE: Summarization of existing literature and unpublished data on the distribution, abundance, and life histories of benthic organisms of the Beaufort Sea.

II. PRINCIPAL INVESTIGATOR:
Andrew G. Carey, Jr.
Associate Professor
School of Oceanography
Oregon State University
Corvallis, OR 97331
(503) 754-2525

III. GEOGRAPHIC AREA AND INCLUSIVE DATES: Beaufort Sea Continental Shelf
Through 30 September 1976

IV. COST SUMMARY

	FY1975 through 30 June 1975	FY1976 1 July 1975 - 30 September 1976
Salaries and Wages	$ 590	$26,210
Benefits	90	3,930
Equipment	6,750	-0-
Travel	500	1,250
Other Direct Costs	613	7,480
Indirect Costs	267	11,850
Total	$8,810	$50,720

V. PROPOSED RESEARCH

A. Background and Objectives

1. Task A-17

(a) Objectives

I propose to define the present state of our knowledge of the systematics and ecology of Beaufort Sea benthos on the outer continental shelf by summarizing and statistically analyzing published and unpublished data including those to be obtained from samples, collections, and bottom photographs already in hand. These data will then be evaluated to determine the type and degree of information that is needed for describing benthic biotic baselines in the western Beaufort Sea.

(b) Specific Objectives

1. The available data will be utilized to determine species lists and distributional patterns of species.

2. Patterns and natural variability of distribution and abundance of benthic species, recurrent species groups (and communities), and ecological types will be defined as far as possible from published data.

3. These patterns will be analyzed for possible correlations with features of the benthic environment to determine those features of potential ecological importance in this subarctic environment.

4. These ecological data will be evaluated to determine the type and degree of information that is needed for describing benthic biotic baselines in the Beaufort Sea.

2. There are few published data available on the benthos of the Beaufort Sea. Extensive sampling has been accomplished off Pt. Barrow on the west (MacGinitie, 1955), the Alaskan shelf (Carey et al., 1974), and in the eastern Beaufort Sea near the Mackenzie River (Canadian Beaufort Sea Project progress reports).

3. The information needed will be derived from samples, photographs, and data already on hand at Oregon State University plus published and unpublished data collected by other organizations.

4. The objectives as stated in VA1 should be accomplished by 30 September 1976.

5. All past biological research and much of the environmental research will be of interest for interpretation of these benthic data summaries and analyses. Exchange of data will be undertaken with individual scientists in the various research areas.

B. Methods

1. Processing of samples on hand and analysis of derived data

Identification of the macro-infauna (1.0mm) will be continued with emphasis placed on the polychaete worms. Analysis of large meiofaunal samples (0.42-1.0mm) also collected on WEBSEC-71 will be initiated. Organisms will be identified as far as possible. Stereo photographs taken on the western Beaufort Sea continental shelf will be analyzed for the the abundance and distribution of common, large epifaunal benthos. Visible fauna in one hundred stereo pairs of high quality photographic prints will be carefully quantified.

The distribution and abundance of the organisms will be summarized and correlated with features of the physical environment that are known to a certain extent to determine the most important controlling features of the environment.

The presence of communities will be analyzed by several statistical grouping techniques, e.g. recurrent group, clustering, and factor analyses.

2. Summarization and analysis of published and unpublished data

Literature searches will be undertaken, by use of bibliographic searches including the use of NOAA's computerized bibliographic service (EDS), library searches, and correspondence. Data reports, unpublished data and benthic faunal collections will be sought in particular.

Appropriate data will be included in analyses of benthic community presence, distribution, and structure.

VI. INFORMATION PRODUCTS

The following reports and papers detailing and critically evaluating as far as possible the status of our current knowledge of the offshore Beaufort Sea benthos will result from these studies:

1. Species list for the Beaufort Sea and a catalogue of existing collections at other institutions.

2. An annotated bibliography of research and data on the Beaufort Sea benthos.

3. Digitized occurrences ane ecological trends of bio-indices and possible correlations of these with various features of the environment with data reported in the appropriate Automatic Data Processing format (codified data entered on appropriate Fortran Coding Forms). These data will be derived from OSU's studies and published and unpublished data from other research.

4. A narrative describing an analysis of benthic community ecology and structure in the western Beaufort Sea including tables and figures.

5. An evaluation of the status of our knowledge of the benthos in the Beaufort Sea with recommendations for research needed to fulfill the BLM requirements for a meaningful environmental assessment program on the outer continental shelf.

VII. DATA OR SAMPLE EXCHANGE

All past appropriate environmental data will be utilized in these analyses. Newly acquired environmental data will be utilized as they are acquired.

Appropriate data from the literature will be summarized and will be transferred to EDS in appropriate ADP format. The species will be codified in the VIMS format and the data transferred to EDS on computer sheets to be card punched and entered into the data base. A duplicate set of punched IBM cards is requested by OSU benthos.

We request that the Environmental Data Service (EDS) provide bibliographic, computer card key punching, data printout, correlative retrieval, and plotting (histograms, xy, and contouring) at no extra cost to the contractor.

VIII. SAMPLE ARCHIVAL REQUIREMENTS

Samples will be archived at Oregon State University appropriately labelled and stored in 70% buffered ethanol. An appropriately identified, labelled, and indexed museum reference collection will be accumulated.

IX. SCHEDULE

The final report will be submitted by 30 September 1976.

X. EQUIPMENT REQUIREMENTS

The EDS computerized bibliographic search service and EDS data processing services will be required.

XI. LOGISTIC REQUIREMENTS

None (except standard travel and shipping).

RESEARCH UNIT #19

Work Statement

I. Title: Herring Spawning Surveys - Southern Bering Sea.

II. Principal Investigator: Ronald Regnart, Regional Supervisor, Alaska Department of Fish and Game, Division of Commercial Fisheries, 333 Raspberry Rd., Anchorage, Alaska 99503. Phone (907) 344-0541.

III. Geographic Area and Inclusive Dates: Southern Bering Sea coastal waters from Unimak Island to the Yukon River delta; May 1, 1975 - September 30, 1976.

IV. Cost Summary:

	FY1975	FY1976	Total
Research	4.5	95.5	100.0
Logistics	3.6	37.9	41.5
	8.1	133.4	141.5

V. Proposed Research:

A. Background and Objectives

1. Background: Herring in the study area are known to play an important role in subsistence utilization by coastal residents, but the magnitude and importance of this harvest has not been documented. Herring also represent a latent commercially exploitable resource of potential benefit to Alaskan coastal residents. In addition, herring and herring eggs constitute one of the fundamental sources of food for many species of fish, mammals and birds.

Herring are known to spawn on open, exposed beaches in the tidal and sub-tidal zones. Therefore, the developing eggs and larvae are highly susceptible to surface-borne pollution.

Very little information exists regarding the range, distribution, seasonal occurrence, relative abundance and life history in addition to the location of spawning areas. This information is necessary to provide information for predicting and mitigating impacts of potential oil and gas exploration and development on the coastal herring resource. Results from this study will also indicate the degree of subsistence dependence upon the herring resource.

2. Objectives (Tasks A-10 and A-25a):

a. Primary objectives:
   1) determine the seasonal occurrence, distribution and relative abundance of spawning herring and herring spawn in the intertidal and shallow subtidal zones.
   2) determine the dependence upon and utilization of herring and herring spawn by coastal residents.

b. Secondary objectives:
   1) determine the important life history characteristics (age, sex and size composition) of selected spawning populations.

2) determine the kinds of mineral and plant substrates used for spawning.

c. Cooperative studies:

1) field sampling and data exchange would be accomplished where appropriate with studies carried out under tasks A-21a and A-21b.

B. Methods

1. Meetings will be held in coastal villages to explain the scope and purpose of the study in order to obtain the fullest cooperation from local residents. Residents will be systematically interviewed to obtain information regarding utilization, seasonal occurrence and location of spawning grounds. Acquisition of subsistence catch information on an annual basis will be facilitated by distribution and collection of specially prepared catch calendars. Catch calendars will remain in the fishermen's possession for twelve consecutive months with monthly forms either being collected in person by Department biologists or mailed in to the nearest Department office.

2. Aerial surveys utilizing single engine aircraft will be conducted of all known and potential spawning areas to determine the distribution and relative abundance of spawning fish. The location and estimated surface area (square feet) of each school will be entered on USGS topographic maps. Surface area estimates will be facilitated by aerial photographs and specially designed hand-held glass grids. Existing sattelite photographs will be examined for possible information relative to the occurrence of major spawning populations.

3. Intensive beach surveys of selected major spawning areas will further delineate spawning grounds and spawn densities and the type of substrate utilized for spawning. The lineal and depth distribution in addition to deposition of spawn will be determined in selected areas through boat, foot and SCUBA surveys.

4. A minimum of two aerial surveys, spaced approximately one week apart, will be made during the anticipated spawning period. The time and extent of beach surveys will be greatly dependent upon logistical concerns and herring distributions.

5. Herring obtained from commercial and subsistence catches and from fishing gear operated by Department personnel will be sampled for age, sex and size information. Depending on available facilities, herring will either be sampled in the field or whole specimens will be frozen for later sampling. Lengths (snout to hypural plate), weights and sex will be recorded and scales and otoliths recovered for age determination. A minimum of 500 herring should be sampled from each selected major spawning population.

6. Information regarding smelt and capelin utilization and spawning distribution will be obtained incidentally during the study.

VI. Information Products: Annual progress reports will contain complete documentation of study objectives, methods and results. Final report of the first years activity will be prepared by August 1, 1976. Maps depicting spawning distribution. timing, relative abundance and spawning habitat will be produced. Data will be provided on the above parameters plus commercial and subsistence utilization. It is anticipated that an ADF&G Informational Leaflet will be published on the results of this study.

VII. Data or Sample Exchange Interfaces: Various oceanographic and climatological conditions in both offshore and near shore marine waters of the southern Bering Sea can be expected to influence temporal and spatial distribution of spawning herring. Information regarding water temperatures, currents,wind direction and velocity, ice pack features, etc., will be required from other agencies. Observations on herring spawning and littoral habitat composition will be exchanged with investigators of Tasks A-21a and A-21b. Cooperative sampling of littoral zones may be possible.

All collected data originating from this study will be entered into a common data base maintained by the Environment Data Service, National Oceanographic Data Center, in a standard format within 120 days of acquisition. Data will be submitted on magnetic tape or punch cards.

VIII. Sample Archival Requirements: None

IX. Schedule: Field studies will be conducted during May - October with major effort during the anticipated spawning period, May - July. Data exchange and analysis, in addition to report preparation and project planning, will be undertaken during the interim months. Full coverage of this area allowing for annual variation in spawner abundance, distribution and timing will require a minimum of two fiscal years work. For further scheduling details see attachment 1.

X. Equipment Requirements: No special equipment is required other than the purchase of Boston Whalers and outboard motors that will be used in selected areas to provide access to spawning beaches and SCUBA gear.

XI. Logistic Requirements: Single engine fixed-wing aircraft (130 hours) May - October, 1975 and May - August, 1976 - Unimak to lower Yukon. Approximately 30 hours of fixed wing required in FY 75, (May and June). Helicopter (25 hours) May - July 1976 -- Bristol Bay - lower Yukon. 30 days vessel charter May - June, 1976 -- Unimak - Bristol Bay with helicopter and small boat capability. Charters for aerial surveys of spawning areas and transportation of survey crews.

Alaska Department of Fish and Game field facilities at several locations including Cold Bay, Dillingham and Bethel will be utilized. Field facilities consisting of

portable tent camps and housing rentals in coastal communities will also be utilized.

Attachment 1.

IX Schedule of Operations - Herring Spawning Surveys - Southern Bering Sea

	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Planning	X	X								X	X						
Purchasing	X	X								X							
Aerial spawning surveys	X	X	X										X	X	X		
Coastal village surveys				X	X												
Intensive beach surveys													X	X	X		
Herring Sampling														X	X		
Data compilation other sources						X	X										
Data analysis							X	X	X								
Report preparation				X	X												X
Progress report					X												
Final Report 1/																	X
Months	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Year	1975												1976				

1/ Final report would actually not be completed prior to Dec 1976 to allow analysis of data collected May - July.

022

FINAL WORK STATEMENT
RU # 23

I. Title: Yakutat Bay Benthos Study (Research unit 23(F))
(Yakutat Bay Demersal Fish and Shellfish Study)

II. Principal Investigator: Jerry McCrary, Region Research Supervisor, Alaska Department of Fish and Game, Division of Commercial Fisheries, Box 686, Kodiak, Alaska 99615. Phone (907) 486-4166.

III. Geographic Area and Inclusive Dates: Gulf of Alaska, Yakutat Bay.

IV. Cost Summary:

	FY 1976
Research	75,000
Logistics	52,500
	127,000

V. Proposed Research:

A. Background and Objectives:

The primary emphasis of this proposed research is outlined in Tasks A-14 and A-18. Of secondary importance are Tasks A-15 and A-20. The fish and shellfish resources of Yakutat Bay are quite limited. With the exception of salmon, most studies to date have been concerned with determining whether a commercial potential for certain shellfish (primarily shrimp and scallops) exists. Exploratory fishing has shown commercial potential for scallops and to a lesser extent shrimp. The Alaska Department of Fish and Game has recorded the statistics on this region's commercial fisheries for Dungeness crab, Tanner crab, king crab, scallops and shrimp. These fisheries, except those for shrimp and Dungeness crab, largely occur in the adjacent offshore ocean waters to Yakutat Bay and near its mouth. Additionally, demersal fish resources of the region, including halibut are utilized by both foreign and domestic fleets. A domestic fishery for halibut exists within Yakutat Bay and it is a known halibut rearing area. It is quite probable that Yakutat Bay contains halibut which significantly contributes to the overall productivity of the region's demersal fish and shellfish resources.

Petroleum related activities in the eastern Gulf of Alaska will probably be staged out of Yakutat Bay. It is therefore imperative to define the distribution and relative magnitude of the demersal fish and shellfish resources that might be impacted by the development of petroleum resources or related activities in this region.

The proposed study will concentrate primarily on the following objectives:

1. Describe the spatial and temporal distribution and abundance of demersal fish and shellfish excluding larval and/or earliest

juvenile stages.

2. Define major molting, breeding, and egg hatching periods and important areas for selected shellfish species.

3. Determine the food habits of selected demersal fish.

4. Determine the length, weight, and age distributions of selected demersal fish and shellfish to develop growth models.

Extensive bi-monthly sampling with trawls and/or pots will be required to meet the primary task objectives. Additionally this study will provide some data to other investigators regarding the spatial and temporal distribution of ichthyoplankton and zooplankton (research unit 349) and benthic epifauna (research unit 281).

To whatever degree necessary, this study could provide some data to all of the above projects since bi-monthly sampling is anticipated whereas most of the above projects anticipate only annual or semi-annual sampling schedules.

The data for this study would be obtained in a manner that would allow a general summary of results by September 30, 1976. Some of this work will of necessity be carried out through August 1976 and only general results would be available by September. Detailed seasonal distribution and density charts by species, size classes, etc. for demersal fish, shellfish, and epibenthic invertebrates probably could not be accomplished until the end of 1976.

B. Methods:

This project at the outset will review published and unpublished exploratory fishing records primarily to delineate known trawlable and untrawlable areas and to generate a preliminary check list of major species encountered.

Bi-monthly trawl surveys will be conducted with a standard NMFS 61-foot shrimp trawl modified so that the groundrope tends bottom closely, and a standard (NMFS) East Coast type bottomfish trawl. Standard 30 minute or one-mile tows would be made randomly with a sampling intensity of not less than one trawl per two square miles of trawlable area. Population estimates (area-swept method) will be made at the 80 percent confidence limit. The desired level of precision will be $\pm$ 25 percent of the mean estimate. The number of tows per unit area will be adjusted in the field until the allotted

time for a survey area, or strata, has been exceeded, or the desired precision level of the population estimate is attained.

It is not known at this time whether or not there is enough trawlable habitat to allow assessment of shellfish resources exclusively with trawls. It is anticipated some pot fishing will be required if only in non-trawlable shellfish habitats. Should extensive pot sampling be required, a standardized systematic sampling plan for Dungeness, Tanner and king crab which has been developed by the Alaska Department of Fish and Game would be employed. This plan calls for four small-mesh pots to be fished per each one-mile station with stations spaced two miles apart perpendicularly and one mile apart laterally.

Demersal fish and shellfish species of commercial significance in the Gulf of Alaska will be identified and appropriate weighted biological observations made as the opportunity presents. All species will be identified at least to family and composition by weight estimated. Biological samples of shellfish for length, age, sex determinations will include families Pandalidae, Lithodidae, Parathenopidae, Cancridae, and Pectinodie with identifications to genus.

Demersal fish biological samples will include the following species when they occur: flathead sole, Hippoglossoides elassodon; yellowfin sole, Limanda aspera; rock sole, Lepidopsetta bilineata; arrowtooth flounder, Atheresthes stomias; Alaska plaice, Pleuronecetes quadrituberculatus; longhead dab, Limanda proboscidea; walleye pollock, Thereagra chalcogramma; Pacific cod, Gadus macrocephalus; sablefish, Anoplopoma fimbria; Pacific ocean perch, Sebastes alutus; Greenland turbot, Reinhardtius hippoglossoides; and halibut, Hippoglossus stenolepsis.

Sampling procedures for king crab, Tanner crab, Dungeness crab, scallops, and commercial pandalid shrimp species will follow standard procedures that have been developed by the Alaska Department of Fish and Game. Those for demersal fish will follow standard procedures developed by NMFS.

VI. Information Products: The research will provide the following bi-monthly and seasonal information:

1. Standing stock estimates for major species.

2. Density distributions for major species by habitat type and/or depth zones.

3. Representative size frequency distributions for major species.

4. Scale and/or otolith readings and length frequencies for age determinations of selected species.

5. Descriptions of important stages in life histories of selected species.

6. Identification of shellfish molting and breeding, hatch sites.

7. All digital data will be submitted on magnetic tape or punch cards in format suitable for EDS processing and storage.

VII. Data or Sample Exchange Interfaces: This study will likely require no data or samples from other investigators but will furnish data for research units 281 and 349.

Study coverage at or off mouth of bay will be coordinated with the trawl studies of the NWFC so that serious gaps or duplications of data may be avoided.

VIII. Sample Archival Requirements: All archiving of materials will be handled by ADF&G.

IX. Schedule: Sampling would be conducted bi-monthly beginning no later than September 1975. Quarterly progress reports would summarize in general the results of all sampling and project progress. For further scheduling details see attachment 1.

X. Equipment Requirements: Much of the equipment required by this project can temporarily be furnished by the Alaska Department of Fish and Game on an interim basis prior to receiving ordered project equipment. This would allow sampling to be conducted early in FY76. At present delivery dates on trawls and accessories cannot be guaranteed. The following equipment would be required:

1. Standard 400-mesh Eastern otter trawl constructed of 3½ inch web throughout with a 1¼ inch cod end liner.
2. Standard 61 foot high opening NMFS shrimp net.
3. Standard 6 x 9 foot Astoria "V" type trawl doors.
4. 10,000 pound capacity digital readout scale.
5. Miscellaneous sampling equipment including calipers, measuring boards, and various sampling containers.
6. Plankton sampling gear to be furnished by other investigators.

XI. Logistics Requirements: Seventy days of vessel charter is the only logistics support required, but can be arranged by the state.

State research vessels may be able to assist in conducting a portion of this study although charter funds for a 60-foot range vessel with trawl and pot fishing capabilities would be required. About $52,500 ($750 per day for 70 days) in vessel charter funding would be required. Ten days of charter per bi-monthly sampling period is required, not including 10 days of charter for gear tests and down time for weather.

Attachment 1.

IX. Schedule - Yakutat Bay Benthos Study

	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Dec
Field Sampling		X			X		X		X		X		X		X	
Sample Analysis				X		X		X		X		X		X	X	
Purchase of Equipment	X	X														
Planning - Sampling Schemes	X	X	X													
Coordination other Investigators	X	X	X													
Quarterly Reports			X			X			X			X				
Completion Report															X	
Final Report 1/															X	X
Month	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Dec
Year	←						FY 1976					→	←		FY 1977	→

1/ It is anticipated that final report preparation will not be completed prior to December 1976.

I. Title: Razor Clam Distribution and Population Assessment Study (Research unit 24(F)

II. Principal Investigator: Rod Kaiser, Alaska Department of Fish and Game, Division of Commercial Fisheries, Box 686, Kodiak, Alaska 99615. Phone (907) 486-4166

III. Geographic Area and Dates of Study: Razor clam assessment studies will be conducted in the Gulf of Alaska from the Copper River Delta near Cordova to Unimak Pass in the Aleutians, including off-shore islands. The initial phase of the investigation will be conducted from July 1, 1975 to September 30, 1976 (15 months).

IV. Cost Summary: FY 76:

Research	43.5
Logistics	9.0
	52.5

A. Background and Objectives

1. At the present time, knowledge of razor clam distribution and density is limited in the Gulf of Alaska area. Previous investigations have been localized in nature, most notably in the lower Cook Inlet area, Orca Inlet near Cordova, and Swikshak Beach on the Alaska Peninsula near Kodiak Island. Information on distribution and abundance of razor clams is virtually unknown for Kodiak Island and ocean beaches west of Swikshak Beach to Unimak Pass on the Alaska Peninsula.

   This study will coordinate its research activities with current investigations being carried on by the Division of Sports Fisheries and Division of Commercial Fisheries of the Alaska Department of Fish and Game in the Gulf of Alaska region and with littoral zone studies of the NWFC Auke Fisheries Laboratory.

2. Specific study objectives are as follows:

   a. Primary

      1) Investigate and map areas of significant razor clam abundance for beaches of the Gulf of Alaska from Copper River to Unimak Pass, including off-shore islands.

      2) Estimate relative densities, population size and total habitat for selected study areas where extensive razor clam populations occur.

      3) Collect razor clam samples for size frequency, weight and age analysis from all beaches studied.

4) Prepare data for appropriate publications.

b. Secondary

1) Collect toxicity samples from all beaches, as possible, for analysis of paralytic shellfish poisoning (PSP).

2) Compile existing published and unpublished razor clam information from ADF&G for the study area.

3) Collect, identify, and record incidentally captured mollusks to provide general baseline data.

4) Establish spawning periods, time of sexual maturity and periods of larval setting for razor clams on selected beaches.

5) Combine past and current razor clam data for Gulf of Alaska areas to study similar and dissimilar biological parameters in conjunction with this baseline study.

6) Study the pre-recruitment and success of year class setting.

The initial fifteen months of the study should define major razor clam distributions for all important beaches within the study area. Initial samples will be collected and analysed. Population studies will also be conducted as established by the initial surveys.

B. Methods

1. Present information on razor clam populations will be collected from departmental and public sources. From this information a list of beaches within the study area believed to support razor clam populations will be established.

In the first survey, each beach will be mapped and a systematic sample of razor clams will be collected to obtain a general indication of distribution by habitat type, abundance, size, and toxicity (PSP).

As soon as feasible, beach transects will be established encompassing the entire tidal range of the razor clam distribution on those beaches determined to be important from the first survey. Each beach will contain a minimum of two transects, with larger beaches having a minimum of two per mile whenever possible. Clams will be marked and replaced in each transect. After a minimum of thirty days, each transect will be redug and the population estimated for each transect

and expanded to the entire beach.

Determinations of population abundance will follow mark-recapture formula established by Ricker (1958).

Razor clam samples will be measured for size frequency. Age of clams will be determined by counting the annual rings. Measurements to each annuli will be made and mean length to each annulus calculated. The degree of sexual maturity will be determined from samples to establish spawning time.

All other mollusks encountered will be identified in the field or preserved for laboratory identification.

At each beach surveyed, water, air and beach temperatures (in sand) will be obtained, as well as a general determination of beach composition.

VI. Information Products:

A. Progress reports will be prepared as required. A general summary report will be completed by September 1976 and final project completion report by December 1976. Additionally it is anticipated to produce an ADF&G informational or technical series leaflet on the results of this study. Specific segments may also be published in appropriate scientific journals.

Products of this study will include

1. Maps indicating major and minor razor clam beaches with estimates of the size of areas inhabited by razor clams.

2. Estimates of relative densities and/or population size for selected beaches.

3. Age, growth, weight, size frequencies, spawning periods, time of sexual maturity, and periods of larval setting will be summarized for selected beaches.

4. A compilation of all available data on razor clams, including the data from this study, over the entire range of the study area.

5. All digital data to be reported on magnetic tape or punch cards in format suitable for EDS processing and storage.

VII. Data or Sample Exchange Interfaces:

It is not anticipated that data or samples will be needed from other investigators.

This project will coordinate sampling activities with research units 21A and 21b so that supplemental littoral zone studies, encompassing razor clam habitat types, can be conducted simultaneously.

Samples of razor clams will also be provided to research unit C-4 for hydro carbon analysis.

VIII. Sample Archival Requirements:

No archiving of materials is anticipated other than shell samples for age analysis which would be handled by ADF&G, or samples supplied to other investigators.

IX. Schedule:

Detailed sampling schedules cannot be established until basic assessment and cataloging of beaches is completed in the 1975 field season. For further scheduling details see attachment 1.

X. Equipment Requirements:

Expenditures for equipment will be minimal but may include:

1. All terrain vehicle with trailer	$1,200
2. Metal stakes, steel chains, clam shovels, sampling frame, gas containers, camping equipment, raft, outboard, and packboards	800
Total	$2,000

XI. Logistics Requirements:

A minimum of sixty hours of fixed - wing amphibious aircraft and/or helicopter time will be needed to provide access to razor clam beaches to conduct this study. Ten hours of aircraft charter per sampling period is required (see attached schedule).

Estimated cost: 60 hours at $150 per hour = $9,000.

Attachment 1.

IX Schedule of Operations - Razor Clam Study - Prince William Sound to Unimak Pass

	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Initial assessment & cataloging 2/	X	X													
Selection of sampling sites				X	X										
Data compilation other sources	X	X	X	X	X	X	X	X	X						
Data analysis	X	X	X	X	X	X				X	X	X	X	X	X
Selected beach surveys 2/										X	X	X	X	X	X
Quarterly Progress Reports			X			X			X			X			
Sampling of selected sites											X	X	X	X	
Preparation of completion report 1/														X	X
Year	← FY 76 →												← FY 77 →		

1/ It is anticipated that final report preparation will not be completed prior to December, 1976.

2/ Ten hours per month sampled of amphibious fixed-wing and/or helicopter time required.

033

WORK STATEMENT (Research Unit #27)

TITLE: An Ecological Assessment of the Littoral Zone Along the Outer Coast of the Kenai Peninsula

PRINCIPAL INVESTIGATORS: Loren B. Flagg
Alaska Dept. of Fish & Game
Homer, Alaska

R. J. Rosenthal
Senior Biologist
Dames and Moore

GEOGRAPHIC AREA AND INCLUSIVE DATES: Outer Coast of Kenai Peninsula Between Point Adam and Core Point (Figure 1) Inclusive dates: July 1, 1975 to September 30, 1976.

COST SUMMARY FY 1976:

A.	Personnel	
	Alaska Department of Fish & Game Supervision[1]	-0-
	Two Marine Biologists[2]	18.0
	Temporary Support	3.0
B.	Travel and Subsistence	2.0
C.	Commodities	1.0
D.	Equipment	4.0
E.	Logistics	12.2
		$40.2

[1]Salary provided by State
[2]With diving capabilities

PROPOSED RESEARCH:

A. Background and Objectives

1. Task A-20 "Provide a general description of the distribution and abundance of the dominant intertidal and subtidal organisms."

2. There is presently no baseline in formation on the inshore littoral communities in this portion of the Gulf of Alaska. The present state of knowledge in this area is limited to distribution, timing, and abundance of salmon stocks.

3. An inventory of the plants and animals inhabiting the intertidal and subtidal zones within the study area will be required to meet the task objective. Species diversity, distribution, and relative abundance will be measured within study sites using standard sampling techniques. Sampling techniques to be coordinated with methods used in concurrent littoral surveys conducted by the NWFC.

4. The baseline information required to meet the task objective can be acquired by September 30, 1976, under full funding of the study. Seasonal variation may be identified within this time frame, however, long term ecosystem variation would require monitoring of selected stations on a regular basis for several years.

5. There is no other research being conducted in this area at the present time. NMFS has selected a potential study site for baseline characterization approximately 20 miles east of the boundary of the Alaska Department of Fish and Game proposed study area. Under the NMFS proposal (Research Unit 78) there would not be any intensive littoral research in this area unless it is selected as one of their final three sites (out of 11 in the Gulf of Alaska). The adjacent offshore area will be included in the proposed benthic study by the University of Alaska (Research Unit 281). Research activities will be coordinated with both NWFS #78 and UAK #281.

B. Methods

1. Unpublished data, mainly salmon catch and escapement records for the various embayments within the study area, will be compiled and reported on as part of the study. Published data from various exploratory fishing cruises within the bounds of the study area will also be compiled.

2. The first-year study (July, 1975 - August, 1976) would be based upon three seasons of observation: summer, fall, and spring. During the summer (1975) we would make a series of reconnaissance dives and intertidal surveys on the southern end of the Kenai Peninsula, from Gore Point to Koyutilik Bay. Our initial plan would be to map and describe objectively the marine biota encountered in this section of the Gulf. Most of the sampling would be done from MLLW to 30 m below the sea surface. The intertidal areas would be studied at low tide; sublittoral areas would be examined while scuba diving. Quantitative information on species abundance, frequency of occurrence and distribution would be obtained with aid of transect lines, quadrats, and still photography. A species inventory would be made of the biota in each location.

After this information has been gathered, we would establish fixed stations (approximately 28) in representative habitats of the intertidal and shallow subtidal zone. A stratified - systematic sampling plan will be developed. Fixed quadrats or transects would be examined at seasonal intervals by the same observers; these would be used in recording temporal population change in this part of the littoral zone. Ecological studies in the nearby Kachemak Bay area have indicated dramatic seasonal changes in distribution and abundance of organisms in the intertidal and nearshore subtidal areas. We will concnetrate our studies on this nearshore, productive zone and on the characteristic macroscopic organisms which demonstrate a high frequency of occurrence or high density within this zone. Both belt transects, where all organisms are studies along a measured strip, and random quatrat sampling will be utilized.

3. Representative marine habitats will be chosen for further study with special attention on characteristic biota. Characteristic organisms will be considered to be those species that are seen and that dominate the habitat both numerically and in terms of their demand and impact on the habitat. Herbivores utilizing the Macrophyte zone for food and/or cover and preditors feeding on these herbivores will be selected for more detailed study involving interrelationships. Biomass estimates will be made on the clam resources (phylum Mollusca, class Pelecypoda) and other studies involving food habits and reproductive development will focus on phyum Arthropoda.

4. The marine consultant biologist to be employed on this program is an accomplished Pacific Coast taxonomist who has been involved in a comprehensive ecological study of the nearby Kachemak Bay area. Because of this expertise it will be possible to identify most of the plants and animals in the field and thus few specimen will be removed from the area for identification. In other words this study will rely heavily on non-destructive techniques.

5. The sampling techniques and data analysis that will be used in this project have been used by plant ecologists (Creig - Smith, 1964) for the past two decades. Techniques developed for subtidal sampling by Fager in 1968 will also be employed in the study. Crebs (1972) book dealing with on ecological relationships, along with the investigators personal background experience will be used in determining sampling adequacy and in measuring variance. Transformations will be within the metric system. For statistical analysis Tate and Clellends "Non-parametric and Short-Cut Statistics" (1957) will be used by the investigators.

INFORMATION PRODUCTS:

Interim progress reports will be completed within two months following each seasonal sampling period. A summary report will be completed by September 1976. The summary report will include a complete listing of plant and animal species

found within the study zone and will reference them as to their frequency of occurrence or relative abundance. Maps will be used in the report to depict species distribution and "critical or sensitive" habitat areas. The final report will include a detailed plan for continued baseline monitoring within the selected study sites. All digital data will be submitted on magnetic tape or punch cards in format suitable for EDS processsing and storage.

DATA OR SAMPLE EXCHANGE INTERFACES:

Samples and data from other investigators may not be needed for this study. This will depend on the final selection of sample sites by other investigators such as NMFS (Littoral study - Research Unit 78) and the University of Alaska (Benthic study - Research Unit 281). If these other investigators select sites within or immediately adjacent to our study area then a data exchange should be arranged. Sampling plans, techniques and methods of analysis will be reviewed with other littoral investigators.

SAMPLE ARCHIVAL REQUIREMENTS

Archiving of materials will take place in Homer and will be the responsibility of the Alaska Department of Fish and Game. In addition, to select plant and animal specimens a photographic inventory will be maintained at the Homer office of the Alaska Department of Fish and Game.

IX. Schedule of Operations - Kenai Peninsula Littoral Zone Study

Year	Month	Operation
1975	July	Final planning; purchasing of equipment. Aerial and ground reconnaisance surveys
	August	Selection of study sites - surveying and photographing
	Sept. - October	10 day fall field sampling period
	October	Labaratory sample analysis - draft fall report
	November	Fall report submission
1976	March	planning; purchasing of equipment
	April	10 day spring field sampling period
	May	Laboratory sample analysis - draft spring report
	June	Spring report submission
	July	10 day summer field sample period
	August	Laboratory sample analysis - draft final report
	September	* Final Report Submission

* An extension on final report date to December, 1976 would be desirable.

IX. Schedule of Operations - Kenai Peninsula Littoral Zone Study

Planning	X					X						
Purchasing	X					X						
Initial Survey	X											
Site Selection		X										
Survey study plots		X										
Photograph Study plots		X										
10 day seasonal survey			X	X			X			X		
Laboratory analysis				X				X			X	
Report preparation				X				X			X	
Progress reports					X				X			
Final report												
Months	July	Aug.	Sept.	Oct.	Nov.	Mar.	Apr.	May	June	July	Aug.	
Year			1975						1976			

X. Equipment Requirements.

Equipment needed consists of a skiff and outboard motor, an inflatable rubber raft, diving gear (scuba), specialized sampling gear, and an air compressor. All of these items will be ordered and deployed out of the Homer office of the Alaska Department of Fish and Game in time for the initial survey work in August, 1975.

XI. Logistic Requirements.

1. Aircraft requirements - Alaska Department of Fish and Game will arrange.

   a. 5 hours fixed wing initial surveillance and photographing of study area. 6 hours fixed wing for supervisor, inspection and transport during field operations.

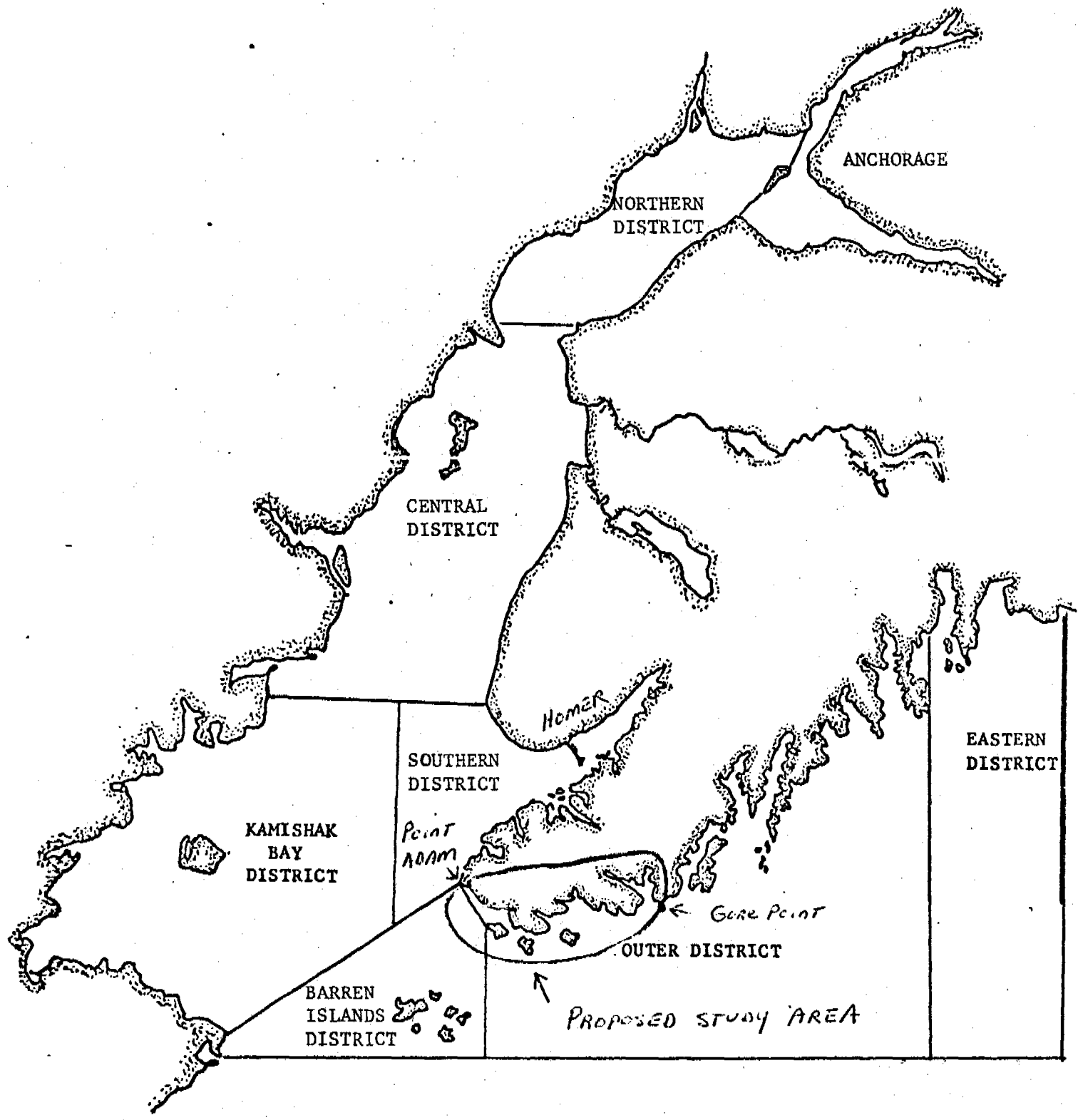
   b. 10 hours helicopter time for ground field reconnaissance to select study sites. 6 hours helicopter time for supervision, inspection, and transport during field sampling operations.

2. Vessel requirements - Alaska Department of Fish and Game will arrange.

   a. 35 - 50 vessel with accomodations for 3 scientists - charter for 30 days (three 10 day surveys).

FIGURE 1.

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF COMMERCIAL FISHERIES
COOK INLET - RESURRECTION BAY AREA



9 May 1975

Work Statement (Research Unit #58)

I. Title:

A Description and Numerical Analysis of the Factors Affecting the Processes of Production in the Gulf of Alaska

II. Co-Principal Investigators:

Dr. George C. Anderson, Research Professor - (206) 543-5087

Dr. Ronald K. Lam, Research Associate - (206) 543-0147

III. Geographic Area and Inclusive Dates:

Gulf of Alaska - 1 July 1975 to 30 September 1976

IV. Cost Summary:

FY 1976: July 1, 1975-Sept. 30, 1976 - $63,818

V. Proposed Research:

A study of the potential impact of modifications to an ecological system must determine both the quantity and distribution of organisms and the relationship between these various organisms. Baseline studies are necessary in order to assess the average stocks in an area and the natural variations within these stocks. Knowledge about the energetics which relate the different organisms is also necessary in order to estimate changes which might be expected from modifications of the system. Even more important, a general understanding of the gross processes controlling the ecological system, when applied to a simple model, is an invaluable tool in designing and implementing the baseline studies.

Within the marine pelagic community, phytoplankton are important because of their role in the conversion of solar energy to biomass. In this proposed study we will:

1) Conduct a search and present a compilation of available baseline data for the Gulf of Alaska. These data, including measurements of phytoplankton distributions, nutrient supply and hydrography, will be taken from the published literature, technical and data reports, and from data available at the University of Washington. A synthesis of the data will result in a description of the seasonal and geographic distribution of phytoplankton standing stock, production and related physical and chemical factors.

2) Adapt a numerical model, presently under development for waters off the Washington coast, for use in the Gulf of Alaska. Utilizing this model and the available data we will identify the major factors involved in phytoplankton dynamics, knowledge which would be necessary for the design and implementation of further field studies.

Some of the readily available information on the physical oceanography of the subarctic Pacific Ocean has been described by a number of authors (e.g., Tully and Barber, 1960; Uda, 1963; Dodimead, Favorite and Hirano, 1963; Tully, 1964; Tabata, 1965, and references cited therein). Likewise, some of the major publications with biological data for the same area include the works of McAllister, Parsons and Strickland, 1960; Anderson, Parsons and Stephens, 1969; Parsons and LeBrasseur, 1969; Parsons and Anderson, 1970; Larrance, 1971; and Anderson and Munson, 1972. In addition to the more readily available data mentioned above, other relevant biological information from the area are contained in the north-south sections made through the Gulf in past years, e.g., Ursa major and Zetes expeditions in 1964 and 1965 (Scripps Institution of Oceanography, 1967), the HAKUHO MARU in 1970 (Marumo, 1970), and the R/V T. G. THOMPSON in 1972. Also, a winter cruise in February, 1967 by the R/V THOMPSON which covered a large area of the Gulf of Alaska has produced a unique set of data on primary production, plant nutrients and hydrography at a time when observations are most difficult to obtain.

One of the largest blocks of existing data was obtained through several decades of study carried out at Ocean Weather Station "P" by Canadian oceanographers, the results of which are reported in various papers and technical reports. A second very large block of data was obtained during a five-year study (January-June, 1968-1972) made from commercial vessels crossing from North America to Japan via the Gulf of Alaska and near to the Aleutian Islands (Anderson and Munson, 1972; Munson, in preparation). In these studies, enumeration of phytoplankton species, and measurements of surface chlorophyll and nutrient concentrations, productivity, zooplankton volume, mixed layer depth, temperature, and insolation were made at frequent intervals during the period of the spring bloom. In addition to the measurements made from the commercial vessels, more sophisticated sampling from research vessels including measurements of the vertical distribution of parameters was carried out from a number of oceanographic cruises taken over similar cruise tracks. In March and April 1969, studies were conducted by the Fisheries Research Board of Canada, Nanaimo (T. R. Parsons) aboard the ENDEAVOUR; in June and July 1970, samples were collected by Hokkaido University (S. Motoda) aboard the OSHORO MARU; and the University of Washington (G. Anderson) made similar measurements from the T. G. THOMPSON in the spring of 1971. Other biological cruises aboard the R/V THOMPSON were made during the summers of 1973 and 1974. These data are available at the University of Washington and will be incorporated into the proposed study.

The investigations show that there are high nutrient concentrations in the waters of the Gulf of Alaska during the winter and that, in the summer, the nutrients in the coastal waters are substantially reduced while the nutrients in the oceanic waters, though reduced, remain in fairly high concentration. However, surface concentrations of phytoplankton remain relatively uniform throughout the year. Parsons and LeBrasseur (1969) have shown that the relationship between the thermocline depth and the incident radiation lead to establishment of a spring bloom which starts in March around the edge of the Gulf of Alaska but does not begin until May in the central portion of the Gulf. This shorter period of plant growth from the coast outward is offered as an explanation for the reduced level of nutrient removal from offshore oceanic waters as compared with coastal waters. It is further suggested (McAllister, Parsons and Strickland, 1960) that secondary production in the offshore waters also contribute to limiting the standing stock of phytoplankton and to recycling nutrients. In the winter, high vertical mixing in combination with low light intensities result in higher nutrient concentrations in the surface waters.

We are presently in the process of developing a model of phytoplankton production for the waters off the Washington coast. This model treats the distribution of phytoplankton in depth and time (i.e., one-dimensional in space) in response to environmental factors. Our experience with the model and the experience of Radach and Maier-Reimer (in press), with a similar model, have shown that the phytoplankton dynamics are highly sensitive to changes in certain parameters. It is very likely that the sensitivity of the model to parameter changes will depend on the conditions chosen for the "standard" case. Because of the differences in the relative importance of various processes important in the production of phytoplankton together with the differences in the level of solar radiation and the amount of vertical mixing between Washington and Alaska, it would be unrealistic to apply the results obtained from Washington directly to the Gulf of Alaska.

The numerical model which we propose to apply to the Gulf of Alaska will consist of coupled, time-dependent equations for chlorophyll concentration and for nutrient concentration. The time rate of change of these dependent variables will depend on turbulent mixing, phytoplankton sinking, gross productivity and the related nutrient uptake, respiration, zooplankton grazing and nutrient regeneration. Each of these processes is regarded as a submodel within the chlorophyll and nutrient model. We will be guided in our choice of these biological and physical submodels by the literature, by our continuing experience with the model of Washington waters, and by biological experiments which are now in progress here at the University of Washington.

The proposed study will test the sensitivity of the chlorophyll and nutrient distributions to different formulations in the various process submodels and to changes in the "measured" independent variables. These variables include the diffusion coefficient, light intensity, nutrient concentration and zooplankton density. We will impose reasonable initial distributions of phytoplankton and nutrients from available data and then simulate the changes in the phytoplankton population and nutrient distribution over a season as the external conditions (independent variables) evolve. Boundary conditions on the model will include no flux of either phytoplankton or nutrients at the sea surface, a vanishing normal derivative of chlorophyll concentration at depth and a known nutrient concentration at the bottom boundary. Numerical integration of the model equations will proceed from the prescribed initial states, using implicit, finite-difference methods. By changing each of the submodels individually and by changing the evolution of the independent variables separately for different runs, we expect to be able to discriminate between those processes and variables which strongly influence the results and those which are less important. We also expect to be able to identify those processes that need to be better studied and measured.

Information on the variables and processes which strongly influence the model results will be needed by investigators because these are the ones which need careful study in the field and laboratory. These same variables and processes if modified by external environmental stress may be expected to strongly influence the primary production and will therefore be of interest to planning agencies. We will conduct some runs with hypothetical changes in the environmental conditions. For instance, a layer of oil on the sea surface may be expected to decrease the transmission of light and the transfer of turbulent energy across the air-sea boundary. This will be modeled by decreasing the incident radiation and by reducing the vertical mixing. As another example, one possible result

of toxic substances in the water column may be simulated in the model by decreasing the maximum production rate and by increasing the respiration rate (an artificial means of increasing mortality). These demonstrations will allow us to evaluate the value of this scientific model as a management tool.

Bibliography

Anderson, G. C., T. R. Parsons, and K. Stephens. 1969. Nitrate distribution in the subarctic Northeast Pacific Ocean. Deep-Sea Res. 16: 329-334.

Anderson, G. C., and R. E. Munson. 1972. Primary production studies using merchant vessels in the North Pacific Ocean, p. 245-251, in Biological Oceanography of the Northern North Pacific Ocean. (A. Y. Takenouti et al., eds.), Idemitsu Shoten, Tokyo.

Dodimead, A. J., F. Favorite, and T. Hirano. 1963. Salmon of the North Pacific Ocean. Part II. Review of Oceanography of the Subarctic Pacific Region. Int. North Pac. Fish. Comm. Bull. 13, 195 p.

Larrance, J. D. 1971. Primary production in the mid-Subarctic Pacific region, 1966-68. Fish. Bull. 69: 595-613.

Marumo, R. 1970. Preliminary Report of the Hakuho Maru Cruise KH-69-4 (IBP Cruise) August 12-Nov. 13, 1969. The North and Equatorial Pacific Ocean. Ocean Research Institute. University of Tokyo.

McAllister, C. D., T. R. Parsons, and J. D. H. Strickland. 1960. Primary productivity at Station "P" in the North-east Pacific Ocean. J. Cons. int. Explor. Mer 25: 240-259.

Munson, R. E. (in preparation) Quantitative analysis of factors influencing the distribution of primary productivity in the subarctic North Pacific Ocean. Ph.D. Thesis, University of Washington.

Parsons, T. R., and R. J. LeBrasseur. 1969. A discussion of some critical indices of primary and secondary production for large scale ocean surveys. Calif. mar. Res. Comm., Calcofi Rep. 12: 54-63.

Parsons, T. R., and G. C. Anderson. 1970. Large scale studies of primary production in the North Pacific Ocean. Deep-Sea Res. 17: 765-776.

Radach, G., and E. Maier-Reimer. (in press) The vertical structure of phytoplankton growth dynamics: a mathematical model. Proc. Sixth Colloq. Ocean Hydrodynamics, Liège 1974, Mem. Soc. Roy. Sci. Liège.

Tabata, S. 1965. Variability of Oceanographic Conditions at Ocean Station "P" in the Northeast Pacific Ocean. Trans. Roy. Soc. Canada 3, ser. IV: 367-418.

Tully, J. P. 1964. Oceanographic regions and assessment of temperature structure in the seasonal zone of the north Pacific Ocean. J. Fish. Res. Bd. Canada 21: 941-970.

Tully, J. P., and F. G. Barber. 1960. An estuarine analogy in the subarctic Pacific Ocean. J. Fish. Res. Bd. Canada 17: 91-112.

Uda, M. 1963. Oceanography of the subarctic Pacific Ocean. J. Fish. Res. Bd. Canada 20: 119-179.

University of California. 1967. Physical, chemical and biological data, URSA MAJOR Expedition. 4 August-4 October 1965. S.I.O. Ref. 67-5, 43 p.

VI. Information Products:

We will:

1) Search existing literature and unpublished data in order to compile baseline information on factors of importance to phytoplankton production. Pertinent data will be provided in computer compatible format on magnetic tapes.

2) Synthesize the baseline information into a description of the seasonal and geographic distribution of phytoplankton standing stock, production and related physical and chemical factors insofar as the existing data are suitable. Results will be presented in graphic form.

3) Use the data to initialize a numerical model and to determine the combinations of process submodels which lead to distributions in the dependent variables that are in agreement with observations. A written description of the model and the results of this "standard" run will be provided.

4) Test the sensitivity of the results of the "standard" run to changes in the submodels and independent variables; identify those variables and processes which strongly influence the results. The results of these tests, along with recommendations for future work, will be made available in the form of an illustrated report.

VII. Data or Sample Exchange Interfaces:

We would like the following information for the Gulf of Alaska (as soon as possible):

1) Meteorological information with special emphasis on:

   a) solar radiation reaching the sea surface, and
   b) surface winds,

   as a function of time and position. (Request this information also be obtained on all planned cruises in the area.)

2) Oceanographic parameters such as:

   a) density profiles,
   b) vertical shear of horizontal currents, and
   c) FNWC data on mixed layer depth, etc.,

   as a function of time and position.

3) Biological and chemical information from EDS including all available data on nutrients, phytoplankton and zooplankton.

VIII. Sample Archival Requirements:

Not applicable.

IX. Schedule:

The following information will be provided by September 30, 1976:

1) Baseline information - intensive assembly will begin immediately.

2) Seasonal and geographical distributions - will be initiated during second half of study.

3) Standard run - will begin immediately.

4) Model report - will be undertaken during second half of study.

X. Equipment Requirements:

HP 65 calculator - needed immediately.

XI. Logistics Requirements:

Not applicable.

WORK STATEMENT

(Research Unit #64)

I. TITLE
Review and Evaluation of Historical Data Base on Nonsalmonid Pelagic Fishery Resources of the Gulf of Alaska Shelf and Slope

II. PRINCIPAL INVESTIGATORS
Walter T. Pereyra and Martin O. Nelson, NMFS, Seattle

III. GEOGRAPHIC AREA AND INCLUSIVE DATES
Gulf of Alaska 1 July 1975 to 30 September 1976

IV. COST SUMMARY

-0- FY 75 through June 30, 1975
36.3 FY 76 July 1, 1975 - September 30, 1976

V. PROPOSED RESEARCH
Except for that concerned with the inshore herring fishery, no U. S. research program has been aimed at assessing the status of the nonsalmonid pelagic fishery resources of the Gulf of Alaska. The primary U. S. fisheries in the area are for salmon, crab, shrimp, and halibut. U.S. research efforts have been concentrated on these species and other groundfish resources. Foreign commercial fisheries and research efforts have been directed primarily at groundfish resources. As a consequence of these circumstances, information on the nonsalmonid pelagic fishery resources is very fragmentary and unorganized.

This project will review and synthesize published and unpublished literature, and incidentally collected data (from both research surveys and the commercial fisheries) on the nonsalmonid pelagic fishery resources of the study area. Emphasis will be on an inventory and analysis of species composition, distribution, relative abundance and size composition, and identification of the principal gaps in the available data base.

Data sources to be examined include:

(1) Publications and scientific literature, particularly Russian and Japanese, including translations.

(2) Catch records of nonsalmonid pelagic fishes from offshore fishing by NMFS and the Fisheries Research Institute, University of Washington, collected incidental to data required for International North Pacific Fisheries Commission (INPFC) purposes.

(3) Unpublished data collected by Alaska Department of Fish and Game (ADF&G).

(4) U.S. groundfish surveys (1954-75).

(5) U.S. observer program on Russian vessels (1975).

(6) Canadian groundfish surveys (1962-1975).

(7) Japanese and Russian research surveys.

(8) Japanese and Russian fisheries statistics (1960-1975).

VI. INFORMATION PRODUCTS

1. A narrative report and bibliography reviewing and summarizing the literature and unpublished data on the distribution, abundance and biology of nonsalmonid pelagic fishes.

2. A detailed data report (digital or analog data) on records of the distribution, abundance and size composition of the subject species.

Both reports will be completed by September 30, 1976.

PRELIMINARY

WORK STATEMENT

(Research Unit #78)

I. TITLE: Baseline Characterization: Littoral Biota, Gulf of Alaska

II. PRINCIPAL INVESTIGATORS: Steven T. Zimmerman
Theodore R. Merrell
National Marine Fisheries Service
Auke Bay Fisheries Laboratory
Auke Bay, AK 99801
(907) 789-7231

III. GEOGRAPHIC AREA AND INCLUSIVE DATES: Gulf of Alaska
1 July 1975 - 30 September 1976

IV. COST SUMMARY:

FY1975	FY1976
$17,500	$352,500

V. PROPOSED RESEARCH

A20 - Provide a general description of the distribution and abundance of the dominant intertidal and shallow subtidal organisms

A21b- Select sites representing dominant littoral habitats for intensive study, and document the intertidal and shallow subtidal biota and biotic composition of beach debris at these sites

A. Background and Objectives

The composition of littoral communities in the Gulf of Alaska is largely unknown. To date, only two intertidal littoral zone surveys in the Gulf of Alaska have been reported in the literature - one on Kodiak Island (Nybakken), and the other on Prince William Sound (Hubbard). Other studies have been reported in the literature at Amchitka in the Western Aleutian Islands and at Izembeck Lagoon in Southern Bristol Bay.

Unpublished reports on littoral communities contain information in the littoral communities of Baranof Island and Berner's Bay in Southeast Alaska, and Kachemak Bay and Orca Inlet in Southcentral Alaska. A review of information on Alaskan littoral communities has been published by the University of Alaska (Feder and Mueller).

In 1974, as part of first year NEGOA studies in the Gulf, intertidal communities were sampled at 10 sites between Yakutat Bay and Day Harbor near Seward, Alaska. The study will be continued on an expanded scale in FY 1976, extending westward from Day Harbor to the Shumagin Islands.

In order to complete this task, the following questions must be answered: What is the distribution and percent occurrence of the major intertidal habitat types? What are the seasonal and spatial distributions of biota in areas representative of these habitat types?

B. Methods

1. Major habitat types - In order to determine the distribution of major habitat types along Alaska's coastline in the study area, several methods will be used.

   Existing charts and photographic records collected by the National Ocean Survey and other agencies will be studied in habitat typing. In order to complement and expand this information, many beach areas will be overflown by NMFS personnel noting major physiographic zones and beach types. We have also requested NASA to provide this project with high resolution color and infra-red photographic records of much of the Gulf coastline. If feasible, the photographic coverage will result from flights made during low tide periods in the summer of 1976. These efforts will be coordinated with agencies already involved in documenting the nature of the Alaskan coastline, such as the Arctic Environmental Information and Data Service and the Marine and Coastal Zone Management Sections of the Alaska State Government.

2. Studies of biota at representative sites - Field work to determine the seasonal and spatial distribution of dominant species at representative sites was begun in 1974 at 10 sites in the Eastern Gulf. A total of three visitations to these sites and to approximately 7-8 sites in the Western Gulf are planned.

   (a) General survey sampling - Adequate sampling will be conducted to characterize the biota of each of the major habitats to enable extrapolation of the data to region-wide estimates of biotic distribution. Rocky outer coastal habitat types will be emphasized because they have the highest productivity, provide

habitat for many commercial species, and their highly-variable nature requires intensive sampling to obtain statistically valid population estimates. Sand-mud habitat types will be sampled near the mouths of large river systems (such as the Copper River). Razor clam beaches will be studied in conjunction with studies by the Alaska Department of Fish and Game.

At each site, one to three transect lines will be laid from the highest level of marine habitation to low tide levels. Samples will be collected at one to five intervals along these lines for sorting and analysis of communities.

A second procedure useful for randomizing sampling in specific zones will also be utilized. This involves viewing the beach through a clear plastic sheet held out at arm's length wich contains randomized arrays of dots. The dots are used to determine the placement of sampling frames when the beach is viewed through the plastic sheet.

Elevations in relation to the tide will be measured and photographs taken at each sampling point. Nested quadrat samples will be collected to determine the degree of community heterogenity. Underwater observations by biologist divers will be made at several sites in order to extend and standardize intertidal lines into the subtidal area.

(b) Sorting - Collection resulting from this sampling program will be sorted by the University of Alaska Marine Sorting Center. All dominant organisms will be counted and wet weights will be reported. Wherever appropriate, major species will be sorted into different size categories to determine the contribution made by different age-size groups. Dry weight determinations of some dominant species will also be made.

The resulting data will be included in a series of reports. By 30 September 1976, all general survey work on habitat types and biota will be completed in the Eastern Gulf. All general survey work and sorting of all but the last series of samples from the Western Gulf should also be completed by this time.

(c) Data report - A summary report will include a comprehensive atlas of intertidal habitat types. A list will be prepared of all species encountered at representative sites, as well as biotic measures of commonness or rarity and the relative contributions of dominant species to the habitat types. These measures will be related to tidal level and substrate type. Statistical validity of these data will be analyzed and discussed.

(d) Eastern Gulf monitoring stations, 1975 - After the general survey work in the Eastern Gulf has been completed in summer, we shall move into a "monitoring-oriented" phase in that area.

Intensive studies of seasonal and spatial variability will be carried out at two or three key sites. Research at these sites will begin in the early spring of 1976. Repetitive estimates of abundance will be made to obtain a better understanding of natural variabilities and statistical precision when estimating population levels. The spatial extent of the study areas will be broadened and the seasonal frequency of sampling will also be increased.

Intensive subtidal observations and surveys at the monitoring sites will be conducted by biologist divers to extend and standardize the intertidal data. This will provide better comparative data between stations sampled on different tides as well as more complete information on densities of deeper intertidal forms. These studies will be conducted by the Auke Bay Laboratory staff and by contract with Dames and Moore, Inc.

Diving methods will be similar to intertidal methods although few destructive samples will be collected. Calibrated transect lines will be laid as extensions of intertidal lines. Quadrat frames of varying sizes will be laid along the lines and the population densities within each frame will be determined. Surveys and estimates will be made of the species composition of biota washed up on the beach at the high tide zone (drift zone). These surveys will be made at two or three open coast sites quarterly and following major storms. The resulting data will be used to better assess the effects of oil spills in this highly-visible area.

This project also will utilize to the extent possible any additional remote sensing and photographic technology which can be made available and which is applicable and appropriate to littoral biota studies.

VI. INFORMATION PRODUCTS

1. Data on distribution of littoral environments and on density distribution of biota will be furnished on magnetic tape in EDS -compatible format.

2. Narrative including figures, tables, and charts giving methods and their rationale; summary of the findings; conclusions regarding possible impacts of OCS oil and gas development on the littoral biota and its ecosystem; and recommendations for further research.

VII. DATA OR SAMPLE EXCHANGE INTERFACES

We shall be participating with ADF&G personnel in their study of razor clam beaches. After ADF&G has screened the clams for their program, we will preserve the reamining organisms for sorting and identification by the Marine Sorting Center. We shall also collect intertidal plants and animals for chemical analysis by other OCS projects, and assist the National Bureau of Standards in collecting water samples for hydrocarbon analysis.

Aerial surveys and photographs will be coordinated with the Coastal Zone Management Section of the State of Alaska.

VII. SAMPLE ARCHIVAL REQUIREMENTS

Storage of samples may be required and will be coordinated between the University of Alaska Marine Sorting Center and the Auke Bay Fisheries Laboratory.

IX. SCHEDULE

A. Aerial Survey and Reconnaissance

July 1975 - Begin aerial survey flights by ABFL personnel
July 1975 - Consummate contractual agreement with Arctic Environmental and Data Center to develop coastal habitat charts
July 1975 - NASA flights to provide sample imagery of coastline (tentative)
May 1976 - Aerial reconnaissance flights to fill in gaps in Eastern Gulf
June 1976 - Aerial reconnaissance flights to fill in gaps in Western Gulf

B. Field Sampling

July 1975 - Field sampling in Eastern Gulf
Aug. 1975 - Field sampling in Western Gulf
Sep. 1975 - Field sampling at Yakutat and sites missed due to weather
July 1975 - Drift zone studies begin
July 1975 - Diving studies begin
May 1976 - Final field trip in Western Gulf
Apr. 1976 - Monitoring studies, 2-3 sites

X. EQUIPMENT REQUIREMENTS

The need for special equipment is not anticipated.

XI. LOGISTICS REQUIREMENTS

A. Vessels

Vessel with a helicopter platform will be needed at the following times:

July 6-14, 1975
August 4-12, 1975
May 10-20, 1976

B. Helicopter

A helicopter will be required during the following periods:

July 6-14, 1975
August 4-12, 1975
May 10-20, 1975

Two additional 10-day periods, one in the summer of 1975 and one in the summer of 1976, may be needed to perform the aerial survey work.

C. Fixed Wing Aircraft

Fixed wing aircraft will be needed for approximately 10 days in the summer of 1975 and 30 days in the summer of 1976 to complete aerial surveys.

WORK STATEMENT

(Research Unit #79)

I. TITLE: Baseline Characterization: Littoral Biota, Bering Sea

II. PRINCIPAL INVESTIGATORS: Steven T. Zimmerman
Theodore R. Merrell
National Marine Fisheries Service
Auke Bay Fisheries Laboratory
Auke Bay, AK 99801
(907) 789-7231

III. GEOGRAPHIC AREA AND INCLUSIVE DATES: Bering Sea
1 July 1975 - 30 September 1976

IV. COST SUMMARY:

FY1976
$370,000

V. PROPOSED RESEARCH

A20 - Provide a general description of the distribution and abundance of the dominant intertidal and subtidal organisms

A. Background and Objectives

The composition of littoral intertidal communities in the Bering Sea is largely unknown. Feder and Mueller have reviewed littoral community studies by the University of Alaska which provides some background material concerning specific organisms.

In order to provide a general description of the littoral communities, the following questions must be answered: What is the distribution and percent occurrence of the major intertidal habitat types? What are the seasonal and spatial distributions of biota in areas representative of these habitat types?

B. Methods

1. Major habitat types - In order to determine the distribution of major habitat types along the Bering Sea coast, several methods will be used. If the NASA photographic imagery for the Gulf of Alaska is satisfactory, we shall request overflights in the Bering Sea using color and color infra-red film.

Existing photographic records, especially those of the State of Alaska and National Ocean Survey, will be assembled and studied. The assistance of the Arctic Environmental Information and Data Center will be sought to draw together existing records on coastal geomorphology and habitat types.

In order to complement and expand this information, many beach areas will be overflown using small planes and helicopters at low tides. Landings will be made at some locations to sample biota and make photographic records.

All of these efforts will be coordinated with State and Federal agencies requiring similar information.

2. Studies of biota at representative sites - Field work on representative intertidal sites will begin with a program in August. During August, a team of eight scientists and divers will carry out detailed intertidal studies at approximately six sites in the Southern Bering Sea. Areas of emphasis include Unimak Pass, Port Moller, Southern Bristol Bay, and the Pribilof Islands.

   Distance, logistics, and weather constraints mean that fewer sites can be studied repetitively in the Bering Sea than in the Gulf of Alaska. One or two sites will be visited during each of the sampling periods in August 1975, June 1976, and August 1976. The rest of the sites will be visited only once. This sampling scheme will make it possible to sample a greater number of sites in the Bering Sea than would be possible if effort were devoted to repetitive sampling of the same sites. Estimation of seasonal variability will be extrapolated from those sites which will have been visited repeatedly during each trip.

   (a) General survey sampling - each of the major habitat types will be sampled. Effort will be concentrated in areas where different habitat types occur adjacent to each other in order to increase efficiency. It is anticipated the rocky areas will be emphasized in the Southwestern Bering Sea, while sediment areas will predominate in the Eastern Bering Sea.

   At each site, one to three transect lines will be laid from the highest level of marine habitation to low tide levels. Samples will be collected at one-to-five meter intervals along these lines unless the exposed area is very extensive. Samples will vary in size depending on the nature of the area and the height above tide.

A second procedure, most useful for randomizing samples in specific zones, will also be used. This involves viewing the beach through a clear plastic sheet. Tidal heights and photographs will be taken at each sampling point. Wherever possible, nested quadrat samples will be collected to determine the degree of community heterogenity.

Tidal fluctuations are not as dramatic in the Bering Sea as they are in the Gulf of Alaska. Subtidal observations and sampling will be done by biologist divers with scuba to extend the intertidal sample transects into the subtidal area. At least three divers will accompany the field party during each sampling period.

(b) Sorting - Collections resulting from the field sampling program will be sorted by the University of Alaska Marine Sorting Center. All dominant biota will be counted and wet weights will be measured. Whenever appropriate, major species will be sorted into different size categories to determine the contribution made by different age-size groups. Dry weight determinations of some dominant species will also be made.

The resulting data will be included in a series of reports. By 30 September 1976, all general survey work on habitat types and representative biota will be completed. Sorting of samples from the third sampling trip (and possibly part of the second trip) may not be completed by that time. General trends, especially those resulting from the first trip, will be evident and they, at least, will be discussed in the report.

(c) Data report - A summary report will be prepared which will include a comprehensive atlas of intertidal habitat types. A list of all species encountered at representative sites, as well as biotic measures of commonness and/or rarity and the relative contribution of dominant species to the habitat types, will also be prepared. These measures will be related to tidal level and substrate type. Statistical validity of these data will also be analyzed and discussed.

This project also will utilize to the extent possible any additional remote sensing and photographic technology which can be made available and which is applicable and appropriate to littoral biota studies.

VI. INFORMATION PRODUCTS

1. Data on distribution of littoral environments and on density distribution of biota will be furnished on magnetic tape in EDS - compatible format.

2. Narrative, including figures, tables, and charts, giving methods and their rationale; summary of the findings; conclusions regarding possible impacts of OCS oil and gas development on the littoral biota and itx ecosystem; and recommendations for further research.

VII. DATA OR SAMPLE EXCHANGE INTERFACES

As part of our sampling schedule, we shall collect intertidal plants and animals for chemical analysis by other OCS Project research units. Aerial surveys will be coordinated with the Coastal Zone Management sections of the State of Alaska.

VIII. SAMPLE ARCHIVAL REQUIREMENTS

Storage of samples may be required. This will be coordinated between the University of Alaska Sorting Center and the Auke Bay Fisheries Laboratory.

IX. SCHEDULE

A. Aerial Survey and Reconnaissance

July 1975 - Begin aerial survey flights by ABFL personnel. Flights during low tide periods in July, August, and September 1975, and June 1976.

B. Field Sampling

July 1975 - Reconnaissance of sampling sites in Bering Sea
Aug. 1975 - Field Sampling at approximately six sites in the Bering Sea
June 1976 - Field sampling at approximately six sites in the Bering Sea
Aug. 1976 - Field sampling at approximately six sites in the Bering Sea

X. EQUIPMENT REQUIREMENTS

The need for special, costly equipment is not anticipated.

XI. LOGISTICS REQUIREMENTS

A. Vessels

A vessel with a helicopter platform will be needed during the following periods:

July 15-24, 1975 (tentative)
August 13-20, 1975
June 6-16, 1976
August 1-10, 1976

B. Helicopter

A helicopter will be required during the following periods:

July 15-24, 1975 (tentative)
August 13-20, 1975
June 6-16, 1976
August 1-10, 1976

Two additional 10-day periods in the summer of 1976 will be needed to finish the aerial survey work.

C. Fixed Wing Aircraft

Fixed wing aircraft will be needed for approximately 30 days in the summer of 1976, and 10 days in the summer of 1976 to complete aerial survey requirements.

FINAL

WORK STATEMENT (Research Unit #156/164a)

I. TITLE: Plankton of the Gulf of Alaska - Ichthyoplankton

II. PRINCIPAL INVESTIGATOR: T. Saunders English
Department of Oceanography
University of Washington
Seattle, Washington 98195

III. GEOGRAPHIC AREA AND INCLUSIVE DATES: Gulf of Alaska
1 July 1975 - 30 September 1976

IV: COST SUMMARY: FY 1976

1 July 1975 - 30 September 1976

$150,000

V. PROPOSED RESEARCH

The task of primary emphasis is A-23 -- determine the seasonal density distributions and environmental requirements for principal species of ichthyoplankton, in this case in the Gulf of Alaska. The present state of knowledge is deficient in the area, especially for seasonal and geographic coverage of a density necessary for decision-making or ecological models. This program will also examine zooplankton larger than copepods.

The information required to meet this task objective will be gained from a series of samples and environmental observations taken on joint cruises in the Gulf of Alaska. Both the density in time and space will be limited to what can be accomplished on those scheduled cruises.

By September 30, 1976, a report can be prepared on the results of samples taken over three or four seasons by scheduled cruises.

Methods for the net sampling will include MARMAP-I type techniques, using Bongo nets. The samples and observations will be collected by NOS technicians. The acoustic observations will be made initially by lowering a transducer into the sea at each station. Later the transducer will be towed, hull-mounted, or affixed in an over-the-side mounting. Five minutes of magnetic tape will be taken at each station.

VI. INFORMATION PRODUCTS

The information products will include quantitative assessments of distributions and abundance of ichthyoplankton over space and time. The information products will include magnetic tape records taken with the sonic system. If resources become limiting, the research will emphasize species of commercial and ecosystem importance. Samples will be analyzed from as many as four cruises, resulting in 42 sets of zooplankton samples, with approximately 100 total samples for each cruise. There will be a magnetic tape record for each station.

Information products will be summarized and transmitted in quarterly reports and a final report. All numerical data will be in ADP format as specified by the OCS project office. The final report will include a narrative summary of the overall findings of the research, discussing species composition, key species, and comments on the oil related impacts as viewed from the perspective of this part of the total program.

VII. DATA OR SAMPLE EXCHANGE INTERFACES

The ichthyoplankton samples from the Bongo nets will be sorted and provided by PMEL. The environmental observations of other parts of this program will be needed before a final report can be completed.

VIII. SAMPLE ARCHIVAL REQUIREMENTS

The samples will be archived at the University of Washington until this research is completed, when they will be offered to the U.S. Government.

IX. SCHEDULE

The sampling cruises are scheduled for October, April-May, of 1975, and July and August of 1976. The sorting by PMEL will limit the time at which we can begin, but the delay is not expected to be long. The time between the first and second cruise will be used to examine the resulting samples and magnetic tapes. The final two cruises will be less completely described in the final report.

X. LOGISTIC REQUIREMENTS

Our logistic requirements are being made by PMEL. It would be desirable to have a few days on the *Acona* in the Prince William Sound area in August of both years.

WORK STATEMENT (Research Unit #156/164b)
ENVIRONMENTAL ASSESSMENT PROPOSAL BLM/NOAA

I. Plankton of the Gulf of Alaska - Initial Zooplankton Investigations

II. Dr. D. M. Damkaer (Principal Investigator)
PMEL/NOAA
3711 - 15th N.E.
Seattle, WA 98105 (206) 442-4580 or 442-4598

III. Gulf of Alaska, FY 1976 (1 July 75 - 30 September 76)

IV. Total Budget $150,000.

V. Proposed Research

A. Background and Objectives

Zooplankton are important components of the environment in terms of volume, in terms of their roles in the ecosystem, and in terms of probable sensitivity to the kinds of development anticipated on the Alaska OCS. Zooplankton are necessary for the maintenance of fish, shellfish, and other living resources. Zooplankton are also important in the movement and concentration of environmental contaminants. In the northeastern Pacific, particularly its estuaries and coastal seas, relatively little is known of the distribution and abundance, seasonal cycles, or vertical distributions and migrations of zooplankton. Assessments of these factors are necessary for the study of ecological processes relevant to environmental problems. OCSEP Task A-23, to determine the seasonal density distribution of principal species of zooplankton, is addressed by the proposed study.

Some groups of zooplankton of the Gulf of Alaska are known fairly well taxonomically, but not much is known of their horizontal and vertical distributions within the Gulf. Even less is known of the seasonal cycles of single species, species successions, or recruitment.

Limits of variability in time and space should be outlined in such a way that we can specify subsequent sampling efforts required to detect given changes. This is the fundamental problem, and should be given high priority. Almost nothing is known about the dynamics of communities, especially feeding patterns and rates, reproduction and growth, migrations, metabolic processes, and relative sensitivities.

As the data base expands, enabling a quantification and understanding of the relationships of zooplankton communities to each other and to higher and lower trophic levels, it will be possible to interface with other disciplines using descriptive and predictive mathematical models. Eventually "key parameters" and "representative areas" will be identified which can be monitored during OCS exploitation.

It will be necessary to begin by obtaining seasonal samples from the areas of interest within GOA (NEGOA, western GOA; Prince William Sound, etc.). The principal zooplankton species and most species of copepods will be identified. This will include the majority of the net-zooplankton species. Samples from at least two cruises (two seasons) should be analyzed by the end of FY 76, so that quantitative and qualitative comparisons of individual species and associations can be made. Analyses of other cruises will be in progress.

These studies have been planned in conjunction with the chemical studies and other biological studies conducted by PMEL. The study areas, seasonal coverage, on-station techniques and timing, and sharing of certain equipment and technicians, are all compatible. In addition, it will be valuable to have synoptic observations on the geographic and seasonal distribution and concentration of phytoplankton, zooplankton,

light hydrocarbons, and suspended matter, for these parameters are conceptually related. Future monitoring correlations between these parameters may prove to be more sensitive than either independently.

B. Methods

Discrete depth layers will be sampled by vertically-towed closing ring-nets (110 or 220 mm mesh), at noon and midnight regardless of the ship's position. Replicates will be taken occasionally. A surface sample will also be collected, towing a ring-net horizontally. About 1-1/2 hours station time will be required for the zooplankton sampling, or about 3 hours each 24-hour day. The proposed cruise tracks for NEGOA and western GOA are indicated in Figures 1 and 2. Most cruises are expected to take ca. 21 days, according to the following schedules:

Vessel Schedule

	1975			1976	
Dates	September	October	April-May	July	August
Duration	15 d.	21 d.	21 d.	21 d.	21 d.
Area	Pr.Wm.S.	NEGOA	NEGOA	NEGOA	West Gulf

Zooplankton samples will be collected by NOS Technicians, as specified by OCSEP management. Initial cruises may require supervision by a project oceanographer. There will be 42 sets of zooplankton samples (21 each day and night), with approximately 200 total samples, for each cruise

Analyses of the samples will be done at PMEL. Settled volumes will give an indication of total "biomass." Large or otherwise conspicuous organisms will be removed, counted, and identified (at least to major taxonomic group), from each whole sample. Subsamples will be

obtained using Folsom plankton splitters (McEwen, et al., 1954). Selected subsamples will be sorted entirely, to major taxonomic groups. Principal species (initially based on frequency of occurrence, suspected activity, etc.) and copepods will be identified and counted. Ichthyoplankton from the collections will be given to Dr. T. S. English.

Within the time and funding constraints, the study intends to consider selected GOA zooplankton samples from the IPHC 1926-1938 plankton collection. Some of these samples have already been analyzed by the principal investigator and G. A. Heron (Heron and Damkaer, 1969; Damkaer, 1975), but the full potential of the collection has yet to be appreciated. We have identified over 100 species of copepods from this collection. The Smithsonian Institution has agreed to sort (to major taxonomic groups) ca. 100 samples at cost (or below) to increase the interest in this collection.

VI. Information Products

The immediate task products will include quantitative assessments of distributions and abundance of zooplankton total biomass and groups over space and time (see Figures 1 and 2). Species composition, key species, and characteristic communities or associations will be outlined. All numerical data will be in ADP format as specified by OCS Program Office.

The long-term goals are to describe the biological baselines, especially the distributions and abundance of zooplankton groups over space and time. This work will lead to development of a monitoring strategy. Also, it will ultimately contribute to an ecosystem model by defining pathways and amounts of energy or material flow and indicating the relative importance of the several populations.

VII. Data Interface

Temperature and salinity distributions will be routinely determined during each cruise. These data are often essential in interpreting the distribution of zooplankton. It will be useful to compare the zooplankton distributions with the distribution and abundance of phytoplankton (species and chlorophyll). Sonic mapping of acoustic targets is essential to delineate the vertical distributions as well as the detailed continuous between-station distributions of the larger zooplankton and smaller nekton.

It would be valuable to compare zooplankton distributions with the seasonal cycles of primary productivity. An interesting comparison could also be made of net zooplankton with the suspended matter distribution (studies undertaken by other investigators at PMEL).

VIII. Archival Requirements

All of the specimens collected during this study will be saved. Each sample will be subdivided into various subsamples and taxonomic units. The resulting collection will number many hundreds of lots. Some subsamples and the ichthyoplankton will not be examined during the present study. Other groups will be analyzed more or less completely. Certain specimens could well form the nucleus of a museum-quality State of Alaska Reference Collection. Other selected specimens may be deposited in the U.S. National Museum as types of new species or as representatives of material forming the bases of published reports. The retained material will be the responsibility of PMEL/NOAA.

IX. Schedule

It is expected that samples will arrive at PMEL within 2 weeks of the end of each cruise. It is difficult to predict the required analytical time, for this depends not only on the size of each sample, but also on its consistency, mechanical tractibility, state of preservation, and complexity. Roughly 1 person-day is required to process each whole sample and to sort a subsample into major components. Probably a person-week will be needed to specifically identify the major components and the copepods. Clearly, the specific identifications and enumerations will be the limiting factor.

Samples from the first two cruises (September-October 1975) will be available for processing beginning about November '75. Assuming that 50 samples merit immediate analysis, it will require about 5-6 months to identify and enumerate the major species, and to tabulate the data. This stage would coincide with the arrival of the samples from the third cruise (April-May 1976). The data from the first two cruises should be available by the end of FY 76. Only a cursory examination can be made (perhaps also sample volumes) on the collection from the fourth cruise (July 1976), and there will be no time to examine any samples from the western GOA (August 1976).

X. Equipment Requirements

The project will provide ring nets for surface samples. The OCSEP office will supply the ships with vertical closing nets. A large category of equipment includes microscopes. The principal investigator will provide a set of research quality stereoscopic and compound microscopes, but a second set is required, in addition to

one compound and three-four stereoscopic microscopes. These, like all other equipment, should be made available at the onset of the project.

XI. Logistics Requirements

Plankton will be sampled during two or three joint 3-week cruises in the northeastern Gulf of Alaska with the Light Hydrocarbon and Suspended Matter programs proposed by PMEL. Data from the western Gulf will be obtained as the opportunity arises on other cruises, e.g., physical oceanography. Discussions with Drs. Cline and Feely indicate that shipboard activities by the chemical and plankton programs will not conflict and joint field operations will maximize efficiency of vessel usage. In addition, relationships between suspended matter and plankton data may prove advantageous in future interpretations.

A. Vessel Facility Requirements

The vessel used must provide the following:

1. Laboratory space (phytoplankton) - ca. 110 sq. ft. including:
   - laboratory bench (6' x 2' min) with drawer and cupboard storage below and 40" of clearance above bench.
   - sink adjacent to bench supplied with hot and cold fresh water and a continuous flow of seawater, preferably from a hull tap other than the engine-room sea chest.
   - laboratory must be located on main deck near sampling area. Water sampled by submersible pump over the side will be routed to laboratory via flexible plastic tubing.
   - cabinet for storing supplies and equipment.

2. Laboratory space (zooplankton) -

Laboratory must be located on sampling deck near winch area. Minimum space is 10' x 10' and must include sink with hot and cold fresh water; sink should have a drainboard on at least one side. Laboratory must be equipped with table, chair, cabinet or shelf for some glassware, reagents, and sample boxes. Storage below decks should include shelving (ca. 160 cu ft) for sample jars in wooden sample boxes.

3. Deck space -

Space is needed on the open main deck, or deck immediately above, to mount a portable winch (base 5' x 6') on pad eyes. The winch will contain 250 m of semiflexible hose (ca. 2" OD) with electrical conductors molded into the jacket, will have its own hydraulic pump (to be supplied with electric power) and controls, and should be placed to lead through a suspended block and over the side or stern.

4. Winch for towing plankton nets -

Open deck space should be available near water level so that A-frame or crane can lift nets and end-weight (150 lbs) into and out of the water. Winch should have continuously adjustable speed to at least 60 m/min. The winch must have a meter-wheel and be capable of towing large (61 cm) Bongo nets obliquely from 200 m, and of towing 1-m ring nets vertically from at least 500 m.

5. Storage space -

- for gear: ca. 100 sq ft of deck space for nets.

6. Electric power -

   - in laboratories: three double receptacles in each laboratory supplying 110V, 60 Hz current.
   - on deck: the portable winch-submersible pumps system will require approximately 10 kw of 440V, 3-phase power.

7. Scientific personnel -

   One to three scientists will accompany these cruises to conduct plankton work.

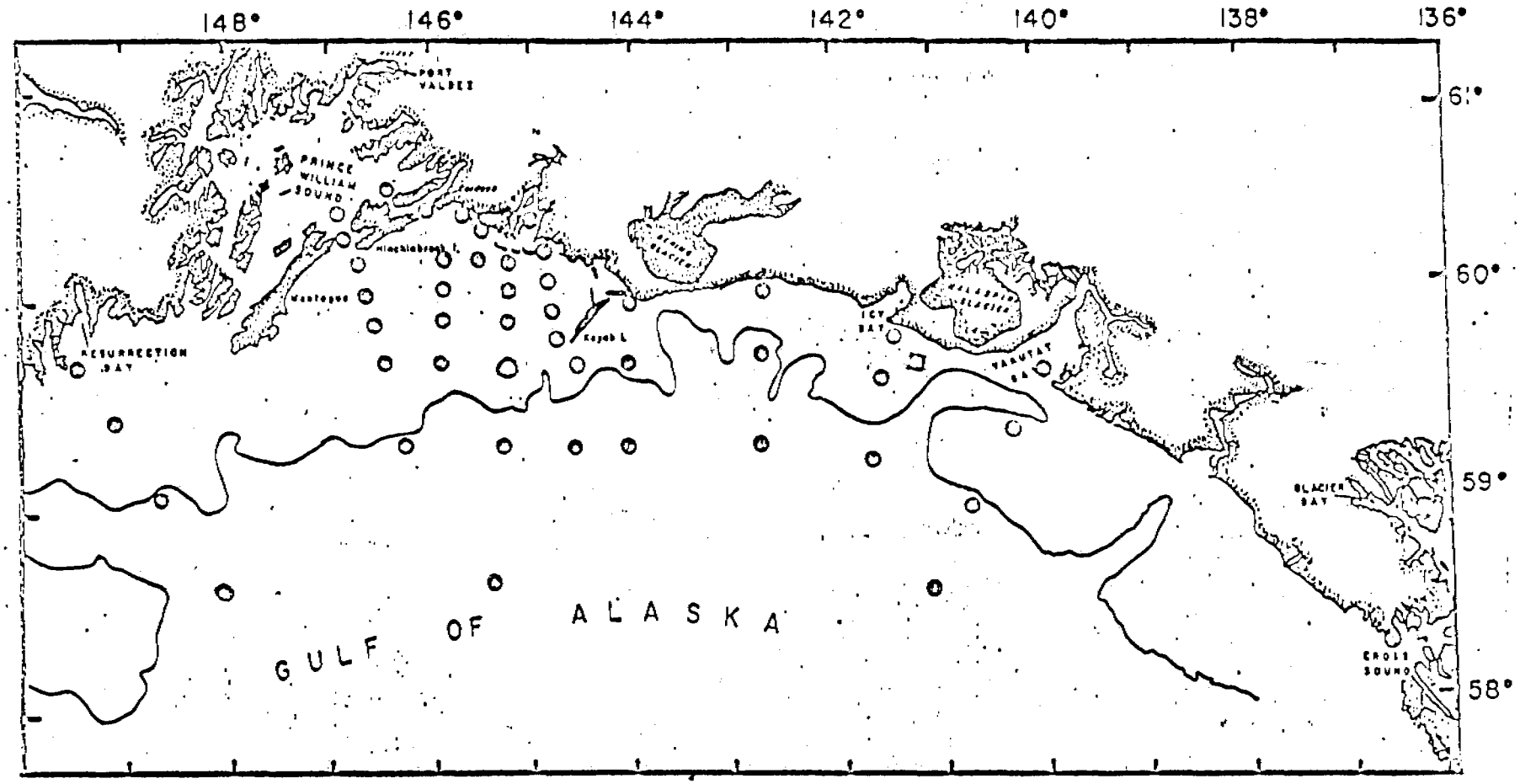


Figure 1. Proposed locations of the particulate matter stations (0) and the bottom mooring (□). Zooplankton samples will be collected at 1200 and 2400 hrs.

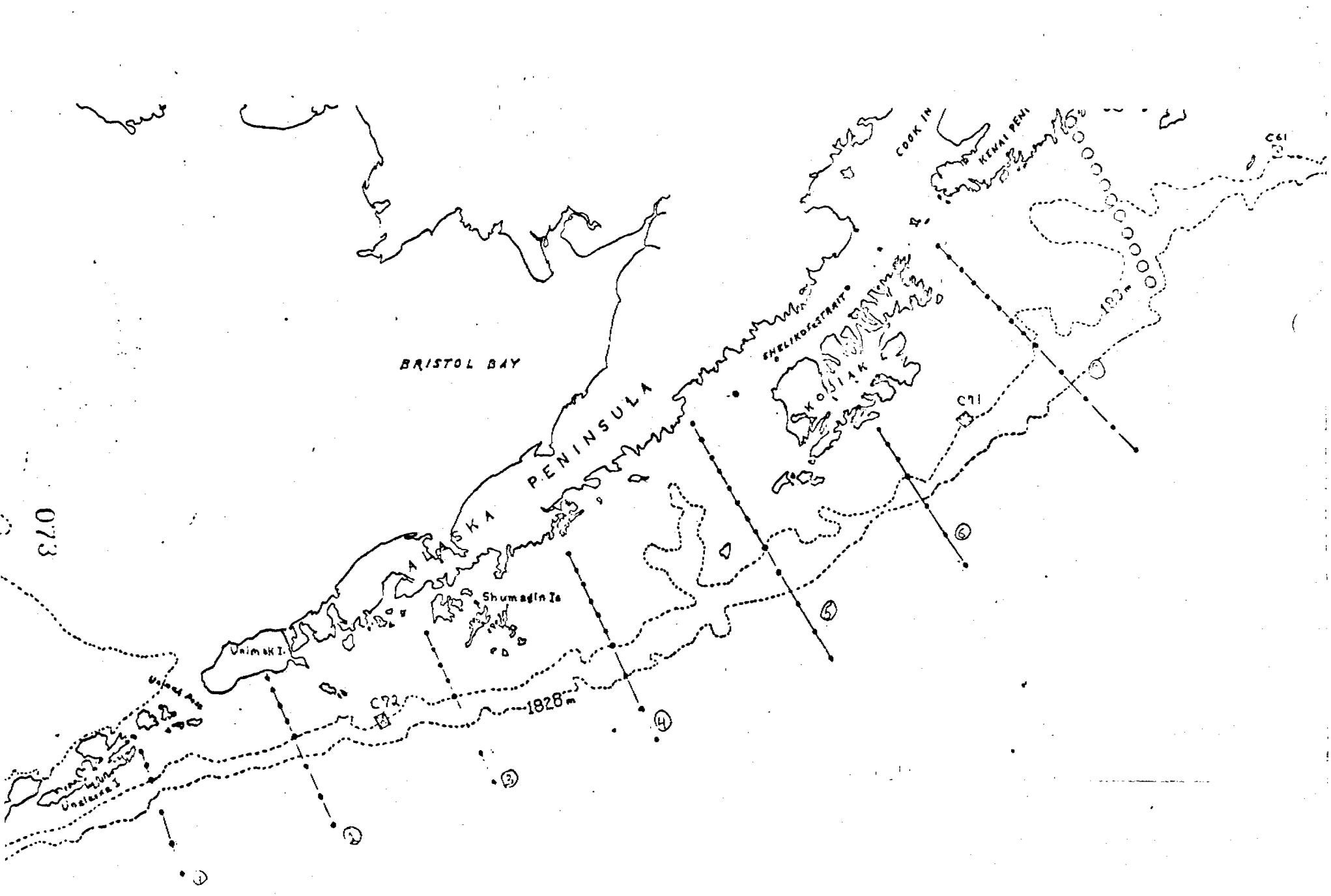


Figure 2. Proposed cruise grid for chem/bio cruise in western GOA. Zooplankton samples will be collected at 1200 and 2400 hrs.

ENVIRONMENTAL ASSESSMENT - OCS

WORK STATEMENT (Research Unit #156/164c)

I. Title: Phytoplankton and Primary Productivity of the Gulf of Alaska

II. Principal Investigator:

J. D. Larrance
Pacific Marine Environmental Laboratory, ERL
3711 - 15th Avenue N.E.
Seattle, Washington 98105

Phone: (206) 442-4580, -4598

III. Area: Gulf of Alaska, FY 1976 (1 June 1975 - 30 September 1976)

IV. Total Budget: $155,000

V. Proposed Research:

A. Background and objectives

1. Related tasks

This proposal addresses portions of tasks A-23, seasonal density deistributions of principal phytoplankton species, and A-24, seasonal indices of phytoplankton production.

2. Objectives and required information

The primary objectives are (1) to describe the distributions of chlorophyll a and related pigments by season in the Gulf of Alaska, (2) to describe the distributions of principal species of phytoplankton occurring in the Gulf of Alaska by season and (3) to determine the seasonal indices of primary production in the Gulf of Alaska.

Measurements of incident and underwater ambient irradiance will also be made. Data on light, temperature, salinity, nutrients, zooplankton and suspended matter can subsequently be related to productivity and standing stocks to gain insights into the major driving forces of primary production.

The information required to meet the task objectives includes measurements of chlorophyll a within the upper 100 m, the several dominant phytoplankton species present and their population densities, and primary productivity in the euphotic zone. The information will be obtained via the proposed sampling program. Although logistic limitations preclude determination of a complete seasonal picture, data from representative months in spring, summer and fall will describe conditions at critical periods. It will be possible to analyze only a selected portion of the phytoplankton samples before FY 77 and to enumerate only the principal species. The remainder of the samples will be archived for future analyses as needed.

3. Related OCSEP research

This proposal is one of three concerning plankton in the Gulf of Alaska which will be integrated for purposes of sampling and ecological interpretation. The other two proposals are for zooplankton, submitted by Dr. D. Damkaer, PMEL, and for ichthyoplankton and acoustic detection of pelagic populations by Dr. T.S. English, University of Washington.

In addition, the field efforts for plankton will be closely coordinated with the PMEL efforts in light hydrocarbons and suspended particulate matter. The simultaneity of data on suspended matter, phytoplankton, primary production, chlorophyll and zooplankton will result in coherent data sets which will permit more meaningful ecological interpretations in the future.

4. Existing Information

The information available in the literature on phytoplankton standing stocks in the Gulf of Alaska is limited mainly to open waters of

the southern portion of the Gulf. Studies conducted inshore include Iverson et al. (1974) who reported successive summer blooms of the Thalassiosira aestivalis and Skeletonema costatum in Auke Bay, Alaska; and Horner et al. (1973) who found a major diatom bloom in March-April in the Valdez area followed by a summer population composed principally of small flagellates and dinoflagellates in the fall. The major peaks of chlorophyll and primary production coincided with the spring diatom bloom (Goering et al., 1973).

Several Japanese workers have reported diatom species from the southern Gulf of Alaska sampled by fine mesh nets. Karohji (1972) summarized Alaskan Gyre populations as dominated by Nitzschia seriata, Phaeoceros and Rhizosolenia hebatata f. spinifera. Ohwada and Kon (1963) concentrated algae from water samples by centrifugation. Their results from open water agree in general with Karohjii's (1972) and they found 3×10^6 cells/l near Juneau of which 88 per cent were Skeletonema costatum.

Koblents-Mishke, O.I. (1961) attempted to show the phytogeographical regionalization of the northeastern Pacific. She characterized a boreal group of phytoplankton including Thalassiothrix longissima, Denticula marina, Chaetoceros decipiens, and Certaium pentagonum.

Larrance (1971) reported primary productivity and chlorophyll a data from the southwestern portion of the study area. During and before the 1960's, Canadian scientists of the Pacific Oceanographic Group at Nanaimo, B.C., measured chlorophyll a at Ocean Station "P" (latitude 50^{o}N, longitude 145^{o}W) along with studies of primary production and zooplankton. The data from these measurements can be found in several numbers of the Fisheries Research Board of Canada, Manuscript Report Series (Oceanographic and Limnological). From the Canadian data, McAllister (1969) estimated the mean annual primary production at Station "P" was

48gCm^{-2} and Larrance (1971) estimated annual production between 80 and 100gCm^{-2} at the 176^{o}W meridian. Koblents-Mishke (1965) estimated annual production of 102gCm^{-2} in the Gulf of Alaska and Goering, et al. (1973) estimate net annual primary production in the Prince William Sound area at 185gCm^{-2}.

Although the referenced information given here is incomplete three pertinent points are apparent. (1) The existing information describes primarily the southern portion of the Gulf of Alaska and limited data are available along the northern and western Gulf of Alaska continental shelf. (2) No sampling program has produced phytoplankton and primary production data applicable to the OCSEP objectives in terms of spatial and temporal continuity and frequency in the study region. (3) A coherent picture of phytoplankton species distribution cannot be presented from information in existing reports.

B. Methods

Phytoplankton, primary productivity and chlorophyll a will be sampled seasonally on grids of stations to be devised in conjunction with the zooplankton, macrozooplankton, and other proposed studies. These stations will be concentrated in the northeastern Gulf with one cruise in the western Gulf. At least three cruises in an area (northeastern and western Gulf) are necessary to obtain seasonal conditions there. Logistics do not permit coverage of both areas in sufficient detail during FY 1976. The one cruise in the western Gulf can be considered the first of a sequence in that area for the following year. In addition to the sampling during the designated biology cruises, a limited number of

surface phytoplankton samples will be collected during ships-of-opportunity cruises to provide information on species successions.

Water samples will be collected by Niskin bottles on a Rosette sampler or by submersible pump, preserved, and returned to Seattle for microscopical analysis. The several dominant species will be identified and counted, using the Utermohl (1931) inverted microscope technique, only to the extent necessary to determine approximations of absolute quantities. Of more importance are the relative standing stocks of the most important species, their temporal successions, and areal distributions.

Chlorophyll a and related water properties will be measured using a submersible pump-sensor system for sampling in the upper water column. The advantages of this method of sampling are: (1) measurement of continuous vertical profiles, (2) simultaneous measurement of related variables, (3) real-time data display, (4) cost effectiveness due to savings in technician time, and (5) reduction of human errors. Rapid pump casts for chlorophyll will be taken at stations where productivity is not measured to obtain more detailed coverage of subsurface chlorophyll concentrations.

Chlorophyll a and phaeopigments will also be measured in discrete samples from the Niskin bottles by fluorometric techniques described in Strickland and Parsons (1968) and Yentsch and Menzel (1963). Fluorescence of phytoplankton cells in a continuous sample stream pumped from a hull tap will be measured and recorded on strip charts while the vessel is in transit between stations (Lorenzen, 1966). Chlorophyll a in the continuous flow will be calculated using daily calibrations from the discrete sample measurements. Thus, maps of near surface (about 5m) Chlorophyll a values can be provided from continuous data along track lines.

Primary productivity will be measured by standard carbon-14 techniques (Strickland and Parsons, 1968). Two bottle casts will be taken each day - predawn and prenoon. Half-day photosynthesis experiements will be conducted using simulated in-situ incubations. Incubation periods will be dawn to LAN (local apparent noon) and LAN to dark. At least once during each cruise simultaneous in-situ and simulated in-situ experiments will be attempted for calibration purposes. Nine depths at each station down to the 0.1% light depth will be sampled according to light transmission ratings of neutral density filters used in the photosynthesis experiments. At noon stations, geometric sampling depths will be determined from measured subsurface irradiances. Irradiance will be measured by an underwater irradiance meter which gives quanta of light in the photosynthetically active spectrum. Sampling depths for the morning stations will be determined from the previous day's noon irradiance measurements.

Two light and one dark bottle from each depth will be incubated. The resulting filters will be immersed in scintillation-fluor solution and returned to Seattle for liquid-scintillation analysis.

VI. Information Products

Phytoplankton species data will be numerically coded in formats to be provided by OCSEP data management and punched onto standard Hollerith

cards. Productivity and chlorophyll data will also be entered on Hollerith cards in standard formats and submitted to OCSEP. Data in the final report will be presented in narrative, tabular, and graphic form including distributional maps. The narrative will include ecological interpretations where possible.

VII. Data or Sample Exchange Interfaces

This program will require nutrient, zooplankton, salinity, temperature, and sigma-t information for comparison and interpretation. Information on the distribution and movement of water masses will also be needed for correlations with areal phytoplankton and productivity distributions. In addition, detailed ERTS multispectral scanner images in the red and green bands during our sampling periods may be used for relating distributions of chlorophyll concentrations to measured values. Interchange of data among plankton projects will be handled locally.

VIII. Archival Requirements

All phytoplankton samples collected will be saved. Aliquot portions will be removed from selected samples for microscopical examination and destroyed, but the remainder of these samples will be saved. The maintenance of all samples will be the responsibility of PMEL/NOAA.

IX. Schedule

The following diagram shows the projected cruise schedule for the phytoplankton program in the Gulf of Alaska.

	1975		1976	
Month	October	April-May	July	August
Duration	21 d.	21 d.	21 d.	21 d.
Area	NEGOA	NEGOA	NEGOA	West Gulf

An estimation of the schedule of delivery of information after each cruise is as follows:

(1) Chlorophyll a and primary productivity — 5 months

(2) Phytoplankton species — 6-8 months

The initial submission of information may take longer until procedures are well established. The OCSEP office will be kept informed of anticipated serious departures from those times indicated.

Milestones

(1) July 1 - September 30, 1975

a) Set up phytoplankton counting and primary productivity laboratories.

b) Familiarize technicians with subarctic species

c) Acquire equipment and supplies

d) Prepare for first cruise

(2) October 1 - December 31, 1975

a) Conduct fall cruise

b) Begin analysis of phytoplankton samples from fall cruise

c) Modify hardware system as needed

d) Process productivity and chlorophyll a data

(3) January 1 - March 31, 1976

a) Report productivity and chlorophyll a data

b) Continue phytoplankton analyses

c) Prepare for spring cruise

(4) April 1 - June 30, 1976

a) Report phytoplankton species data from fall cruise

b) Conduct spring cruise

c) Begin analysis of samples from spring cruise

d) Process productivity and chlorophyll data from spring cruise

e) Prepare for summer cruises

(5) July 1 - September 30, 1976

a) Conduct 2 summer cruises

b) Process productivity and chlorophyll a data from July cruise

c) Continue analysis of samples from spring cruise

(6) By February 1, 1977 - Final report issued.

X. Equipment Requirements

Major equipment will include two inverted plankton microscopes with one set of photographic attachments, a submersible pump system, a liquid scintillation spectrometer, and a fluorometer with recorder. These items will be purchased from funds allocated according to the attached budget.

XI. Logistics Requirements

Vessel requirements: The vessel must provide the following facilties:

1. Approximately 70 sq ft of laboratory space which includes

- work bench (10' x 2') with drawers and cabinets for storing supplies
- the work bench must have a sink with hot and cold fresh water and a seawater tap to provide a modest but continuous flow

(approximately 2 gpm) of seawater. An ideal system exists on the Miller Freeman. Supply from an engine room sea chest is undesirable but may have to be used if no other practical modification can be made.

- laboratory must be located on the main deck, easily accessible to the sampling area. A hose or piping from the laboratory must penetrate an outer bulkhead so that connections to pumping system can be easily made. The distance between laboratory and pumping system should be as short as practicable.

2. Deck space
   - an area (6' x 6') is needed to place the winch for the pumping system so the gear can be conveniently deployed. A special A-frame, boom, or crane may be needed to suspend the sheave. For example, the Miller Freeman has a suitable arrangement for this operation, but other ships may not.
3. Storage space
   - for samples: 15 cu ft inside and 2 cu ft of freezer space
   - for gear and supplies: 30 cu ft inside.
4. Rosette sampler with 10-l. Niskin bottles.
5. Electric power
   - for winch: 440V AC and 110V AC, 3-phase to operate winch and pump
   - laboratories: three double receptacles, 110V, 60 Hz
6. Scientific personnel
   - three scientists will accompany these cruises to conduct the phytoplankton program.

7. Sampling protocol [1]

	NEGOA	NWGOA
Sampling events	Fall 1975 Spring 1976 Summer 1976	Summer 1976
Number of stations/cruise		
Productivity	40	40
chlorophyll profiles (pump)	60	60
Number of standard depths	7-9	7-9
Surface chlorophyll	continuous	continuous
Phytoplankton samples/cruise [2]	250	210
Total phytoplankton samples [2]	750	210
Wire time/cruise	100 hrs	100 hrs
Personnel	3	3

(1) All figures are estimates

(2) Only a portion of the phytoplankton samples will be analyzed

8. Contingency Plans

In the event that opportunities arise to make observations of other variables important to a future ecosystem analysis or to modify the proposed sampling for purposes of providing more meaningful information, we will seek approval from the program office to do so.

If the submersible pump system is unobtainable in the time frame planned or if it malfunctions, discrete samples will be taken by bottle, and chlorophyll samples analyzed individually. Therefore, the amount of chlorophyll data will be reduced.

REFERENCES

Goering, J.J., W.E. Shiels, and C.J. Patton 1973. Primary production. In Environmental Studies of Port Valdez, Ins. Mar. Sco., Univ. Alaska, Occ. Publ. no. 3, p. 251-279.

Horner, R.A., L.S. Dick, and W.E. Shiels 1973. Phytoplankton studies. In Environmental Studies of Port Valdez, Inst. Mar. Sci., Univ. Alaska, Occ. Publ. no. 3, p. 281-294.

Iverson, R.L., H.C. Curl, Jr., H.B. O'Connors, Jr., D. Kirk, and K. Zakar 1974. Summer phytoplankton blooms in Auke Bay, Alaska, driven by **wind** mixing of the water column. Limnol. & Octanogr. 19(2): 271-278.

Karohji, K. 1972. Regional distribution of phytoplankton in the Bering Sea and western and northern subarctic regions of the North Pacific Ocean in summer. In: Biological Oceanography of the Northern North Pacific Ocean. ed, Takenouti, et al.; Idenitsu Shoten, Tokyo, p. 99-115.

Koblents-Mishke, O.I.1961. Specific composition of the phytoplankton and primar production in the northeastern Pacific Ocean in the winter of 1958-1958. In: Oceanographic research by the "Vityaz" in the North Pacific under the I.G.Y. program. ed, N.N. Sysoev; Akad. Nauk SSSR, Trudy Inst. Okeanologii, vol. 45, p. 173-190. (Transl. by Israel Program for Scientific Translations.)

Koblents-Mishke, O.I. 1965. Primary production in the Pacific. Oceanology. 5 (2): 104-116.

Larrance, J.D. 1971. Primary production in the mid-subarctic Pacific region, 1966-68. Fish. Bull, 69(3): 595-613.

Lorenzen, C.J. 1966. A method for the continuous measurement of in vivo chlorophyll concentration. Deep-Sea res. 13: 223-227.

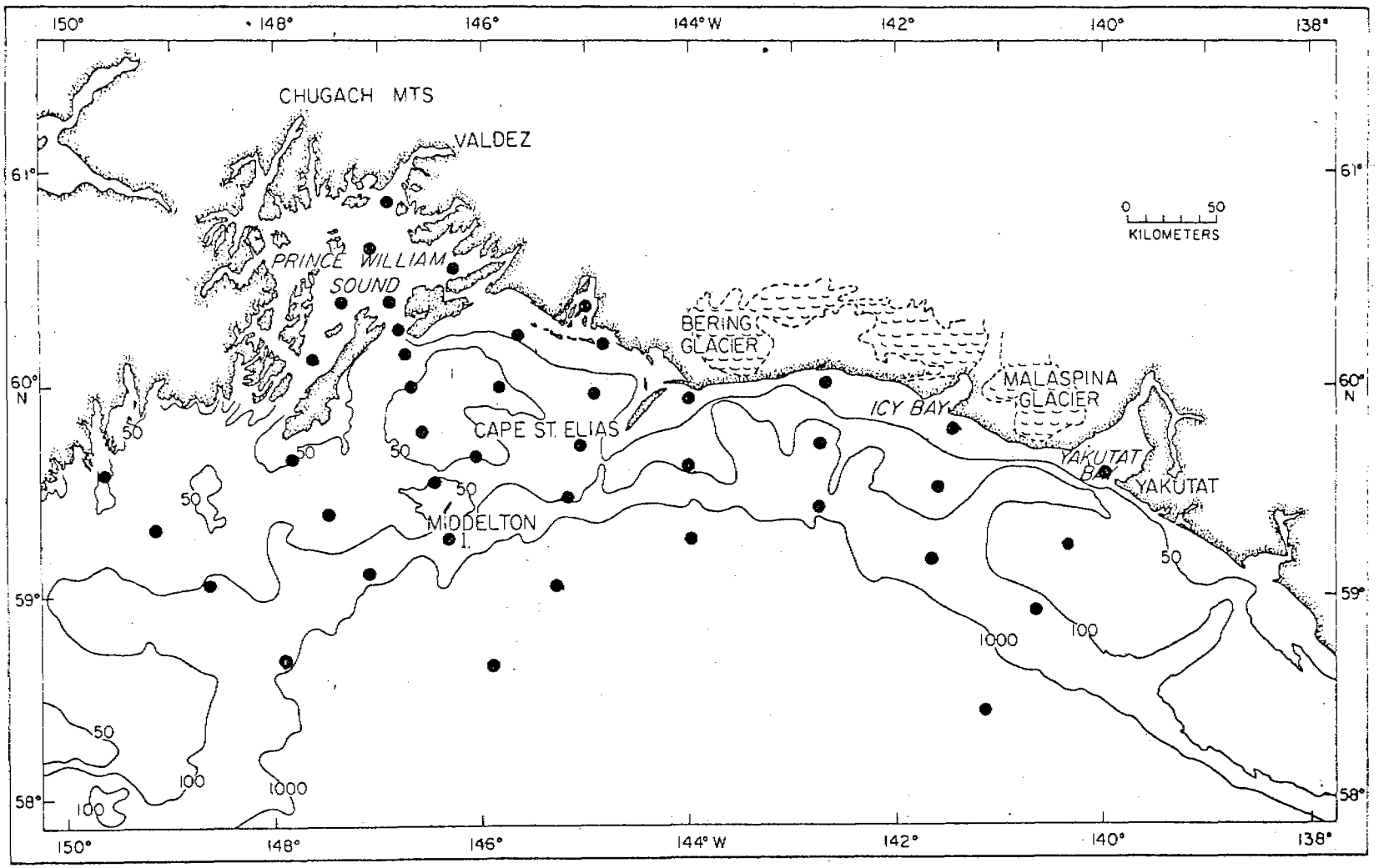
McAllister, C.D. 1969. Aspects of estimating zooplankton production from phytoplankton production. J. Fish. Res. Bd. Canada 26: 199-220.

Ohwada, M. and H. Kon, 1963. A microplankton survey as a contribution to the hydrography of the North Pacific and adjacent seas (II). Oceanogr. Mag., 14(2): 87-99.

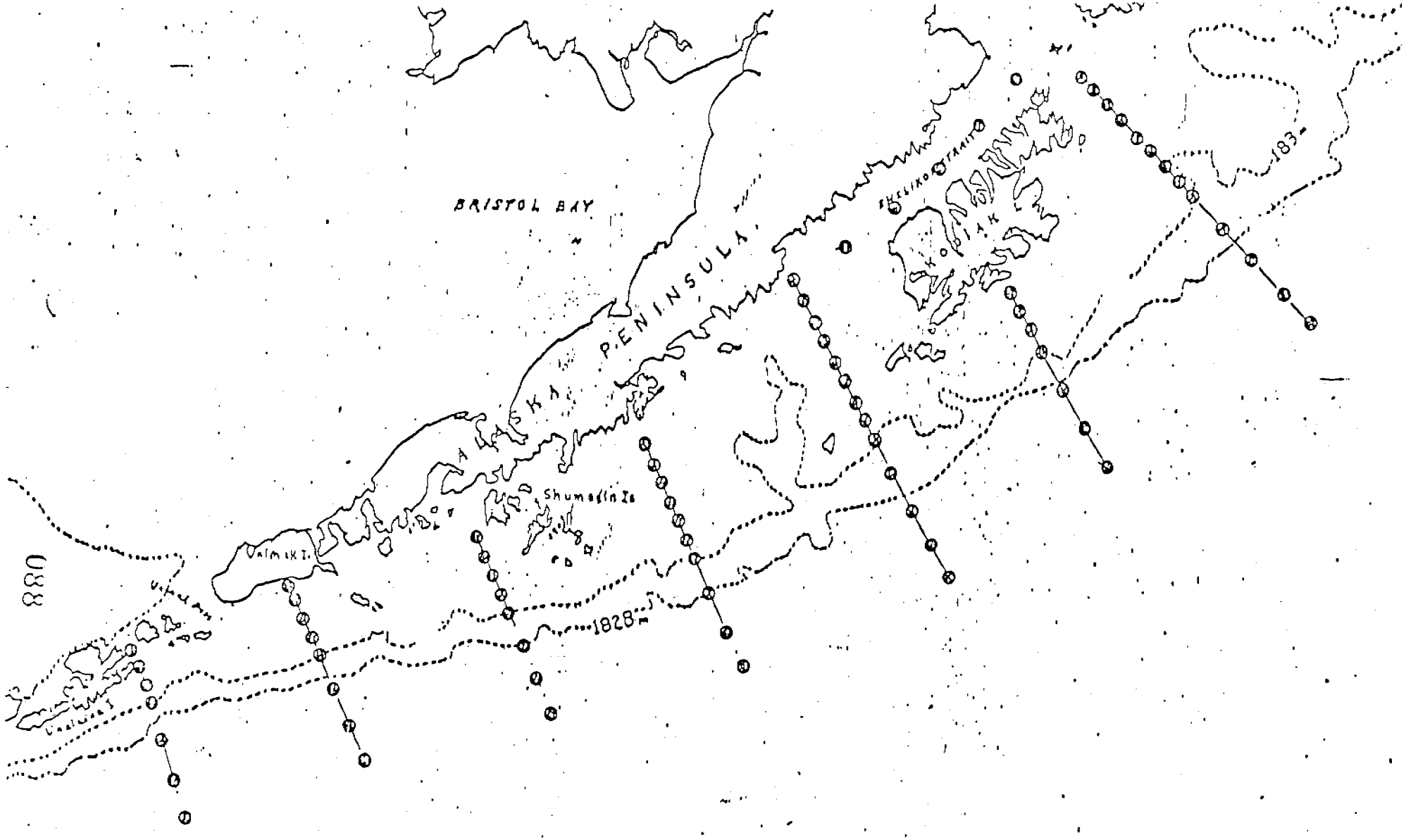
Strickland, J.D.H. and T.R. Parsons 1968. A Practical Handbook of Seawater Analysis. Queen's Printers, Ottawa, 311 pp.

Utermohl, H. 1931. Neue Wege in der quantitativen Erfassung des P anktons. Verh. int. Verein, theor. angew. Limnol. 5: 567-596.

Yentsch, C.S. and D.W. Menzel, 1963. A method for the determination of Phytoplankton chlorophyll and phaeophytin by fluorescence. Deep-Sea Res. 10: 221-231.



Proposed locations of the primary productivity stations in the northeastern Gulf.



Proposed locations of the particulate matter stations in the western Gulf.
Primary productivity and chlorophyll will be measured on a similar grid.

June 30, 1975
FINAL

ALASKA MARINE ENVIRONMENTAL ASSESSMENT PROGRAM
WORK STATEMENT (Research Unit #156/164d)

I. Title

Zooplankton and Micronekton Studies in the Bering-Chukchi/Beaufort Seas

II. Principal Investigator:

Dr. R. Ted Cooney
Assistant Professor of Marine Science
and Fisheries Biology
Institute of Marine Science
University of Alaska
Fairbanks, Alaska 99701
(907) 479-7210
SS#: 516-44-6552

III. Geographic Area and Inclusive Dates

Bering Sea	April 1, 1975 - Sept 30, 1976
Bering-Chukchi/Beaufort	seasonal ice-edge study

IV. Cost Summary

FY 1975 through June 30, 1975	FY 1976 July 1, 1975 through Sept 30, 1976
$62,752	$151,173

089

V. Proposed Research

A. Background and Objectives

The following tasks will be addressed within the geographic areas and time schedule specified in III. above.

1. A-9; describe the food dependencies of commonly occuring species of pelagic fishes as this task applies to dielly migrating bathypelogic species sampled with bongo nets and NIO Tucker midwater trawls.

2. A-22; summarize the existing literature and unpublished data on the transfer of synthesized organic matter to zooplankton micronekton, and ichthyoplankton.

3. A-23; determine seasonal density distributions and environmental requirements of principal species of zooplankton, micronekton, and ichthyoplankton.

4. A-24; identify pathways of matter (energy) transfer between synthesizers and consumers.

5. A-25a; identify and characterize critical regions and habitats required by egg and larval stages of fish and shellfish species.

6. A-31; determine the relationships of zooplankton and micronekton populations to the edge of the seasonal ice pack as it occurs in the Bering, Chukchi, and Beaufort Seas.

Much of the present state of knowledge concerning seasonal distributions of zooplankton and micronekton in the study areas as specified has been summarized by Hood and Kelley (1974). Although U.S. workers have been active in northern ocean studies. Most of the recent descriptive information concerning the pelagic community is the result of Japanese efforts in conjunction with hydrographic and high-sea fishery surveys, 1956-1970. The bulk of these data is now available as generalized distributional maps for dominant species or composites occuring in the upper 150 m of the water column during the summer season. Although year to year fluctuations in standing stock biomass (wet weight; g/m^2) are reported, the significance and cause of this variability has not been considered.

A much more detailed information base will be required to address the tasks outlined above. While the presently available observations are helpful in the conceptualization and development of a field sampling program, and may also serve as a preliminary model for summer distributional patterns, they do not represent a definitive understanding of the components and dynamics of the Bering Sea pelagic ecosystem. The work proposed here will involve not only measures of standing stocks but also extimates of the variance structure from which these data are to be obtained.

Given appropriate field logistic support (i.e. vessels capable of conducting the rather routine sample collection to be described), and access to adequate library facilities, all the tasks described can be expected to produce significant results during the funding period specified; the literature review should certainly be completed through most currently available publications. It must be understood that the resolution of the remaining tasks is open-ended in the sense that patterns in nature become more clearly defined only as the observational data base expands through time. Certainly it is not unreasonable to expect a 3-5 year program to produce data of high modeling quality. The efforts of the first funding period will be directed toward this end.

A newly developed international study of resources and processes of the Bering Sea, PROBES, is slated for funding at levels permitting field work this coming year 1975-76. Cooperative efforts between U.S. and Japanese workers are planned. The food web supporting the immense pollack fishery in the southeastern Bering Sea will act as in initial focal point for interacting physical, chemical, and biological studies. I expect to participate in this program in the subject area of secondary productivity, and organic matter transfer processes. This work should compliment the studies addressing related OCS tasks.

In addition to PROBES, I will also follow closely the BLM/NOAA studies continuing in the northern and western Gulf of Alaska. The distributions of many pelagic species extend northward beyond the Aleutian passes into the Bering Sea, so that local changes further north may reflect, to some extent, fluctuation in recruitment of organisms from the western Gulf.

B. Methods

To the extent possible, archived samples and raw data from reports (published or unpublished) which are deemed relevant to the tasks described above will be submitted according to acceptable format for OCS shorage and retrieval. I do not intend to process or reprocess all the old plankton samples previously collected in the Bering Sea and now stored in various institutions and laboratories around the country. In instances where I can determine that samples now on hand are appropriate to the understanding of the tasks as listed, collections will be accepted for sorting and identification.

The field program described here, and the subsequent analysis of data has its basis in the powerful statistical proceedure of Analysis of Variance. In the general sense I plan to randomly sample specified (fixed) spatial strata on a periodic basis. My sampling error will be estimated from a subset of replicated (time and space) observations selected from all strata and periods; gear types will be treated seperately. Count data (numbers per m^3 or m^2) will be transformed by base 10 logarithms; a technique commonly used to stabilize the variance in cases where standard deviations and means tend to be proportional rather than additive.

The specific design for the two major field studies is as follows:

1) Zooplankton and micronekton studies in the southeastern Bering Sea;

Two regions of the area will be examined: the St. Matthews Basin, and Bristol Bay (Fig. 1). Four subareas have been selected on the basis of depth within each of these region for detailed study (Fig. 2). These subareas include three nearshore or coastal regimes (depths less than 50 m,

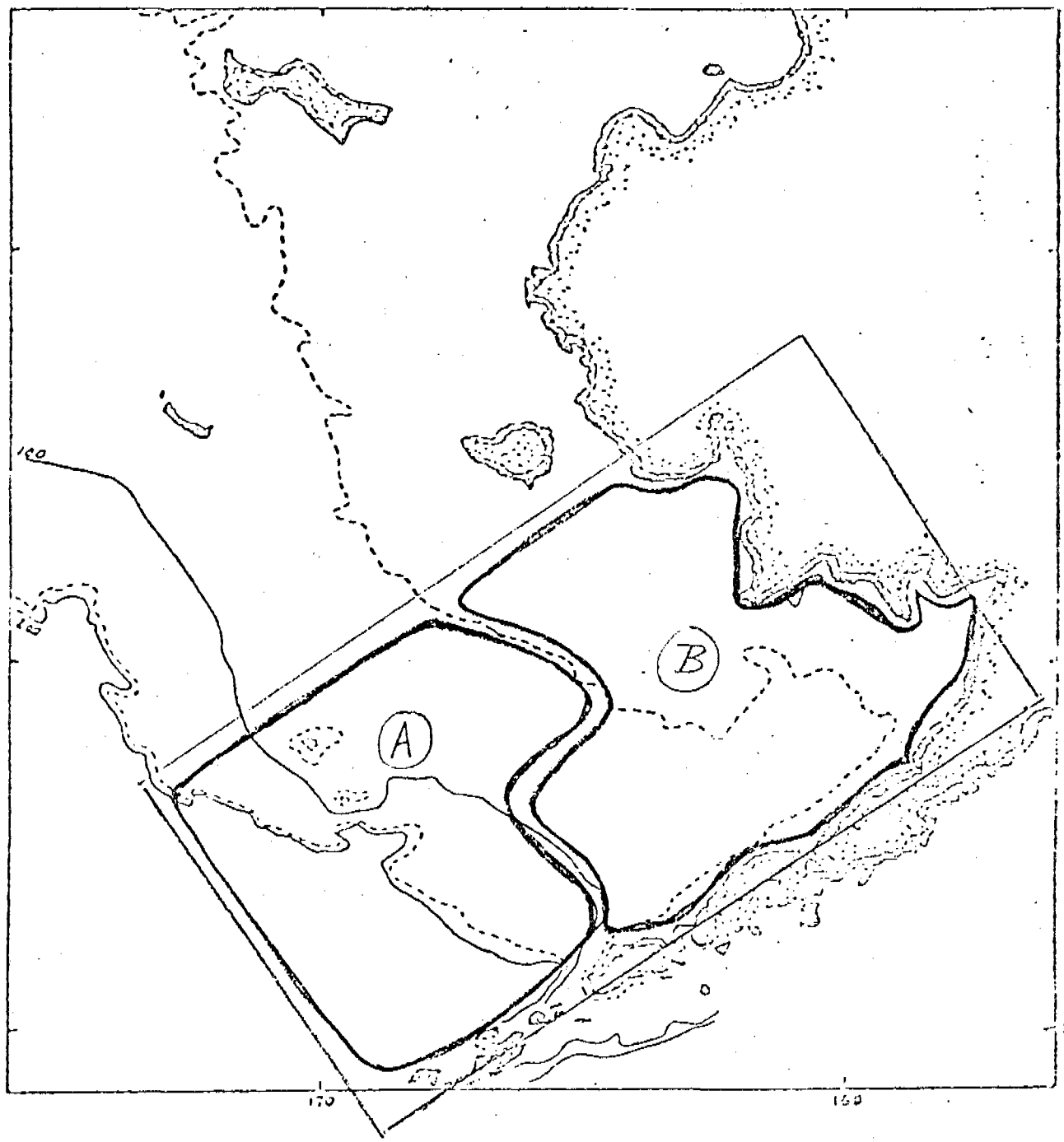


Figure 1. Proposed sampling areas in the southeastern Bering Sea.

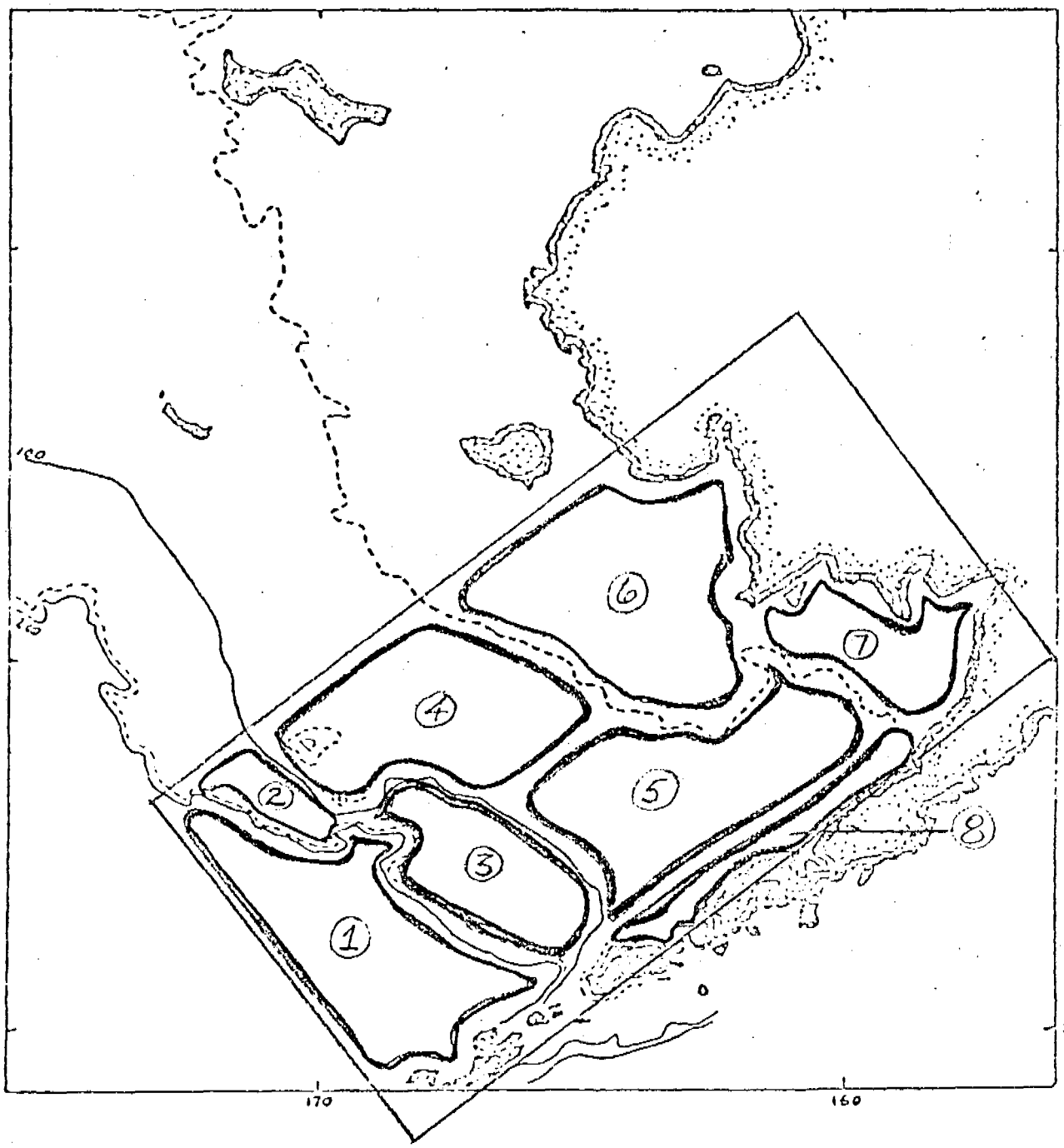


Figure 2. Major proposed subareas in the southeastern Bering Sea.

denoted as 6, 7, and 8), central Bristol Bay (subarea 5, 50-100 deep), on ocaeanic regime (subarea 1; > 200 m), two shelf break regions (subareas 2 and 3; 100 - 200 m) and a central shelf area north of the St. George Basin (subarea 4; 50 - 100 m).

Within these eight subareas, samples will be taken using an open bongo-net fished obliquely through the water column between the sea surface and 10 m above the bottom; the amount of water filtered will be measured by flow meter. Catches will be preserved in 10 percent buffered formalin and returned to the University of Alaska Marine Sorting Center for processing. The collection of these samples will be the responsiblity of NOAA technicians and officers who will be instructed by me or my personnel in the operation, maintenance, and use of the bongo system at sea. The number of samples per subarea and the time of day of sampling will be specified in each cruise plan. Early critiques of planned OCS zooplankton work suggested levels of effort sufficient to detect real differences of one-half order of magnitude or more. On the basis of previous experience, between 6 and 10 observations per subarea will likely be necessary to approach this precision on each cruise. Once a suite of within-subarea data are on hand, statistical analysis will be used to evaluate the sufficiency of this design and appropriate changes made. No fewer than four cruises (spring, summer, fall, and winter) will be attempted.

Dielly migrating bathypelagic fishes will be sampled in the upper 75 m of the water column by fishing a 2 m MIO Tucker trawl after dark at specified locations. The trawl will be lowered closed to depths of interest (using acoustic-link telemetry when possible) as determined by a portable high-

frequency (100 kHz) echosounder. Once at depth, the net will be opened, and then closed by messenger from the surface; the amount of water filter during each tow will be measured by flow meter.

Sample processing will be conducted according to accepted procedures. Since quite large volumes of water will be filtered at sea (thousands of m^3) individual catches are expected to contain many more organisms than can be directly counted. These collections will first be examined in their entirety for the obvious and usually rarer organisms (i.e. bathypelagic fishes, large shrimps, squids, etc). Following this screening, a portion of the sample (one-half, one-fourth, etc) will be archived for future reference. The remaining fraction will be sorted to remove all zooplankters except copepods and perhaps chaetognaths. These latter taxa will be enumerated and identified in even smaller subsamples of 100 - 200 organsisms.

This techniqe provides estimates of numbers of animals per sample for numerically dominant species, and direct counts for the larger, rarer organisms. Identification of specimens will be taken to genus and species whenever possible. Taxonomic verification will be coordinated with workers sampling the northern Gulf of Alaska for plankton and micronekton.

2) Zooplankton and micronekton studies near the edge of the seasonal ice pack as it may occur in the Bering, Chukchi, or Beaufort Seas.

Zooplankton and micronekton will be samples directly at the ice-edge using nets and trawls, and indirectly with a portable high-frequency acoustic system. Animals in the size range 0.3-10.0 mm will be censused with closing 1-m nets fished through selected strata between the sea bed and the surface. The larger organisms, 10.0 - 100 mm, will be taken in opening - closing

horizontal tows utilizing a 2 m NIO Tucker trawl positioned at depths with acoustic-link telemetry and activated from the surface by messenger.

Levels of precision and methods for evaluating samping variability and the adaquacy of the field and laboratory effort will be the same as those described for the bongo-net survey in the southeastern Bering Sea.

A high-frequency (100 kHz) recording (precision echogram; magnetic tape) echosounder will be operated to obtain quantitative sonic data for correlation with observed animal plankton and micronekton standing stocks. Measurements of acoustic volume-scattering intensity, corrected for distance from the transducer and gated for specific depth intervals will be the parameter of initial interest. Additional signal processing will be undertaken using computer software when it becomes desirable to reduce large numbers of observations to discrete estimates of standing stocks measured along continuous transcect adjacent to, and along the ice edge.

Organic matter pathway information describing exchange between primary producers (phytoplankton) and pelagic grazers will be obtained from shipboard culture experiments. Representative samples of naturally occuring plant cells (composites from several depths or discrete portions of the water column based on chlorophyll profiles) will be incubated with subsamples of the grazing community (from net tows) and the relative change in cell abundance by species used as a measure of selective feeding (manual counting, or colter counter system augmented with direct identification and enumeration).

We anticipate that between 100 and 200 stations will be occupied during each of the four cruises each year. In addition, we expect to take 20-50 samples in the ice.

VI. Information Products

On the basis of the tasks listed in section V, the following will constitute the information content and format:

1. A-9; species lists and descriptions of seasonal variations in the diet of the principal bathypelagic fishes taken in the bongo-net survey, and with the NIO Tucker trawl.

2. A-22; a bibliography of existing literature and available unpublished reports concerning the transfer of primarily synthesized organic matter to pelagic grazers (this information can be listed on computer cards if desired).

3. A-23; abundance per sample of all categories sorted from individual catches. Counts to be submitted according to the VIMS code for species on the EDS format. Analysis of variance tables describing levels of variability for factors considered in the field and laboratory design will be available. Correlations with environmental parameters will appear as statistical statements augmented by appropriate verbal descriptions.

4. A-24; lists of species and size-class data for dominate phytoplankters removed by specific grazers or zooplankton composites will be reported.

5. A-25a; the locations and major environmental factors describing egg and larvae abundance will appear as a written statement supplemented by appropriate statistical analyses.

6. A-31; abundance per sample of all categories sorted from individual catches. Counts to be submitted according to the VIMS code for species on the EDS format. Analysis of variance tables describing levels of variability

encountered within the sampling design and the importance of selected factors will appear in support of a written report of interpretation. Correlation with measured environmental and acoustic parameters will be provided as statistical statements supplemented with written descriptions.

It is understood that no later than 120 days after aquisition of the data (defined in this project as the results of laboratory processing for the most part) they will be entered by appropriate format on magnetic tape.

VII. Data or Sample Exchange Interfaces

The major outside data requirement will be in the field of physical oceanography. Charts depicting large-scale current paths and seasonal vertical distributions of temperature and salinity within the subareas or regimes considered by this project will be required. The physiology group may request species composition data and seasonal abundance to predict possible influences of hydrocarbons on the pelagic community.

VIII. Sample Archiving

It is expected that subsamples of several hundred zooplankton and micronekton catches will be archived by the marine sorting center or Institute of Marine Science. Approximately 100 ft^2 of dry space will be requested. I will assume the responsibility for this collection during the funding period specified.

IX. Schedule

No fewer than four observational periods at sea will be necessary to meet the data requirements addressing the tasks outlined above (section V). I suggest that ice-edge cruises be scheduled during the following periods: 1. August - September 1975; 2. November - December 1975; 3. March - April 1976; and 4. May - June 1976. Since the vessel must cross all, or some portion (depending on season) of the proposed southeastern Bering Sea study area, bongo-net samples could also be taken from accessible subareas on these cruises. The remaining samples for the bongo-net survey will be aquired on NOAA cruises of opportunity throughout the year. NOAA personnel on each vessel operating in the study area will be instructed in the use of the bongo-net system at sea and responsible for obtaining samples as specified by the cruise plan, and for shipping these samples to the University of Alaska Marine Sorting Center. No samples will be accepted for processing after 1 July 1976.

Data submission to EDS/NODC will follow aquisition by no later than 120 days; milestone will be identified as successfully completed cruises, and the completion of laboratory processing of samples.

Interaction with other workers, and data bases will be through direct correspondence or contact with the Project Data Base, EDS/NODC.

As of this date, formating of data to the necessary EDS requirement will be handled by the Institute of Marine Science data analysis section.

The preparation of a final report will begin on 1 July 1975 and be finalized before 30 September 1976.

X. Equipment Requirements

The major equipment items include the acoustic-link depth telemetry for use with the NIO Tucker Trawl, and the portable sonic data aquisition system. Both these field support items should be available for the first cruise in August - September and definately on line by November - December, subject of course to the date of the final contract agreement with the University of Alaska.

XI. Logistic Requirements

To successfully complete the tasks defined above (section V), the following minimal logistic support must be provided by NOAA:

1. An ice-strengthened vessel capable of working in the pack-ice adjacent to the edge of the seasonal ice in the Bering, Chukchi, or Beaufort Seas. This ship must be able to routinely set and retrieve vertical plankton nets (metered wire; 1 m/sec retrieval speed; A-frame or boom lift of 15 feet above any working deck) and NIO Tucker trawls and bongo-nets. The latter two types of gear must be lowered with the vessel underway (3-4 knts), fished horizontally or obliquely, and then retrieved with way on.

2. A filtered and regulated 110 V-ac power supply available for operation of acoustic equipment.

3. A seawater hose to rinse nets after towing and to cool incubation facilities for on-deck experiments.

4. Approximately 100 ft^2 of storage space for samples and gear used during cruises.

5. Approximately 10 ft^2 of dry bench space to setup and op[illegible]e the acoustic system.

6. Permission to tow underway, or lower on station, sonic transducers.

7. Appropriate winches and booms or A-frames on other vessels operating in the southeastern Bering Sea capable of handling the bong-net survey throughout the funding period.

The Institute of Marine Science will arrange travel, shipping and other logistic support.

ALASKA MARINE ENVIRONMENTAL ASSESSMENT PROGRAM
WORK STATEMENT (Research Unit #156/164e)

I. Title:

Phytoplankton Studies

II. Principal Investigator:

Dr. Vera Alexander
Professor of Marine Science
Institute of Marine science
University of Alaska
Fairbanks, Alaska 99701
(907) 479-7210
SS#: 099-26-1788

III. Geographic Area and Inclusive Dates:

Bering Sea April 1, 1975 - Sept 30, 1976

IV. Cost Summary:

FY 1975 through June 30, 1975	FY 1976 July 1, 1975 through Sept 30, 1976
$27,214	$225,501

V. Proposed Research:

A. Background and objectives

The proposed study satisfies the needs, in part, of A-22 and A-23, and addresses specifically Task A-24. It also relates closely to Task A-31.

The Bering Sea is well known as an area of high biological production that supports extensive commercial fisheries as well as large populations of marine birds and animals. Certain aspects of the oceanography and production of the Bering Sea have been studied thoroughly, principally physical and geological areas. On the other hand, primary productivity and biological cycling studies have been meager, and in all aspects, the ice-free season of the year has been studied most intensively. What little is known of the Bering Sea in winter and early spring suggests that it is extremely important in the annual cycle of biological production (McRoy, et al, 1972; Irving et al. 1970; Burns 1970). Studies of phytoplankton productivity have been surprisingly sparse, such that to date no comprehensive data exists. Available productivity information for both ice and water communities has been reviewed by McRoy et al. (1972). An aspect which will be also considered because of its importance to primary production is nutrient distribution, especially near the ice edge, but also including the role of sediment in supplying nutrients during the summer season.

This appears to be of major importance to primary production in the shelf area. Dr. William Reeburgh has agreed to cooperate in the latter aspect.

In order to meet the task objectives, seasonally distributed cruises must be manned which will investigate distribution of phytoplankton species in the ice-edge region, both in the water column and within the ice itself, to determine the photosynthetic rates and efficiencies of these populations, and their role in the food chain through studies of transfer of the newly-produced organic matter to the next trophic level. Nutrient distribution and release from sediment is as essential component. Some bioassay work is also to be involved. These cruises must concentrate on intensive sampling and experimentation with sufficient areal scope to allow estimation of patchiness and overall regional significance.

By 30 September 1976, the results of a complete year-round study should be available. This will approach fulfillment of the study needs, but will not allow estimation of year-to-year variations in regime. Such estimations are essential if potential impact becomes a problem, so that normal variation can be separated from the effects of stress. However, five cruises should have been completed, and the results finalized by that date.

Research closely related to the phytoplankton work is not being carried on at present, with the exception of the study carried out by Drs. Alexander, Cooney, and Barsdate on Bering Sea primary production processes under the sponsorship of the national Science Foundation. This is a fundamental process study of zooplankton-phytoplankton dynamics. The methodology, of course, is closely correlated with some of the techniques to be used in this present study. Some of the methodology was developed in a recently completed study on ice production in the Chukchi Sea (Clasby et al. 1973). Other research on ice-related production has recently been carried out in Antarctic waters by Bunt and his coworkers.

In one of the earliest studies of primary production in the Bering Sea, Holmes (1958) reported that the highest values for the North Pacific Ocean occur in the eastern Aleutian Islands in what we now know to be an upwelling area. In more recent work near the central Aleutian Islands McAllister et al. (1968) found the expected low winter rate of 38 mg C/m^2-day. Taniguchi (1969) has completed the only widespread study. He found that the highest rates in summer occurred in the south central basins; productivity in the Bering Sea ranged from 160 to 630 mg C/m^2-day depending on the region, (Fig. 4). Dawson (1965) presented data obtained on five cruises from 1959 to 1962 in the northern Bering and Chukchi seas. Physical and chemical data are included along with measurements of chlorophyll a values were for stations located in, and just south of, Bering Strait.

In previous studies conducted by the University we have found rates as high as 4 g C/m^2-day in Bering Strait in summer; this rate compares with the highest values ever reported for the world ocean.

Based on our current understanding of the region, production apparently begins with a spring bloom of non-planktonic algae that develop in the sea ice sometime in February or March. The few centimeters of sea ice can have a standing stock equal to the entire water column in summer. The bloom in the ice is followed by a phytoplankton bloom in the water column which occurs in March in the Aleutians but not until late May or early June in the northern sea. The bloom appears to move north with the receding ice edge. Throughout the shallow Bering Sea, moderate rates of production apparently persist during the summer (the one cruise of Taniguchi provides the only available published data). However, during a cruise of the R/V ALPHA HELIX in June and early July 1974, we found very low primary productivity rates over large areas of the Bering Sea shelf.

The phytoplankton community in the Bering Sea has not been adequately described in terms of species composition or standing stock. Mann (1925) reported on the diatoms found in four samples collected at Cape Romanzof, Teller, and Port Clarence. Many of the species he listed were not planktonic forms, but were collected from the bottom during dredging operations. More recently, Motoda and Minoda (in press) have listed the phytoplankton species they found in material collected on cruises of the Oshoro Maru from 1956 to 1970.

The species composition of the ice community in the Bering Sea has received little attention, although the assemblage of organisms that live in the sea ice has been described in detail from the Antarctic (Bunt and wood 1963) and from Point Barrow, Alaska (Meguro et al. 1966, 1967; Horner and Alexander 1972 and unpublished observations). In addition, the Barrow ice community has been studied in detail in terms of primary productivity, nutrient and salinity regimes, seasonal distribution and cholorophyll a concentrations (Clasby et al. 1972, 1973, and unpublished observations).

B. Methods

Currently available data will be incorporated into the analysis of the results of the field work to be undertaken. This includes data currently in the files of the principal investigator which has previously not been synthesized, and also some unpublished data in the possession of Dr. J. J. Goering. The initial portion of the project was intended to devote some time to the synthesis of available published and unpublished primary productivity data for the Bering Sea, but involvement in the May DISCOVERER cruise has not allowed time to initiate this work at this time, and it may not be practical to approach this aspect until later in the fall of 1975.

The sampling scheme will involve quarterly cruises in the Bering Sea, emphasizing the ice edge at suitable times of year, but especially in the spring and early summer. Sampling at the ice edge will be in zig-zag transects to and away from the ice edge, as well as sampling of the under ice community during the ice-covered period. The methods of sampling are well established, and involve simple hydrocasts at each station. All phytoplankton organisms will be counted and identified, and the total complement of phytoplankton will be included in all the experimental work.

Phytoplankton will be preserved in Lugol's solution for counting by the inverted microscope method of Utermohl (1958) following sedimentation. Primary productivity will be measured by the Carbon-14 method using tecques similar to those described in Vollenweider (1969). Chlorophyll a will be measured using the spectrophotometric method as described in Strickland and Parsons (1968). C, H, and N will be dtermined by filtering aliquots of sea water through precombusted glass filters and drying the filters, and analyzing them upon return to the laboratory. Samples for these determinations will be taken as aliquots of single Niskin bottle casts taken at discrete intervals through the water column. Nutrient samples will be taken from selected stations, filtered and frozen for subsequent analysis using out automated techniques. Nutrient analysis will be carried out using standard automated methods currently in use in our laboratory. Dissolved oxygen will also be determined at selected stations using the Chesapeake Bay titration method. For routine stations in most cruises, fluorometric methods will be used for pigment analyses on shipboard, and samples will be returned to the laboratory (frozen on glass filters) for pigment analysis using aceton extraction and scanning spectrophotometry. For studies of ice algae populations, either SIPRE cores will be taken, the cores returned to shipboard and carbon-14 incubations carried out under low light conditions, on deck, or alternatively and ideally, divers would collect cores on a transect under the ice away from the edge, and these cores would be handled in a similar manner. Pigment concentration determinations will be done on the core material also.

For studies of nutrient-sediment relationships, rates of nutrient uptake near the water-sediment interface will be measured using tracer techniques and the utilization rate determined, which must be of the same order of magnitude of the total supply rate. Cores will be taken using a Benthos gravity corer, the interstitial water extracted by core squeezing and nutrient determinations carried out on the water recovered. From this, along with estimates of diffusion rates, the potential for the sediment to satisfy the nutrient requirements can be estimated. This is an approach to understanding why mid-summer plankton activity seems to be confined to the area immediately above the sediment, where active photosynethesis is carried on under extremely low light conditions. Since the nutrient

levels in the water column are extremely low at this time, it is reasonable to assume that a source of nutrient exists near the bottom and is responsible for this regime. This is relevant since such exchange of nutrients would be subject to perturbation by pollutants and dredging activity.

Grazing experiments will use labeled phytoplankton (^{14}C or ^{15}N) to determine assimilation rates by selected size classes of zooplankton in the water column (see work plan submitted by Cooney).

Bioassay work will involve long-term incubation (greater than 24 hours) of natural populations of phytoplankton in carboys in the presence of trace metals in various concentrations, with carbon-14 determinations of productivity rates determined at intervals through the incubation period. We anticipate that between 100 and 200 stations will be occupied during each of the four cruises each year. In addition, we expect to take 20 to 50 samples in the ice.

This project will cooperate with the microbiological work of Drs. Morita and Atlas by analyzing nutrient samples for their Beaufort Sea and Gulf of Alaska work as well as for the Bering Sea Plankton Program.

VI. Information Products:

A. Routine (on all cruises)

1. Primary productivity data as depth profiles
2. Phytoplankton biomass and compoisition (species lists and numbers) for depth profiles
3. Nutrient concentrations for depth profiles at selected stations
4. Dissolved oxygen as depth profiles at selected stations
5. pH and alkalinity for all primary productivity samples
6. When ice is present, primary productivity and plankton composition from ice cores
7. Chlorophyll a concentrations for depth profiles
8. C, H, N concentrations in particulate material for selected stations
9. Where practical data from the field or unpublished data available to the investigator or in the literature will be supplied in digitized form on magnetic tape

B. Experimental (on selected cruises only)

1. Grazing experiments (with Cooney)
2. Nutrient uptake by near-sediment populations
3. Sediment core interstitial nutrient concentrations
4. Trace metal bioassay results

The data collected under the routine category is basically the routine information which this project is obligated to provide. The cruises will primarily be planned around this work, and the experimental work done on a space and time available basis.

All data will be tabulated in a form suitable for machine processing.

VII. Data or Sample Exchange:

Data on physical oceanographic aspects, such as temperature and salinity, will be needed for the purposes of correlation of rates and distributions. This project will work closely with the zooplankton research, and will obtain zooplankton as needed in cooperation with Dr. Cooney.

The only samples which may require archival storage would be phytoplnakton, approximately 200 samples/cruise or 800 to 1000 samples per year.

VIII. Samples Archival Requirements

It is expected that subsamples of selected samples will be archived by the Marine Sorting Center. No funding has been included to continue this archival beyond this funding period.

IX. Schedule

May 1975
First cruise, sample collection and preliminary ice-edge work involving phytoplankton populations and production near ice and within ice. Some nutrient and oxygen data to be obtained. No bioassay or sediment experiments planned, but grazing experiments will be done as time allows.

June 1975
Work on phytoplankton counts and identifications initiated. Carbon-14 counts started.

July 1975
Continuing lab, work-up on cruise.

August 1975
Productivity data on raw form, all other data from cruise available in tabular form except phytoplankton counts.

September 1975
Second cruise, incorporating sediment work and possibly bioassay work.

October, November, December 1975
Work-up of cruise information as above. Similar schedule can be anticipated after all cruises. By the end of the first 18 month period, the results of two cruises should be complete, the next two cruises will be partly worked up, and the literature and unpublished data review completed.

X. Equipment Requirements:

Fluorometer
Zeiss microscope and particle counting system

XI. Logistics Requirements:

Ship time for four cruises annually with the capability of near-ice work. Ideally, a means of transportation onto the ice should be available (helicopter - 20 hours in fall, 40 hours in spring), and the ship should have technical personnel on board with diving capability. Small boat capability is also needed. These cruises should be approximately two-week cruises.

Work Unit 174 WORK STATEMENT

I. TITLE: Baseline Studies of Demersal Resources of the Northern Gulf of Alaska Shelf and Slope: An Historical Preview.

II. PRINCIPAL INVESTIGATORS: Dr. Walter T. Pereyra
Lael L. Ronholt
Steven E. Hughes

III. GEOGRAPHIC AREA AND INCLUSIVE DATES: Northern Gulf of Alaska
July 1, 1975 - September 30, 1976

IV. COST SUMMARY (exclusive of ship time):

	NMFS Contribution ($1000)	BLM Contribution ($1000)	TOTAL ($1000)
FY 1976 (7-1-75 to 9-30-76)		35	

V. PROPOSED RESEARCH:

A. Background and objectives

The proposed BLM/OCS work represents a subset of the Northwest Fisheries Center's MARMAP, Gulf of Alaska Groundfish and Foreign Fisheries Observer Program. As such, many of the needs of the proposed BLM/OCS research can be met through specialized analysis of the data generated by these ongoing MARMAP Tasks, in addition to analysis of other data bases existing at the Northwest Fisheries Center, e.g., historical Japanese catch and effort statistics. BLM support is needed primarily to allow the MARMAP survey effort to be augmented to satisfy BLM/OCS objectives, to analyze existing data bases, to complete a historical baseline information inventory, and to prepare final reports.

1. TASKS OF PRIMARY AND SECONDARY EMPHASIS IN PROPOSED RESEARCH.

Task A-13--Summarize existing literature and unpublished data on the distribution, abundance, and productivity of demersal fish, shellfish.

Task A-14--Determine the distribution and abundance of demersal fish, shellfish, and other epibenthic organisms. Estimate the productivity, length, weight, and age distributions of selected demersal fish and shellfish, to develop growth models and provide a data base against which later changes in these parameters may be compared.

2. PRESENT STATE OF KNOWLEDGE IN THIS AREA.

A comprehensive survey of demersal resources in the Northern Gulf of Alaska was completed by the International Pacific Halibut Commission with cooperation from the (then) U.S. Bureau of Commercial Fisheries during 1961-63. A number of less ambitious survey efforts preceded and followed the Halibut Commission survey, but nothing approaching the scope of this operation has taken place until the present plans were formulated. During the years since 1963, however, large fisheries by Japan and the Soviet Union have brought considerable fishing pressure to bear on the demersal resources. Fishery scientists of the United States, Japan, and the Soviet Union have agreed informally that some of the resources have been endangered by the combined fishing effort during the past 15 years.

Japan has furnished systematic and detailed statistical information on her catches, fishing efforts and size compositions, but the data supplied by the USSR are much less refined and of questionable accuracy.

3. OBJECTIVES OF PROPOSED RESEARCH.

a. Provide an historical perspective on the demersal fish and shell fish resources residing in the continental shelf and slope waters of the Gulf of Alaska between the Semidi Islands and Yakutat Bay.

b. Provide growth and age composition information in selected demersal fish species of importance to man as food resources.

4. EXTENT OF WORK COMPLETION BY SEPTEMBER 30, 1976.

By September 30, 1976 reports will have been completed on (1) the historical data inventory and (2) growth and age composition of selected species in the baseline area. A schedule of activity and major events is shown in Figure 1. However, a report covering the first year's activity will be submitted by August 1, 1975, and amended thereafter.

5. RELATED RESEARCH AND COOPERATION.

The proposed research is concerned with data that has already been collected.

B. Methods

1. HISTORICAL DATA

Along with a review of the biological literature, existing data bases will be examined to provide historical perspective to the status of demersal populations in the baseline period. Existing data sources to be examined include:

a. International Pacific Halibut Commission (IPHC) trawl survey (1961-63).

b. BCF scallop surveys

c. NMFS/BCF groundfish surveys

d. ADF&G domestic catch statistics

e. Foreign fisheries statistics including catch and effort data from the Japanese fishery (1964-73).

f. U.S. Foreign Fisheries Observer Program (1972-74).

g. IPHC halibut fishery catch-effort statistics

Additional data obtained from these sources will also be analyzed for inclusion in the proposed study.

2. GROWTH AND AGE COMPOSITION.

Age indicator structures collected during the BLM funded demersal fish and shellfish survey in April to August 1975 will be read for age. From age and length data, estimates of growth parameters and age composition will be made on selected species. Growth note parameters (L_∞, K, and t_0) described by Von Bertalanffy (1938) will be determined by the method of Fabens (1965).

3. SAMPLING PLAN

(No field activities scheduled)

4. SPECIES

The species of demersal fish and shellfish that will be included in the historical survey are listed below:

*Pacific pollock (Theragra chalcogramma)
*Dover sole (Microstomus pacificus)
Rock sole (Lepidopsetta bilineata)
*Flathead sole (Hippoglossoides elassodon)
Pacific halibut (Hippoglossoides stenolepis)
*Pacific cod (Gadus macrocephalus)
Sablefish (Anoplopoma fimbria)
Pacific ocean perch (Sebastes alutus)
*Arrowtooth flounder (Atheresthes stomias)
*Rex sole (G. zachirus)

King crab (Paralithodes)
Dungeness crab (Cancer magister)
Snow crab (Chionoecetes opilio, C. bairdi)

Growth and age compositions estimates will be given for the above species marked with an asterisk.

Criteria used for selecting species and their priorities is based on their importance as human food resources.

VI. INFORMATION PRODUCTS: The final report to BLM scheduled for September, 1976 will include the following outputs:

A. Comparison of information in the distribution and abundance of demersal fish and shellfish from the baseline survey of the North Pacific in 1975 with historical information from the literature and existing data sources (e.g. the International Halibut Commission travel surveys in 1961-1963 and those of the NMFS in the early 1960's).

B. Historical treatment of the foreign and domestic fisheries and research in demersal resources in the baseline study area (continental shelf and slope waters from Semidi Islands to Yakutat Bay). This treatment would include annual catch trends, changing emphasis by the fisheries on specific resources, and the condition of resources past and present.

C. Annotated bibliography on the demersal fish and shellfish resources residing in the baseline study area.

D. Estimates of growth rate and age composition of selected demersal fish species in the region between Cape Cleare and Yakutat Bay. These estimates would be based on age data collected during the BLM funded survey by the chartered commercial trawler, North Pacific, in the spring and summer of 1975. Age data from this survey would be submitted separately in ADP format.

VII. DATA OR SAMPLE EXCHANGE INTERFACES: Not applicable.

VIII. SAMPLE ARCHIVAL REQUIREMENTS

ADP cards having length and age data for selected fish species would be stored at the NWFC by cruise number and vessel. Structures (otoliths, scales) used for aging fish would be archived by cruise number and by species.

Copies of age data will be submitted to the Juneau Project Office upon completion of age data analysis. Data documentation form 24-13 will accompany these copies. In addition, data will later be submitted to the Project Office on magnetic tape in the format requested in the Data Management Instructions.

IX. SCHEDULE (see Figure 1).

X. EQUIPMENT REQUIREMENTS: (none required)

XII. COST:

FY 1976 (Based upon 15-month period, 7-1-75 to 9-30-76)

	MARMAP CONTRIBUTION	BLM	TOTAL
1. Personnel (including benefits and OT)	75	19	91
2. Travel		2	2
3. Equipment and Supplies	1	1	2
4. Contracts	--	--	--
5. Data Processing	1	2	3
6. Indirect 1/	15	11	26
Total	92	35	127

1/ MARMAP - 20% of direct labor; BLM - 55% of direct labor.

2/ Part of salary, travel and equipment costs related to demersal fish and shellfish survey cruise of North Pacific that extended into FY 76 and could not be charged to FY 75 funds.

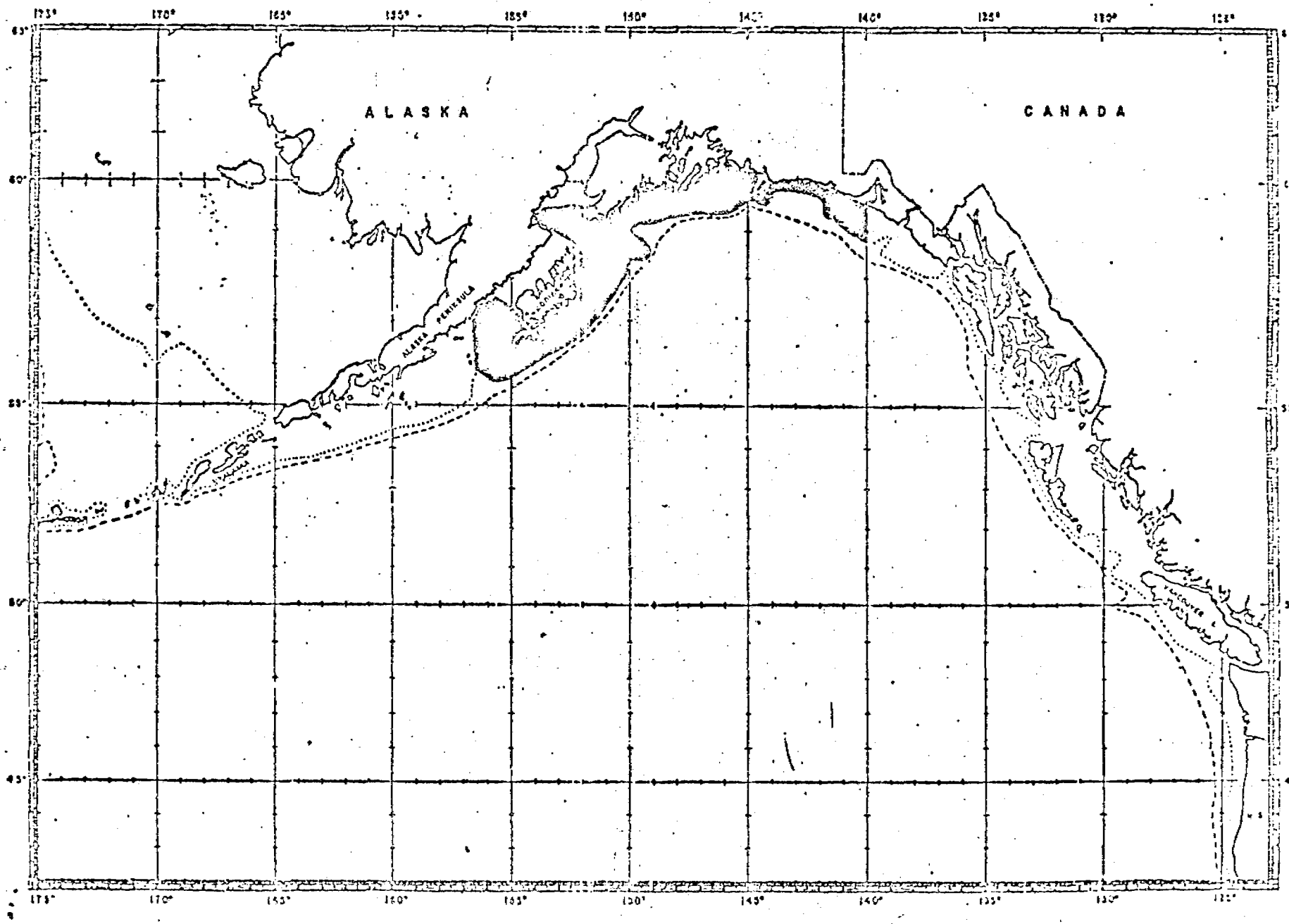
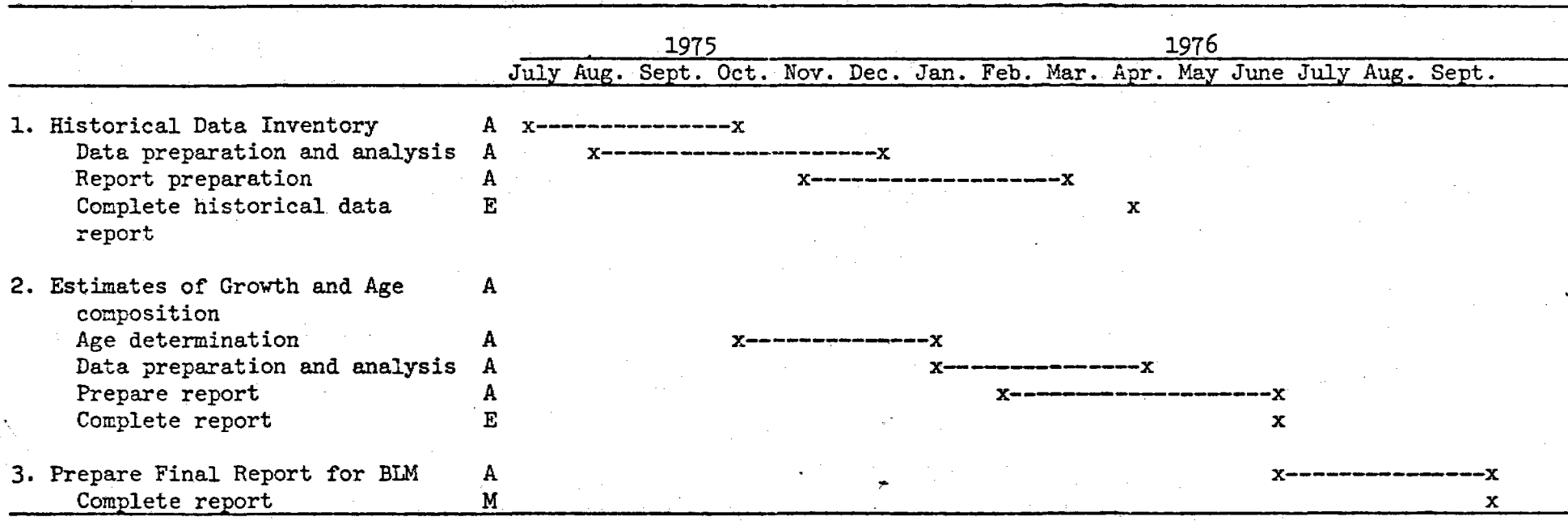


Figure 2.--NEGOA Demersal Fish and Shellfish Study Area

Figure 1.--Major task activities, events and milestones, July 1, 1975 - Sept. 1976



8/11

Literature Cited

Bertalanffy, L. Von.
1938. A quantitative theory of organic growth. Human Biology 10 (2): 181-213.

Fabens, A. J.
1965. Properties and fitting of the Von Bertalanffy growth curve. Growth 29: 265-289

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Fisheries Center
2725 Montlake Boulevard East
Seattle, WA 98112

RECEIVED
AUG 1 1975
MEAP

WORK STATEMENT

Work Unit 175

Task A-13--Summarize existing literature and unpublished data on the distribution, abundance, and productivity of demersal fish, shellfish, and other epibenthic organisms.

Task A-14--Determine the distribution and abundance of demersal fish, shellfish, and other epibenthic organisms. Estimate the productivity, length, weight, and age distributions of selected demersal fish and shellfish, to develop growth models and provide a data base against which later changes in these parameters may be compared.

I. Baseline Studies of Demersal Resources of the Eastern Bering Sea Shelf and Slope

II. Principal investigators: Dr. Walter T. Pereyra, Dr. Jerry E. Reeves, and Richard G. Bakkala.

III. Eastern Bering Sea: April 1, 1975-Sept. 30, 1976.

IV. Cost Summary (exclusive of ship time):

	MARMAP contribution	BLM contribution	Total
FY 1975 (through June 30, 1975)			
Demersal fish	80,000	25,000	105,000
Epibenthos	37,000	9,000	46,000
FY 1976 (July 1, 1975-Sept. 30, 1976)			
Demersal fish	635,000	128,000	763,000
Epibenthos	259,000	53,000	312,000
Total	1,011,000	215,000	1,226,000

V. Proposed Research

A. Background and Objectives

The proposed BLM/OCS work represents a subset of the Northwest Fisheries Center's MARMAP, Bering Sea Groundfish and Crab Assessment Tasks, and Foreign Fishery Observer Program. As such, many of the needs of the proposed BLM/OCS research can be met through specialized analysis of the data generated by these ongoing MARMAP Tasks, in addition to analysis of other data bases existing at the Northwest Fisheries Center. BLM support is needed primarily to allow the MARMAP II survey effort to be augmented to satisfy BLM/OCS objectives, to analyze existing data bases, to complete a historical baseline information inventory, and to prepare final reports.

Knowledge pertaining to demersal fish of the eastern Bering Sea is sketchy. Some scientific literature is available on commercially important species but these studies have normally dealt with a single season and only a portion of the species distribution. Biological information has usually been inadequate to fully describe population parameters from any single species. In addition, many of these studies date back to the early and mid-1960's. Thus, although these studies are of value in providing historical perspective to some current population parameters, they do not provide a complete description of the species distribution and population attributes at any point in time nor provide information on the recent condition of stocks.

The large Japanese and Soviet trawl fisheries for demersal fish and shellfish in the eastern Bering Sea have caused research programs to be

initiated in this region. Basic catch, size and in some cases, age data are available from Japanese and U.S. studies but much of the information still requires analysis. These research surveys have been mainly limited to the summer season and to the southeast portion of the Bering Sea.

Similarly, knowledge of the distribution and abundance of shellfish is confined primarily to this region and to the commercially important species. An information base exists for species of king and Tanner crab from commercial catch records of U.S. and Japanese fishing fleets and from research surveys conducted by the U.S. and the U.S.S.R. For the king crab, Paralithodes camtschatica, extensive literature exists on the life history of the species and some information on growth and mortality. Less extensive information is available in this area for gastropod species exploited by the Japanese as well as other unexploited invertebrate species. Information on shellfish and other epibenthic invertebrates in the northern half of the proposed survey area is almost totally lacking.

Catch, effort, and size data for commercially important species of fish taken by the Japanese commercial trawl fishery in the eastern Bering Sea has been made available to the United States since 1964. United States observers have also collected biological data on major species of fish and crabs in this fishery since 1972. Analysis of commercial trawl and observer data is current and provides some insight into the present status of major commercial species.

Task Objectives:

1. To describe the composition, distribution, and abundance of demersal fish, shellfish, and principal epibenthic invertebrate resources

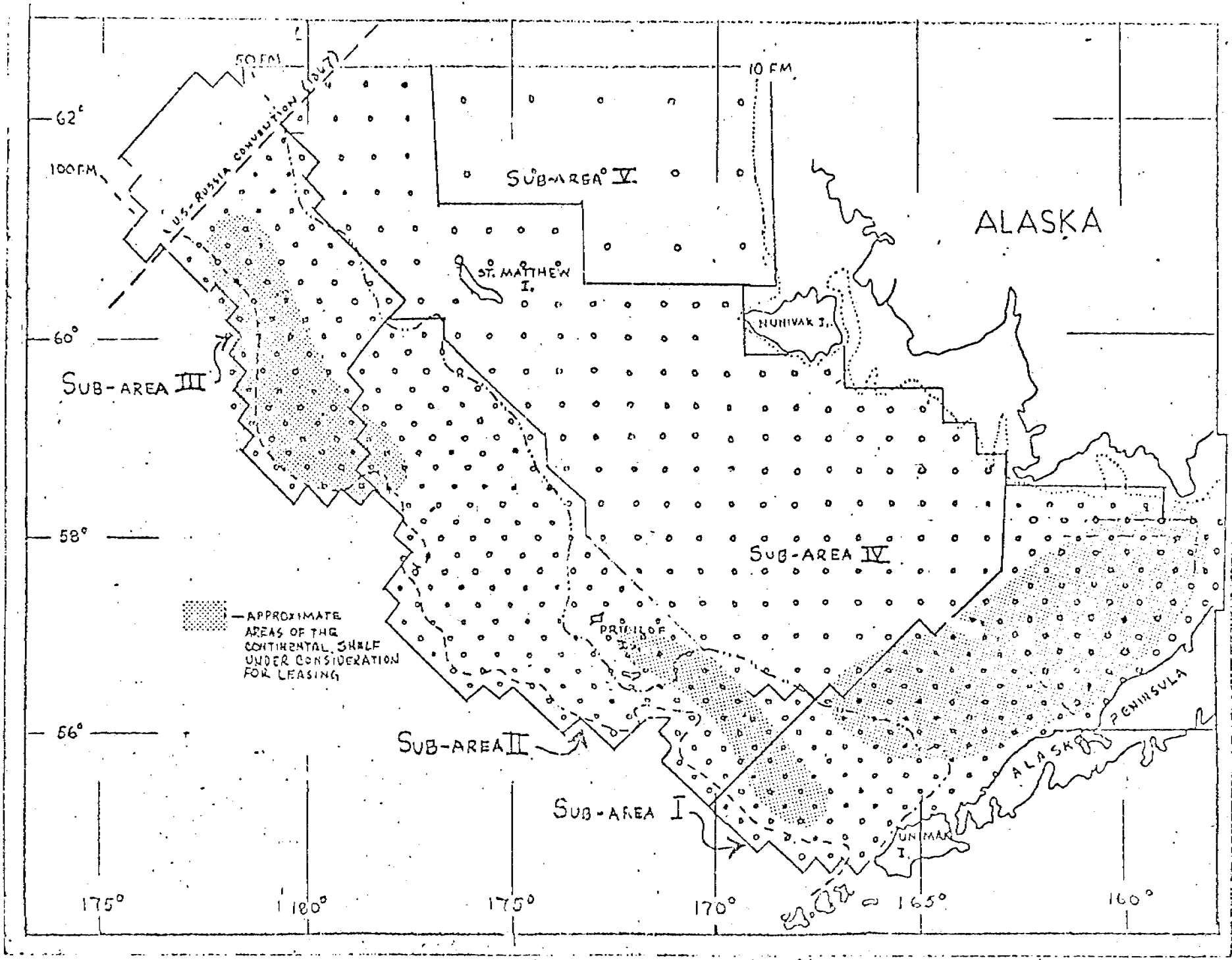
of the eastern Bering Sea by season (spring and summer) and within season by area and depth.

2. Establish for selected demersal fish and invertebrate populations, parameters which could change because of environmental stresses; e.g., stock size, size and age composition, growth rates, and length-weight relationships.

3. Compare information from the baseline period with historical information available from the literature and existing data sources.

To meet baseline objectives trawl surveys will be conducted in August and September, 1975 and April to mid-June, 1976. Stations will be fished on the shelf and slope areas of the eastern Bering Sea (Figure 1). The summer survey will be more extensive than the spring survey and will be conducted using the NOAA research vessel, Miller Freeman, and two chartered commercial trawlers. Unless MARMAP increases occur, the spring survey will be done by the Miller Freeman and the NOAA vessel Oregon only. All fish and principal epibenthic organisms in the catches will be identified and their weights and numbers recorded--catches of selected species will be subsampled and lengths, weights, sex, and maturity recorded and age structures taken at each station with adequate numbers of specimens. The duration and distance of the hauls, depth of fishing, surface and bottom temperatures, and bottom type will also be recorded.

It is anticipated that all requirements for baseline information will be met and reported on by September, 1976. This assumes that vessel needs are met and the vessels are able to operate without breakdown throughout the survey periods. However, a report covering the first years activity will be submitted on August 1,1976 and amended thereafter.


50 FM
10 FM
62°
100 FM
U.S.-RUSSIA CONVENTION LINE (1867)
SUB-AREA V.
ALASKA
ST. MATTHEW I.
NUNIVAK I.
60°
SUB-AREA III
58°
SUB-AREA IV
APPROXIMATE AREAS OF THE CONTINENTAL SHELF UNDER CONSIDERATION FOR LEASING
PRIBILOF I.
PENINSULA
56°
SUB-AREA II
ALASKA
SUB-AREA I
UNIMAK I.
175°
180°
175°
170°
165°
160°

The surveys will assist other related programs (studies on benthos, food webs, pathological baseline, and natural limits of potential contaminants) by providing platforms for scientists to conduct these studies or through collection of samples provided by trawl catches. Methods of data collection for demersal fish and shellfish will be the same as that used by NEGOA so that common data processing methods and computer programs can be used.

B. Methods

1. Use of published and unpublished material--In addition to a review of the biological literature, existing data bases will be examined for information to extend that obtained in the baseline period back to previous years. These data sources are:

(a) Annual U.S. crab survey (1965-70) and joint crab-groundfish surveys (1971-75).

(b) IPHC juvenile halibut trawl surveys (1963, 1965 to date).

(c) Japanese research survey (1966-71).

(d) ADF&G domestic catch statistics.

(e) Foreign fisheries statistics including catch, effort and size information from the Japanese commercial fishery (1964-73).

(f) U.S. Foreign observer program (1972-74).

The formal literature will mainly contribute historical information on life history, size and agecomposition, and growth parameters for certain important commercial species. These data in some instances predate the period of intensive harvest of the resources.

The above data sources collectively will provide for years preceding the baseline period information on species composition, distribution of species, size and age composition, and growth parameters. Biomass estimates will also be available for some species from the U.S. crab-groundfish survey for 1971-75 in the southeastern Bering Sea.

Each of these data sources cover certain portions of the eastern Bering Sea and thus only have application to the baseline data in these areas. Other limitations of these data sources are the wide variation in the types of fishing trawls and vessels used and in the types of data collected.

2. Sampling plan--The proposed survey sampling plan for the Bering Sea area of interest to BLM was designed around the following operational objectives:

(a) Coverage at two seasons of the year when population movements have somewhat stabilized and populations are at the seasonal extremes of their distribution, i.e., early spring (April-mid-June) and late summer (August-September). As mentioned before the extent of the spring coverage of the area in 1976 will be dependent on MARMAP funding increases.

(b) Surveys conducted over a reasonably short time span, i.e., about two months, to provide synoptic coverage at depths from 15 to 200 fathoms; and,

(c) All sampling done during daylight hours to accommodate diurnal movements of fish.

Study area would be divided into five subareas (Figure 1):

Subarea I - near-shore waters (less than 20 fathoms) along the north side of the Alaska Peninsula and in Bristol Bay, where oil exploration

might have the greatest environmental impact.

Subarea II - site of proposed oil exploration and region of main concentrations of adult king crab, Tanner crab, and pollock and spawning-nursery area for these and other species.

Subarea III - another area of possible oil exploration and location of major summer concentrations of pollock.

Subarea IV and V - nursery areas for many of the adult populations residing in Areas I, II, and III.

A stratified-systematic sampling design will be used for the baseline trawl surveys. Station densities will vary depending on the location of main concentrations of the more important species, the most probable location of oil lease sites, and areas with a high potential for environmental impact. Densities are lowest (one per 1600 square miles) in Subarea V, where the abundance of demersal species is lowest. Station densities are increased to one per 400 square miles in Subarea IV which is a nursery area for many of the commercially important species. For Subareas II and III where major concentrations of adult fish and shellfish reside, and which contain potential sites of oil leases, station densities are further increased to one per 250 square miles. The highest station density, approximately one per 125 square miles, will be used in Subarea I, involving near-shore waters (less than 20 fathoms) along the north side of the Alaska Peninsula and in Bristol Bay, where there is a high potential for environmental impact from the oil and gas exploration and development activities.

All subareas will be surveyed during the August-September (1975) period but only Subareas I and II and the southern part of Area IV will

be surveyed in the spring of 1976.

The timing of the spring survey (April and May) is designed to provide information on the more restricted winter-spring distribution of species relative to their broader summer distribution and to sample pollock in their spawning season.

The trawl surveys will follow MARMAP II procedures. A commercial-type trawl (modified 400-mesh Eastern trawl) will be fished for one-hour periods. Catch composition in numbers and weight will be determined and for selected species, size, sex, weight, and maturity data taken and age structures collected. XBT casts would be made for vertical water temperature profiles.

3. Sampling adequacy--Sampling adequacy (one station per 250 square miles or greater) in the more critical areas is designed to provide relative abundance estimates within approximately ±30% or better of the seasonal mean value (Grosslein, 1971).

Comparative fishing experiments will be conducted to adjust catches for differences in fishing power between survey vessels (Robson, 1966).

Within-block sample variance will be measured by multiple trawl hauls in certain blocks, the location of which will be determined by the various density levels of selected species.

Catch data will be transformed, as necessary, to satisfy statistical assumptions. A determination of the transformation used (log or square root) will be based on the relationship between sample means and variances.

4. Species studied--All species of demersal fish, shellfish, and other epibenthic organisms evaluated will be weighed and enumerated or estimates of these made from subsamples. Species of fish for which size, age, sex and maturity data will be taken are listed below in order of priority.

Pacific pollock (Theragra chalcogramma)
Yellowfin sole (Limanda aspera)
Rock sole (Lepidopsetta bilineata)
Flathead sole (Hiproglossoides elassodon)
Pacific halibut (Hippoglossus stenolepis)
Pacific cod (Gadus macrocephalus)
Sablefish (Anoplopoma fimbria)
Pacific ocean perch (Sebastes alutus)
Arrowtooth flounder (Atheresthes stomias)
Alaska plaice (Pleuronectes quadrituberculatus)
Greenland turbot (Reinhardtius hippoglossoides)

Shellfish species receiving major emphasis in the study are red king crab, Paralithodes camtschatica, blue king crab, P. platypus, and the Tanner crab, Chionoecetes bairdi and C. opilio, and several genera of snails the most abundant of which are Neptunea, Buccinum, Volutopsius, Fusitriton, Beringius, and Plicifusus. Potentially latent resources which will also receive major emphasis are golden king crab, Lithodes aquispinis, and Korean hair crabs, Erimacrus isenbeckii. Data to describe the distribution, abundance, size and for age composition and other population parameters will be collected for these species. Gross information on distribution and abundance will be collected for other invertebrates encountered such as the sea anemone (class Coelenterata), other crabs (class Decapoda), nudibranchs (order Nudibranchia), clams (class Pelecypoda), starfish (class Asteroidea), sand dollars and sea urchins (class Echinoidea), basket stars and brittle stars (class Ophiuroidea), sea cucumbers (class Holothuroidea), sponge (phylum Porifera) and sea pen (class Chordata).

Criteria used for selecting species and their priorities is based on their current importance as human food resources or those having latent potential.

5. Analysis of data--Computer programs will be developed to analyze data and illustrate results by computer graphics. Formats of data collection forms will allow direct punching to ADP cards. Programs will be developed to list species composition by weight and numbers by station or summarized over stations by area and depth strata. They will also provide charts of distribution and density of species. Length frequencies will be expanded to total catches to provide size composition information and age length keys developed to convert size composition to age composition.

The growth rate parameters (L_∞, K, and t_0) described by Von Bertlanffy (1938) will be calculated for selected species of fish by the method of Fabens (1965).

Biomass estimates will be obtained based on the "area swept" technique of Alverson and Pereyra (1969). Tracklines will be planned to have vessels fish alternating rows of stations, so that each vessel will fish the entire survey area and independent estimates of standing stock and associated variance will be available from catches of each vessel. Both independent and combined estimates of biomass will be made by subarea and for the total area by age group and for age groups combined.

Analyses will generally follow procedures established from the current theory of population dynamics (Ricker, 1958; Seber, 1973; Gulland, 1969).

VI. Information Products

A. Computer listings of species composition by weight and numbers by station and summarized by area and depth strata.

B. Computer charts showing the distribution and density of species.

C. Charts illustrating the size and age composition of more important species by area and depth.

D. Growth rate parameters for selected species.

E. Biomass estimates for selected species by subarea and for the total area by age group and age groups combined.

VII. Data or Sample Exchange Interfaces

Hydrographical and sediment-type distribution information and results of feeding dependency studies are requested. It would be desirable to have this information by July, 1976.

VIII. Sample Archival Requirements

Archiving of materials and data will be accomplished at the Northwest Fisheries Center and the Center's Kodiak Facility.

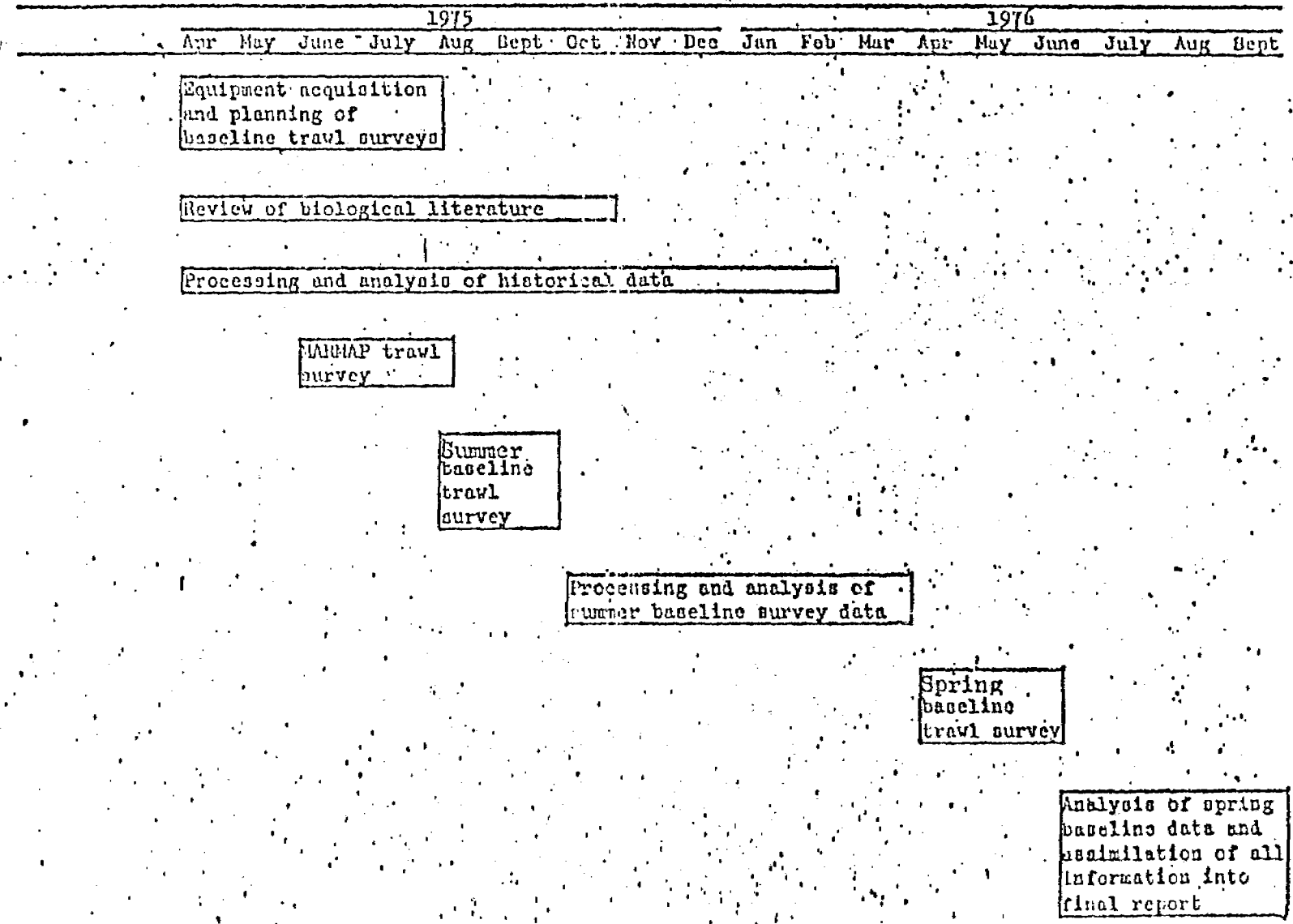
XI. Schedule

See Table 1.

X. Equipment Requirements

	Description	Number	Date Needed
A.	Otter trawls and accessories	6	July 1, 1975
B.	6' x 9' otter boards	2 pair	July 1, 1975
C.	Catch sampling and handling gear	--	July 1, 1975

Table 1.--Task activities and events during 18-month study period.



Description	Number	Date needed
D. XBT systems	2	July 1, 1975
E. Wireless netsonde		
F. Resupply of above needs if required for spring survey		

XI. Logistics Requirements

As mentioned in B2, two synoptic trawl surveys of the Bering Sea south of 63°N are proposed during the 18-month study period. A three-vessel synoptic trawl survey of the eastern Bering Sea (Figure 1) is proposed for the summer (August-October, 1975) period using the NOAA research vessel, Miller Freeman, and two chartered commercial trawlers. The spring survey would be less extensive in coverage since only two vessels, the Miller Freeman and the R/V Oregon, would be used. If sufficient increase occurs in MARMAP funding, additional vessel(s) would be chartered for the spring survey period. The vessels involved, survey periods, and funding sources follow:

	Survey Time				
Vessel	Dates	No. Days	No. 1/ Days Other	Total	Operational Support
Oregon	6/1 - 8/12/75	70	5	75	MARMAP Base
Miller Freeman	8/1 - 10/2/75	63	10	73	BLM/MARMAP Increa
Charter	8/1 - 10/3/75	64	14	78	BLM
Charter	8/1 - 10/3/76	64	14	78	BLM
Oregon	6/1 - 8/14/76	100	10	110	MARMAP Base
Miller Freeman	4/1 - 6/3/76	64	14	78	BLM/MARMAP Increa

1/ Includes time required for staging and for running to survey area.

The above projection of vessel needs was based upon the following assumptions:

(1) BLM support available for two 78-day charters (approximately $312,000;

(2) Miller Freeman available for summer, 1975 survey, and spring, 1976 survey; and

(3) Trawl sampling is the primary mission of these surveys and any piggy-back operations do not compromise this mission in time and area.

LITERATURE CITED

Alverson, D. L. and W. T. Pereyra, 1969. Demersal fish explorations in the northeastern Pacific Ocean--An evaluation of exploratory fishing methods and analytical approaches of stock size and yield forecasts. J. Fish. Res. Bd. Can., 12(8): 1,985-2,001.

Fabens, A. J. 1965. Properties and fitting of the Von Bertalanffy growth curve. Growth 29: 265-289.

Grosslein, M. D. 1971. Some observations on the accuracy of abundance indices derived from research trawl surveys. International Commission for the Northwest Atlantic Fisheries Redbook 1971, Part III, 249-266.

Gulland, J. A. 1969. Manual of methods for fish stock assessment. FAO Manual in Fisheries Science, No. 4, 154 p.

Ricker, W. E. 1958. Handbook of computations for Biological statistics of fish populations. Bull. Fish. Res. Bd. Can., No. 119, 300 p.

Robson, D. S. 1966. Estimation of the relative fishing power of individual ships. International Commission for the Northwest Atlantic Fisheries, Res. Bull. No. 3: 5-14

Seber, G. A. F. 1973. The estimation of animal abundance. Hafner Press, 506 p.

Von Bertalanffy, L. 1938. A quantitative theory of organic growth. Human Biology 10 (2): 181-213

WORK STATEMENT

I. Title: Beaufort Sea Estuarine Fishery Study

II. Principal Investigator:

Eugene A. Roguski
Fishery Biologist
Sport Fish Division
Alaska Department of Fish and Game
1300 College Road
Fairbanks, Alaska 99701

III. Geographic Areas and Inclusive Dates:

Beaufort Sea near shore estuarine environment between Harrison Bay and Flaxman Island. Field work will commence on July 1, 1975 and will continue until September 30, 1976.

IV. Cost Summary (Including Logistics)

FY 1975 through June 30, 1975	FY 76 July 1, 1975 - September 30, 1976
$98,000	$65,100

It will be too late to initiate field work during FY 75 but prior to FY 76 equipment monies are needed so that necessary equipment can be purchased and shipped to the study area for field work commencing in July, 1975. Monies must also be available in FY 75 for hire of study personnel.

V. Proposed Research:

A. Background and Objectives

There are approximately 71 species of marine and estuarine fishes found in the Beaufort and Chukchi seas, representing 13 families. Of these, 19 species are also found in freshwater. As is typical of Arctic fauna, species diversity is low. However, individual species are commonly very abundant.

Knowledge of fish in the Beaufort Sea is minimal at present. A search of the literature indicates that fisheries research in the Beaufort Sea has been restricted to stenohaline and euryhaline species of

the near shore areas, mainly the area adjacent to Barrow and in the estuarine environment inside the barrier islands along the eastern shore of the Beaufort Sea. To date, this research has amounted to cursory surveys. No in-depth or long term studies have been conducted.

The Beaufort Sea is characterized by two distinct fisheries habitats, the off-shore marine water and near-shore brackish areas. These two areas differ in salinity, temperature, dissolved oxygen, chemical nutrients, primary productivity, marine invertebrates and fish species.

At least two near-shore habitat zones exist. One is unprotected coastal area with a bottom that drops off rather rapidly northward and salinities closer to normal sea water. This habitat is found from Cape Simpson to the mouth of the Colville River and at Camden Bay.

A second near-shore habitat consists of a narrow band of water isolated from the sea environment by a network of barrier island lying 1-15 miles north of the mainland coast.

The input of freshwater by large rivers emptying into the area inside the barrier islands has a major influence on the aquatic environment and faunal life. The lagoon areas are shallow (less than 25 ft.) and of low salinity (1-25 ppt). Much of the area is less than 6 meters deep and ice is frozen to the bottom for most of the year. As ice forms it restricts circulation, creating troughs and pockets of hypersaline water, less than 0°C and probably deficient in oxygen. Ice scouring is prevalent in the shallow areas. Due to these factors invertebrate in-faunal populations are prevented from establishing in shallow waters. But mobil epifaunal species do move into these areas during the summer, to provide forage for large numbers of fish.

The purpose of this study is to research fish life within the near-shore environment, protected by barrier islands, which exists between the mouth of the Colville River and Canning River.

Objectives:

1. To determine the seasonal distribution, relative abundance, size and species composition, growth rates, feeding habits, and reproductive capabilities of Beaufort Sea near-shore fishes in the area from the Colville to Canning rivers and between shore and the barrier islands, including river deltas.

2. To determine the migration patterns and timing of these fishes.

3. To identify critical habitats including spawning, overwintering, feeding, rearing, and migration areas.

4. To determine the interrelationship of Arctic fishes to lower food-web organisms.

5. To determine the present rate of exploitation of the anadromous fishes of the area and to monitor changes in this useage as development of the area's petroleum resource progresses.

Elements of the following tasks will be responded to in this study:

A-9 Determine the food dependencies of commonly occurring species of pelagic fish to establish ecological relationships and provide a data base against which later changes in feeding may be ascertained.

A-12 Determine distribution, relative abundance, and migratory route of Arctic, Yukon, and Kuskokwim stocks of salmonids (i.e. salmon, char, shoefish, and whitefish).

A-14 Estimate the distribution, abundance, and productivity of demersal fish. Determine the length, weight, and age distributions of selected demersal fish, to develop growth models and provide a data base against which later changes in these parameters may be compared.

A-15 Determine food dependencies of commonly occurring demersal fish to establish ecological relationships and provide a data base against which later changes in feeding may be ascertained.

A-25a Identiy and characterize critical regions and habitats required by egg and larval stages of fish and shellfish species, especially those of commercial or ecosystem importance.

Exceptions to A-9, 12, 14, and 15 are that all fishes inhabiting the study area will be studied; the study will not be limited to demersal, pelagic or salmonid fishes.

The exception to A-25 is that habitat requirements of adult fish, as well as those of egg and larval stages will be studied.

Field work to accomplish the above objectives will continue through September 1976.

B. Methods:

As stated above, data on the fishes of the study area are meager, but those existing data will be reviewed for possible usefulness in directing timing of sampling by various methods.

Standard fishery research techniques will be used. Fish samples will be collected using gill nets, beach seines, fyke nets, traps, and trawls.

Objective 1 will be accomplished by sampling fish populations at selected locations throughout the year, including under ice sampling in the winter. Non-selective gear will be used.

Objective 2 will be accomplished by live tagging fish at selected locations and monitoring movements throughout the study area.

Objective 3 will be accomplished by correlating important life history and habitat requirement knowledge gained in the early phase of this study with the identification of preferred habitat types within the study area.

Objective 4 will be accomplished through fish food habit studies which will be an integral aspect of fish life history.

Objective 5 will be accomplished by spot checks at known sport, subsistence, and commercial fishing sites along the Beaufort Sea coast. Most observations can be made concurrent with other aspects of the study.

VI. Information Products

1. Digital data on magnetic tape suitable for EDS processing and storage. Data to include seasonal density distributions of principal life history stages, growth information, trophic information, migration timing and pattern, and reproductive information.

2. Narrative, including figures, graphs, and tables, summarizing methods, results, and giving conclusions regarding possible agents of petroleum development and their action on the fish-related section of the ecosystem. Recommendations for further research, with rationale, will also be furnished. The present rate of fishery exploitation of the inshore area will also be evaluated.

VII. Data or Sample Exchange Interfaces:

It is anticipated that all data and samples pertinent to this study will be collected within the framework of the study. Data or samples requested by other researchers will be provided whenever possible, consistent with the limitations of this study.

The products of this research will be required by resource managers, persons involved in the preparation and evaluation of environmental impact statements, and persons involved in the decision making processes relating to when, where, and how off-shore development is to proceed. It is also anticipated that information will have intrinsic scientific value as well as use in the construction of ecological models.

VIII. Sample Archival Requirements:

No special archival requirements are anticipated.

IX. Schedule:

Field work will begin in July, 1975. Data aquisition and sampling will continue throughout the year, including winter sampling, until September 1976. Samples requested by other researchers will be made available to them as soon as practicable upon acquisition. Analysis of data will proceed both in the field and laboratory concurrently with acquisition.

X. Equipment Requirements:

The following special equipment must be purchased and deployed as soon as possible upon approval and funding of the study.

a.	26'-27' Copper River gill netter	$ 3,500
b.	Inboard-outboard 150 hp engine	5,000
c.	20 - 125' x 6' gill nets	4,000
d.	Radar	2,500
e.	Recording fathometer	1,500
f.	Radio	1,000
g.	10' bait trawl and engine	1,000

h.	16' Boston Whaler	2,500
i.	Outboard motor	1,000
j.	12' Avon raft	700
k.	7 1/2 hp outboard motor	600
l.	Triple beam balance	100
m.	Nansen bottles	500
n.	Bathythermograph	500
o.	Limnological analysis equipment	300
p.	Miscellaneous equipment	3,000
Total		$27,700

XI. Logistics Requirements

Logistics is the most crucial element in conducting a study such as this. Thus, we intend to provide for all of our own logistics requirements with no dependence on NARL for transportation or support. Both helicopter and fixed-wing aircraft needs will be met through commercial charter and costs have been included in contractural services cost estimates. Surface transportation will be principally by boats - of the types indicated in the equipment list.

June 30, 1975

FINAL

ALASKA MARINE ENVIRONMENTAL ASSESSMENT PROGRAM
WORK STATEMENT (Research Unit #281)

I. Title: The Distribution, Abundance, Diversity, and Productivity of Benthic Organisms in the Gulf of Alaska.

II. Principal Investigator:

Howard M. Feder, Professor
Institue of Marine Science
University of Alaska
Fairbanks, AK 99701
SS#: 548-38-8943

III. Geographic Area and Inclusive Dates:

Gulf of Alaska: July 1, 1975 through September 30, 1976.

IV Cost Summary:

FY1975 through June 30, 1975	FY1976 July 1, 1975 - Sept 30, 1976
	$215,629

V. Proposed Research:

A. Background and Objectives:

This proposal addresses itself to Task A-18.

Little is known about the biology of the benthos of the Gulf of Alaska, although a compilation of some relevant data on the Gulf of Alaska is available (Rosenberg, 1972). Some scattered data based on trawl surveys by the Bureau of Commercial Fisheries is available, but most of the information on the invertebrate fauna is so general so as to have little value. Some information on the epifauna is available (i.e., Alaska Department of Fish and Game King Crab Indexing Surveys in the vicinity of Kodiak Island). The result of the benthic investigations of Feder and Mueller (1974) in the first year of the OCS studies in the Gulf will represent the first intensive examination of the biota of the benthic infauna and epifauna of the Gulf of Alaska.

Data collected in the first year of the OCS study in the Gulf will serve as a springboard and an intensive data base for the studies in 1975-76. Additional data will be collected in the cruises of 1975-76 and will set the basis of analysis needed to meet the task objectives. Additional information obtained by way of the literature search (Task A-17) will probably uncover some data which will aid in the interpretation of the biology of the organisms to be studied.

The objectives of this study are:

1) A qualitative and quantitative inventory census of dominant benthic species within the identified oil-lease sites.

2) A description of spatial and seasonal distribution patterns of selected species in the designated study areas, with emphasis on assessing patchiness and correlation with microhabitat.

3) A preliminary comparison of the distribution of dominant species with physical, chemical and geological features with emphasis on the latter parameter.

4) Preliminary observations of biological interrelationships between selected segments of the benthic biota in the designated study areas.

B. Methods

All of the stations occupied in the first year of the benthic program will be sampled in the second year. Additional stations will be chosen, as necessary, to provide better spatial coverage within the entire study area and also to examine specific details of distribution of particular species relative to environmental parameters (e.g. sediment distribution or bathymetric irregularities). A maximum of 60 stations will be occupied on two (2) to three (3) separate occasions (mid-summer, late fall, mid-spring). Sampling will be expanded to encompass the lease area to Unimak Pass. Five Van Veen grab samples ($0.2m^2$) are planned for each station occupied with at least 5 stations planned for statistical testing by way of approximately 10 grabs. The results of these stations will be used to determine the optimum numbers of grabs needed per station in further studies in the area. Appropriate analyses of variance will be used to test the validity of the numbers of replicates taken.

Data collected by the Trawl Survey team of the Nat. Mar. Fish. Ser. will be used to relate to the grab-sample program, and will be used to expand the understanding of the species distribution and abundance on the shelf. The stomach data analyzed by Dr. Smith will be used to initiate basic understandings of the food webs involved on the shelf, and will point to the importance of certain bottom invertebrates as key food organisms. Cod stomach data of Mr. Steve Jewett will be used extensively to further understand trophic relationships on the shelf relative to this abundant fin fish species.

In the first two years of the survey it will be possible to identify, count and weigh all species taken by way of the quantitative grab program. The most abundant species will be examined from the trawls taken by the National Marine Fisheries Service. Biologically Important Species will be chosen for examination in detail (see Feder and Mueller, 1972 for criteria of Biologically Important Species). Important invertebrate food species will be selected for special treatment. Evidence to date indicates that Annelida, Mollusca and Echinoderms will be of prime interest.

An evaluation of the information obtained via grab and trawl samples will provide a continuing and expanding list of infaunal and epifaunal species, the distribution of these species in space and time, diversity indices for the stations on the grid, and a preliminary statistical analysis of the species taken in the quantitative samples (e.g. a multivariate analysis and other appropriate types of analysis of assemblages of species in selected stations). The data will also result in an understanding of various aspects of the general biology of selected, biologically important species (criteria to be selected according to Feder and Mueller, 1972); features to be examined will be recruitment, feeding biology and food-web interactions, growth and reproductive biology. Candidates for continued monitoring will be selected on the basis of a preliminary screening at the end of the second year, and will be based on the biological information obtained in laboratory results.

VI. Information Products

1. Data representing the seasonal density, distribution and ecology of benthos life history stages. Data to be gained from sampling by trawl and bottom grab. Data where possible will be provided on magnetic tape.

2. Narrative, tables and figures describing the ecology, growth and life history of the principal benthos.

3. Conclusions and recommendations regarding research gaps and recommendations for corrective research.

VII. Data or Sample Exchange Interfaces:

1. Data from Dr. Smith on food habits of demersal fishes will be needed to initiate basic understanding of the food webs.

2. Sediment data from the U.S.G.S. will be necessary to make correlations between distribution of species and substrate characteristics.

3. Data collected by the trawl survey of the National Marine Fisheries Service will be required to supplement the grab-sample program.

VIII. Sample Archival Requirements:

Samples will be stored in the Marine Sorting Center. No provisions have been made in the work statement for long-term storage of the samples.

IX. Schedule:

Cruises are required three times per year, mid-summer, late fall, mid-spring. Four months will be required to work up samples.

X. Equipment Requirements:

Replacement grabs.

XI. Logistics Requirements:

Vessel capable of working in the Gulf of Alaska. Ship must be capable of sampling with Van Veen grab. Laboratory space with finne hood aboard vessel is required.

June 30, 1975

ALASKA MARINE ENVIRONMENTAL ASSESSMENT PROGRAM
WORK STATEMENT (Research Unit #282/301)

I. Title: Summarization of Existing Literature and Unpublished Data on the Distribution, Abundance and Productivity of Benthic Organisms of the Gulf of Alaska and Bering Sea.

II. Principal Investigator:

Dr. Howard M. Feder
Professor of Marine Science and Zoology
Institute of Marine Science
University of Alaska
Fairbanks, Alaska 99701
SS#: 548-38-8943

III. Geographic Area and Inclusive Dates:

Gulf of Alaska and Bering Sea: April 1, 1975 -- Sept 30, 1976

IV. Cost Summary:

FY 1975 through June 30, 1975	FY 1976 July 1, 1975 - Sept 30, 1976
$9,495	$88,324

V. Proposed Research:

A. Background and Objectives:

This proposal addresses itself to Task A-17.

The benthic macrofauna of the Gulf of Alaska has not been well studied, although several compilations of some of the literature are available. The benthic macrofauna of the Bering Sea is relatively well known taxonomically, and some data on distribution, abundance and feeding mechanisms are reported in the literature.

A summary of existing data, published and unpublished, for both regions is required. In addition, access to and loan of archived material is essential; contact with the necessary laboratories will be essential to workup of this material.

The literature survey can be completed by the deadline provided that sufficient travel and per diem is available in the project budget; first-hand contact with the necessary literature and data will be essential in many cases. The workup of the archive can be completed in most cases provided that the loan of the material can be negotiated early in the project period.

Presumably other investigators in the OCS projects will be compiling literature citations in reference to their own work. With the assumption that these workers may have found access to literature that

we may have overlooked, it is intended to contact all workers in these areas peripheral to benthic biology.

B. Methods:

Intensive library research will be accomplished at the University of Alaska library within the library system and by way of inter-library loans. In addition, visits will be made to the University of Washington library. An extensive search will be made for archived data by way of correspondence with museums and other agencies that might have collections harboring Gulf of Alaska and Bering Sea material. Fisheries groups that have been operating within these areas will also be contacted. The University of Alaska will attempt to acquire this material for examination.

All groups of benthic animals will be examined when made available from archived material. All benthic species will be examined in the literature search. Final decisions of importance of species will only be made as a result of the field studies.

Accepted library research techniques will be employed. Standard laboratory taxonomic procedures will be used for the archived material. Comparison with data from the field studies will be made whenever possible.

VI. Information Products:

1. Where practical, a conversion to digital form on magnetic tape of all pertinent published and unpublished data on the seasonal density, distribution, and ecology of the benthos life history stages.

2. An annotated summary of all available published data on the seasonal density distribution of benthos life history stages.

3. A list of unpublished data located but not available for analysis.

4. A list of archived materials available for analysis and an evaluation of their value to OCS objectives

5. Recommendations for further research on benthos based on a comparison of OCS objectives with the information gained in 4. above, and a narrative summary of the research.

VII. Data or Sample Exchange Interfaces

Literature compilations may be requested from other OCS investigators in closely allied fields in hope of locating literature not located by our techniques. This data will be needed throughout most of the first part of the study year. Some actual benthic data and material may be archived by other investigators, specifically the geologists of the USGS using Box Corners, and access to their thin section data might

give some vertical distribution data not otherwise available. This data and/or material could be used as soon as possible. Most of the other biologists in the OCS project should find the output of this project of interest, and would probably want such information as soon as it became available.

VIII. Sampe Archival Requirements

Literature will probably be coded suitable for recording in a key work computer system. Archived data will be recorded in the same format as that of the benthic research project output.

IX. Schedule

It is impossible to provide a detailed schedule of anticipated accomplishments. The literature survey will progress at the rate possible according to success with inter-library loans and library visitations and colleague correspondence. The archived data investigations will be dependent on time lapses for acquisition of the material. It is anticipated that the literature survey will be completed by the end of the project period. The data on the cod stomachs (material belonging to G. Powell and S. Jewett) should be completed by the end of the project period. All other archived material acquired early in the project period will be processed and completed when possible.

X. Equipment Requirements

None

XI. Logistics Requirements

None

June 30, 1975

ALASKA MARINE ENVIRONMENTAL ASSESSMENT PROGRAM
WORK STATEMENT (Research Unit #284)

I. Title: Food and Feeding Relationships in the Benthic and Demersal Fishes of the Gulf of Alaska and Bering Sea.

II. Principal Investigator:

Dr. Ronald L. Smith
Associate Professor of Zoology
University of Alaska
Fairbanks, AK 99701
907-479-7542
SS# 546-56-3254

III. Geographic Area and Inclusive Dates

Gulf of Alaska: 1 July 75 - 30 September 76
Bering Sea: 1 July 75 - 30 September 76

IV. Cost Summary:

FY1975 through 30 June 75	FY1976 1 July 75 through 30 Sept 76
	$75,163

V. Proposed Research:

A. Background and objectives

This proposal addresses itself to Task A-15. Some information exists on food habits of the fishes occurring in the Gulf of Alaska. Most of these works, however, utilized collections from areas other than the Gulf. The literature for these fishes has been summarized by Hart (1973). Other references to Alaskan fishes may be found in Quast and Hall (1972). Food habits of some of the benthic and demersal fishes of the Bering Sea have been examined by a number of Russian investigators. These include: Skalkin (1963 - flatfish diets); Shubrikov (1963 - sablefish biology); Skalkin (1964 - rockfish diets); Novikov (1964 - halibut biology); and Neiman (1964 - benthos utilization by flathfishes).

Some information which will be required to meet the task objective includes the following:

1. Location, depth, and time at which individual fishes were caught.

2. Species, sex, size, and age (if possible) of individual fishes sampled.

3. Input and coordination with Marine Sorting Center, University of Alaska, for identification of invertebrate food items.

4. Coordination with and utilization of the findings of Dr. James E. Morrow, University of Alaska, and Dr. Thomas English, University of Washington for identification of fish food items.

5. Input from Environmental Science Information Center on existing data on feeding in these fishes.

B. Methods

The sampling scheme employed for collecting fishes will be determined by the cruise schedule arrived at by Dr. Pereyra and others (see especially Research Units 174 and 175). Fishes sampled will be caught at the stations and times determined by their sampling regime. During the sampling protocol after each trawl comes on board, some time will be devoted to removing the stomach and intestine of the fish, placing it in a cloth bag with identifying label and preserving the stomach and contents. Individuals of smaller species might most profitably be returned preserved intact. It is anticipated that the procedures of fish handling and data acquisition at the time the trawl is on board may simply be too involved to allow for stomach removal from all specimens of forage fishes. An adequate sample of guts from a single species would be 200-300 gut samples from a variety of size ranges, locations, depths, and seasons. Food items will be sorted into different taxa, identified, % of the total volumn measured.

Since the level of funding on this project is very low, we anticipate performing stomach analyses on only two species from the Gulf of Alaska and two species from the Bering. Tentatively, we will examine the pollock and the rock sole. If time permits, we will begin the food analyses of some other species as well, perhaps including the yellowfin sole, turbot, and Pacific Ocean perch. It should be emphasized that more stomachs will be collected than can possibly be analyzed during FY1976 with the present funding level.*

*We expect and will attempt to arrange for the collection of perhaps as many as 800-1000 stomachs from each of the major fish species from the two areas. We would wish those collections to include material from both mid- and southern Bering Sea, including a variety of depths. Also, we hope the material will include collections from both eastern and western Gulf of Alaska at various depths. Seasonal variations should also be included by suitable collections where possible. If these sources of data are ever to be analyzed, a level of funding must be provided appropriate to the amount of work to be done. Therefore, substantial budget increases for FY1977 are anticipated with respect to studies of food and feeding relationships in benthic and demersal fishes of the Gulf of Alaska and Bering Sea.

VI. Information Products

The product which will result from this research will be a collection of guts with contents and information about the food items found in those guts. Food data, when reported will be both % volume and % frequency of occurrence. As mentioned above, we will present data only on the pollock and the rock sole. Data contributed will be submitted when possible on magnetic tape. Also included, where feasible, will be summaries of food habits data from other sources.

VII. Data or Sample Exchange Interface

In order to complete my report on the food habits of the fishes collected, I will require information items 1, 2, and 4 from V-A above.

The precision gained in identification of invertebrate food items will depend on interaction with Dr. Howard Feder and his group of people in the Marine Sorting Center, University of Alaska. The results of my research will be useful to the other fish investigators and to Dr. Feder in his benthic investigations.

VIII. Sample Archival Requirements

Guts and their contents will be preserved and stored on the Fairbanks Campus, University of Alaska. Each individual gut will be placed in a cloth bag with an identifying tag. Guts from the same species will be placed in a plastic bucket with lid and labeled accordingly. The bucket containers will be stored in the Marine Sorting Center or other suitable storage area awaiting analysis. No funds have been included for archival of material beyond September 1976.

IX. Schedule

Sample acquisition will proceed according to the cruise schedules formulated. Personnel from the benthic investigations and the demersal resources projects will be responsible for collecting stomachs from fishes trawled in the Gulf of Alaska. This sampling program will occur in the summer months of 1975. This project will have the responsibility of placing personnel on board the RV Miller Freeman for stomach collections in the Bering Sea in the fall of 1975. When gut material is returned to Fairbanks for analysis, we will begin the process of curating, sorting, identification and other data acquisition. Only sufficient funds exist for a total of two full-time personnel for 12 months on this project.

To accomplish the gut sampling in the Bering Sea for April 1976, additional support will be required to place a technician aboard the vessel

or other personnel aboard the cruise will need to take the samples. This same situation exists for the Jan-Mar 1976 and June-Aug 1976 trawling cruise in the Gulf of Alaska.

X. Equipment Requirements

None.

XI. Logistics Requirements

Logistic requirements for vessels will be those of the other projects in which fish will be collected. We will require transportation of collected material from the ports of Seward, Dutch Harbor and Seattle to Fairbanks, Alaska for study. Samples may be transported by truck from Seward to Fairbanks. To avoid excessive time delays, the samples from Dutch Harbor and Seattle may require air transportation to Fairbanks.

FINAL

ALASKA MARINE ENVIRONMENTAL ASSESSMENT PROGRAM
WORK STATEMENT (Research Unit #285)

I. Title: Preparation of Illustrated Keys to Skeletal Remains and Otoliths of Forage Fishes - Gulf of Alaska and Bering Sea

II. Principal Investigator: Dr. James E. Morrow, Professor Zoology
Department of Biological Sciences
University of Alska
Fairbanks, Alaska 99701
(907) 479-7524
SS#: 028-14-3735

III. Geographic Area dn Inclusive Dates: Gulf of Alaska and Bering Sea
1 July 1975 to 30 Sept 1976

IV. Cost Summary:

FY 1975 through June 30, 1975	FY 1976 July 1, 1975 through Sept 30. 1976
-0-	$43,962.00

V. Proposed Research

A. Background and Objectives:

This proposal addresses iteslef to Task A-16.

There is a rather large amount of literature on fish otoliths, including a number of works by Dr. John E. Fitch, a long series of papers from 1925 to 1930 by G. A. Frost, and others, but to date the only key to otoliths that I know of is that by R. W. Castile, 1974, dealing with the identification of the five species of Pacific salmon by means of otoliths.

Similarly, there are a great many studies on the osteology of various groups of fishes, almost all of which have been undertaken from the standpoint of elucidating relationships within and between groups. There are very few keys to osteological characters of fishes, and to the best of my knowledge, none to the osteological characters of the Beaufort Sea, Gulf of Alaska, and Bering Sea. Nevertheless, the literature on these subjects will be screened most carefully to derive information which will be of help in preparing the necessary keys.

Most of the information required to meet our objective will be obtained directly from material provided by the trawling expeditions. As noted in previous proposals, this material will be shipped in a frozen condition to the University of Alaska. At the University, otoliths will be removed from specimens, and skeletons will be prepared. These will be studied carefully in order to prepare the diagnostic keys.

I am confident that the keys to the otoliths can be completed by the scheduled completion date of 30 September 1976. I must admit that I am not so sanguine about the skeletal characters. There we will be dealing with a large number of different bones in an equally large number of different fishes. It is a problem of much greater magnitude and difficulty. Nevertheless, I anticipate that we will at least make reasonable progress towards our goal.

B. Methods:

Fresh specimens will be obtained by trawling. It is anticipated that field personnel engaged in other aspects of the Demersal Fish Program will be able to provide the specimens needed. The materials will be frozen on board ship and sent in that condition to the Marine Sorting Center of the University of Alaska. At the Marine Sorting Center, the material will be thawed. X-ray pictures will be taken of fairly large samples of each species, primarily to provide statistically valid vertebral counts and also to assist in the preparation of complete skeletons. A suitable number of specimens, including as wide a size range as is possible, given the limits of the sampling gear, will be skeletonized. Both complete and disarticulated skeletons will be prepared.

The X-ray plates and the skeletal materials will be studied carefully and a set of illustrated keys prepared. From these keys, it should be possible to identify the skeletal remains of the species included.

In addition, otoliths will be taken from a graded size-series of each species and a key to otoliths will be prepared.

Criteria to be used in determining which species will be included in the keys are first, species known to be preyed upon by other fishes, by birds, and by mammals. There is a considerable literature on this subject. Secondly, species which we can obtain in the trawling surveys; and third, species which we believe should be included but which must be obtained from museum specimens. A preliminary list of families to be included is as follows: Ammod-tidae, Anoplopomatidae, Bathmasteridae, Bothidae, Clupeidae, Cottidae, Cyclopteridae, Gadidae, Hexagrammidae, Osmeridae, Pholididae, Pleuronectidae, Scorpaenidae, Stichaeidae, Trichodontidae, Zoarcidae.

VI. Information Products:

The product which will result from this research will be a set of dichotomous keys to the otoliths and to the more important skeletal structures of the forage fishes of the Bering Sea and Gulf of Alaska.

VII. Data or Sample Exchange Interfaces:

All the materials to be used in the preparation of these keys will be provided by the trawling surveys. We will request material from each cruise and the amount and species requested will vary with the success and variety provided by the previous cruises, as well as by the rapidity with which we are able to process the material.

It appears that the keys to be produced in this study will be useful to the principal investigators of projects A-2, 5, 6, 9, 12, 14, and 15; possibly also the principal investigators of projects A-18 and 31; and certainly to project E-1. Undoubtedly, it would be very handy for most of these investigators to have these keys in hand at the beginning of their projects. However, this being impossible, we shall do our best to provide them with usable means for identifying skeletal structures at the earliest possible date.

However, this being impossible, we shall do our best to provide them with usable means for identifying skeletal structures at the earliest possible date.

VIII. Sample Archival Requirements:

Heavy pasteboard boxes of suitable size will be required for storing the skeletal materials after preparation. I anticipate between one and two thousand individual specimens will be so stored. These will range from single pairs of otoliths mounted on glass slides to complete articulated skeletons of relatively large fishes, that is, up to 3 or 4 kilograms in weight.

IX. Schedule:

It is impossible to provide a detailed schedule of anticipated accomplishments. In the first place, our sampling will depend entirely upon the schedule of the trawling expeditions. In the second place, the rate of accomplishment will depend largely upon the success of these expeditions in providing the variety of species which are expected to be included. We can only say that we anticipate having the otoliths more or less complete by about the first of April, 1976, and hope to have the skeletal structures in relatively good shape by 30 September 1976.

X. Equipment Requirements:

No x-ray equipment is available at the University of Alaska. Attempts will be made to utilize a machine owned by a local veterinarian. Costs for this use have not been included in this work statement. Should this equipment not be available the government will be required to furnish one in order to complete this poject as described.

XI. Logistics Requirements:

None

June 30, 1975

ALASKA MARINE ENVIRONMENTAL ASSESSMENT PROGRAM
WORK STATEMENT (Research Unit 318)

I. Title: Preparation of Illustrated Keys to Skeletal Remains and Otoliths of Forage Fishes

II. Principal Investigator: Dr. James E. Morrow, Professor Zoology
Department of Biological Sciences
University of Alska
Fairbanks, Alaska 99701
(907) 479-7524
SS#: 028-14-3735

III. Geographic Area dn Inclusive Dates: Beaufort Sea; 1 April 1975-30 Sept 1976

IV. Cost Summary:

FY 1975	FY 1976
through June 30, 1975	July 1, 1975 through Sept 30, 1976
$4,583.00	$23,643.00

V. Proposed Research

A. Background and Objectives:

This proposal addresses iteslef to Task A-16.

There is a rather large amount of literature on fish otoliths, including a number of works by Dr. John E. Fitch, a long series of papers from 1925 to 1930 by G. A. Frost, and others, but to date the only key to otoliths that I know of is that by R. W. Castile, 1974, dealing with the identification of the five species of Pacific salmon by means of otoliths.

Similarly, there are a great many studies on the osteology of various groups of fishes, almost all of which have been undertaken from the standpoint of elucidating relationships within and between groups. There are very few keys to osteological characters of fishes, and to the best of my knowledge, none to the osteological characters of the Beaufort Sea, Gulf of Alaska, and Bering Sea. Nevertheless, the literature on these subjects will be screened most carefully to derive information which will be of help in preparing the necessary keys.

Most of the information required to meet our objective will be obtained directly from material provided by the trawling expeditions. As noted in previous proposals, this material will be shipped in a frozen condition to the University of Alaska. At the University, otoliths will be removed from specimens, and skeletons will be prepared. These will be studied carefully in order to prepare the diagnostic keys.

I am confident that the keys to the otoliths can be completed by the scheduled completion date of 30 September 1976. I must admit that I am not so sanguine about the skeletal characters. There we will be dealing with a large number of different bones in an equally large number of different fishes. It is a problem of much greater magnitude and difficulty. Nevertheless, I anticipate that we will at least make reasonable progress towards our goal.

B. Methods:

Fresh specimens will be obtained by trawling. It is anticipated that field personnel engaged in other aspects of the Demersal Fish program will be able to provide the specimens needed. The materials will be frozen on board ship and sent in that condition to the Marine Sorting Center of the University of Alaska. At the Marine Sorting Center, the material will be thawed. X-ray pictures will be taken of fairly large samples of each species, primarily to provide statistically valid vertebral counts and also to assist in the preparation of complete skeletons. A suitable number of specimens, including as wide a size range as is possible, given the limits of the sampling gear, will be skeletonized. Both complete and disarticulated skeletons will be prepared.

The X-ray plates and the skeletal materials will be studied carefully and a set of illustrated keys prepared. From these keys, it should be possible to identify the skeletal remains of the species included.

In addition, otoliths will be taken from a graded size-series of each species and a key to otoliths will be prepared.

Criteria to be used in determining which species to be included in the keys are first, species known to be preyed upon by other fishes, by birds, and by mammals. There is a considerable literature on this subject which we will extrapolate from the Gulf of Alaska and Bering Sea into the Beaufort Sea. Secondly, species which we can obtain in the trawling surveys; and third, species which we believe should be included but which must be obtained from museum specimens. A preliminary list of families to be included is as follows: Ammodytidae, Anoplopomatidae, Bathymasteridae, Bothidae, Clupeidae, Cottidae, Cyclopteridae, Gadidae, Hexagrammidae, Osmeridae, Pholididae, Pleuronectidae, Scorpaenidae, Stichaeidae, Trichodontidae, Zoarcidae.

VI. Information Products:

The product which will result from this research will be a set of dichotomous keys to the otoliths and to the more important skeletal structures of the forage fishes of the Beaufort Sea, Bering Sea, and Gulf of Alaska.

VII. Data or Sample Exchange Interfaces:

All the materials to be used in the preparation of these keys will be provided by the trawling surveys. We will request material from each cruise and the amount and species requested will vary with the success and variety provided by the previous cruises, as well as by the rapidity with which we are able to process the material.

It appears to me that the keys to be produced in this study will be useful to the principal investigators of projects A-2, 5, 6, 9, 12, 14, and 15; possibly also the principal investigators of projects A-18 and 31, and certainly to project E-1. Undoubtedly, it would be very handy for most of these investigators to have these keys in hand at the beginning of their projects.

However, this being impossible, we shall do our best to provide them with usable means for identifying skeletal structures at the earliest possible date.

VIII. Sample Archival Requirements:

Heavy pasteboard boxes of suitable size will be required for storing the skeletal materials after preparation. I anticipate between one and two thousand individual specimens will be so stored. These will range from single pairs of otoliths mounted on glass slides to complete articulated skeletons of relatively large fishes, that is, up to 3 or 4 kilograms in weight.

IX. Schedule:

It is impossible to provide a detailed schedule of anticipated accomplishments. In the first place, our sampling will depend entirely upon the schedule of the trawling expeditions. In the second place, the rate of accomplishment will depend largely upon the success of these expeditions in providing the variety of species which are expected to be included. We can only say that we anticipate having the otoliths more or less complete by about the first of April, 1976, and hope to have the skeletal structures in relatively good shape by 30 September 1976.

X. Equipment Requirements:

No x-ray equipment is available at the University of Alaska. Attempts will be made to utilize a machine owned by a local veterinarian. Costs for this use have not been included in this work statement. Should this equipment not be available the government will be required to furnish one in order to complete this poject as described.

XI. Logistics Requirements:

None

June 30, 1975

ALASKA MARINE ENVIRONMENTAL ASSESSMENT PROGRAM
WORK STATEMENT (Research Unit #348)

I. Title: Literature Search on Density Distribution of Fishes of the Beaufort Sea.

II. Principal Investigator:

James E. Morrow
Department of Biological Sciences
University of Alaska
Fairbanks, AK 99701
907-479-7542
SS#: 028-14-3735

III. Geographic Area and Inclusive Dates:

Beaufort Sea: July 1, 1975 through September 30, 1976.

IV. Cost Summary

FY1975 through June 30, 1975	FY1976 July 1, 1975 - Sept. 30, 1976
-0-	$20,002

V. Proposed Research

A. Background and Objectives:

This proposed research refers to Task A-7 and A-13.

The present state of knowledge of the density distribution of the Beaufort Sea fish is one of virtual non-existence. Such sampling as has been done has been done on a sporadic basis by expeditions from various and sundry universities and oceanographic institutions. There is a very little data contained in reports of Arctic explorations of the 19th century, and beyond these two sources we do not expect to find very much information. There may also be some data available in the files of the Alaska Department of Fish and Game, and the National Marine Fisheries Service.

The task objective will have been met when we have discovered, filed, and coded all the references and data files which we can discover.

We anticipate that we will be able to complete this work in good season and be able to submit a completion report by September 30, 1976.

Related research is being carried out in Projects A-1, 4, 8, 17, 19, 20, and 26. We will make formal request to the principal investigators of these projects to keep us informed of any literature or data they may discover relating to the fishes of the Beaufort Sea. In turn, we ourselves will inform them of literature and data that we may discover relating to their particular searches.

B. Methods:

We will utilize every available reference source to trace down literature and unpublished data. These will include such things as the Zoological Record, Biological Abstracts, lists of holdings in such libraries as the Amundsen Library at Dartmouth, the Arctic Institute of North America, the libraries at Yal and Harvard, the University of Washington, the University of British Columbia, and so forth. We will also search the reports and files of the Alaska Department of Fish and Game, the National Marine Fisheries Service library at Auke Bay and the Environmental Science Information Center, Technical Information Division of NOAA.

Criteria to decide what species are to be included in the analysis will be known, suspected, or probable occurrence in the Beaufort Sea. Fishes which have been recorded from nearby areas and may reasonably be expected to occur in the Beaufort Sea will be included as well as those which are already known from the Beaufort Sea.

VI. Information Products:

1. An annotated bibliography by species of each fish known to occur in the Beaufort Sea. This bibliography will be presented in a form suitable for EDS transcription and storage.

2. A summary of known data on density, distribution of the species, particularly in regard to geography, bathymetry and seasonal occurrences. This data will be presented in a form suitable for EDS transcription and storage.

3. A narrative summary of the distribution data, including tables and figures, with recommendations for research needed to fill gaps in regard to OCS objectives.

VII. Data or Sample Exchange Interfaces:

We will appreciate receiving information and/or references which may be discovered by other investigators in this overall project. The products of this research will be useful to the principal investigators of tasks A-1, 2, 4, 5, 8, 9, 12, 14, 15, 17, 18, 19, 20, 23, and 26. We do

not know when the information will be required, but it will be made available to the principal investigators on a continuing basis as we accumulate the information. We request that EDS transcribe all tabulated data found and enter it in the project data base.

VIII. Sample Archival Requirements:

It is not anticipated that archiving of material will be done. However, some xerox copies may be accumulated and will be retained in the library, either of the University of Alaska or of the Life Sciences Unit or the Institute of Marine Sciences of that University. We cannot predict the number of items to be so archived.

IX. Schedule:

It is impossible to provide a detailed time schedule for this project. Assuming that we are able to begin work on July 1, 1975, we will search the library files and reference works, acquire titles and contents summaries, and file these in the form of a bibliography. It is anticipated that the work will not proceed at a uniform rate, but that it may go rapidly at one point and slowly at another. However, we do expect to have a fairly complete bibliography on the fishes of the Beaufort Sea by the time the project is expected to close.

X. Equipment Requirements:

None.

XI. Logistics Requirements:

None.

WORK STATEMENT (Research Unit #349)

I. TITLE: Alaska Marine Ichthyoplankton Key

II. PRINCIPAL INVESTIGATOR: T. Saunders English
Department of Oceanography
University of Washington
Seattle, Washington 98195

III. GEOGRAPHIC AREA AND INCLUSIVE DATES: Gulf of Alaska and Bering Sea
1 July 1975 - 30 September 1976

IV. COST SUMMARY: FY 1976

1 July 1975 - 30 September 1976

$60,000

V. PROPOSED RESEARCH

A. Background and Objectives. The task of primary emphasis is A25b -- develop an ichthyoplankton key to aid identification of the ichthyoplankton occurring in Alaskan waters. This will support work elsewhere on task A23 -- determine the seasonal density distributions and environmental requirements of principal species of phytoplankton, zooplankton, and ichthyoplankton.

The present state of knowledge in this area is scattered. The fish eggs have been less well described than the larvae. The northernmost part of the area has never been intensively investigated growing from national concern for economic development or national security.

The information required to meet the task objective will come initially from local and foreign literature. Lists will be made of species reported from the area and of descriptions of eggs and larvae in the literature. A format will be selected and the information compiled into a key to the ichthyoplankton.

A working key, with gaps identified, can be prepared and reported on by September 30, 1976.

Ichthyoplankton samples will be taken in all of the Alaskan OCS geographic areas. Those specimens will be sorted by the programs taking the samples and will be available for our examination.

B. Methods. We will initially search the literature for a format that seems best suited to the requirements of this research. Drawings will be made to illustrate aspects not well treated by written descriptions alone.

VI. INFORMATION PRODUCTS

The key to the ichthyoplankton will be the major information product from this research. The format will be of a quality that can be printed for broad distribution. In case of a shortage of resources to complete drawings and descriptions of all species which could be included in the key, emphasis will be directed to forms of economic and ecosystem importance.

VII. DATA OR SAMPLE EXCHANGE INTERFACES

The samples from the Bering Sea will be needed when they can be sorted at the University of Alaska. The samples from the Gulf of Alaska will be sorted by PMEL and available from them. The data from the Beaufort Sea will be available from the University of Washington, Department of Oceanography.

VIII. SAMPLE ARCHIVAL REQUIREMENTS

The archived samples will be kept at the University of Washington until the termination of the research and then offered to the U.S. Government.

IX. SCHEDULE

There will be quarterly reports and a final report containing the ichthyoplankton key.

The important interface between my research and the activities of others is that the archived ichthyoplankton samples can best be identified and analyzed when this ichthyoplankton key is available and workers have been trained in its use.

X. EQUIPMENT REQUIREMENTS

The office equipment and microscopes needed in this research will be available at the University of Washington

XI. LOGISTIC REQUIREMENTS

No logistic requirements are related to this research.

WORK STATEMENT

(Research Unit #354)

I.. TITLE

Review of Literature and Archived Data for Non-Salmonid Pelagic Fishes of the Eastern Bering Sea - MEAP Solicited Proposal

II. PRINCIPAL INVESTIGATORS

Walter T. Pereyra and Paul T. Macy, NMFS, Seattle

II. GEOGRAPHIC AREA AND INCLUSIVE DATES

Eastern Bering Sea 1 July 1975 to 30 September 1976

IV. COST SUMMARY

-0- FY75 - through June 30, 1975

$5.9 FY76 - July 1, 1975 - September 30, 1976

V. PROPOSED RESEARCH

Knowledge of the non-salmonid pelagic fishery resources of the eastern Bering Sea is extremely limited. Nearly all data on the subject species which have been obtained during U.S. surveys were collected incidental to salmon, groundfish, and other research efforts. These data and those available in the foreign literature and from foreign commercial fisheries have not been systematically and intensively evaluated.

This project will review scientific literature and collect published and unpublished biological and statistical data on non-salmonid pelagic resources (e.g., herring, capelin, smelt, pollock, Atka mackeral, and Arctic cod) of the study area.

Data sources to be inventoried and analyzed include the following:

(1) Publications and scientific literature, particularly Russian and Japanese, including translations.

(2) Catch records of non-salmonid pelagic fishes from offshore fishing by NMFS and the Fisheries Research Institute, University of Washington (FRI), collected incidental to data required for International North Pacific Fisheries Commission (INPFC) purposes.

(3) Unpublished data collected by Alaska Department of Fish and Game (ADF&G).

(4) U.S. groundfish surveys (1944-74).

(5) U.S. observer program (1972-74).

(6) Japanese and Russian research surveys.

(7) Japanese and Russian fisheries statistics, particularly those on herring and pollock from the Japanese fishery from 1964-73.

(8) Other U.S. research surveys; e.g., Coast Guard, ONR, etc.

Because it is anticipated that hydroacoustic-midwater trawling fish surveys will eventually be conducted as part of the BLM/OCS research program, during review of the historical data base a special effort will be made to define the feasibility and potential scope of such surveys.

All catch and biological data will be screened and loaded on magnetic storage devices in a standardized format.

VI. INFORMATION PRODUCTS

1. A narrative report reviewing and summarizing the literature and the available unpublished data on the distribution, abundance and biology of non-salmonid pelagic fishes.

2. A detailed data report on records of the occurrence and abundance of the subject species.

3. A description of any existing trends and cycles of non-salmonid pelagic fishes relative to temporal and spatial variation.

Both reports will be completed by September 30, 1976.

WORK STATEMENT (Research Unit #356)

I. Title: LITTORAL SURVEY OF THE BEAUFORT SEA

II. Principal Investigator: A. C. Broad, Ph.D.
Professor of Biology
Western Washington State College
Bellingham, Washington 98225
Telephone (206) 676-3632

III. Geographic Area and Inclusive Dates: Selected representative habitats in the littoral zone (from the highest high tides to at least wading depth) from Point Barrow to the Canadian border will be sampled for invertebrates and other infauna, marine plants, and birds and mammals that make use of the beach. Some planning and administrative work will be done during May and June, 1975. Field work will be done in July, August and September, 1975 and July, August and September, 1976. Data reduction and literature search will occupy part of the time from September, 1975 to August 31, 1976. September, 1976 will be devoted to report writing, and the final report will be filed prior to December 31, 1976.

IV. Cost Summary (tentative--see f.n. on page 13).

	FY 1975 (through 6-30-75)	FY 1976 (through 9-30-76)
Salaries	1,793	66,528
Fringe benefits	273	8,875
Travel	--	9,000
Equipment	1,800	--
Supplies	1,000	--
Card punching	--	600
Overhead	487	8,500
Total	$5,353	$93,503

V. Proposed research.

A. Background and Objectives. The research and reporting are divided into six tasks with a seventh (administration) implied. These are:

Task 1. Planning, design of sampling and data processing, techniques, logistics.

Task 2. Survey of the Beaufort Sea littoral and identification of habitat types.

Task 3. Field work and data collection.

Task 4. Literature research.

Task 5. Data analysis and identification of collected material.

Task 6. Report writing.

A timetable for the several tasks is offered below.

	1975								1976								
Task	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
1	x	x	½									x	x				
2			½														
3				x	½										½	x	½
4			x	x	x	x	x	x	x	x	x	x					
5					x	x	x	x	x	x	x	x	x	x	x	x	
6																	x

The tasks are described in more detail under part B, Methods.

We are familiar with G. E. MacGinitie's work in the Arctic Ocean at Point Barrow and three of the research participants (Broad, Webber, and Mason) have had limited field experience in the Beaufort Sea littoral. Other agencies we know to have interests in the area include the Institute of Marine Science of the University of Alaska, University of Washington Oceanographers, and the U.S. Fish and Wildlife Service. Our understanding of the littoral flora and fauna of the Beaufort Sea is that it is quite limited and probably includes very few species and few individuals.

Should the first summer's field work verify this impression, we shall request a reevaluation of the work planned for the second summer with the objective of reducing, modifying, or even eliminating it. In what follows, however, we proceed on the assumption that the results obtained will justify the full project as outlined.

The research proposed will yield data on abundance and distribution of principal invertebrates (and any other littoral animals), marine plants, and birds and mammals that feed on or otherwise depend upon the littoral ecosystem. Data will be reported in number of individuals per unit of area by habitat types, and general ecological relationships within the sampled areas will be described. Since the Beaufort Sea littoral is much too large (more than 500 miles of coastline) and generally too inaccessible to treat other than by selection of representative habitats, it is planned to sample sites near the west (Point Barrow), central (Prudhoe Bay) and east (Barter Island) extremities of the Beaufort Sea. The sampling sites will be chosen to represent of habitat types found in each area.

This kind of research is being done now in the state of Washington for the State Department of Ecology and, on a consulting basis, for the Mobil Oil Company by project participants (Webber, Dube, Broad, and Schneider). Coordination with other Arctic research will be achieved through joint planning sessions, contact with other investigators, and with the Juneau Project Office.

B. Methods. The several tasks are described below. Methods are discussed as appropriate.

Task 1--Planning

Objectives: Initial planning; logistics; scheduling; design of sampling techniques; design of data output for tape storage; preliminary selection of sampling stations; modification of methods for second summer as needed.

Personnel: Principal (1/8), 3 Associates (1/16), Programmer (1/4).

Period: May, June, and part of July, 1975, and April and May, 1976.

Methods: Participation in planning sessions (May 7-9 in Seattle), and otherwise as indicated. Use of charts, maps, physical descriptions, pictures, etc. of Beaufort Sea. Planning sessions involving participant personnel.

Supplies: Charts, maps, etc., miscellaneous office supplies.

Logistics: None.

Task 2--Survey of Beaufort Sea

Objectives: Aerial (and limited ground) survey of Beaufort Sea from Point Barrow to Canadian border; description of habitats; classification of habitat types; selection of littoral sampling areas to include barrier islands, sand beaches, gravel beaches, mud flats, deltas, salt marshes, other; modify sampling design and logistics as indicated by survey.

Personnel: Principal (1), Associate (1).

Period: July 15-31, 1975.

Method: Travel by air with landing for closer examination to cover entire coast. Operation from Point Barrow (July 15-20), Prudhoe Bay (July 21-25), and Barter Island (July 25-31). This schedule is flexible within the period July 15-31.

Equipment: On hand or same as Task 3.

Supplies: As in Task 3.

Travel: 2 round trips--Bellingham to Point Barrow.

Logistics: 30 days board; use of float plane or helicopter for 15 days.

Task 3--Collection of Data

Objectives and methods to collect data as follows:

1. For density distribution of invertebrates, other infauna, and marine plants: one transect line per station with samples taken at 0.5M elevation intervals (or at linear intervals if field conditions so dictate) from high tide to "wading depth." Samples with Eckman grab (hand held) screened to 1.0 or 0.5 mm and preserved in formalin in field. If possible, 6 samples

per littoral elevation (or linear interval). One or more $0.25M^2$ surface quadrats for macrofauna per elevation where possible (probably limited to drift area and beach). Representative macrofauna preserved in field. Seine hauls, baited traps, and use of a push-net or sea sled, or small beam trowel for submerged epifauna.

Estimate of number of samples:

(a) 6 habitat types × 1 transects × 6 elevations × 6 samples × 3 areas (Barrow, Prudhoe Bay, Barter Island vicinities) = 648 infauna samples in 1975. (This is a maximum number based on a littoral and intertidal zone 3M deep).

(b) 6 habitat types × 1 transect × 3 elevations × 2 quadrats × 3 areas = 108 $0.25M^2$ quadrats in 1975.

(c) At least two seine or push-net samples per station.

(d) Trapping as required to provide specimens not encountered otherwise.

2. For general density distribution of birds and mammals: census by air or boat, field notes of personnel. Data in number/species/unit of beach (mile?)/day. No specimens contemplated.
3. For general ecological relationships: field observations and literature research on identified species.
4. General hydrographic data: temperature (air and water); salinity (optical or conductive method); pH; dissolves oxygen (if possible); general climatic observations at all stations.

Personnel: Principal (1/2); 3 or 4 Associates (as available); 6 field assistants (full time).

Period: August 1-September 15, 1975; July 15-September 15, 1976. Alternative schedules of activity with different logistic requirements are suggested for the first summer:

Schedule A. Three teams of three persons each (one Associate and two field assistants) will be stationed at each principal site (Point Barrow, Prudhoe Bay, and Barter Island) for the period from August 1 to September 15. Each field team will require an assigned small boat (16' Whaler or equivalent) and an operator competent in small boat seamanship in the Arctic. The field teams will require complete camping and field kitchen equipment and supplies for parties of four. The teams will operate from the principal sites by water and will return to the principal sites at least weekly. The maximum distance of operation from the principal sites will be 30 or 40 miles.

Schedule B. The field teams will be constituted as in Schedule A, and will have comparable camping and field kitchen requirements. They will depend upon air transportation to get to the sampling stations. Field teams will fly from principal sites to sampling stations and from sampling station to sampling station on schedules logistically feasible. Field crews will return weekly to the principal sites.

Schedule A provides greater individual options for the field teams, considerably increases the sampling capability of the teams (in Schedule B teams are limited to wading depth), provides for more careful general ecological observation, and can be supported at less cost. It requires the assignment of boats and operators where none presently are available (Prudhoe Bay and Barter Island).

Schedule B requires coordination of movements of all teams and probably nearly full-time use of an aircraft. Under this schedule the teams may have a greater range of operation.

In either schedule, the principal investigator will spend part of the time with each field team (and part of the time not in the field). His transportation to and from the principal sites can be arranged by commercial flights (Wien Airlines) or on a space available basis. He will carry a sleeping bag and individual rations.

Equipment: 1 stereoscopic microscope (on hand); 3-4 pairs binocular field glasses (probably on hand); 2 cameras (on hand); 3 Eckman grabs with handles (purchase); 3 sets appropriate screens (purchase); 3 sighting levels (purchase); 3 stadia rods; miscellaneous digging tools; personal collecting equipment; 3 short seines (purchase); 3 push-nets or 3 small beam trowels (purchase); line; optical salinometer (purchase); pH and DO equipment (on hand or purchase).

Supplies: 2000 whirly bags; formalin; hexamine; rose bengal; miscellaneous (purchase).

Travel: 3 round trips Bellingham to Point Barrow in 1975;
3 round trips Bellingham to Prudhoe Bay in 1975
3 round trips Bellingham to Barter Island in 1975
9 round trips Bellingham to Point Barrow in 1976.

Logistics: Board 435 days in 1975*
Board 588 days in 1976*
*including field kitchen and camp for 9 people.
Travel by air or surface 9 people:
45 days in 1975
60 days in 1976.

Task 4--Literature Research

Objectives: Survey of available data and literature and copying as appropriate to support:

1. narratives, charts and maps;
2. extrapolation of summer data to other seasons;
3. relate present work to prior work in the Arctic; and
4. support field teams.

Personnel: Literature assistant (1/5)

Period: July 1975 to end of August 1976.

Methods: Use of ENDEX, available climatic Atlases, Environmental Information Center; other libraries.

Supplies: Copying charges (supplies).

Logistics: None.

Task 5--Data Analysis

Objectives: Identification and counting of all plant and animal species collected during field operations; statistical treatment of numerical data; reduction of data to ADP form and storage on magnetic tape.

Personnel: Principal (1/8); 2 lab assistants (1/2--1 taxonomy, 1 statistics); Programmer (1/8).

Period: September 15, 1975 to September 15, 1976.

Methods: Conventional methods of identification of material may include sending some specimens to experts or stop at University of Alaska Museum. Statistical methods include conventional population parameters (range, mean, standard deviation and variance), ADP methods to those designated by NOAA (Data management Instructions from ERL).

Supplies: Computer time; card punching; alcohol; labels, miscellaneous; use of labs, microscopes, etc.

Logistics: None.

Task 6--Report writing

Objectives: Creation of narrative, charts, maps, tables, etc., to describe distribution of habitats and biota; narrative and diagrams to describe general ecosystems and ecological relationships.

Personnel: Principal (1), Associates (up to 1/2 as available); Programmer (1), Artist.

Period: Principally September 1976 but much work will be done before then. The final report will be filed by December 31, 1976.

Methods: Written report supported by charts and diagrams; data stored on tapes.

Supplies: Artist (overhead); hexographic (overhead); photographic copying (purchase); office supplies (purchase).

Logistics: None.

VI. Information products. Density distribution data (number of individuals given in range, mean and standard deviation by units of area) of principal biota and general ecological relationships (descriptive rather than quantitative) of littoral zone of Beaufort Sea, as described above. General oceanographic and climatic data for each station visited.

VII. Data or Sample Exchange Interfaces. This project principally interfaces with Alaskan Marine Environmental Assessment Program projects on Beaufort Sea Offshore Benthos (Carey); Beaufort Sea Estuarine Fishes (Roguski); and Hydrocarbon and Trace Metal Analyses of Alaskan Marine Biota (Burrell and Shaw). To a lesser extent, there are areas of mutual interest with Littoral Surveys of the Gulf of Alaska and Bering Sea (Zimmerman), and Literature on the Plankton of the Beaufort Sea (English).

It seems unlikely that there will be surface activity in the Beaufort Sea Offshare Benthos project before the summer of 1976. This project should be reevaluated after the summer of 1975 for possible seaward extension of the sampling in conjunction with the offshore benthos work. (We will operate entirely in the region of total ice scour in 1975. We should consider operation between this zone and 10-20M depth where the

ice scour is not complete if arrangements can be made in 1976.)

Specimens and information exchange with other investigators (mainly Carey and Roguski) is necessary and will be arranged (Roguski is concerned with food of estuarine fish).

As possible (logistics of freezing samples and shipping them provides some currently unsolved problems), this project will collect and identify samples of isopods, mysiids, amphyiods, and algae for hydrocarbon and trace metal analysis (Burrell and Shaw). Samples of arctic biota for comparison purposes may be required in task 5 (identification). These usually can be borrowed from museums or can be seen at museums. All data will be entered into the common data base designated by the Environmental Data Service of NOAA. The date of data acquisition for material collected in the summer of 1975 will be May 30, 1976.

VIII. Archival Requirements. Specimens will be preserved in 10% glycerin in 70% ethanal and maintained at Western Washington State College for at least one year following termination of contract. Representative samples will be permanently stored in the marine collection there.

IX. Schedule. See Parts V(A) and (B) above. Data from the summer of 1976 may not be incorporated into a final report by September 30, 1976, but will be in final form by December 31, 1976.

X. Equipment requirements. See Part V(B) above.

XI. Logistic requirements (summarized from above):

Task	Days board	Days use of helicopter, period float plane or boats
2	30	15 (full) July 1-15, 1975
3	435	45 (part time) July 16-Aug. 31, 1975
3	588	60 (part time) July 1-Aug. 31, 1976

Travel to and from Point Barrow will be arranged by Western Washington State College.

WORK STATEMENT (Research Unit #359)

I. TITLE: Beaufort Sea Plankton Studies

II. PRINCIPAL INVESTIGATOR: T. Saunders English
Department of Oceanography
University of Washington
Seattle, Washington 98195

III. GEOGRAPHIC AREA AND INCLUSIVE DATES: Beaufort Sea
16 May 1975 to 30 September 1976

IV: COST SUMMARY: FY 1976

1 July 1975 - 30 September 1976

$300,000

V. PROPOSED RESEARCH

The two tasks of primary emphasis are A-23 and A-24 -- determine seasonal density distribution and environmental requirements of principal species of phytoplankton, zooplankton, and ichthyoplankton, and, determine seasonal indices of phytoplankton production, including the sea ice flora. The task of secondary emphasis will be to summarize the existing literature, unpublished data, and archived samples.

The present state of knowledge in the area is scant and unsystematic, largely because of logistic difficulties for investigators. Also, the region has never been intensively investigated because of national concern for economic development or national security.

The information required to meet the task objectives is a series of biological observations of phytoplankton, zooplankton, and ichthyoplankton over space and time which can be related to a series of environmental observations from the same area close in time and space.

The summary of existing literature, data, and samples can be substantially completed and reported on by September 30, 1976. The determinations of seasonal distributions, environmental requirements, and indices of phytoplankton production will have been examined against roughly one year of field observations and those results can be reported by September 30, 1976.

Much related research is planned in the BLM-NOAA program. Environmental observations will be made and other organisms in the food web will be studied. We will coordinate our field observations through the Arctic Project Office in Fairbanks and our analyses and reports through Juneau.

Methods. We will search and summarize published and unpublished materials relating to phytoplankton, zooplankton, and ichthyoplankton in the Beaufort Sea. We will locate and describe archived samples; we will consider analyses of those samples where the results would seem to further the tasks of this program.

The sampling schemes involve several working platforms. An ice station platform will be used to gain information on representative conditions under the permanent ice cover. Helicopter platforms will be used to cover transects from shore to deep water at several locations along the Beaufort Sea coast. Shore stations will be used, particularly for the study of the sea ice flora.

We expect to try to identify all organisms to the lowest practicable taxonomic level. The zooplankton studies may emphasize copepods and the phytoplankton studies will probably emphasize diatoms.

Our field methods will be standard oceanographic observational techniques, all used in past years from ice stations and the Naval Arctic Research Laboratory by these and other investigators. Phytoplankton will be sampled with water bottles, pumps, and divers. Zooplankton and ichthyoplankton will be sampled with nets, acoustic techniques, and possibly by cameras.

VI. INFORMATION PRODUCTS

The products of this work will include seasonal density distributions of phytoplankton, zooplankton, and ichthyoplankton of the Beaufort Sea. The information will be prepared and transmitted in ADP format acceptable to project management.

Samples from the ice station will consist of 2,400 chlorophyll *a* observations from 8 or more depths over summer 1976. There will be accompanying carbon-14 and nutrient observations.

The helicopters operating out of Point Barrow, Prudhoe Bay, and Barter Island will fly transects in at least July and October. There will be as many as 8 stations along each transect line. Samples will be taken at multiple depths. This effort should result in at least 128 samples, each, of chlorophyll *a*, net plankton, water bottle phytoplankton, and ichthyoplankton. Sonic records will be made at each station on each transect, for a total of at least 16 magnetic tape records.

Bibliographic entries will include at least 50 phytoplankton entries, 30 zooplankton entries, and 4 ichthyoplankton entries.

Archived samples examined will be at least 16 phytoplankton samples and 32 zooplankton samples. The number of available ichthyoplankton samples available cannot be estimated yet.

VII. DATA OR SAMPLE EXCHANGE INTERFACES

Environmental data will be needed from physical and chemical programs. Meteorological data, water properties, water chemistry, and currents will be needed to accompany the seasonal density distribution of organisms,

particularly when the modelling stage is reached. The workers at higher trophic levels, fishes, birds, and mammals, will need our data when they reach the stage of interpreting stomach contents and early life histories.

VIII. SAMPLE ARCHIVAL REQUIREMENTS

Archival responsibility will rest with the University of Washington.

IX. SCHEDULE

Sampling on the ice station must begin before the end of May; the occupants must plan to remain at sea for 4 months. Analysis of those samples will be complete in time or plan for summer 1976.

Sampling at the shore station will begin in July 1976. The analysis of the data will be documented in quarterly progress reports.

Sampling from helicopter will be possible at times and places designated within the ice-free time window in each summer. The analysis of the data will be documented in quarterly progress reports.

X. EQUIPMENT REQUIREMENTS

The equipment needed will be similar to that used on other programs in past years. We will attempt to borrow existing units with a promise to replace them as time permits.

XI. LOGISTICS REQUIREMENTS

We will work through the Arctic Project Office in Fairbanks to coordinate or learn of platforms available to us for sampling. We would like to occupy the ice station for the duration of its existence, hopefully through FY 1976. We would like to have a party of one or two on platforms doing oceanographic work in the area. We would like to maintain a summer party of four at the shore station.