PROJECT TITLE: Development of an Ecological Characterization and Site Profile for Kachemak Bay/Lower Cook Inlet

Project Number:	99278
Restoration Category:	Ecosystem Synthesis, General Restoration (suggested)
Proposer:	ADFG
Lead Trustee	ADFG
Duration:	1st year of 2-year project
Cost FY 99:	$105,200
Cost FY 00:	$35,000
Geographic Area:	Kachemak Bay, Southern Kenai Peninsula, and Lower Cook Inlet
Injured Resource/Service:	Kachemak Bay includes all injured resources (except cutthroat trout, Dolly Varden, and AB Killer Whale pod) and all the lost or reduced services, each of which will be addressed in the development of this ecological characterization and site profile of the Kachemak Bay Watershed/Lower Cook Inlet area.

ABSTRACT

This project will develop an ecological characterization and site profile to collect, synthesize, analyze, and document available physical, biological, and human or socioeconomic information on the Kachemak Bay/Lower Cook Inlet area. The project will result in the development of a database management system with products produced in electronic format (hypertext markup language with selective use of compact computer disk – CD – and Internet media) and summarized on paper. Three main project components include: 1) the ecosystem narrative description; 2) a spatial data component using a Geographic Information System (GIS); and 3) the annotated bibliography and research summary/tracking system. This project will update and expand existing information based on work with EVOS researchers, the overall scientific community, and the collection of local knowledge. The products will be represent an interactive, easy-to-use imformation source to: 1) identify future restoration opportunities, 2) assist in the use and protection of land (including parcels purchased by the EVOS Trustees), 3) plan for a possible long-term ecological monitoring and research program in the Northern Gulf of Alaska, and 4) assist in agency management and planning for the Lower Cook Inlet area. This project may also serve a model for future EVOS efforts to synthesize, manage, and disseminate information.

INTRODUCTION

The proposal to develop an ecological characterization and site profile (hereafter referred to as the "characterization") of Kachemak Bay will represent a new project for funding by the *Exxon Valdez* Oil Spill (EVOS) Trustee Council. While ADFG did submit a proposal under the same project number in FY98 (entitled "Development of an Ecological Characterization and Long-Term Environmental Monitoring Program for Kachemak Bay"), it was not funded by the Trustee Council.

The current proposal has been substantially restructured and focused to address questions and concerns by peer reviewers, the Chief Scientist, and Trustee Council staff, as well as several Trustee Agency liaisons. Enclosure 1 includes a description of these questions and concerns, and how they were addressed in the revised proposal. The most notable change is that the department has eliminated the environmental monitoring component of the FY98 proposal. This aspect of the FY98 proposal was premature, recognizing that the Council is in the process of formulating direction on long-term ecological modeling and monitoring.

Six months of planning has lead to a clearer project focus and emphasis. It now focuses exclusively on developing a characterization to provide ecological information from EVOS and other sources to the stakeholders, and develop a research, management, and planning tool for the EVOS restoration effort and other agency functions. ADFG has completed an initial user need survey (Enclosure 2), and have designed this project with the users in mind to create the most useful project. This project will gather, synthesize, analyze, and distribute ecological information about the Lower Cook Inlet area, with an emphasis on the Kachemak Bay Watershed. This comprehensive information base will cover all elements of the ecosystem, including the biological, physical, and human or socioeconomic elements. The project delivers this information through these tools: 1) the interactive and detailed ecosystem description; 2) the Geographic Information System (GIS); and 3) the annotated bibliography and research synthesis and tracking system. Information will be presented electronically in hypertext markup language (HTML) on a CD-ROM and the Internet, as well as summarized on paper. Data and information will be gathered from existing literature, the scientific community, and local knowledge (including traditional ecological knowledge from indigenous peoples).[1] The resulting interactive digital characterization will include detailed, site-specific information that both the novice and technically sophisticated users can access and understand.

To begin this rigorous project, the department has secured additional funding and partners, hired staff, and established additional cooperative agreements. The principal contributing partner in this project is the National Oceanic and Atmospheric Administration (NOAA), Coastal Services Center (CSC). While a major player, the CSC is not requesting funding from the Trustee Council. The Center has done a similar ecological characterization for Otter Island and is completing a second one in the Ashepoo-Cambahee-Edisto (ACE) Basin in South Carolina (SCDNR, NOAA/CSC,

1 For purposes of this proposal, "local knowledge" includes the knowledge of general public who live in or are familiar with the area and what the Trustees Council refers to as "traditional ecological knowledge" or TEK. The proposed project will collect and integrate information from the local community that are willing to participate.

NGDC, 1996). The Kachemak Bay project is in its third partnership with a state agency to develop a characterization. The CSC not only brings a great deal of experience and expertise, but also brings substantial cost sharing opportunities to the EVOS restoration effort. The Center has also funded a two-year "Coastal Management Fellowship," partnered with ADFG to collect existing spatial data (Enclosure 3), and entered into cooperative agreement with ADFG for the overall project (Enclosure 4).

Creating and integrating the extensive ecosystem description, GIS atlas and models, searchable bibliography, and research synthesis in an electronic format represents a large and complex undertaking. With sufficient resources to complete all aspects of the project, this project will result in a comprehensive, easy-to-use product of great value to many users. ADFG does not yet have the full complement of staff necessary to complete all aspects. The Trustee Council can play a critical role in the success of this project. Trustee participation will not only ensure the needs of the restoration effort are factored into this characterization, but will help create a valued information source and management tool for researchers, managers, educators, and the general public. A summary of benefits that Trustee participation will bring is summarized in Figure 1.

Figure 1: Summary of eleven benefits of EVOS Trustee Council participation.

SUBJECT AREA	NO EVOS PARTICIPATION	WITH EVOS PARTICIPATION
1. Injured species and services coverage	Include only some of the injured species and services.	Include all of the injured species and services.
2. Depth of Research and Coverage.	Literature and information search limited to published literature and readily available information.	Detailed search extended to gray and unpublished literature, including all available EVOS studies
3. Incorporation of Local Knowledge	No local knowledge component (use only existing published sources).	Focused effort to update, map, and expand existing information based on local knowledge (including traditional ecological knowledge).
4. Scientific Information Update	Limited to readily available sources.	Interview biologists, researchers, and managers to update existing information and add a regional and site-specific focus.
5. Incorporation of EVOS Studies	Limited to published and readily available literature.	Review all EVOS studies and incorporate pertinent spatial, life history, other ecological information.
6. Integration with EVOS Studies	No additional assessment of EVOS restoration needs and no further integration.	Focused effort to integrate with EVOS restoration efforts, including: contacting Trustee staff and PI's to determine information needs, coordinating with monitoring planning efforts, interviewing project staff and collecting information not in reports.
7. Participation in 10th Annual EVOS Workshop and Technical Sessions	No participation.	Three projects staff to participate. The workshop will also be used as one of many forums to collect latest and best information, and to integrate with EVOS efforts.
8. Integration with EVOS Projects to Synthesize/Distribute Information	None.	Coordinate with other projects to avoid overlap and to assist the Trustees in disseminating information to researchers, managers, and the public.

9. Collection of Spatial Data	Limited to existing small-scale digitized spatial data.	Expanded to update existing data and digitized new data from scientists and local knowledge. Information will be more regional and site-specific.
10. Community Involvement	Limited, only as time allows.	Extensive, through efforts to collect local knowledge and directly involving the community in the project.
11. Timing Considerations and Cost Efficiency	Schedules of cooperating agencies are set.	Timing critical: for this project to meet and address the needs of EVOS, the Trustees would need to participate in FY99, the year of intensive data collection/synthesis.

It is noteworthy that Kachemak Bay has been proposed for inclusion in the National Estuarine Research Reserve (NERR) System, and is likely to be designated by October 1998 (ADFG and NOAA, 1998).[2] The NERR System is a non-regulatory program of twenty-two protected estuaries that focuses on long-term research, monitoring, and education. The proposed KBNERR will play a lead role in maintaining the ecological characterization and the associated GIS. The goals and objectives of the proposed reserve are compatible with the goals of the Trustees Council as presented in the EVOS Restoration Plan (EVOS Trustee Council, 1994). Reserve designation presents numerous cost-sharing opportunities, and can bring additional NOAA expertise and public participation into the EVOS restoration effort. Moreover, the NERR System as whole, and in particular the proposed Kachemak Bay NERR, places great emphasis on getting scientific information to managers, resource users, and the general public. Through this project and future efforts, we can assist the Trustees in getting the information to the stakeholders.

NEED FOR THE PROJECT

A. Statement of Problem

EVOS restoration efforts to date have focused largely on restoration projects, research, and monitoring. The Invitation to Submit Restoration Proposals for FY99 indicated a shift from research to synthesizing and integrating information (see pp. 31 and 32, Ecosystem Synthesis section). Closing comments from most of the EVOS peer reviewers at the 1998 EVOS Restoration Workshop emphasized the need to bring information to managers, researchers, and communities in a usable and interesting manner. Increased emphasis was also placed on community involvement, and demonstrating the value of restoration efforts, research, and monitoring to the public and agencies. The need for such an effort was further illustrated recently in community meetings in Homer area for EVOS restoration reserve, where the public failed to see the value of EVOS restoration and monitoring efforts. This project is designed in part to meet this need, to summarize existing information, involve stakeholders in its development, and develop and easy-to-use product of value to many stakeholders.

The Trustee Council is also in the process of outlining the use of the EVOS Restoration Reserve, putting considerable effort towards developing a long-term monitoring plan. Comments from both the EVOS Chief Scientist and visiting scientists at the 1998 EVOS Restoration Workshop pointed

2 Copies of the plan are available from ADFG. The plan is also available on the World Wide Web at the following address: http://www.state.ak.us/local/akpages/FISH.GAME/habitat/geninfo/nerr/index.html

to the need to compile comprehensive baseline data on the ecosystem's physical, chemical, biological, and human elements. This project will summarize available information for all these elements and provide baseline data for future monitoring efforts.

ADFG has conducted an extensive survey of potential ecological characterization users to determine their information needs and the most appropriate delivery and presentation format (Callahan *et al*, 1998). The survey summary is provided in Enclosure 2. Some of the highlights include:

Assessment Participants: Over forty managers, researchers, and educators from 28 organizations active in the Kachemak Bay/Lower Cook Inlet area were interviewed. These include researchers involved in the EVOS restoration studies.

Management Issues: This section lists some of the primary management issues identified in the survey. Respondents noted the importance of distinguishing between human-induced and natural changes. In addition to meeting the needs of EVOS, compiling this information in a single source can significantly help managers and resource users of the region.

Primary Information Needs for Managers and Researchers: Managers and researchers need to better understand the whole ecosystem and how its components interact. In addition, they agreed that the current information is too general. This project proposes to update existing information and develop more site-specific information.

Geospatial Information Needs, Capabilities, and Uses: To better understand the audience, this section of the survey identified spatial data needs, agency capabilities, and existing and potential uses of GIS. This project will help meet these needs by providing training and GIS demonstrations designed to address Kachemak Bay problems.

Product Format and Access Recommendations: Respondents identified the primary problem as inability to access information. They prefer to have ecosystem information readily available using a combination of CD, Internet, and paper media.

Summary: Respondents voiced a need to develop a socioeconomic and ecological database for research, management, and planning. At the present, the managers and researchers seek information from a wide array of sources, leading to time-consuming and often fruitless searches for site-specific details. Data and qualitative information are separately archived in management agencies throughout the state. The daunting task of searching for information and the lack of access drives repeated requests for a centralized source of site-specific details on the Kachemak Bay watershed. For community members, obtaining information is frequently even more frustrating and unsuccessful. This project will help bring needed information into their hands.

All of the interview participants valued the proposed characterization and associated GIS products as a tool for management, research, and general information management. A detailed, site-specific knowledge base that identifies and summarizes what is known and not known about the

bay's ecosystem would be very useful for daily and long-term activities. Applications include planning and developing recommendations for use of the bay's resources, restoration, research, and ecological monitoring. The ongoing survey will be expanded to further address the needs of the EVOS restoration effort, including ongoing projects (e.g., APEX) and long-term monitoring needs. Community involvement and participation is also built into project and has been part of our outreach efforts to date.

B. Rationale/Link to Restoration

The proposed project is closely linked to the mission, policies, and objectives of the Trustee Council. Creating the ecological characterization and associated products will include the following tasks:

1. Describe the state of knowledge of injured species, resources, and services;
2. identify gaps in ecological knowledge of Kachemak Bay;
3. identify restoration and enhancement opportunities for these resources and services;
4. assist in collection of information for other EVOS efforts related to restoration, research, and long-term monitoring; and
5. provide an information base and data management system for future EVOS and agency restoration(both research and long-term monitoring), management, and resource planning.

The ways in which this project addresses the Trustee Council policies are summarized below. Policy numbers refer to those listed in Chapter 2 of the 1994 EVOS Restoration Plan (pages 12 to 17).

- *Ecosystem Approach, Policies 1 and 2* – A primary focus of this project is to promote an ecosystem approach towards restoration, management, and use of Kachemak Bay. The study area includes the Kachemak Bay Watershed, encompassing those lands purchased by the Council on the south side of the bay and the proposed purchases on the north side. This project will clearly benefit multiple species and services.
- *Injuries Addressed by Restoration, Policies 3, 4, and 6* – Tasks 1 to 5 above relate to the restoration of injured species and resources. Many of the injured species and services have substantial economic, cultural, and subsistence value to the state, regional, and local economies.
- *Location of Restoration Actions, Policy 8* – Kachemak Bay is in the spill area. Council policy allows study of other areas of the ecosystem that may affect marine resources.
- *Restoring a Service, Policy 9* – Most of the injured services occur within the Kachemak Bay area. Through an analysis of present and historical information, this project will identify services that can be protected, restored, or enhanced.
- *Efficiency, Policies 11 and 14* – This project maximizes cost sharing. The EVOS restoration effort can gain significant benefits from this product with relatively little expense. Proposed EVOS funding represents a relatively small but critical component of total costs for creating the information synthesis.
- *Partnerships, Policy 15* – This project emphasizes establishing partnerships with governmental and non-governmental agencies to define user needs, develop the product, and maintain it.

- *Clear, Measurable, and Achievable Endpoint* – The ecological characterization will be completed in mid FY00. The products will be available to managers, researchers, local governments, and the public. ADFG is requesting assistance primarily for FY99, during the intensive data collection and synthesis phases. FY00 requests staff needed during the final production and evaluation phases of the project.
- *Synthesis of Findings/Project Integration/Remaining Issues and Information Gaps, Policy 18* – The project summarizes and synthesizes available information (EVOS and non-EVOS), and identifies information gaps. Moreover, the project will mesh with other EVOS studies. For example, the work will be closely coordinated with the EVOS-funded APEX studies in Kachemak Bay, led by John Piatt. This project and future monitoring efforts could also be designed to address management issues for the lands and resources purchased by the Council. Monitoring restoration projects in the Kachemak Bay area (e.g., project 98314, the proposed Mariner Park Restoration Project) represents another possibility for project integration. In addition, small parcels in the Homer area (Beluga Slough and Homer Spit) and large parcels of Seldovia Native Association land purchased by the Council are included in the study area. This project can help support protection of those lands and the injured species and services they support.
- *Public Participation, Policy 19* – ADFG has sought comments from several non-governmental entities in project design, and has completed an extensive need assessment (Enclosure 4). Continued involvement of agencies and the public will foster ownership and ensure the utility of the products.
- *Access to Information and Data, Policy 20* – A major focus of this effort is making both EVOS-funded and other information readily available to the public and agencies in a user-friendly form. Involving representative users in the project will make sure it is useful and understood. This project will complement other efforts of the Trustee Council's staff to disseminate information.
- *Normal Agency Activities* – The preparation of an ecological characterization is not a normal agency activity and has not been conducted by the department in any other area.

C. Location

The project study area is mapped in Figure 2 (next page). Figure 2-A represents the "focus area," or the area of intensive data collection and synthesis. This includes Kachemak Bay and its watershed. Data collection and synthesis in the focus area will include updating existing data and incorporating additional scientific and local knowledge. To illustrate how Kachemak Bay is influenced by and influences the larger ecosystem, the overall extent of spatial data collection will be extended to all of Cook Inlet and parts of the outer Kenai Peninsula as delineated on Figure 2-B. Outside the focus area, spatial data capture will be limited to priority existing data sets. The primary affected communities include Homer, Anchor Point, Kachemak City, Kachemak Selo, Halibut Cove, Seldovia, Port Graham, Nanwalek, and adjacent areas.

Figure 2-A: Kachemak Bay Focus Area

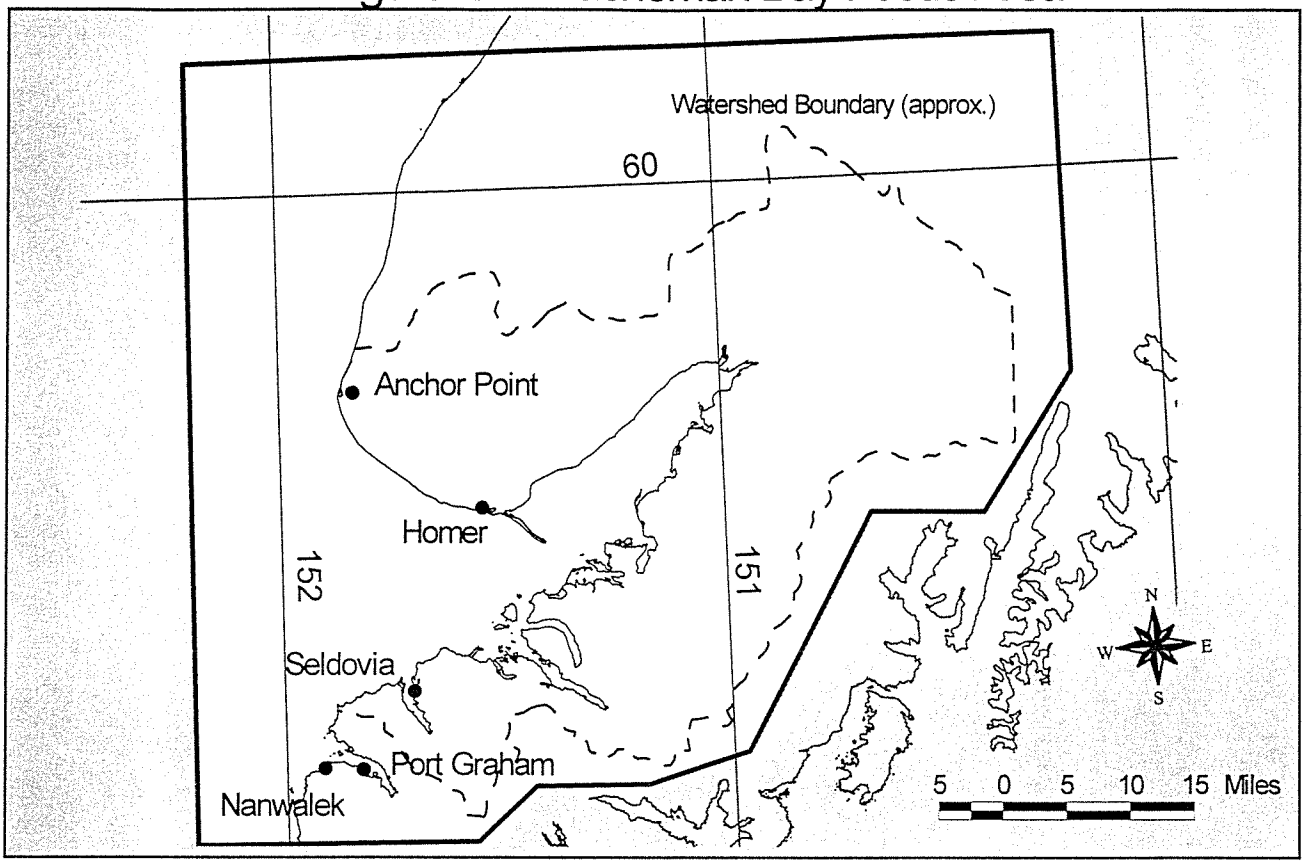
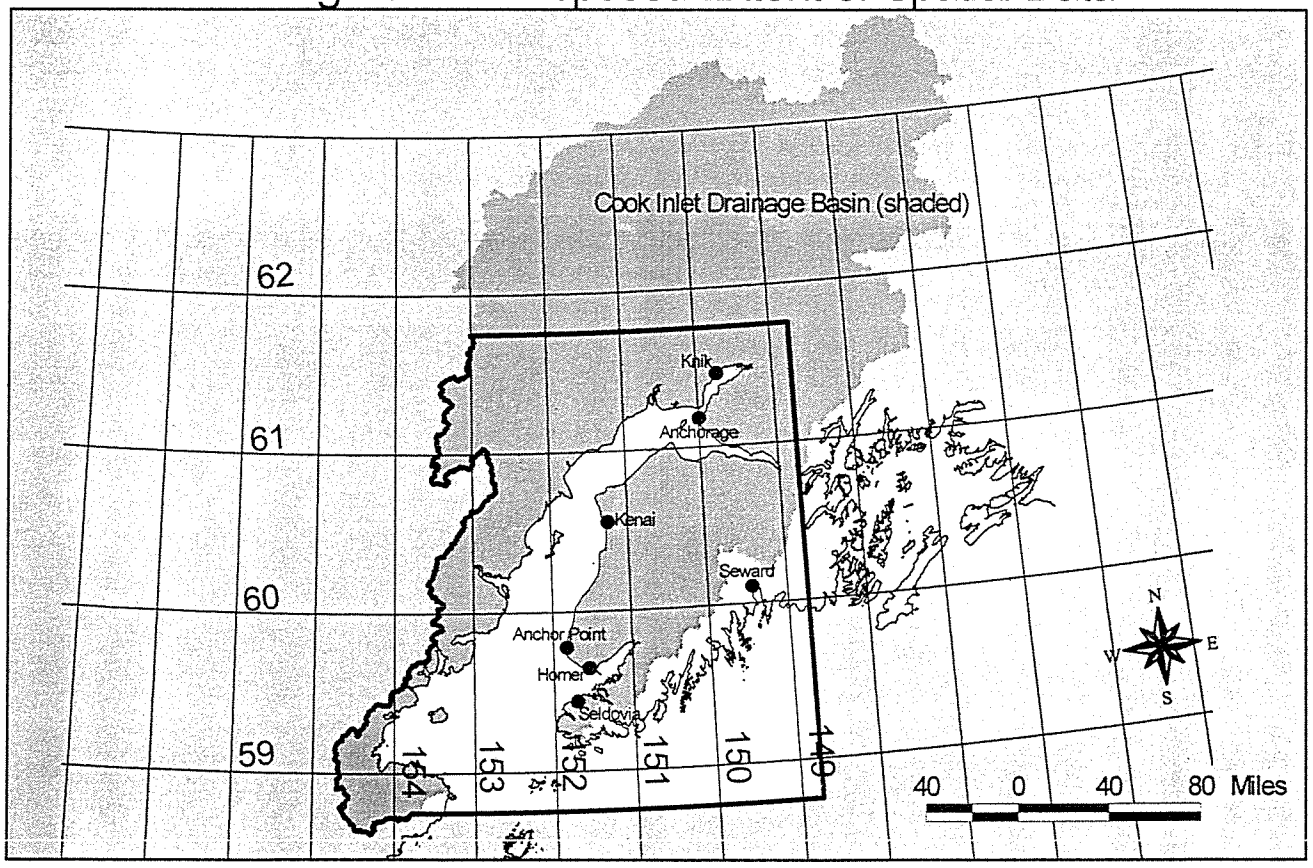


Figure 2-B: Proposed Extent of Spatial Data



COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Community involvement in this project is a significant and very important part of this project. ADFG has already started efforts to inform the community of this project, and have already received a expression of interest from some individuals and groups on this project. We would like to continue and expand those efforts. We would like to request the assistance of staff working on project \052B to conduct "Informational Workshops" in the communities of Seldovia, Port Graham, and Nanwalek early in the EVOS project. The direction and extent of community involvement will, in part, be shaped by the outcome of these meetings. We have included travel budgets for two project staff to travel to these communities for follow-up work. With respect to TEK, all work involved with this component of the project will follow the Trustee's established protocols for including indigenous knowledge.

PROJECT DESIGN

As noted previously, the proposed project is part of larger cooperative effort with NOAA/CSC to develop a characterization for Lower Cook Inlet and the Kachemak Bay Watershed. ADFG and CSC have made substantial progress, including compiling the background information and planning for this proposed project. The project's scope is outlined in the proposal to enter into a cooperative agreement with CSC. The substantive parts of the proposal, and a recent project summary are on the Internet[3] and in Enclosure 5. The following narrative summarizes key aspects of the project, and illustrates how the proposed EVOS-funded staff and contract employees will contribute to the overall effort.

The proposal to the CSC was prepared with an understanding that we would seek additional resources and partners to create the most comprehensive and useful product. The ecological characterization represents a major effort that will have extensive utility for many audiences. However, the primary "target audience" (the primary audience that will guide the development of the project) is researchers and managers, with full consideration of EVOS information and information management needs with Trustee funding. The Trustee Council is a logical partner to help achieve its goals and objectives in common with those of the NERR and the project. The Council's involvement would also gain efficiencies in cost by jointly addressing specific EVOS restoration, research, and monitoring needs. Council participation will, in part, result in (1) a more comprehensive product; (2) greater emphasis on collection of local knowledge; (3) an update of existing information; and (4) collection and synthesis of more detailed and site-specific information on the human, biological, and physical elements of the ecosystem (see Figure 1).

A. Objectives

The broad project goals are included in Enclosure 5. The objectives of the overall project are as follows:

---

3 Web address is: http://www.state.ak.us/local/akpages/FISH.GAME/habitat/geninfo/nerr/kbec/index.html

1. Identify EVOS restoration, research, and long-term monitoring information needs, and tailor the characterization to meet those needs.
2. Identify resource management issues and the information needed to address them in the Kachemak Bay ecosystem.
3. Summarize and document available information on all components of the Kachemak Bay ecosystem.
4. Develop a personal computer-based GIS for the Kachemak Bay ecosystem for use in the characterization and as tool for research, monitoring, and resource management and planning.
5. Develop GIS applications to demonstrate how it can be used for management, research, monitoring, education, and restoration.
6. Summarize past and ongoing research efforts and develop a system to track future research and monitoring projects.
7. Summarize existing information and prioritize data, research, and information technology needs.
8. Publish the ecosystem information, information needs, and the GIS applications as an ecological characterization on a compact computer disk (CD) and, as appropriate, on the Internet.
9. Actively involve researchers, managers, and public users in the planning, development, use, and maintenance of the ecological characterization.

The significance of the project goals and objectives is in "*B. Background/Introduction*" of the CSC proposal in Enclosure 4.

B. Methods

The methodology is discussed in the CSC proposal in "*D. Project Description/Methodology*" and in the general summary in Enclosure 4. A working outline for the CD/Internet Product is in Enclosure 5.[4] A summary of the product and method of data collection and synthesis is provided below.

Project Framework: The ecological characterization will present information through three tools. The following tools are components that work together to create an interactive information system:

1. *Ecosystem Description*: The interactive narrative will describe the Kachemak Bay watershed's ecosystem in great detail and discuss primary resource issues. It will synthesize information about the physical processes, biological systems, and human uses of the bay, referring the user to research on these topics. For example, the salmon section will contain descriptions of each species' life history, habitat requirements, commercial and recreational importance, ecosystem processes that affect their abundance, a summary of research efforts, and bibliographic references. Each section will have HTML links to related spatial data in the GIS such as harvest areas, spawning concentrations, and required habitats. It will also have links to

4 This should be considered a **general draft** outline. It will continue to evolve as the project progresses, and will be further refined to more fully meet the needs of EVOS restoration effort with the Trustee Council's participation. Sections addressing the injured resources and services are noted in a table at the beginning of the outline.

photographs, maps, and data sets as appropriate. The Trustee Council's participation will allow us to develop this detailed and site-specific information, incorporate local knowledge, and place greater emphasis on EVOS restoration needs.

2. *GIS/Spatial Data Component*: The GIS database and its demonstration component will contain digitized spatial data and associated metadata (i.e., a description of the data). GIS layers of habitat, natural resources, physical processes, human use, roads, land use, management status, and other features will allow managers and researchers to better analyze problems using an ecosystem perspective. The GIS demonstrations will show how to use this tool to investigate questions specific to Kachemak Bay, and will generate a GIS analysis of subjects such as land use planning and fisheries management for this area. In addition to the research, management, and modeling applications, the educational benefits of visualizing the data will help involve and educate the community. With the Trustee Council's support, the community will also participate by bringing their knowledge of the region into the GIS.

   ADFG has completed an initial inventory of available spatial data which includes the Kachemak Bay/Lower Cook Inlet Area (Enclosure 5, Section B). The available information does not have the high resolution that the local residents can provide, and that researchers and managers need. The focus of data collection will be the Kachemak Bay Watershed, but we will also collect data to analyze ecological relationships between the bay, Cook Inlet, and the Northern Gulf of Alaska (see Figure 2B). Participation of the Council will allow us to collect more detailed, site-specific data and incorporate local knowledge, and ensure that the information needs of the EVOS restoration effort are met (e.g., include data that will help support long-term monitoring).

3. *Annotated Bibliography and Research Synthesis*: This component will include a searchable, annotated bibliography of EVOS research and other information about the ecosystem. In addition to studies involving Kachemak Bay and Lower Cook Inlet, it will also include auxiliary literature about the resident species. This section will also summarize past and ongoing research, and link to a mechanism for tracking research activities. The bibliography of EVOS and other literature on the Kachemak Bay ecosystem will greatly increase access to and use of this information. While a bibliography for Cook Inlet currently exists, the Kachemak Bay and Lower Cook Inlet entries will be expanded to include current research efforts and a broader range of topics (Dames and Moore, 1996). The bibliography will encompass journal articles, unpublished reports, EVOS projects, gray literature, and major public documents on the watershed and resource that inhabit the area. All of the documents will be searchable by subject, key words, author, and title. The research synthesis will summarize past and current research, thus displaying the value of this research to the ecosystem and communities. This synthesis will also facilitate better coordination among organizations working in the Bay, and assist others in accessing the latest research. Links from the project web page will channel updates on new research directly to the characterization system that ADFG will maintain.

Method of Data Collection and Synthesis (Year 1/FY99):

1. *Database Design:* ADFG and the CSC have begun designing the database to enable easy information access, analysis, and update. This database will also work with the search software of the bibliography and research synthesis component, as well as the GIS applications and ecosystem description. The database design must also accommodate the Internet and CD interfaces.

2. *Literature Search/Review*: ADFG will undertake an extensive search to expand on existing literature reviews and address the goals and objectives of this project. Project staff will use this information, combined with the sources below, to develop the ecosystem description, GIS, bibliography, and research synthesis.

3. *Interviews*: This project will involve extensive networking and outreach with the scientific, management, and local communities to collect the most recent, accurate, and site specific information available. The following sources will be targeted.

    a) *Researchers and Managers:* Information from the literature will be supplemented with interviews of researchers and managers. This will include university, agency, and other EVOS researchers who have conducted studies in the Kachemak Bay area. ADFG project staff will collect most of this information (note: the contractor under (b) below will assist in collecting historical information).

    b) *Collect and Synthesize Existing Information on Historical Use:* A substantial amount of information has been collected on human habitation and use of the Kachemak Bay area. The Pratt Museum, located in Homer, is one of the best sources of this historical, human use information. Local knowledge will be collected from residents of Homer, Seldovia, and adjacent communities. This will include, but not be limited to, information on species' distribution, abundance, trends, and historical and present human use of these resources. ADFG will seek the services of a contractor to research records at ADFG, the Pratt Museum and other appropriate sources to collect and synthesize historical human use of region. The contractor's search will be driven by gaps in the literature and questions provided by ADF&G. The department will also provide the format in which the information will be provided. The contractor's efforts will be closely coordinated with the work of other project staff. The contractor will be selected through a process pursuant to Alaska Procurement Code, AS 36.30.

    c) *Community Involvement and Local/Traditional Ecological Knowledge:* ADFG is interested in involving the community in this project. This will be accomplished through keeping the community well-informed, involving them in an advisory capacity, and developing and implementing a local knowledge component of the project. This aspect will be coordinated with the staff of Trustee Council Project \052B, "Traditional Ecological Knowledge." Both long time local residents and Natives indigenous to the area hold a wealth of knowledge on the physical, biological, and human elements of the Kachemak Bay/Lower Cook Inlet Area. After consultation with Dr. Henry Huntington (under contract to the Trustees), it appears that the best vehicle for initiating discussions about local knowledge is through "Informational Workshops" with the local communities. Workshops should be

held in Seldovia, Port Graham, and Nanwalek. The purpose of the workshops will be to inform the communities of our project, identify and address their concerns, and identify opportunities for incorporating local and traditional ecological knowledge into our project. ADFG project staff and the contractor selected under (b) above will participate in the Informational Workshops.

ADFG project staff will be responsible for the collection and synthesis of knowledge. The project includes travel for two Homer-based project staff to attend the initial Informational Workshops and follow-up with the community's recommendations and ideas conceived at the workshops.

Outyear Task (Year 2/FY00):

This project is proposed as a discrete, 1.5 to 2 year project. The information synthesis will be completed by the end of FY99. The final six months of the project will focus on development of the CD and Internet interface and products. It is essential that at least one project staff person continue working with the CSC to review products, conduct the project evaluation, and complete the other tasks below.

Descriptions of likely FY00 tasks are provided below.

1. *Development of CD/Internet Products*: The information collection and synthesis phases will be completed at the end of FY99. This also marks the end of the two-year Coastal Management Fellowship project. As part of the cooperative agreement, the CSC is responsible for incorporating the information compiled by ADFG into the CD/Internet products. The anticipated completion date is April 2000.

2. *Reproduction and Distribution of CDs*: As part of the cooperative agreement, CSC will produce approximately three hundred copies of the CD. Depending on the number desired by the Council, the department or CSC might need additional funding to reproduce additional CDs.

3. *Production of the Paper Copy*: In the need assessment, several respondents recommended that a paper copy of the ecological characterization be produced. It may be appropriate to develop, at a minimum, a hard copy summary of the ecological characterization for individuals who do not have access to a CD drive or the Internet, or who otherwise need a hard copy.

4. *Product Evaluation*: ADFG and CSC intend to conduct an evaluation of the product before it is distributed. Modifications to the product will be made before the product is released.

5. *Maintenance Plan*: ADFG intends to develop a product that can be maintained. The CD and associated GIS through the Kachemak Bay NERR. ADFG will develop the plan to update and maintain the CD, Internet, and GIS products of the ecological characterization. This will include identification of potential uses, product evaluation, and recommendations for further work.

6. *Coordinate With Other EVOS Projects*: ADFG will coordinate with other EVOS projects to collect and synthesize information and make it available to the stakeholders in EVOS restoration process. The level of effort required in this task will be dependent on what projects are supported by the Trustees.

C. Cooperating Agencies, Contracts, and other Agency Assistance

Agency Requesting Funding:

ADFG is the only Trustee Council agency requesting funding. NOAA/NOS/CSC is a cooperating agency, but is not requesting funding as part of this project.

Contractors:

Through the procedures under Alaska Procurement Code (AS 36.30), ADFG will seek the services of a contractor to assist in collecting and synthesizing information about the human history of the Kachemak Bay area. ADFG will contract out for these services because: (1) there is great expertise in collecting and documenting historical information in the area; (2) local collections provide excellent information on history and human use of the area; and (3) a contractor can most efficiently collect and compile this information.

SCHEDULE

A. Measurable Project Tasks for FY98

1st Quarter:
- Hire habitat biologist.
- Select a contractor.
- Review available sources of EVOS and other data.
- Hold "Informational Workshops" in Seldovia, Port Graham, and Nanwalek.
- Develop questionnaire to use in interviews.
- Begin interviewing and collecting scientific and local knowledge.
- Anchorage GIS staff continue capturing GIS data and start digitizing new spatial data.

2nd Quarter:
- Continue interviewing sources in Homer, Seldovia, Port Graham, and Nanwalek.
- Draft sections in project outline.
- Distribute sections for review.
- Continue collecting and preparing spatial data.
- Start to provide draft materials to CSC for review and comment.

3rd Quarter:
- Complete interviews/start integrating additional information with scientific information.

- Complete additional sections in project outline.
- Complete peer review of drafts.
- Continue to provide drafts to CSC for review and formatting.
- Complete the capture, digitization, and manipulation of most GIS data.
- Attend 10th Annual Workshop and associated meetings.

4th Quarter:
- Complete CSC review of products.
- Finalize all spatial and narrative products.

B. Project Milestones and Endpoints

1st Quarter:
- Literature and information source review completed.
- "Informational Workshop" completed and opportunities for coordination identified.
- Contractor selected and initial planning completed.
- Complete interview framework
- 66% of existing GIS spatial data captured.
- 33% of additional GIS spatial data digitized.

2nd Quarter:
- 33% complete in drafting narrative sections.
- Distribute sections for review.
- 100% of existing GIS spatial data captured.
- 66% of additional GIS spatial data digitized.

3rd Quarter:
- Interviews completed.
- 100% of additional GIS spatial data digitized.
- Peer review of draft narrative and spatial data completed.
- Attend 10th Annual Workshop.

4th Quarter:
- Ecosystem narrative description completed and provided to CSC.
- GIS spatial data section complete and provided to CSC.
- Bibliography and research synthesis and tracking mechanism complete and provided to CSC.

C. Completion Date

Estimated completion date of *April 30, 2000*

PUBLICATIONS AND REPORTS

The ecological characterization will be published in electronic media using CD and Internet.

ADFG would like to consider developing a manuscript with the CSC upon the completion of this project. This will be addressed in our FY00 proposal.

PROFESSIONAL CONFERENCES

NOAA provides funding for the Coastal Management Fellow to participate in at least one conference per year. This summer, the Fellow and a CSC team member will present a poster and paper on the project at the Coastal Society conference (Callahan *et al* 1998, Olmi *et al* 1998). In FY99, the paper will be presented at the conference "Coastal Zone 99."

NORMAL AGENCY MANAGEMENT

Neither ADFG nor NOAA requires development of a characterization. All aspects of this project – the Coastal Management Fellowship project, the NSDI project (Enclosure 2) and the cooperative agreement with NOAA (Enclosure 5) – were funded through a competitive process. Through this proposal, we are seeking to fund staff to complete the characterization and address the EVOS restoration effort's needs.

COORDINATION AND INTEGRATION WITH THE RESTORATION EFFORT

Coordination with the EVOS Restoration Effort: ADFG has begun coordination with restoration projects on several fronts:

- We have spoken to Trustee Council staff to determine if summary work has been done for Kachemak Bay. Apparently little work has been done to summarize and compile existing information, and nothing in the form proposed herein.
- We have initiated coordination with the APEX project (\163), which has a significant study effort in Kachemak Bay/Lower Cook Inlet. We will work with project staff to help define data needs (e.g., spatial data and other information we can collect to assist the modeling or other aspects of their project) and will incorporate their findings in the characterization.
- We will coordinate with the staff of other EVOS projects to include the most up-to-date information in the characterization. Three EVOS-funded staff, including the principle investigator and Homer staff will participate in the 1999 annual EVOS workshop in Anchorage. We have also budgeted for Homer project staff to attend the Technical Review Sessions associated with the 10th Annual Workshop.
- We will coordinate with other related projects if funded. This may include:
  - The NOAA HAZMAT Office project "Mapping of Sensitive Habitats" (no project number available). The project is expected to focus on Prince William Sound.
  - The U.S. Forest Service's proposed project entitled "EVOS Information Transfer Workshop for Managers" (project #99382). This proposes to work with the management agencies and EVOS project staff to develop information transfer workshops. The actual workshops would held in the fall of 1999 (FY00). This project is highly compatible with

and will benefit from ADFG's project as proposed herein. Information developed during our needs survey and other lessons learned during the course of #99238 could play key role in defining the management workshop. Moreover, ADFG project staff under the proposed #98238 could play an active role the manager workshop proposed to be held in FY2000.

- The Department of Natural Resources (DNR), as we understand it, is proposing to develop and watershed-based information management system for the entire Cook Inlet Watershed (no project number available). We have little information about the products that DNR will produce. ADFG #99238 will focus on Kachemak Bay/Lower Cook Inlet Area, and will include narrative, attribute data, and spatial data. New spatial data will be collected only for the focus area (see Figure 2).

Other Funds/Major Contributors: ADFG has secured substantial financial resources and established cooperative agreements in this project. These are detailed below.

A. Currently Funded

1. **NOAA/CSC Coastal Management Fellowship:** The CSC is providing funds to support a Fellowship position in ADFG's Habitat and Restoration Division. The Fellowship will last two-years, starting October 1997. It was anticipated that most of the Fellow's effort would go toward project coordination and design and production of the CD. Bridget Callahan was selected as the Fellow to work on this project. The approximate NOAA contribution (21 months)[5] is **$64,000**.

2. **NOAA/CSC - ADFG National Spatial Data Infrastructure (NSDI) Project**: CSC and ADFG have a cooperative agreement with the NSDI to inventory available spatial data, capture priority data sets, and create a shared data resource on the Internet (see Enclosure 2). Including NOAA's and ADFG's matches, the total cost of this project is **$67,000**.

5 Does not include the 12K match which is required as part of this project. If funded, the match would be met through this project..

3. **NOAA/CSC – ADFG Cooperative Agreement**: As of April 1, 1998, the CSC and ADFG began a two-year cooperative agreement to "Develop an Ecological and Socioeconomic Characterization of Kachemak Bay, Alaska." This involves $140,000 for each of two years, or **$280,000** to ADFG. As part of this agreement, ADFG is responsible for data collection, synthesis, and analysis. We are presently in the first year of the agreement (April 98 to March 99), which includes funds for a Habitat Biologist I, a Fish and Game Technician, an Analyst Programmer (2 months), and cartographer and intern time for the GIS work. This does not include the CSC's contribution.

   The CSC will be responsible for producing the CD and Internet products. The Center has budgeted approximately 1 full-time-equivalent (FTE) in year one and 2 FTE's in year two. The CSC will also reproduce and distribute the CDs. The CSC will also reproduce and distribute several hundred copies of the CD. No precise estimate for the CSC contribution has been established, but will likely exceed **$150,000** before project completion.

4. **Project Management**: Approximately 1.5 months of staff time during the first six months of this project (October 97 to September 98) will have been devoted to project management. This amounts to approximately **$10,000**.

5. **Kachemak Bay NERR**: This project will be closely integrated with the KBNERR. The Final Management Plan/Environmental Impact Statement (FEIS/FMP) is likely to be completed by July 1998, after which ADFG will proceed with hiring NERR staff. Formal designation is likely to occur around October 1998. The Kachemak Bay NERR Manager and Research Coordinator will assist with this project in a review and advisory capacity and eventually assume the responsibility for project management. The Research Coordinator, once hired, with lead the effort to define and prioritize information needs. This will be integrated with researchers and general public through a "Research and Monitoring Advisory Group" that will be set up by the developing NERR. We estimate that this will take approximately two months of staff time, or about **$12,000** of personal services time.

PROPOSED PRINCIPAL INVESTIGATOR

Glenn A. Seaman
ADFG, Habitat and Restoration Division
333 Raspberry Road
Anchorage, Alaska 99518-1599

Phone: 267-2331
Fax: 267-2464
E-mail: glenns@fishgame.state.ak.us

Qualifications:

- From 1975 to 1980, Glenn worked with marine mammal research in Northern and Western

Alaska for ADFG and NMFS. Responsibilities included: (1) field collection of biological samples and data from pinnipeds and cetaceans from coastal villages from Nome to Kaktovik; (2) completing lab analysis of specimens; (3) conducting aerial surveys; and (4) assisting in preparing publications.

- Since 1980, Glenn has functioned as ADFG's Alaska Coastal Management Program (ACMP) coordinator. In that capacity, he was responsible for overseeing the development and implementation of the ACMP. He has gained an extensive understanding of the Alaska Coastal Management Program and coordinated the department's involvement in many planning, policy, and implementation issues. He has gained a very good understanding of regulatory agency needs. As the ACMP coordinator, he was responsible for developing and overseeing the completion of the department's ACMP budget and completion of all Section 309 studies. Two of the more notable 309 projects were the *Kenai River Cumulative Impact Study*, which assessed cumulative impacts and developed a comprehensive GIS for the Kenai River (Liepitz 1994, Seaman 1995); and the aquatic habitat restoration and enhancement studies (Parry *et al* 1993, Parry and Seaman 1994).
- Glenn has led the state's effort to establish a NERR in Alaska that began in 1994. He has been the project manager for the Kachemak Bay Ecological Characterization Project since its inception. He is also the mentor for the NOAA/CSC Fellow.

Glenn has proven his coordination abilities and consistently produces high quality products on time. He will continue to be responsible for overall project management. He will participate in a number of the meetings with EVOS researchers, coordination meetings with CSC, the 10th Annual workshop, and be responsible for overall project administrative responsibilities. This is estimated to require 2.0 months of Glenn's time, of which we are requesting 1.0 month of funding from the Trustee Council.

OTHER KEY PERSONNEL

This project will be completed through a team approach. Based on initial planning and the CSC's experience with other characterization projects,[6] the project requires a minimum of four core staff (not including GIS support in Anchorage) during the intensive information collection and synthesis phases (i.e., FY99). With EVOS funding , we will be able to realize the full complement of four core staff: the Fellow, a Fish and Game Technician, and two Habitat Biologists. All of the core staff will be located in Homer. The Fellow is in Homer at this time. A Habitat Biologist I and Fish and Game Technician III will be hired within the next two months. The fourth position, a second Habitat Biologist I, will be filled on October 1 if the project is funded.

The entire project is tied to the EVOS restoration goals, as it promotes an ecosystem-based approach to restoration, research, and monitoring, while bringing many fringe benefits to other

6 A summary of the Otter Island and Ace Basin ecological characterizations projects can be found on the Internet at the following address: http://www.csc.noaa.gov/lcr/index.html. The Otter Island project is included in its entirety on the Web at this site. While Otter Island provides a sense of the product, the project goals, objectives, and products are quite different.

management and research agencies. This project will add the FTE of one Habitat Biologist I (i.e., 12 months) to the project. Staff time will focus on collecting, summarizing, and synthesizing information on injured resources and services in Kachemak Bay/Lower Cook Inlet.

- *Bridget Callahan/Coastal Management Fellow* – .25 FTE/3 months: Bridget was selected as the Coastal Management Fellow to provide the primary coordination/leadership function for the Kachemak Bay Ecological Characterization/Site Profile Project. Her resume is included in Enclosure 6. Bridget is responsible for overall project design, providing leadership and direction to the Homer project staff, coordinating with the CSC staff, and coordinating efforts with advisory groups, project partners, and the public. CSC provides funding for all but $12,000 (about 3 months) of the fellowship. ADFG is requesting EVOS funding to cover this match, which only represents approximately 13% of the fellowship costs.

- *Habitat Biologist I* – 1 FTE/12 months: As currently envisioned, EVOS responsibilities will be split between two Habitat Biologist I's: one biologist will be responsible for the spatial or GIS component, while a second biologist will be responsible for the ecosystem narrative, bibliography, and research components. While working on EVOS funds, their focus will be on collecting and documenting information on the species and services injured by EVOS. We anticipate that approximately five months of spatial data biologist will billed to the EVOS project, while seven months of the ecosystem narrative bilogist will billed to the EVOS project. One of these positions (most likely the former) will also oversee collection of local knowledge, and will lead interactions with the contractor. ADFG will appropriate the Trustee Council funds to ensure a close link to the species and services injured by EVOS.

  Ongoing efforts to hire the Technician and first Habitat Biologist positions indicate that there are many strong applicants with the requisite computer, GIS, writing, coordination, and personal communication skills necessary to complete the required tasks. Through advanced planning, ADFG will be prepared to hire the new Habitat Biologist I around October 1, 1998.

LITERATURE CITED

Alaska Department of Fish and Game, 1998. *Proposed Kachemak Bay National Estuarine Research Reserve: Draft Environmental Impact Statement/Draft Management Plan.* 114pp plus Appendices.

Callahan, B., Seaman, G., Olmi, G., Fowler, C., and C. Smith. 1998. *The Kachemak Bay ecological characterization: an interactive coastal management and research system.* Poster to be presented at the meeting of The Coastal Society, Williamsburg, Virginia, July 1998.

Dames and Moore, Inc. 1996. *Final Annotated Bibliography for the Cook Inlet Keeper Program.* Anchorage, Alaska. 70pp.

Exxon Valdez Oil Spill Trustee Council, 1994. *Exxon Valdez Oil Spill Restoration Plan.* Anchorage, Alaska. 74pp.

Liepitz, Gary S., 1994. *An Assessment of the Cumulative Impacts of Development and Human Uses on Fish Habitat in the Kenai River.* Technical Report No. 94-6. Alaska Department of Fish and Game, Habitat and Restoration Division, Anchorage.

Olmi, G., Fowler, C., Smith, C., Callahan, B. and G. Seaman. 1998. *Establishing a Shared Spatial Data Resource for Kachemak Bay, Alaska.* Paper to be presented at the meeting of The Coastal Society, Williamsburg, Virginia, July 1998.

Parry, Betsy L., C. M. Rozen, and G. A. Seaman, 1993. *Restoration and Enhancement of Aquatic Habitats in Alaska: Project Inventory, Case Study Selection, and Bibliography.* Alaska Department of Fish and Game, Habitat and Restoration Division, Anchorage.

Parry, Betsy L. and G. A. Seaman. 1994. *Restoration and Enhancement of Aquatic Habitats in Alaska: Case Study Reports, Policy Guidance, and Recommendations.* Alaska Department of Fish and Game, Habitat and Restoration Division, Anchorage.

Seaman, Glenn A., 1995. *The Continued Assessment and Management of Cumulative Impacts on Kenai River Fish Habitat.* Technical Report No. 95-6. Alaska Department of Fish and Game, Habitat and Restoration Division, Anchorage.

South Carolina Department of Natural Resources, and U.S. Department of Commerce, National Oceanic and Atmospheric Administration Coastal Services Center and National Geophysical Data Center. *Ecological Characterization of Otter Island, South Carolina; A prototype for interactive access to coastal management information.* Charleston, SC: U.S. Department of Commerce, National Oceanic and Atmospheric Administration Coastal Services Center. 1996. NOAA CSC/7-96/001.

FY 99 EXXON VALDEZ TR[illegible]E COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$61.6
Travel		$7.5
Contractual		$20.0
Commodities		$1.5
Equipment		$4.0
Subtotal	$0.0	$94.6
General Administration		$10.6
Project Total	$0.0	$105.2
Full-time Equivalents (FTE)		1.3
Other Resources	$251.0	$293.0

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		
	$35.0				
Dollar amounts are shown in thousands of dollars.					
	$110.0				

Comments: Summary of other sources and EVOS contribution is provided below.

FY98: *NOAA/CSC Fellowship, $43.0* -- Needs analysis, project design and planning, establish agreements, identify partners, staff selection
NOAA/NSDI Project, $67.0 -- metadata training, spatial data inventory, prioritize data layers, start capturing/formating priority spatial data
CSC/ADFG Coop. Agreement, $70.0 -- begin data collection, establish data management structure, continue capture of spatial data
NERRS Designation, $10.0 -- project management, administrative tasks, project design, leadership in establishing partnerships

FY99: *NOAA/CSC Fellowship, $31.0* -- project coordination, work with public and advisory group, interface with CSC, overall coordination of project
CSC/ADFG Coop. Agreement, $175.0 -- GIS support and partial staff necessary for the intensive data collection effort, socio-economic study
CSC Participation, $75.0 (est.) -- assistance in project design and development, begin prepatory work necessary to produce CD
NERRS Operation., $12.0 -- Research Coordinator assistance in establishing information needs and research priorities
EVOS/Project Mgmt., $6.4 -- covers half of PI's time on the project for project oversight, management, interact Trustee staff, EVOS meetings
EVOS/Fellowship Match (3 mo.) and HBI (12 mo.), $55.0 -- meets FY99 fellowship match require (see tasks above), provide critical staff support needed to integrate with EVOS restoration effort, update existing and collect additional specific ecological information/local knowledge
EVOS/Contractual, $15.0 -- contract our for collection, synthesis, and documentaton of historical and human use information
EVOS/Other Support and Administration, $28.2 -- phone, contractual, computer, other support, administrative overhead

FY00: *CSC/ADFG Coop. Agreement, $35.0; CSC Participation, $75.0*; EVOS Participation, est. $35.0 -- estimated costs for partners for completing the evaluation, development of maintenance plan, reproduction and distribution, coordinating with other EVOS projects

FY 99

Prepared:

Project Number: 99278
Project Title: Development of an Ecological Characterization and Site Profile for Kachemak Bay/Lower Cook Inlet
Agency: ADF&G

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 99 EXXON VALDEZ TR[illegible]E COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
Glenn Seaman	Habitat Biologist III	18L	1.0	6.4		6.4
Bridget Callahan	Coordinator (Coastal Mgmt. Fellow)	N/A	3.0	4.0		12.0
(Vacant -- will be filled 5/98)	Habitat Biologist I (Long-Term/Non-perm)	14A	5.0	3.6		18.0
(Vacant -- will be filled 10/98)	Habitat Biologist I (Long-Term/Non-perm)	14A	7.0	3.6		25.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		16.0	17.6	0.0	
					Personnel Total	$61.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
10th Annual Restoration Workshop (x2, Homer to Anch, Fellow & HBI)	0.2	2	10	0.1	1.4
Technical Review Sessions (w/workshop, 3 days each x 2)		2	6	0.1	0.6
Homer to Anch, Information Gathering Trips (1 person, 4 trips)	0.2	4	12	0.1	2.0
Prof. Symposium (e.g., Ecosystems Considerations in Fisheries Mgmt.)	0.2	1	4	0.1	0.6
Informational Workshop/Local Knowledge and TEK (Homer-Seldovia & PG)	0.1	2	3	0.1	0.5
Followup Trips to Seldovia (1 person x 3 trips)	0.1	3	9	0.1	1.2
Follow-up Trips to Port Graham/English Bay (1 person x 3 trips)	0.1	3	9	0.1	1.2
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$7.5

FY 99

Prepared:

Project Number: 99278
Project Title: Development of an Ecological Characterization and Site Profile for Kachemak Bay/Lower Cook Inlet
Agency: ADF&G

FORM 3B
Personnel
& Travel
DETAIL

FY 99 EXXON VALDEZ TRU[illegible]E COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed FY 1999
Description	
Contract to Collect Historical/Human Use Information [see DPD page 12, 3(b)]	15.0
Telephone	3.0
Photocopying (publications, reports)	2.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$20.0

Commodities Costs:	Proposed FY 1999
Description	
Office Supplies	1.5
Commodities Total	$1.5

FY 99

Prepared:

Project Number: 99278
Project Title: Development of an Ecological Characterization and Site Profile for Kachemak Bay/Lower Cook Inlet
Agency: ADF&G

FORM 3B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TR[illegible]E COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases:		Number	Unit	Proposed
	Description	of Units	Price	FY 1999
1	Personal Computer*	1	4.0	4.0
				0.0
	* ADFG does not have enough computers for all staff. This equipment costs will cover the cost of a computer sufficient for use of GIS and associated ESRI programs (ArcView and Spatial Analyst). Cost includes software costs for MS Office Professional and ArcView.			0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
				0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.			**New Equipment Total**	$4.0

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency
Camera Equipment (Visual and Digital)	3	ADFG
Sun Workstation and other GIS equipment in Annchorage Office	extensive	ADFG
Personal Computers (dedicated to other Ecological Characterization Project staff)	3	ADFG
Color Printer	2	ADFG
CSC GIS and other Equipment for Production of CD/Internet Products	extensive	CSC
Scanners (Anchorage and Homer)	2	ADFG

FY 99

Project Number: 99278
Project Title: Development of an Ecological Characterization and Site Profile for Kachemak Bay/Lower Cook Inlet
Agency: ADF&G

FORM 3B
Equipment
DETAIL

Prepared:

ENCLOSURE 1

Description of Concerns and Responses Questions and Concerns with the FY98 Proposal, No. 98278

1. Spreadsheet B: Preliminary Executive Director's Recommendation/FY98 Work Plan

Chief Scientist's Recommendation

(a) *"proposal relatively unfocused plan to develop an ecological characterization and long-term monitoring program"*

The element of the FY98 proposal to develop a long-term monitoring program has been dropped. Development of this aspect of the project was premature. ADFG has undertaken extensive project planning by hiring a project coordinator in Homer, securing additional funds, and establishing cooperative agreements. The result is a much more focused project.

(b) *"excellent coordination with other funding sources, and a clear goal to build stakeholder coalition"*

ADFG continues to closely coordinate with its funding sources and has substantially expanded efforts to secure other funding for this project. As a result, several of the funding sources that were identified as "likely" have been secured. Moreover, the state has continued to build stakeholder coalitions, in both this project and the larger state effort to designate a National Estuarine Research Reserve in Kachemak Bay that will promote long-term research, monitoring, and education.

(c) "useful for small-scale land use planning decisions, with marginal relevance to restoration objectives"

As described in this proposal, this project has substantial utility and value for the EVOS Restoration effort. The project responds to the need to collect and summarize existing information as described by peer reviewer comments, the Chief Scientist, and visiting scientists at the 1998 Restoration Workshop in Anchorage. This project will: (1) get the information to researchers, managers, and the public in an effective and easy-to-use form; (2) promote ecosystem-based research and management; (3) help the public and management agencies perceive the value of the restoration effort; and (4) provide a useful information base. This base will help guide the design and development of the long-term monitoring program under consideration by the Trustees.

(d) *"little discussion of the objectives of the monitoring program, and the need for continuous water quality monitoring"*

The task to develop a monitoring program has been dropped.

Executive Director's Preliminary Recommendation

(e) *"has little link to the Trustee Council's restoration objectives"*

See comments on 1-c above.

2. September 3, 1997 letter from Molly McCammon to Claudia Slater

(a) "synthesis of available ecological information about Kachemak Bay is, in itself, a worthy goal ... and synthesis of this information could provide important background for development of a northern Gulf of Alaska monitoring program"

We strongly agree. One of the project's main objectives is to synthesize ecological information in a form that will help the monitoring program.

(b) *"attractive aspects ... was the involvement of stakeholders from local to national levels (e.g., the NOAA National Estuarine Research Reserve system)"*

See response to 1-b above.

(c) *"cost sharing for support of Coastal Management Fellow was also attractive ... (if) information relevant to EVOS"*

See response to 1-b above.

(d) "development of a NERRS program, per se, is not necessarily of direct interest to the EVOS restoration program, nor is a water quality monitoring program"

With respect to review and evaluation of this proposal, the development of a NERRS may not be of "direct interest to the EVOS restoration program": this project, like others, should be evaluated on its own merits. Policies 11 and 14 of the EVOS Trustees Council (EVOS 1994), however, emphasize the need for and importance of cost sharing. The designation of a NERR – a program with similar goals and objectives – will provide substantial cost sharing opportunities, as evidenced by the current proposal. Moreover, the NERR will also help open the door for partnerships with NOAA's national monitoring and restoration initiatives that can benefit the EVOS restoration program (e.g., its effort to develop a long-term monitoring program).

(e) "use the Detailed Project Description to describe the major existing source of information and how what you have in mind incorporates and improves these sources of data (e.g., NOAA sensitivity maps)"

In its project planning over the last several months, ADFG has reviewed existing sources of information on the Kachemak Bay and Lower Cook Inlet area. While there is a large amount

of information available, it is often difficult or impossible to access and understand. This inaccessibility and lack of an adequate information synthesis was the most common comment made by researchers, managers, and the public during the Kachemak Bay NERR designation process (ADFG and NOAA, 1998) and in the needs assessment (see Enclosure 4). Through this project, we will determine user needs and how to most effectively present the information.

There have been few efforts to synthesize information on Kachemak Bay and Lower Cook Inlet. While the Kachemak Bay and Fox River Flats Critical Habitat Area Plan and the EIS for the Cook Inlet Planning Area Oil and Gas Lease Sale 149 summarize some information, they do not include a thorough search and assessment of available information (ADFG 1993, MMS 1996). The Critical Habitat Area Plan, for example, was based on studies from the 1970's and limited local knowledge. The maps are outdated, and the users we surveyed need more detailed, site-specific information. Similarly, the management plan for the Kachemak Bay State Park and Wilderness Area provides only limited resource information for the region. The Lease Sale 149 EIS focused on an area to the north and did not include detailed information for Kachemak Bay. ADF&G and other reviewers also criticized the maps and narrative FEIS for being incomplete and inaccurate. The NOAA sensitivity maps are very general and focus only on limited number of fish and wildlife resources.

The proposed Kachemak Bay Ecological Characterization will build upon these and other sources of information for the study area. ADF&G will also update this and develop a more detailed, site-specific characterization based on scientific information, local knowledge, and TEK.

(f) *"clear plans for sustaining the project beyond the initial support from restoration funds (are needed)"*

As stated in the Kachemak Bay NERR DEIS/DMP (ADFG and NOAA, 1998 – see Research and Monitoring Chapter), it is the intent of the NERR to develop and maintain the ecological characterization and its GIS. Maintenance of the product has been and will continue to be an important ADFG and NOAA priority.

(g) *"suggest a hard-nosed evaluation ... whether such a (GIS) database is needed and whether the need is best addressed through a new or existing system"*

In a strict sense, this project is not creating a new GIS, but is extending ADFG's existing GIS to the Kachemak Bay area and the proposed NERR. The GIS will largely be created using ADFG, Habitat and Restoration Division's existing system in Anchorage. This project will essentially bring this technology and training to Homer. With a trend in the industry from a workstation-based GIS to personal computers, it may soon be possible to create a totally independent GIS in Homer. In the near future, however, it will be supported by the Anchorage GIS and its staff.

(h) *"if there is a clear need for another database, what goes in the system and who creates and maintains it"*

Increasing its accessibility and ease of use optimizes GIS use. Our needs survey revealed a widespread interest and desire by researchers, managers, and the education community to make GIS more readily accessible. This project is in part a response to that need.

As stated above, it is intended that the Kachemak Bay NERR will be responsible for maintaining the GIS. Our needs survey in Enclosure 2, refined further by an assessment of EVOS restoration needs, will drive what goes into the system. Another very important consideration is that the *information is usable*. Its utility will ensure its maintenance.

ADFG does not intend to include all attribute and spatial data available for Kachemak Bay, but will instead prioritize among them based on need and probable use. GIS is becoming an increasingly important tool in research and resource management. Most of EVOS research and monitoring projects use GIS in some capacity. NOAA has also started an initiative titled the "PAGIS", or the "Protected Area Geographic Information System." The purpose of this system-wide project is to bring GIS technology and training to each of the NERRs and National Marine Sanctuaries. With the immediate benefits of a carefully designed and planned GIS, and the long-term research and monitoring goals of the Kachemak Bay NERR and EVOS, we have little doubt that the GIS will be maintained.

ENCLOSURE 2

Summary of User Needs

Purpose of the Needs Assessment

From October 1997 through March 1998, Bridget Callahan, (a NOAA/Coastal Services Center Coastal Management Fellow working with Alaska Department of Fish and Game) conducted interviews with managers, researchers, and educators who work in the Kachemak Bay watershed. Our goal was to determine who would use the characterization, their informational and information management needs, and how to best satisfy those needs. The interview participants represented almost thirty local, state, federal, and private organizations that focus on research and monitoring; fish, wildlife, and public land management; contingency planning for oil spills, environmental education; conservation; land use planning; and using GIS as a tool for all of the above.

This needs assessment will help us to identify the common natural resource issues and needs among different user groups to ensure that the end product succeeds in its goal. While we have not yet finished the assessment, our preliminary results indicate that the proposed project, "The Kachemak Bay Ecological Characterization," will meet many of their needs and support sound resource stewardship and management in the ecosystem.

Contents

- Assessment participants
- Primary management issues
- Priority informational needs for managers and researchers
- Current geospatial information needs, capabilities, and uses
- Characterization product format and access recommendations
- Summary

Assessment Participants

At the time of this proposal, we have interviewed over forty managers, researchers, and educators at twenty-eight organizations who actively work in the Kachemak Bay watershed (see attachment 1). In personal interviews, they responded to 20 questions about their management or research activities, pressing issues, needs, plans, and ways in which this project could assist them or their agency (see attachment 2). While the survey group does not encompass all potential users, the variety of responsibilities held by the participants captures a wide range of interests in this preliminary assessment. The range of responsibilities include: coastal project review and coordination; management of state lands and waters; fish and wildlife research and management; contingency planning, land use planning; research; environmental advocacy, economic analysis, information management, development and implementation of geographic information systems (GIS); and public education and outreach.

Primary Management Issues in Kachemak Bay

For almost all respondents, the most important resource management issues facing Kachemak Bay involve changes in the ecosystem due to anthropogenic and natural factors. The following specific issues command the most attention: the spruce bark beetle infestation, competition between multiple users, commercial and residential development, declining fisheries, cumulative impacts of land and water uses, changes in the watershed's hydrology, water quality degradation, wetlands loss, and other changes in the ecosystem (Table 1).

Table 1. Primary natural resource issues concerning managers, researchers and educators in Kachemak Bay.

Ecosystem Focus	Primary Issues of Concern
Forests	The health of the evergreen forests is declining sharply due in part to a spruce bark beetle infestation, bringing accelerated timber harvesting, catastrophic fire risks, habitat changes, and water quality impacts.
Fisheries	Over the past 10 to 15 years, populations of commercially important crab and shrimp have severely declined, likely due to a combination of human and natural factors. These and other significant changes in Kachemak Bay and the northern Gulf of Alaska have been observed over the past several decades, yet they are poorly understood.
Hydrology and Water Quality	Upland forest changes and increased development in the bay are altering the hydrology of the estuary and affecting water quality. Oceanographic patterns and contaminants from the Gulf of Alaska and Cook Inlet also affect the bay in unknown ways.
Climate	As a background factor, climate variability and change in such forms as ENSO (El Nino/Southern Oscillation) events, increasing greenhouse gases, and ocean regime shifts have strong but poorly understood impacts on the water, forest, and fishery resources.
Human Resource Uses	Increased competition between multiple resource user groups is straining the ecosystem's resources and socioeconomic system. Marine transportation needs and the threat of hazardous spills raise concerns about the sensitive habitats of the bay and compatibility of competing resource uses.
Habitat Changes	Natural processes and anthropogenic factors are driving rapid habitat changes in the uplands and estuaries. The resulting loss of sensitive habitats threatens the rich fish and wildlife resources that support local communities.

Priority Informational Needs for Managers and Researchers

To better understand and address the issues above, managers and researchers need new information and greater access to that which already exists. Their greatest needs are 1) site-specific data on resource uses, 2) maps of fish and wildlife habitat use, and 3) impacts to and location of sensitive habitats. Trends in environmental conditions as well as human use must be understood to analyze changes in the ecosystem and make sound management decisions.

Researchers would like to document and analyze long term changes in the ecosystem to project future conditions. Documenting human activities is also very important for meeting management needs. For example, in order to consider these interests in the

management and planning processes, managers must know which sites support local commercial and recreational fishing activities. Geographically, they need information on heavily used areas of Kachemak Bay which have undergone observable changes in recent years. Examples include Bishop's Beach, China Poot, Jakolof, and Little Tutka Bays, the Homer Spit, and Halibut Cove. Overall, the respondents voiced a need to develop a database on the human, biological, and physical elements of the ecosystem to inform management, planning, and economic development. They recommended that the characterization include a synthesis of historical studies and current research. A sampling of specific questions is shown in Table 2.

Table 2. Specific questions lacking adequate information.

Ecosystem Focus	Specific questions needing further information.
Forests	What is the best management action to mitigate the effects of the bark beetle infestation? How can we minimize the risks of fire and negative impacts to ecosystem from beetle kills? What will be the effects of turpenes and increased sediment on water quality and the ecosystem? How will logging and tree removal affect large mammal habitat? What will the forest look like in 20 years?
Fisheries	How are habitats used by species through their life cycle? Which areas are critical to fisheries and at risk from degradation? What are the impacts of climate variability on fish populations? Which human use areas should we monitor most closely for negative impacts? How do changes in the ecosystem affect populations in the bay? How can we use local knowledge as an information resource for managers? How are upland changes affecting fish habitats and populations? What is the future for fishing opportunities in Kachemak Bay?
Hydrology and Water Quality	What are the baseline water parameters? What are the water quality impacts of human activities? How did the Bradley Lake project and changes in freshwater inputs affect the bay? How would placing a dam at McNeil Canyon affect the bay? Does Homer face a freshwater supply crisis? How will the turpenes and other forest changes affect the bay? How do upland activities influence estuarine physical and biological processes?
Human Resource Uses	What is the carrying capacity of bay, and how fast is the human population growing? How do we balance user needs to maintain a sustainable community? How does the huge annual influx of tourists affect the community and its infrastructure? How many new hotels, B&B's, and charter operations have opened in recent years? How can local people provide input to the management system? What are the economic impacts of non-consumptive and consumptive uses of the bay?
Habitat Changes	How can we document and analyze upland and estuarine habitat changes? What are the effects of residential and commercial development? How many sensitive habitats have been lost and can we restore them? What are the limits of acceptable change to the ecosystem?

Much of the information needed to answer these questions exists and must be compiled in one central location for better access. To supplement this information, many participants

recommended that we interview long-time residents of Kachemak Bay to gain local knowledge about trends, habitats, species occurrence and distribution, and other relevant observations. This would also help us map habitat types and uses.

At the present time, managers and researchers seek this information (when available) from other resource agencies and their own staff. Due to the dispersed nature of information, they often spend much of their time making phone calls, and conducting fruitless searches for critical, site-specific details. For example, if they need water quality data, they usually go to Department of Environmental Conservation, fisheries harvest data comes for Alaska Department of Fish and Game, and the Department of Natural Resources- Parks division provides recreation information. However, the local managers that they query often have large geographic areas of responsibility, and frequently can not provide site-specific information. This burdensome task of searching for information fuels their repeated requests for a centralized, site specific reference for the Kachemak Bay watershed.

All of the respondents feel that their agency would highly value an ecological and socioeconomic characterization specifically about the Kachemak Bay watershed. They could often use a comprehensive knowledge base for planning and managing people and resources. The searchable research synthesis would help biologists to support their professional opinion with readily accessible data and information.

Current Geospatial Information Needs, Capabilities, and Uses

We questioned the survey participants on their GIS needs, uses, and capabilities. Specifically, we gathered details on their use of GIS and their interest in applying it to analyze management problems and evaluate management options. Sixteen out of twenty-eight organizations have a GIS division in their office or currently use GIS. Of those with GIS capabilities, most use Environmental Systems Research Institute's (ESRI) ArcView software. About half of the respondents had plans to expand their use of GIS and their technical capabilities in the future, although few could provide specific details. The three primary barriers to further use of GIS include a (1) lack of understanding of the benefits and applications of GIS as tool for management, research, or planning (i.e., "technophobia"); (2) lack of clearly defined management applications; and (3) lack of funding.

Despite limited plans to develop their in-house capabilities, the respondents had many suggestions on how improved access to GIS data on Kachemak Bay would help them improve on their current procedures. For example, many enthusiastically described potential GIS applications toward managing fisheries, land use planning, analyzing habitat changes such as those caused by the bark beetles, measuring the cumulative impacts of development and logging, making permit decisions, monitoring water quality, and modeling the effects of an accident in Kachemak Bay.

Respondents identified numerous site-specific geospatial data needs, including fish and wildlife habitat uses, habitat type, sensitive habitats, threatened and endangered species,

land use, vegetation, tideland leases, coastal hazards, set net fishing, mariculture, pollution, wildlife migration, forest fuels, trails, cabins, and other public uses. Due to the small geographic area covered in the characterization, respondents thought that increased specificity in the spatial scale was preferable. However, they also acknowledged that the appropriate scale depends upon the question one is seeking to answer.

Characterization Product Format and Access Recommendations

To determine the most accessible and acceptable format, we asked the respondents to compare the proposed project and similar digital information products they had used before. Specifically, we asked them to comment on the Otter Island, Exxon Valdez Oil Spill, and Prince William Sound informational CDs. Those respondents who had used these CDs found them useful, but also had suggestions to improve upon them. For example, they suggested that the Kachemak Bay characterization product go into greater detail, both spatially and substantively, than the other CD products.

In order to ensure that managers can access the proposed product, we asked them if they had CD-ROM drives and/or an Internet connection. Most managers had one or the other of these options at their desks. Some users also reported difficulty running the EVOS and Otter Island programs on their computers, due to insufficient hard drive space. To facilitate better access, many would prefer an Internet product. Several respondents also noted the value of hard copy of data characterization available for individuals who do not have access to computer technology and for quicker access by researchers and managers when computers and software are not available. The managers and researchers also strongly recommended that we update the CD after the initial production and development phases to keep the information current and useful. This would also encourage other organizations to develop and tailor it further to meet specific needs.

Summary

Respondents voiced a need to develop a socioeconomic and ecological database for management, planning, and development. At the present, the managers and researchers seek information from a wide array of sources, leading to time-consuming phone calls, and fruitless searches for site-specific details. Data and qualitative information are separately archived in management agencies throughout the state. The daunting task of searching for information and the lack of access drives repeated requests for a centralized source of site specific details on the Kachemak Bay watershed. All of the interview participants valued the characterization and associated GIS products as a valuable management, research, and educational tool for their organization. A detailed, site-specific knowledge base that identifies and summarizes what is known and not known about the bay's ecosystem would be very useful for planning and developing recommendations for use of the bay and the resources and in prioritizing research and monitoring efforts.

Attachment 1.

ECOLOGICAL CHARACTERIZATION NEEDS ASSESSMENT INTERVIEWS

DECEMBER1997 – MARCH 1998

GOAL: To determine who the users of the information synthesis product will be, what their informational needs are, and how best to deliver that information. This will also help us to identify the common ground among different user groups to ensure that the end product will benefit the whole community.

Names	Primary Interests	Agency or Organization
1. Don McKay, Steve Albert, Mark Fink	management, research, habitat	Alaska Dept. of Fish and Game- Habitat and Restoration Division
2. Wes Bucher, Ted Otis, Bill Bechtol, Lee Haberstroh.	management, research, fisheries	Alaska Dept. of Fish and Game, Commercial Fisheries Division - Homer
3. Nicky Szarzi	management, research, fisheries	Alaska Dept. of Fish and Game, Sport Fisheries Division - Homer
4. Gino Del Fratte	management, research, wildlife	Alaska Dept. of Fish and Game, Wildlife Division- Homer
5. Rod Flynn	management, research, wildlife	Alaska Dept. of Fish and Game, Wildlife Division- Juneau
6. Bruce Talbot, Janetta Pritchard	management, research, land use	Department of Natural Resources- Division of Lands
7. Roger MacCampbell	management, research, recreation	DNR-State Parks and Outdoor Recreation
8. Jeff Davis	management, research	Division of Governmental Coordination
9. Poppy Benson, Leslie Slater	management, research, education	US Fish and Wildlife Service- Alaska Maritime Wildlife Refuge
10. Robin West, Sue Shulmeister	management, research, GIS	USFWS- Kenai National Wildlife Refuge
11. Glenda Landua, Bill Holloway	Land use planning	Kenai Peninsula Borough, Planning Division
12. Eileen Bechtol, Malcolm Brown	Land use planning	Homer City Planning and Zoning
13. Doug Coughenouer	Research, education	Sea Grant Marine Advisory Program
14. Ray Highsmith	Research, monitoring	University of Alaska Fairbanks
15. Gary Drew	Research, monitoring	USGS-Anchorage
16. Mike O'Meara, Carol Harding, Betsy Webb	Education	Pratt Museum
17. Jane Middleton	education	Center for Alaska Coastal Studies
18. Bob Shavelson, Steve Hackett, Mike Gracz	Education, conservation, monitoring	Cook Inlet Keeper
19. Paul Seaton, Nancy Lord, Dorothy Childers	conservation	Alaska Marine Conservation Council
20. Barb Seaman	Conservation	Kachemak Heritage Land Trust
21. Anne Bullington	Contingency planning	Unocal Oil
22. Denise Newbould	Contingency planning	Unocal's Kenai Ammonia/Urea Plant
23. Marilyn Crockett	Contingency planning	Alaska Oil and Gas Association
24. Susan Saupe	Contingency planning, research, monitoring	CIRCAC
25. Doug Lentch	Contingency planning	CISPRI
26. Karl Pulliam	Contingency planning	SOS
27. Craig Layman, Becky Holberg	Economic analysis	Kenai Peninsula Economic Development District
28. Marly Helm	Information	Homer Public Library

Attachment 2.
USER'S NEEDS ASSESSMENT QUESTIONNAIRE

GOAL: To determine who will use the product, what they need in terms of information and information management products, and how best to satisfy those needs. These interviews will help us to identify the common ground among different user groups to ensure that everyone can use, and build from the dynamic end product. While the questionnaire below has structured sections, we conducted the interviews in an informal manner to build rapport and encourage discussion. Therefore, we did not ask some of the questions when and if they did not apply.

A. Profile: Informational Needs and Current System

1. What are your primary management, research, and education activities on a day to day basis and the most important task you do?
2. What management issues facing Kachemak Bay have been the most important to you, or involve you the most in the last 5 years? Which ones will grow in importance in the next? How well do you understand these issues? What information do you lack to better understand them?
3. Is there a particular issue that is ignored, in your opinion? On which issues should the National Estuarine Research Reserve focus?

B. Research and Background Information on Kachemak Bay

4. Are you aware of the research activities conducted in Kachemak Bay on natural and human factors that influence your activities? Would you like to know more? How would that information be best presented to you?

C. Information Systems in Place

5. What information do you need to do your job and what do you want to see in this product?
6. Where do you go for this information now?
7. When you don't have information at your work, would it help if it was more centralized?
8. How valuable is a centralized information synthesis on Kachemak Bay? (show outline, if necessary)

D. Geospatial Information Use, Needs, and Capacity

1. Do you currently use a GIS? If so, for what tasks?
2. What types of GIS software/hardware do you currently have?
3. How many of your staff can and do use GIS? At what level? Do you have any full time GIS staff? Where do you go for GIS technical support now?
4. At what scale are the data coverages most useful for you? At what scale are they of no use at all?
13. Do you plan to expand or develop your use of GIS or your technical capability in the future?
14. How would improved GIS access and capability help you do your job better?
15. What geographic information do you need that you do not now have?
16. What limits your use of a GIS today, or future expansion?

Access, Format, and Other Digital Information Products

17. Have you seen the Otter Island/EVOS/PWS CD's, or the Kenai River database? Do you currently use them? What did you like/dislike about them?
18. Does everyone have Internet connections and CD-ROM drives at their desks? How often do you use the www or CD-ROMs for accessing information?
19. Have you experienced difficulty in accessing information through these media?
20. Do you have any other recommendations for our project?

ENCLOSURE 3: NSDI Project Summary

Establishing a Shared Spatial Data Resource for Kachemak Bay, Alaska[1]

The Federal Geographic Data Committee (FGDC)
The National Spatial Data Infrastructure (NSDI) Benefits Program

Project Summary

Kachemak Bay is a unique, productive estuary located on the east shore of Cook Inlet in South-central Alaska. Although recognized for its pristine natural resources, Kachemak Bay is at risk from increased human use. Through grass roots efforts, Kachemak Bay was recently nominated for inclusion in the National Estuarine Research Reserve (NERR) System. Throughout the NERR designation process, the community recognized that an ecosystem approach to natural resource management in the watershed would require better access to ecosystem information, including spatial data.

In this project, we, the National Oceanic and Atmospheric Administration's Coastal Service Center (CSC) and the Alaska Department of Fish and Game (ADF&G) will create an Internet-based resource for sharing Kachemak Bay information. We intend to establish a spatial data resource that is accessible by all of the parties interested in the comprehensive management of Kachemak Bay. Developing a database that allows access to spatial data and metadata is key to this effort. We will also identify, capture, and format priority data layers that will help managers and researchers to address Kachemak Bay issues.

Specifically, we will:

1) Create an Internet-based framework for sharing spatial data and other information among the local, state, and federal participants.
2) Standardize the format of spatial data in this information resource;
3) Capture, and reformat if necessary, existing relevant spatial data for inclusion in the information resource;
4) Digitize and georeference priority data sets that do not presently exist in a GIS;
5) Create FGDC-compliant metadata for all spatial data in the information resource;
6) Facilitate access to the metadata records via the CSC node on the FGDC network.

The project will benefit management and education efforts in the watershed by providing access to relevant information, creating a GIS for spatial data and metadata, and providing a framework for maintaining the system into the future.

---

[1] From Internet site:
http://www.state.ak.us/local/akpages/FISH.GAME/habitat/geninfo/nerr/kbec/nsdi01.html

ENCLOSURE 4

A. Kachemak Bay Ecological Characterization/Site Profile Project (CSC Proposal)

Introduction

National Oceanic and Atmospheric Administration (NOAA)/Coastal Services Center (CSC) guidelines call for the development of an ecological and socioeconomic characterization of the Kachemak Bay Watershed (hereafter referred to as "characterization" or "ecological characterization"). The proposers view "socioeconomic" or human element as an integral part of the ecosystem. For purposes of this proposal, er use the term "ecosystem" broadly to include the socioeconomic component (hereafter referred to as the "human component" or "human dimension") as well as the physical and biological component. We apply the terms "managers," "management," and "coastal management" broadly to include local, state, and federal management *authorities* and the regulatory and nonregulatory *means* of addressing land and water.

A. Goals, Objectives, and Geographic Area

Project Goals

1. Improve understanding of all components of the Kachemak Bay ecosystem – including the human, physical, and biological components – and how they interrelate.
2. Improve our ability to predict the effects and interactions between the two primary agents of change in the Kachemak Bay ecosystem: the human use or anthropogenic agents and the natural variability in the ecosystem.
3. Promote ecosystem-based land use planning and management decisions.
4. Define and prioritize information and information technology needs to address resource issues in the Kachemak Bay ecosystem.
5. Improve resource manager and researcher understanding of the value and uses of geographic information systems (GIS) and associated data management technologies in resource planning and management.

Project Objectives

1. Identify resource management issues affecting the Kachemak Bay ecosystem, and the information needed for managers to address these issues.
2. Summarize and document available information on all components of the Kachemak Bay ecosystem.
3. Develop a personal computer-based GIS for the Kachemak Bay ecosystem for use in development of the characterization and as tool for subsequent use in resource management, planning, and research.
4. Develop applications to demonstrate use of tools such as GIS for management and research.
5. Summarize ongoing research and develop a system for tracking future research.
6. Summarize existing information and prioritize information, research, and information technology needs.
7. Publish the ecosystem information, information needs, and the GIS applications as an ecological characterization on a compact computer disk (CD) and, as appropriate, on the Internet.
8. Develop a characterization that meets or exceeds the NOAA/Sanctuary and Reserve Division (SRD) site profile requirements.
9. Actively involve researchers, managers, and public users in the planning, development, use, and maintenance of the ecological characterization.

Geographic Focus

The geographic focus of this project includes the Kachemak Bay Critical Habitat Area (CHA) and the Kachemak Bay watershed (i.e., those lands which drain into the CHA) as delineated in Enclosure 1. These

boundaries include the entirety of the proposed Kachemak Bay National Estuarine Research Reserve (KBNERR, see Enclosure 2), and represents the area most often considered by managers and the public as the "Kachemak Bay watershed." The Kachemak Bay watershed as defined represents a full range of coastal management issues and resources common to the lower Cook Inlet and Southcentral Alaska region, and represents a logical boundary for an ecological characterization. As appropriate, this project will also include spatial data and other information on the lower Cook Inlet Region to provide a regional perspective.

B. Background/Introduction

Demonstrating the significance of the project's goals and objectives requires an analysis and clear definition of resource issues and information needs. We base our analysis on two efforts: (1) a survey of potential users for this project (Enclosure 3); and (2) the summary of issues and needs conducted as part the KBNERR designation process [see December 8, 1997 draft of the "Draft Environmental Impact Statement/Draft Management Plan" (DEIS/DMP), mailed to Geno Olmi on 12/19/97]. The project's goals and objectives are described below in the context of the project goals.

Examine Anthropogenic Impacts vs. Natural Ecosystem Variability: To effectively manage coastal resources, one must be able to distinguish between anthropogenic or human-induced changes to the ecosystem and the natural variability in the ecosystem. Significant changes in Kachemak Bay ecosystem and larger ecosystem in the northern Gulf of Alaska have been observed over the past several decades. Changes in abundance of commercially important species of crab and shrimp provide an example. Over the past 10 to 15 years, populations of these species have severely declined. Although crab and shrimp fisheries have been closed for many years, populations failed to recover. Both human and natural factors may have contributed to the decline. With tools such as GIS, managers and researchers can better document and analyze changes in the ecosystem over time. Apart from this project, there is no comprehensive effort underway to obtain and apply the tools to analyze changes in Kachemak Bay ecosystem.

Improve Ecosystem Understanding and Promote Ecosystem-Based Management Decisions: The goals and objectives of the proposed KBNERR and National Estuarine Research Reserve System (NERRS) promote an ecosystem-based approach to research and management. The need for ecosystem management was also a primary impetus behind a broad-based public effort to establish a research reserve in Kachemak Bay. Without proposed Reserve and this project, no government or nonprofit entity has been able to initiate efforts in ecosystem-based management. This project will provide an important start in that direction.

Define and Prioritize the Needs for Information, Research, and Technology: In addition to defining what we do know, we must define information gaps. We can then prioritize needs for researchers to address, and secure the technologies to address those needs at an ecosystem level. The public, researchers, and management agencies involved the Reserve designation process emphasized the need to 1) make information on Kachemak Bay more accessible, 2) define the information and research needs necessary to address key resource management or use issues, and 3) develop a system to promote and monitor research in the Kachemak Bay area. Apart from the proposed KBNERR and this project, no public or agency has assumed the leadership to address these needs.

Improved Understanding and Use GIS: GIS is an extremely powerful information management and analysis tool for resource management, planning, and public education that has not been well utilized by the resource agencies in Homer for the Kachemak Bay area. We must involve agencies and other potential users in the development of this project to ensure that our methods and products will continue to meet their needs and continue to be used. We will develop and demonstrate GIS applications to real management and research issues. While the interest has been high, GIS use in Kachemak Bay by research and management

agencies in Homer has been low. A part from this project, there are no other efforts to get the Kachemak Bay-based management agencies involved in the use of this technology.

C. Audience

The target audience includes resource managers and planners, researchers, and other entities charged with reviewing or guiding land and water use activities (e.g., those that use education as non-regulatory tool to address resource issues). The target audience will be the "driver" for this project, whose needs will define its focus and direction. Examples of product users and their applications include: (1) land use regulators, in making regulatory decisions (e.g., whether or not to issue a permit required for a use or activity); (2) land use planners, in developing/amending the plans that guide the use and management of public or private lands; (3) researchers, to access background information on the bay, develop proposals to addresss priority information needs, and/or use the GIS as research tool; (4) educators, to understand the resource management issues and ecosystem components in order to educate the public and resolve land use issues; (5) fish and wildlife managers, in making resource allocation and management decisions and gaining a broader understanding of the ecosystem; and (6) KBNERR staff, for use in Reserve and System-wide research, monitoring, and educational programs.

A secondary audience is the general public and educational community. While the target audiences will drive the project content, format, and overall design, the general public will also probably use the product. However, the evaluation of the Otter Island Ecological Characterization suggests that it is not practicable to produce a product that will meet the needs of all user groups. Products for a more general and educational audience should be pursued as a follow-up to this project.

D. Project Description/Methodology

Informational and Computational Resources: There are a number informational and data resources that provide a good start for this project. These include a bibliography of literature on the Kachemak Bay area developed for the Cook Inlet Keeper, management plans for the Kachemak Bay CHA and the State Park and Wilderness Area, and the DEIS/DMP for the proposed KBNERR. ADF&G has also inventoried existing data layers, some of which already reside at ADF&G (see Enclosure 4). ADF&G has the computational tools necessary to complete the required work. Most of the GIS work will be done in Anchorage, where ADF&G has a Sun Workstation with ESRI ArcInfo and ArcView (with two Sun terminals and other PC connections) and several high speed personal computers with ArcView (one with ESRI Spatial Analysis). Several project staff will be housed in the Homer office where there several personal computers.

Methodology: NOAA guidelines for the characterization of Kachemak Bay describe two-year cooperative agreement and roles of the CSC and the Cooperator (pages 3 and 4). The summary provided below and the enclosed draft project schedule (Enclosure 5) outline a possible overall approach to conducting the characterization. Since the task plan would be developed jointly by the CSC and ADF&G, our outline should be considered *preliminary and subject to change* based on subsequent discussions with CSC. We will work with CSC to develop a detailed task plan. We recommend the first award be administered for duration of 12 months, April 1, 1998 to March 31, 1999. We will work with CSC to outline the appropriate grant duration and conditions during the second year of this cooperative agreement.

For purposes of this proposal, we have broken the project into three overall categories or "modules": (1) the GIS or spatial data component; (2) the narrative and attribute data component; and (3) the bibliography/research component. The draft project schedule includes each of the three basic components plus a fourth category which applies all of the three components. A general description of each component

is provided below. Numbered tasks refer to the draft project schedule in Enclosure 5. The product will include information types as described the draft product outline provided in Enclosure 6.

- ***GIS/Spatial Data Component***: Developing the spatial data atlas using GIS represents a major component of the ecological characterization. The first step in the process is to assess the spatial data, information management, and GIS training needs of the target audience (Tasks 1 and 12). This assessment is well underway (Enclosure 3), and should be completed by early February. We will begin to address Tasks 2 through 5 through the National Spatial Data Infrastructure (NSDI) project, a cooperative effort between the CSC and ADF&G. Our preliminary assessment suggests that most available datasets do not have metadata that complies with Federal Geographic Data Committee (FGDC) standards. Capturing this data and developing metadata for the primary existing data sets will take more time than is budgeted for under the NSDI project. We propose to use some funds from cooperative agreement to supplement the NSDI project. To address a high priority need of managers and researchers, ADF&G will identify and collect ecosystem site-specific spatial information that has not been digitized (Tasks 2 and 6). This will include more detailed information on the human, biological, and physical elements of the ecosystem. We will consult knowledgeable biologists and local residents to obtain this information, and more thoroughly search and analyze the. Additional spatial information will be digitized from October 98 to March 99 (Task 8).

  ADF&G will develop management applications using to demonstrate the use of human, physical, and biological components of the ecosystem and show relationships that cannot be derived viewing each type of information independently (Tasks 9 and 10). GIS applications will be selected after we have better sense of the information available to support such applications. We will build the application around current management issues in coordination with the applicable management or research agency(s). Based on an initial survey of information needs, these applicatons are likely to include: (1) a fisheries management application (in cooperation with ADF&G fisheries managers and researchers); (2) a planning/land use management application (in cooperation with the ADF&G Habitat and Restoration Division and the Department of Natural Resources); (3) a water quality and/or environmental monitoring application (in cooperation with the Department of Environmental Conservation and Cook Inlet Keeper); and/or (4) a tourism/recreation development application (in cooperation with the Homer Chamber of Commerce, City of Homer, and State Parks). To test their effectiveness, we will demonstrate and refine the tools before inclusion in the final product (Task 11).

- ***Narrative/Attribute Data Component***: Developing a narrative and attribute data to complement the spatial data is the second major component of the ecological characterization. Like the GIS/spatial data component, the needs assessment will drive the focus and format of the narrative and attribute data component (Task 1 and 12). The first six to nine months of the cooperative agreement will focus on collecting the information available in published and gray literature (Tasks 13 and 14). We will collect the information on all components of the ecosystem, including human activities (e.g., fish and wildlife use, recreation, commercial and industrial uses, and myriad upland uses). From October 1998 to March 1999, staff will launch an effort (within the constraints of available funding) to collect site-specific ecological information that is not readily available in the literature. This is not additional "research" in the traditional sense of the term, but rather a more aggressive effort to collect and document the current state of knowledge on the human uses and resources of the Kachemak Bay area.

  At a minimum, this component will include, at a minimum, a description of: (1) the biological system, including a "species gallery" to provide life histories and Kachemak Bay-specific distribution and habitat use information; (2) human uses and activities in the area; (3) the physical environment; (4) natural resource issues; and (5) a description of the management regime (e.g., ADF&G CHA and Department of Natural Resources State Park and Area management plans, KBNERR DEIS/DMP, and

summary of state and federal regulatory authorities). The proposed content and organization of the narrative is further detailed in the draft product outline in Enclosure 6.

To fully utilize and demonstrate the powers of GIS, ADF&G will include attribute data from public sources that will assist managers and researchers. Such attributes may include parcel-specific data from the Kenai Peninsula Borough's (KPB's) GIS, fish and wildlife harvest and population data, economic and demographic data, and data on water quality, timber harvests, etc.

- ***Bibliography/Research Component***: We designed this component to improve access to past research, identify current research, and develop a system to monitor future research as well as identify non-literature sources of information on the Kachemak Bay area. This will be accomplished through Tasks 17 through 20.

- ***Tasks for All Components***: This section of the draft schedule includes those tasks that apply to the entire project. ADF&G will convert information into HTML format (Task 21). User training under this proposal will take several forms (Task 22): 1) metadata training (already completed), 2) Web page training, 3) training of the more active project partners on the development and use of GIS using ArcView, and 4) training of the broader range of users on the use of the CD and Internet products of the this project. The management issues and proposed approach for developing the ecological characterization differs significantly from the Otter Island prototype and the ongoing characterization for the ACE Basin. In this respect, this project provides a valuable learning experience for the NERRS as a whole, and will illustrate the value of different types of characterizations to Reserve managers and management, research, and educational entities. ADF&G NERR staff will give a presentation of the project at the 1999 annual NERRS meeting.

  The department will also develop a user's guide (Task 23). It is our intent that the KBNERR will assume the responsibility for maintaining the characterization and associated GIS. The need to create a product that can be easily updated should be considered throughout the project. A proposed product maintenance plan will be developed at the completion of the project.

  We envision a combination of CD and Internet products from this (Task 24). As a general rule, information that is updated infrequently would be included on the CD (e.g., species gallery, GIS spatial data layers, and historical harvest and population data), while information updated more frequently would be include on the Internet (e.g., information on new research). The CD could include links to the Web sites that contain the other information.

  The final product (Task 25) will also identify and prioritize information, research, to meet those needs, and technology needs (e.g., hardware, software, training). This effort will be linked with the proposed KBNERR, which may be designated by September 1998. The KBNERR will establish two advisory committees, one for education and one for research and monitoring. These committees will assist in identifying and prioritizing information needs.

  Lastly, the products will be evaluated (Task 28). ADF&G will prepare recommendations for additional work with the ecological characterization. This might include development of additional CDs or other products for other audiences or placing the characterization on the Internet.

E. Project Partners

The development of partnerships is a continuing process. In the short time before this proposal, we made progress in formalizing several partnerships. Letters from these partners are included in Enclosure 7.

- *Cook Inlet Keeper (CIK)*: See December 15 letter from Robert Shavelson, Executive Director. The CIK is currently developing a "GIS Atlas" for the Cook Inlet watershed. The Keeper's goal is to include all available digital data for Cook Inlet watershed, of which the Kachemak Bay watershed is a small part. Their metadata is incomplete, and their current plans do not include the development of FGDC compliant metadata. The Keeper has indicated it will share data layers with us in exchange for any public data we develop as part of the ecological characterization. CIK will also participate in an advisory capacity.
- *Alaska Department of Natural Resource (DNR)/Division of Land (DOL)*: See December 22 letter from Jane Angvik, Director. The DOL will: (1) review draft products that relate to their authority and expertise; (2) provide additional information on management needs, issues, and conflicts; (3) participate in an advisory capacity as one of the major users of the product; and (4) share GIS layers that are currently available within DNR.
- *DNR/Division of Parks and Outdoor Recreation (DPOR)*: See December 23 letter from Chris Degernes, Kenai Area Part Superintendent. DPOR will: (1) provide information on human use of the State Park and adjacent waters; (2) identify issues of concern; (3) general project assistance; and (4) participation in an advisory capacity.
- *ADF&G/Division of Commercial Fisheries Management and Development (CFMD)*: See December 16 letter from Ted Otis, Research Biologist. CFMD will: (1) provide site-specific data and information; (2) work with project staff in developing GIS applications for fisheries management and research; (3) participate in an advisory capacity; and (4) review draft sections of the characterization.
- *Office of the Governor/Division of Governmental Coordination (DGC)*: See December 22 letter from Jeff Davis, Project Review Coordinator. DGC will identify coastal management issues and information needs and participate in an advisory role.
- *University of Alaska Fairbanks (UAF)*: See December 24 letter from Ray Highsmith, UAF Professor and Chair of Kasitsna Bay Lab Advisory Committee. UAF will: (1) provide resource information; (2) review draft documents; (3) participate in identifying research needs; and (3) participate in an advisory capacity.
- *Fish and Wildlife Service/Alaska Maritime National Wildlife Refuge (AMNWR)*: See December 29 letter from Leslie Slater, Wildlife Biologist. AMNWR will: (1) provide seabird and other wildlife use information; (2) review documents; and (3) participate in an advisory capacity.
- *Kenai Peninsula Borough*: See December 22 letters from Glenda Landua, Coastal Program Coordinator. The KPB will: (1) share GIS data layers; (2) identify issues and problems; (3) provide GIS technical assistance; and (4) participate in an advisory capacity.
- *Homer Public Library*: See December 19 letter from Marly Helm, Library Director. The Homer Public Library will assist in an advisory capacity with information organization, annotated bibliographies, and possibly metadata. In addition to being a potential user of the product, the Homer Library will help provide an educational and local (non-agency) perspective to the project.

ADF&G project staff will continue to work on expanding the above partnerships or developing new partnerships that are beneficial to project. Addition partnerships include: (1) University of Alaska Anchorage Geomatics Department (e.g., assist in digitizing data layers); (2) Interrain Pacific [e.g., share digital data, share costs in digitizing undigitized data, cooperate in developing metadata (note: Interrain is currently compiling GIS data for the Chugach Native Assoc. for an area south and east of Kachemak Bay)]; (3) Cook Inlet Regional Citizens Advisory Council (e.g., provide information related to oil spill contingency planning, identify information and research needs, participate in an advisory capacity); and (4) Alaska Department of Environmental Conservation (e.g., provide data, participate in the GIS application development, participate in an advisory capacity).

F. Project Milestones

This project includes a number of project milestones that can be used as measures of progress. Proposed milestones are identified in the draft project schedule (Enclosure 5) for most of the project tasks. Section B and D also discuss the significance of these tasks and respective milestones to the goals and objectives of the project.

B. Project Description (Web Site)

Kachemak Bay Ecological Characterization Project

Project Summary

What is an Ecological Characterization?

An "ecological characterization" is a synthesis of regional information emphasizing research, management, and educational needs. It presents a site-specific picture of the region's ecosystem, including its human elements. A characterization may also incorporate auxiliary information, such as annotated bibliographies, tabular and geospatial data, and data access tools.

The Kachemak Bay Ecological Characterization ("the Characterization") will synthesize the available biological, physical, and human use information on the Kachemak Bay watershed. It will be published in an interactive digital format on a compact computer disk (CD), suitable for both novice and technically sophisticated audiences. Unlike a paper document, the CD format will utilize hypertext markup language (HTML, the language used on the Internet) enabling easy updates, and allowing the user to query and manipulate data. Information needing constant updates, such as descriptions of ongoing research, will be housed on the project's Internet site as well. For those who cannot access these formats, we intend to produce a paper version of the executive summary.

This project will also develop a centralized Geographic Information System or "GIS" for the Kachemak Bay watershed. The GIS will include both spatial and tabular data, much of which will be published on the Characterization CD. With assistance from the National Oceanic and Atmospheric Administration's Coastal Services Center, and pending additional funding, the Alaska Department of Fish and Game (ADF&G) intends to develop this GIS into an Internet-based shared information resource for the Kachemak Bay watershed.

Why do we need a Characterization?

Kachemak Bay is a productive estuary with extensive tidal flats, deep-water fjords, clear water and glacial rivers, and diverse fish and wildlife habitats. The Bay is situated at the southern terminus of the road system in Southcentral Alaska, and is one of the more intensely utilized ecosystems in Alaska. The Bay plays a prominent role in its surrounding communities and the Southcentral region. The increasing uses of the region generate conflicts, posing unique challenges for resource users and managers. Community members participating in the designation process for the proposed Kachemak Bay National Estuarine Research Reserve (KBNERR) emphasized the need to synthesize available information and define information gaps. At this time, knowledge of the Kachemak Bay area is dispersed and often inaccessible, information and research needs are undefined, and few people have a clear understanding of past or ongoing research.
ADF&G began this project to increase understanding of the ecosystem, improve access to information, assist in Exxon Valdez Oil Spill (EVOS) restoration efforts, and define which missing information would benefit researchers, resource managers, local governments, and the general public. Better information will support better resource use decisions, promote resource stewardship, and help meet the goals of the proposed KBNERR. By integrating existing

information and developing GIS management tools, we will assist research efforts and promote an ecosystem approach towards managing and using our natural resources.

What will the Characterization include?

Although still preliminary, the draft format includes three main components: 1) the Kachemak Bay Ecosystem Narrative, 2) the Bibliography and Research Synthesis and 3) the GIS and Spatial Data Analysis. A similar CD about Otter Island in the ACE Basin National Estuarine Research Reserve (South Carolina) illustrates the type of formats, data organization, and GIS applications that we could incorporate into this Characterization.

The Kachemak Bay Ecosystem Narrative: The narrative will introduce the Kachemak Bay area and the primary resource issues. The area description will synthesize information on the physical and biological processes, and the human uses of the Bay, and refer to past research on these topics. For example, the salmon section will contain descriptions of each species' life history, habitat requirements, commercial and recreational importance, the biological and physical processes and the human factors that affect their abundance and distribution, a summary of research efforts, and bibliographic references. Each section will have HTML links to related spatial data in the GIS (as available) such as harvest areas, spawning concentrations, and preferred habitat types. There will also be links to photographs, maps, and figures and tables as appropriate.
This narrative provides the background for discussing resource issues that have drawn the attention of researchers, resource managers, and Kachemak Bay's residents. Issues may include water quality, health of the fisheries, recreational use pressures, bark beetle infestations, and residential and commercial development trends. In addition to these brief synopses, the user will be guided to further information via links to the GIS, research synthesis, and bibliography.

GIS and Spatial Data Analysis: This component will contain digitized spatial data and associated metadata (i.e., a description of the data) on Kachemak Bay. GIS layers of natural resources, physical processes, human use, landmarks, land use, and management status will allow managers, researchers, and the public to analyze problems using an ecosystem perspective and GIS technology. The CD will also demonstrate how to use GIS to answer questions specific to Kachemak Bay. For example, it may contain sample GIS applications for land use planning, fisheries management, recreation development, or hydrologic modeling in the watershed. It will also refer to data sets that are not available in digital format. This will serve to compile the available digitized data at a usable scale, and to identify and prioritize non-digitized data sets that meet user's needs. This product and the forthcoming Internet GIS resource will improve access to and use of spatial data and metadata, and increase local decision-making and research capabilities.

The Bibliography and Research Synthesis: This component will contain an annotated bibliography of literature on the Kachemak Bay ecosystem. While an initial bibliography for Cook Inlet currently exists, the Kachemak Bay entries could be expanded to include current research efforts and a broader range of topics. The bibliography will encompass journal articles, gray literature, and major public documents on the watershed. All of the documents will be searchable by subject, key words, author, and title. This will also contain a synthesis of past and current research, thus facilitating better coordination among organizations working in the Bay, and assisting others in accessing the latest research. Links will be provided to allow for periodic updates on new research.

ENCLOSURE 5

Draft outline for Kachemak Bay Ecological Characterization Project

The following outline details the content of each of three main characterization components: the Narrative Ecosystem Description, GIS/Spatial Data, and the Bibliography and Research Synthesis. Detailed, site specific information about and discussions of injured species and lost or reduced services are integrated with ecosystem information in this comprehensive synthesis. The table below shows where this information is found in the outline. All of the eight major sections include discussions and detailed information on injured species and/or lost or reduced services.

EVOS Injured Species and Lost or Reduced Services	**1. Ecosystem Description Sections Containing Information About Them:**	**2. GIS and Attribute Data, and 3. Bibliographic, and Research Sections Containing Information About Them:**
Sediments, Intertidal and subtidal communities, Bald eagle, common murre, mussels, pink salmon, sockeye salmon, cormorants, harbor seal, harlequin duck, marbled murrelet, sea otter, black oystercatcher, clams, common loon, Kittlitz's murrelet, river otter, rockfishes., pigeon guillemot	A. Physical processes B. Biological Systems i. Habitats and Vegetation Communities ii. Species Gallery	2. A. Metadata Catalogue B. Digital Geospatial Data Collection ii. Management models and tools. 3. A. Annotated Bibliography B. Research Tracking Site E. Research and Monitoring Needs
Archaeological resources	C. The Human Element: Socioeonomic Profile and Analysis i. History of Kachemak Bay	2. A. Metadata Catalogue B. Digital Geospatial Data Collection
Commercial fishing, passive uses, recreation and tourism including sport fishing, sport hunting, and other recreational uses, subsistence, and Designated Wilderness Areas	B. Biological Systems i. Habitats and Vegetation Communities ii. Species Gallery C. The Human Element: Socioeonomic Profile and Analysis ii. Modern Community Profiles iii. Coastal and Natural Resource Management iv. Focus on Resource Uses in the Watershed.	2. A. Metadata Catalogue B. Digital Geospatial Data Collection ii. Management models and tools. 3. A. Annotated Bibliography B. Research Tracking Site E. Research and Monitoring Needs

1. Ecosystem Narrative

A. Physical Processes

i. General context/location and climate
ii. Physiographic description
iii. Geology: origin and evolution of the estuary
iv. Glaciation

v. Seismology:
vi. Unique features
vii. Oceanography and coastal processes
viii. Hydrology and Water quality

B. Biological Systems

i. Habitats and vegetation communities
ii. Species gallery

C. The Human Element: Kachemak Bay Socioeconomic Profile and Analysis

i. History of Kachemak Bay

a. Past Societies
b. Development of Seldovia, Anchor Point, and Homer
c. Timeline of important events in the history of Kachemak Bay human settlement

ii. Modern Kachemak Bay community profiles

a. Thumbnail sketches of the individual communities around Kachemak Bay
b. Cultural profile
c. Demographics:
d. Economic characterization
e. Services profile
f. Development analysis

iii. Coastal and natural resource management

a. Introduction to government, private, and tribal perspectives
b. Resource management

iv. Focus on Resource uses in the watershed

a. Qualitative information
b. Quantitative data
c. Natural resource issue summaries

3. GIS/ Spatial Data

A. Metadata Catalogue

i. NGDC compliant metadata on all data layers included in B.
ii. Index of attribute data in Narrative/Attribute Data Module

B. Digital Geospatial Data Collection

i. Basic ArcView shapefiles
ii. Management models and tools for Kachemak Bay
iii. Internet links to additional sources of data

C. User's Guide to Using GIS and Management Tools

D. Identified Data and Information Management Needs

4. Bibliography and Research

A. Annotated Bibliography

i. Past and ongoing research efforts
ii. Journal articles on Kachemak Bay
iii. Gray literature such as public documents, plans, and reports
iv. Literature on similar primary resource issues from other watersheds

B. Research Tracking Site

i. Current research proposals.
ii. Description of ongoing research and monitoring activities

C. User's Guide to Searching Bibliography and References

D. Research Facilities

E. Research and Monitoring Needs

Draft Kachemak Bay Socioeconomic Profile and Analysis Outline

1. History of Kachemak Bay

a. Past Societies (for all we'll include Time period, settlement sites, traditions, and archaeological evidence where appropriate.)

Pacific Eskimo
Dena'ina Native Americans – **(others? How to divide this section?)**
Russians
Brief description of the Russian Orthodox communities
Europeans

b. Development of Seldovia, Anchor Point, and Homer
Early activities: Coal mining, Fox farming, Fishing, Hunting

c. Timeline of important events in the history of Kachemak Bay human settlement, such as natural resource discoveries, immigration, or natural events with strong impacts on humans, such as forest fires, earthquakes (1964), tsunamis, etc.

2. Modern Kachemak Bay community profiles

a. Thumbnail sketches of the individual communities, including Homer, Seldovia, Anchor Point, Nikolaevsk, Fritz Creek, Jakolof Bay, Halibut Cove, Kachemak, Nanwalek, Port Graham, Kachemak Selo, Razdolna, (etc- or should we aggregate them more?)

b. Cultural profile: describes the variety of religious traditions and ethnic backgrounds, cultural and traditional activities (especially those that influence resource uses), arts and entertainment, and active community organizations.

c. Demographics:

1. population trends, in- and out- migration
2. age structure
3. education
4. employment
5. income patterns: average wages, % in poverty, sectoral activity

d. Economic characterization

Major economic sector profile

Where the data are available, we'll include descriptions of, personal income from, (including wages, benefits and multipliers) and environmental impact of the following economic sectors: (*italics are main economic sectors mentioned in the Homer Comprehensive plan,* the others are those in the Homer Community Profile from the Borough)

Commercial Fishing

Transshipping

Tourism
Retail trade
Retirement
Service
Education
Services
Trades

Transportation, communication, public utilities

Local Government: schools, hospital and health services
Manufacturing
Construction
Finance
Real estate
Agriculture

Forestry
Mining

d. Services profile
Transportation
Utilities
Media
Education
Other services

e. Analysis (this is the section in need of the most work- what are the questions we want to answer? The following are just a few possible angles):
1. Patterns in residential and commercial development
Growth: Data on building permits, business licenses, the abundance and diversity of businesses, infrastructure developments, and other measures that may reveal patterns in development.
2. Economic Diversification and Strength
Resource dependency issues
Visitor Industry: attractions and issues
3. Summary of key economic trends and growth projections

3. Coastal and natural resource management

a. Introduction:
Private property perspective
Government agency perspective
Tribal perspective
Evaluating management measures
Land ownership

b. How resource uses are managed
Coastal management activities
Federal, tribal, state, and local jurisdiction and management authorities
Existing uses of the coastal and marine environment, regulatory agency, and
Commercial fishing, sport fishing, personal uses, sport hunting, subsistence hunting, trapping, grazing, marine invertebrate gathering, marine transportation, plant gathering, mariculture, recreation, tourism
Plans to aid resource management:
Kenai Peninsula Borough coastal management plan, Homer Comprehensive Plan, Critical Habitat Area Plan, Kenai area plan, what else is there?

4. Focus on Resource uses in the watershed

a. Qualitative information on mining, commercial fishing, sport fishing, personal uses, sport and subsistence hunting and fishing, logging, trapping/snaring, grazing, plant and animal gathering, marine transportation and other industries, mariculture, and tourism.

b. Quantitative data on these uses and their impact on the economy: (we may wish to just inventory available tabular data on these, I don't expect us to have the time to do anything with

this information for the characterization.) For example, data on timber harvest, standing timber, bark beetle infestation, fisheries catch, stock assessment, industrial growth, oyster culture, mining permits, sport fishing licenses, and many other measures of the economic impacts of resource uses are available.

c. Natural resource issue summaries
(In each issue summary we include a general description, historical background, balanced presentation of the facts, and links to the ecosystem descriptions and attribute data above as well as spatial data in the GIS module. Where appropriate, we may present the "sides" with interviews of people representing alternate viewpoints. We'll have to see what we get in terms of video footage.) Examples:

Spruce bark beetle infestation and the fire risk
Health of the fisheries
Conflicts between multiple users
Water quality and hydrology
Residential and commercial development trends
Climate change impacts

Safe harbor needs and contingency planning

B. Inventory of Data Layers for the Kachemak Bay Ecological Characterization Project

Since we are still in the process of capturing data, please keep in mind the following remarks:

- We have not yet verified the accuracy of the information contained in the following list (esp. the purported scale of each data layer).
- We have not yet verified that the datasets listed actually contain data from Kachemak Bay.
- Some of the datasets may be duplicates of one another due to the frequent exchange of data among different agencies (e.g., KPB received some of their data from ADNR).

Other remarks:

- The fact that some coverages have similar names does not necessarily imply that they are duplicates of one another. There are often subtle differences among similar datasets (e.g., different scale, date, custodian).
- Some of the datasets listed are subsets of other datasets.

Inventory of Data Layers for the Ka k Bay Ecological Characterization Project

Description	Category	Info Source	Custodian	Scale	Type	Name	Date	Metadata	Capture
Anadromous Streams	Biological Features	EVOS CD	ADFG	1:63360	PolyLine	anadst96	96	Outdated	Y
Anadromous Streams (Point)	Biological Features	EVOS CD	ADFG	1:63360	Point	anadsp96	96	Outdated	Y
Bald Eagle Nests	Biological Features	EVOS CD	USFWS	1:63360	Point	fwseagle	91, 96	Outdated	Y
Clams (also CHA)	Biological Features	EVOS CD	NOAA	1:250000	Polygon	clamcik	84, 93	Outdated	Y
Herring (also CHA)	Biological Features	EVOS CD	NOAA	1:250000	Polygon	herrcik	84, 94	Some	Y
Marine Mammals	Biological Features	EVOS CD	NOAA	1:450000	Polygon	cmamm_fa, _sp, _su, _wi	84, 94		Y
Other Birds	Biological Features	EVOS CD	NOAA	1:250000	Polygon	cbird_fa, _sp, _su, _wi	84, 93		Y
Seabird Colonies	Biological Features	EVOS CD	USFWS, ADNR	1:63360 / 1000000	Point	fwsbird	96		Y
Seal / Sea Lion Haul-out Sites	Biological Features	EVOS CD	NOAA	1:250000	Point	haulcik	93		Y
Borough / REAA Boundaries	Boundaries	EVOS CD	ADNR	varies	Polygon	bororeaa	92, 94, 95, 96		Y
EVOS Affected Area	Boundaries	EVOS CD	ADNR	1:2000000	Polygon	evosbnd	93		Y
Habitat Acquisition - Large Parcels	Boundaries	EVOS CD	ADNR	1:63360	Polygon	parcellg	96		Y
Habitat Acquisition - Small Parcels	Boundaries	EVOS CD	ADNR	1:63360	Polygon	prclesm	96		Y
Habitat Acquisition - Small Parcels (Pts.)	Boundaries	EVOS CD	ADNR	1:63360	Point	parsm_pt	96		Y
Sections (Cook Inlet)	Boundaries	EVOS CD	ADNR	derived from protractions	Polygon	sec_cik	93, 94, 95		Y
Township / Range	Boundaries	EVOS CD	ADNR	derived from protractions	Polygon	twps	93, 94, 95		Y
USGS Topographic Quad (1:250000)	Boundaries	EVOS CD	ADNR	1:250000	Polygon	qmqa	93		Y
USGS Topographic Quad (1:63360)	Boundaries	EVOS CD	ADNR	1:63360	Polygon	itma	93		Y
Ferry Ports	Cultural Features	EVOS CD	ADNR	1:250000	Point	ferryprt	95		Y
Marine Highways	Cultural Features	EVOS CD	ADNR	1:63360 / 2000000	PolyLine	marnehwy	91, 95		Y
Roads (1:2000000)	Cultural Features	EVOS CD	ADNR	1:2000000	PolyLine	road2mil	82		Y
Roads (1:63360) (Kenai Peninsula)	Cultural Features	EVOS CD	ADNR	1:63360	PolyLine	row_ken	92		Y
Social Economic	Cultural Features	EVOS CD	NOAA	1:63360 / 100000	PolyLine	seconcik	90, 94		Y
Towns	Cultural Features	EVOS CD	ADNR	1:250000	Point	towns	95		Y
EVOS Projects	EVOS Research Areas	EVOS CD	ADNR	10 min x 10 min	Polygon	evosprj	96		Y
Timber Harvest	Human Use	EVOS CD	ADNR	1:63360	Polygon	timber	95	Outdated	Y
Sediment Hydrocarbon Analysis	Hydrocarbon Analysis	EVOS CD	NOAA	varies	Point	sediment	89, 95		Y
Tissue Hydrocarbon Analysis	Hydrocarbon Analysis	EVOS CD	NOAA	varies	Point	tissue	89, 95		Y
Detailed Land Status (Cook Inlet)	Land Status	EVOS CD	ADNR	1:63360	Polygon	lscik	93		Y
Fed Conservation System Units	Land Status	EVOS CD	ADNR	1:250000 / 63360	Polygon	csu	91 freq updates		Y
Federal Wilderness Designations	Land Status	EVOS CD	ADNR	1:63360 / 2000000	Polygon	fed_wild	93, updated 95		Y
Land Status	Land Status	EVOS CD	ADNR	1:1000000	Polygon	astat96	94-95		Y
Legislative Designated Areas	Land Status	EVOS CD	ADNR	640 acre res.	Polygon	lda_out	93, 95	Some	Y
1964 Earthquake Displacement	Miscellaneous	EVOS CD	ADNR	1:2000000	Polygon	eq_64	64, 65	Some	Y
Bathymetry	Physical Features	EVOS CD	ADNR	1:250,000	Polygon	bath20m	90		Y
Coast (Exxon)	Physical Features	EVOS CD	ADNR	1:60000	PolyLine	coastex	89	Some	Y
Coast (State)	Physical Features	EVOS CD	ADNR	1:63360	PolyLine	coaststt	89	Some	Y
Currents Cook Inlet	Physical Features	EVOS CD	NOAA	1:250000	Polygon	curntcik	93		Y
Elevation Model	Physical Features	EVOS CD	ADNR, USGS	1:250000	Grid	elevevos	95		Y
Elevation Model	Physical Features	EVOS CD	ADNR, USGS	1:250000	Grid	hillevos	95		Y
Glaciers	Physical Features	EVOS CD	ADNR	1:1000000	Polygon	glac1mil	91, 94		Y
Lakes and Names	Physical Features	EVOS CD	ADNR	1:1000000	Polygon	lake1mil	91, 94, 95		Y
Latitude / Longitude Degrees	Physical Features	EVOS CD	ADNR	1 deg x 1 deg	PolyLine	ll1x1	92		Y
Rivers and Lakes	Physical Features	EVOS CD	ADNR	1:63360	Polygon	hy63cik	50, 85		Y
Rivers and Names	Physical Features	EVOS CD	ADNR	1:1000000	PolyLine	rvr1mil	91, 94, 95		Y
Shoretype - Environmental Sensitivity Index	Physical Features	EVOS CD	ADNR, MMS, NOAA	1:80000	PolyLine	esi_cik	90	Some	Y
Winter Ice	Physical Features	EVOS CD	NOAA	1:250000	PolyLine	ice_cik	83		Y
Place Names Annotation	Place Names	EVOS CD	ADNR	1:63360	Polygon	annoitm	96		Y
Place Names as Points	Place Names	EVOS CD	USGS	1:63360	Point	usgsname	94		Y
Cook Inlet Shoreline Oiling (Fall 89, Spring 90)	Shoreline Oiling	EVOS CD	ADNR	1:63360	PolyLine	cik89_90	89, 90	Some	Y
Cook Inlet Shoreline Oiling (Spring 91)	Shoreline Oiling	EVOS CD	ADNR	1:63360	PolyLine	cik0591	91	Some	Y
Cook Inlet Shoreline Oiling (Summer 89)	Shoreline Oiling	EVOS CD	ADNR	1:63360	PolyLine	cik0889	89	Some	Y
Aerial Bird Surveys	Biological Features	Keith Boggs, 97	USFWS	1:63360				Some	
Aquatic Rsrcs. Information Management Sys.	Biological Features	Keith Boggs, 97	BLM				97		
Bald Eagle Nest Locations and Productivity	Biological Features	Keith Boggs, 97	USFWS	1:63360 / 250000				Some	
Bald Eagle Nest Site Locations	Biological Features	Keith Boggs, 97	USFWS				90	Some	
Bald Eagle Nests - EVOS Database	Biological Features	Keith Boggs, 97	ADNR				89, 92	Some	

Description	Category	Info Source	Custodian	Scale	Type	Name	Date	Metadata	Capture
Clam Study Sites - EVOS	Biological Features	Keith Boggs, 97	ADNR				89-91	Some	
Forest Health Management Report	Biological Features	Keith Boggs, 97	USFS				96		
Land Cover PWS and Kenai Pen. - EVOS	Biological Features	Keith Boggs, 97	ADNR					Some	
Marbled and Kittlitze Murrelet Surveys	Biological Features	Keith Boggs, 97	Wildland Rsrc. Enterp.				83-96	Some	
Sea Otter and Pelagic Sea Bird Transects	Biological Features	Keith Boggs, 97	ADNR					Some	
Seabird Catalog - EVOS Database	Biological Features	Keith Boggs, 97	ADNR				92	Some	
Stellar Sea Lion Locations	Biological Features	Keith Boggs, 97	Natl. Marine Fish. Srv.				95	Some	
Borough Boundaries	Boundaries	Keith Boggs, 97	ADNR				92	Some	
Cleared Areas	Boundaries	Keith Boggs, 97	Natl. Rsrc. Con.						
Coastal Zone Boundaries	Boundaries	Keith Boggs, 97	ACZM	1:250000			95	Some	
Coastal Zone District Boundaries	Boundaries	Keith Boggs, 97	ACZM				95	Some	
Conservation System Unit Boundaries	Boundaries	Keith Boggs, 97	ADNR, BLM					Some	
Ecoregions of Alaska	Boundaries	Keith Boggs, 97	USGS				96		
Election District Boundaries for 1994	Boundaries	Keith Boggs, 97	ADNR				95	Some	
Game Management Units	Boundaries	Keith Boggs, 97	ADFG				94	Some	
Hydrologic Unit Codes (HUC) for Alaska	Boundaries	Keith Boggs, 97	USGS				94		
Major Ecosystems of Alaska Map	Boundaries	Keith Boggs, 97	USGS						
Regional Education Attendance Areas (REAA)	Boundaries	Keith Boggs, 97	ADNR				95	Some	
Airports	Cultural Features	Keith Boggs, 97	Rsrc. Data Inc.				92	Some	
Archaeology Preliminary Sites (EVOS)	Cultural Features	Keith Boggs, 97	ADNR					Some	
Cities, Towns and Villages	Cultural Features	Keith Boggs, 97	Rsrc. Data Inc.					Some	
Historical Transportation Routes	Cultural Features	Keith Boggs, 97	ADNR				95	Some	
National Geodetic Survey Monuments	Cultural Features	Keith Boggs, 97	ADNR				94	Some	
Right of Way	Cultural Features	Keith Boggs, 97	ADOT						
Fishing Districts - EVOS Database	Human Use	Keith Boggs, 97	ADNR				91, 92	Some	
Seal Harvest Data - EVOS	Human Use	Keith Boggs, 97	ADFG				94	Some	
Timber Harvest - EVOS Database	Human Use	Keith Boggs, 97	ADNR				93	Some	
General Land Use (EVOS)	Land Status	Keith Boggs, 97	ADNR				89	Some	
Digital Chart of the World (DCW)	Multiple Themes	Keith Boggs, 97	ESRI	1:1000000			92	Some	
Geographic Info. System Database Summary	Multiple Themes	Keith Boggs, 97	ADNR						
Southcentral Regional Database	Multiple Themes	Keith Boggs, 97	ADNR	1:250000			82	Some	
Bathymetric Contours	Physical Features	Keith Boggs, 97	Interrain Pacific				90	Some	
Bathymetry - EVOS Database	Physical Features	Keith Boggs, 97	ADNR		Grid		90	Some	
Bathymetry - Maj. Contours and Depth Range	Physical Features	Keith Boggs, 97	Interrain Pacific				90	Some	
Coastline - 1:250000	Physical Features	Keith Boggs, 97	ADNR	1:250000			94	Some	
Coordinate System of 1927	Physical Features	Keith Boggs, 97	ADNR				95	Some	
Hydrography - 1:63360	Physical Features	Keith Boggs, 97	ADNR	1:63360			91-94	Some	
Hypsography	Physical Features	Keith Boggs, 97	ADNR				94	Some	
Lakes Greater than 20 Acres	Physical Features	Keith Boggs, 97	ADNR	1:2000000			82	Some	
Latitude and Longitude Lines Every 2 Degrees	Physical Features	Keith Boggs, 97	ADNR				92	Some	
Mineral Terranes / Mineral Deposit Areas	Physical Features	Keith Boggs, 97	BLM				95	Y	
Permafrost	Physical Features	Keith Boggs, 97	USGS	1:2500000			96		
Quadrangle Boundaries - 1:63360	Physical Features	Keith Boggs, 97	ADNR	1:63360			93	Some	
Rivers	Physical Features	Keith Boggs, 97	ADNR	1:2000000			94	Some	
Universal Transverse Mercator Grid	Physical Features	Keith Boggs, 97	ADNR				95	Some	
Hydrography and Anadromous Streams - EVOS	Physical/Biological Features	Keith Boggs, 97	ADNR				88, 89, 91	Some	
Place Names	Place Names	Keith Boggs, 97	Rsrc. Data Inc.				93	Some	
ADEC Monitoring Stations	Pollution	Keith Boggs, 97	ADNR					Some	
Beach Segments - EVOS	Pollution	Keith Boggs, 97	ADNR				90	Some	
EVOS Foodsites, Subsistence	Pollution	Keith Boggs, 97	ADFG				94	Some	
Integrated Coastline - EVOS Database	Pollution	Keith Boggs, 97	ADNR				90	Some	
Intertidal Study Sites - EVOS Database	Pollution	Keith Boggs, 97	ADNR				91	Some	
NOAA HAZMAT On-Scene Spill Model	Pollution	Keith Boggs, 97	USFWS					Some	
Preliminary Hydrocarbon Sites - EVOS	Pollution	Keith Boggs, 97	ADNR					Some	
Shoreline Oiling 1989, Month to Month	Shoreline Oiling	Keith Boggs, 97	ADNR				89	Some	
Shoreline Oiling Fall 1989 - EVOS	Shoreline Oiling	Keith Boggs, 97	ADNR	1:63360			89	Some	
Shoreline Oiling Spring 1990 - EVOS	Shoreline Oiling	Keith Boggs, 97	ADNR	1:63360			90	Some	

Inventory of Data Layers for the Kachemak Bay Ecological Characterization Project

Description	Category	Info Source	Custodian	Scale	Type	Name	Date	Metadata	Capture
Graphical Resource Database	Database	Keith Boggs, 97	Alyeska Pipeline Co.	Varies	Varies		95	Some	Y
Anadromous Streams	Biological Features	KPB		1:2400					N
National Wetland Inventory	Biological Features	KPB		1:2400			current		N
Spruce Bark Beetle	Biological Features	KPB					current		N
Advisory Planning Commission	Boundaries	KPB		1:2400			current		N
Chugach National Forest	Boundaries	KPB		1:2400					N
City Limits	Boundaries	KPB		1:2400					N
Coastal Management Boundaries	Boundaries	KPB		1:2400			current		N
Critical Habitat Area	Boundaries	KPB		1:2400					N
National Parks	Boundaries	KPB		1:2400					N
Port Graham / English Bay AMSA Boundary	Boundaries	KPB		1:2400					N
State Game Refuges	Boundaries	KPB		1:2400					N
State Parks	Boundaries	KPB		1:2400					N
Wildlife Refuge Boundary	Boundaries	KPB		1:2400					N
Gravel Pits	Cultural Features	KPB		1:2400					N
Timber Cutting/Units	Cultural Features	KPB		1:2400			ongoing		N
Elevation	Kenai Borough Flood Plan	KPB		1:2400					N
Flood Way	Kenai Borough Flood Plan	KPB		1:2400					N
Flood Zone A	Kenai Borough Flood Plan	KPB		1:2400					N
Flood Zone B	Kenai Borough Flood Plan	KPB		1:2400					N
Miscellaneous Labels	Kenai Borough Flood Plan	KPB		1:2400					N
Miscellaneous Lines	Kenai Borough Flood Plan	KPB		1:2400					N
Parcel	Land Status	KPB							Y
Borough Maintained Roads and Travel Corridors	Landmarks	KPB					current		N
Gas Pipelines	Landmarks	KPB		1:2400					N
Oil and Gas Fields	Landmarks	KPB		1:2400					N
Oil and Gas Leases	Landmarks	KPB		1:2400			current		N
Oil and Gas Rigs	Landmarks	KPB		1:2400					N
Oil and Gas Units	Landmarks	KPB		1:2400					N
Oil and Gas Wells	Landmarks	KPB		1:2400					N
Oil Pipelines	Landmarks	KPB		1:2400					N
State Maintained Roads and Travel Corridors	Landmarks	KPB					current		N
Timber Roads	Landmarks	KPB		1:2400			ongoing		N
100yr Flood Plan	Physical Features	KPB							N
Filled Water Features	Physical Features	KPB		1:2400					N
Surface Hydrography	Physical Features	KPB		1:2400					N
Watershed Boundary	Physical Features	KPB		1:2400					N
Section, Township, Range	Landmarks	KPB					current		N
Some Cultural Features	Cultural Features	NBS					being collected		N
Surface Sand + Local	Physical Features	NBS					being collected		N
Seabird Breeding Population	Biological Features	USFWS		1:250000			updated daily		Y
Digital Line Graphs (DLG's)	Physical Features	USGS	USGS	1:25000	Line			Y	
Digital Line Graphs (DLG's) Hydrography	Physical Features	USGS	USGS	1:63000	Line			Y	
Digital Line Graphs (DLG's) Pipe	Physical Features	USGS	USGS	1:63000	Line			Y	
Digital Line Graphs (DLG's) Roads	Physical Features	USGS	USGS	1:63000	Line			Y	
Digital Raster Graphics (DRG's)	Physical Features	USGS	USGS	1:25000	Grid		97	Y	Y
Flow Info of Drainage into Kach. Bay	Physical Features	WRD					10-20 yrs to present		N
Hydrography	Physical Features	WRD		1:63360			current		N
ANCSA	Land Status								Y
ANILCA	Land Status								Y

ENCLOSURE 6: Resume for Bridget Callahan

Bridget M. Callahan
Post Office Box 3802
Homer, Alaska 99603

Phone: (907) 235-4799
Fax: (907) 235-4794
bridgetc@ptialaska.net

EDUCATION

University of Washington, College of Ocean and Fishery Sciences. Master of Marine Affairs, June 1997.
Thesis: "*The Potential of Climate Forecasts for Water Resource Management in the Columbia River Basin.*"
University of Washington, Wetland Science and Management Professional Program, June 1995.
Smith College, Bachelor of Arts in Biology, Minor in Marine Science, Northampton, MA, May 1992.

PROFESSIONAL EXPERIENCE

NOAA Coastal Management Fellow: Project Coordinator, *Ecological Characterization of Kachemak Bay*, a joint Alaska Department of Fish and Game and NOAA Coastal Services Center project; Homer, AK, 1997-present.

Scientific Diver: University of Washington, University of Alaska Southeast; Auke Bay, AK, 1997.

Water Resources Policy Research Assistant: Joint Institute for the Study of the Atmosphere and Oceans, University of Washington; Seattle, WA, 1995-1997.

Aquatic Habitat Ecologist: King County Surface Water Management Division; Seattle, WA, 1995.

Fisheries Biologist: Puget Power and Light; Baker Lake and Lake Shannon, WA, 1993-1994.

Interpretive Naturalist Assistant: Padilla Bay National Estuarine Research Reserve; Bayview, WA, 1994.

Marine Laboratory and Field Research Assistant: Waquoit Bay National Estuarine Research Reserve and Smith College Marine Ecology Lab; Northampton, MA, 1991-1992.

Fisheries Intern: US Fish and Wildlife Service; Becharof National Wildlife Refuge, AK, 1991.

Marine Naturalist and Crew: *The Four Winds*, Maui Classic Charters; Maalaea, HI, 1990.

SCIENTIFIC AND POLICY RESEARCH EXPERIENCE

Policy Research and Analysis

- Conducted and analyzed interviews of forty water resource managers to determine regional climate forecast needs, technical communication failures, and institutional capabilities to respond to climate variability and extreme events in the Columbia River Basin.

Ecological Research and Assessment

- Researched seasonal and site-related photosynthetic and nutrient uptake activity of macroalgae in eutrophied bay in Massachusetts. Collected algal specimens and physical data, processed samples, and maintained database.
- Conducted water quality studies in lake and river systems in Alaska and Washington; measuring physical parameters such as nutrient levels and turbidity, and sampling plankton populations to assess environmental conditions for both habitat restoration and baseline monitoring efforts.
- Assessed quality of salmonid spawning and rearing habitat; measuring streamflow, channel characteristics, pool and cover distribution, and benthic invertebrate populations in a range of aquatic systems in Washington.

- Mapped coral reef and seagrass communities for baseline study of boating impacts in Belize. Changes in species composition were tracked to determine effects of dock placement and boat access.

Habitat Restoration

- Designed and conducted riparian habitat restoration projects using revegetation, woody cover replacement, culvert retrofitting, and hydrological flow alteration methods in Washington.
- Planned and conducted wetland restoration and mitigation projects on riparian and palustrine systems, and performed surveys to monitor vegetation cover, wildlife use, and other functions at mitigation sites.

Fisheries Biology and Management

- Assisted in predation experiments and deployed, gathered, and processed samples from larval collectors to determine juvenile red king crab habitat requirements and survival factors in Auke Bay, Alaska.
- Developed and conducted fishery restoration programs, including spawning habitat and smolt migration studies and rearing of salmonids. Coordinated fishery activities between private, state, and tribal agencies in Washington.
- Conducted population studies on arctic grayling and rainbow trout for sport fishery management in Alaska.
- Awarded Howard Hughes grant to study spiny lobster habitat in Belize. Habitat characteristics that may influence recruitment and survival were the parameters to be measured.

Scientific Interpretation and Education

- Developed a shoreline ecology trail-book to educate visitors at Padilla Bay National Estuarine Research Reserve in Washington.
- Promoted community stewardship of wetlands by organizing exotic plant removal events and designing interpretive signs for watershed restoration efforts in Washington.
- Educated tourists on coral reef ecology, volcanism, and human influences in the tropical marine environment of Hawaii. Instructed snorkelers and divers on low-impact reef etiquette.

Project and Event Coordination

- Currently coordinating Kachemak Bay Ecological Characterization project teams in Homer and Anchorage, Alaska.
- Assisted in planning, coordinating, and hosting the Marine Conservation Biology Symposium at the Annual Meeting of the Society for Conservation Biology, 1997, Victoria, British Columbia; the World Congress on Coastal and Marine Tourism, 1996, Honolulu, Hawaii; the Annual Meeting of The Coastal Society, 1996, Seattle, Washington; and *Towards Sustainable Fisheries: Balancing Conservation and the Use of Salmon and Steelhead in the Pacific Northwest* conference, 1996, Victoria, British Columbia.
- Managed the School of Marine Affairs weekly seminar series, 1995-1996.

SKILLS

- Proficient in Windows-based software, including Word, Excel, SPSS, and ESRI certified in ArcView.
- Knowledge of Federal, State, and local environmental laws, policies, and jurisdictions.
- Interview, survey, and integrated assessment methodologies.
- Standard habitat survey and evaluation methods, including wetland delineation and stream surveys.
- Water quality monitoring techniques for lake, stream, and estuarine systems.
- Experimental design and sampling methods for population studies of marine and aquatic fish and invertebrates.
- Certified in wetland delineation, SCUBA, dry suit diving, basic and oxygen first aids, and CPR.

PRESENTATIONS AND PUBLICATIONS

Callahan, B. and G. Seaman. 1998. *The Kachemak Bay Ecological Characterization: An Interactive Coastal Management and Research System.* Poster to be presented at the meeting of The Coastal Society, July 1998, Williamsburg, Virginia.

Callahan, B., Miles, E. and D. Fluharty. 1998. *Policy implications of climate forecasts for water resource management in the Columbia River Basin.* School of Marine Affairs Working Paper 98-1. Seattle, Washington. 48 pp.

Callahan, B., Miles, E. and D. Fluharty. 1998. *Policy implications of climate forecasts for water resource management in the Columbia River Basin.* Paper submitted to the Bulletin of the American Meteorological Society.

Miles, E. and B. Callahan. 1997. *Policy implications of long-range climate forecasts for water resource management in the Columbia River Basin.* Presented at the American Meteorological Society, 10th Conference on Applied Climatology, October 1997, Reno, Nevada.

Miles, E. and B. Callahan 1997. *Policy implications of long range-climate forecasts for water resource management in the Columbia River Basin.* American Association for the Advancement of Science, February 1997, Seattle, Washington.

SEABIRD–OCEANOGRAPHIC RELATIONSHIPS IN THE NORTHERN GULF OF ALASKA: INTEGRATION WITH NSF STUDY "GLOBEC" Submitted Under the BAA

RECEIVED
APR 14 1998
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	99287
Restoration Category:	Research
Proposer:	ABR, Inc.
Lead Trustee Agency:	
Cooperating Agencies:	
Alaska SeaLife Center:	no
Duration:	1st year, 2-year project
Cost FY99:	$207,981
Cost FY00:	$210,353 (including publication of results)
Cost FY01:	$0
Cost FY02:	$0
Geographic Area:	Northern Gulf of Alaska (Aialik Bay to Montague Island)
Injured Resource/Service:	Several species of seabirds; secondarily, marine mammals

ABSTRACT

We propose to conduct a 2-year study of seabirds in the Northern Gulf of Alaska (Aialik Bay to Montague Island) by using a ship-of-opportunity sampling platform that is being used by the NSF project "GLOBEC" (Global Ocean Ecosystem Dynamics), which also will provide access to an extensive series of oceanographic data. This proposed study is designed to identify ecological processes affecting temporal (seasonal and interannual) and geographic variation in the distribution and abundance of seabirds, including species that were injured by the *Exxon Valdez* oil spill. It also will be useful to the restoration program by providing data on the year-round status of seabird populations and the processes that influence variation in their numbers.

INTRODUCTION

This study will use an available ship-of-opportunity platform to investigate temporal (seasonal and interannual) and geographic (cross-shelf) patterns of distribution and abundance of seabirds in the Northern Gulf of Alaska (GOA). The primary reasons for this study are (1) it will collect ecological data on a diverse suite of seabird resources, including several that the *Exxon Valdez* Oil Spill Trustee Council concluded were injured by the spill (*Exxon Valdez* Oil Spill Trustee Council 1998); (2) these data can be used, not just to examine temporal and geographical variations in distribution, abundance, and species composition of these seabird species, but to examine the effects of ecological processes on in those variations; and (3) it will describe the natural variation of the system, particularly with respect to seabirds. This work will study several species that have been identified as being injured (*Exxon Valdez* Oil Spill Trustee Council 1998), including common loon, cormorants, common murre, pigeon guillemot, marbled murrelet, and Kittlitz's murrelet. In addition, a large suite of other seabird species also will be evaluated by this study. Further, we will be able to collect supplementary data on the distribution and abundance of marine mammals, some of which (e.g., Killer Whale) were identified as having been injured by the spill (*Exxon Valdez* Oil Spill Trustee Council 1998).

One of the benefits for the Trustees of conducting this study is that we have been offered free space on a ship that is being used for the NSF program "GLOBEC" (Global Ocean Ecosystem Dynamics), which is a project that during years 1998-2000 will study the temporal and geographic variations in thermohaline, chemical, and biological structures of the Northern GOA shelf (Appendix 1). The GLOBEC study will have a series of six 6-day cruises spaced throughout the year, with the timing adjusted to sample periods of biological importance in the Northern GOA (e.g., spring phytoplankton bloom, first movement of juvenile salmon to the sea). The overall thrust of that GLOBEC study is to determine ecosystem-level causes of successful versus unsuccessful recruitment in juvenile salmon. That study will make available to us a free sampling platform and access to an extensive series of oceanographic data that will be collected as part of that study. The objective of this study will be to identify ecological processes affecting temporal and geographic variation in the distribution and abundance of seabird resources, by capitalizing on data generated by the GLOBEC study.

The proposed research described here is designed to provide new information on the causes of temporal and geographic variation in the distribution and abundance of these seabird species. We believe that this information will be important for effective conservation and management of these species.

NEED FOR THE PROJECT

A. Statement of Problem

There are three important reasons for conducting this study. First, most of the avian mortality (particularly of murres *Uria* spp., but also of many other species) after the *Exxon Valdez* oil spill is believed to have occurred in the Northern GOA, rather than in Prince William Sound (PWS; Piatt et al. 1990, Ford et al. 1996, Piatt and Ford 1996). Second, breeding seabird colonies are both larger and more numerous in the Northern GOA than in PWS (USFWS Seabird Colony Catalog, electronic version), as generally are seabird at-sea densities (Day, unpubl. data). In spite

of these important facts, however, the amount of effort dedicated to post-spill research in the GOA was just a fraction of that dedicated in PWS. Further, this study would enable us to collect data as a long time-series that would enhance our understanding of the variation in at-sea communities of seabirds. Finally, these first three years of data collection (including the first year in 1998) possibly will lead to another five consecutive years of data collection (funded by NSF), thus providing one of the temporally longest data sets of at-sea data ever collected in Alaska. Thus, this study would occur in the area of greatest avian mortality, would collect data in the area of greatest number of seabirds, and would provide a long (and possibly longer) time-series that would be analyzed for temporal and geographic variation.

Seabirds exhibit variation in at-sea distribution and foraging with respect to oceanographic features: fronts of various types (e.g., Schneider 1982, Haney 1985b; Haney and McGillivary 1985a, b; Harrison et al. 1990, Schneider et al. 1990, Day 1992, Hunt et al. 1996, Mehlum et al. 1998; but also see Loggerwell and Hargreaves 1996, and Mehlum et al. 1996), frontal eddies (Haney 1986a, b), internal waves (Haney 1987), upwelling (either within cyclonic eddies or bathymetrically driven; Haney 1985a), pycnocline topography (Haney 1991), and water masses (e.g., Wahl et al. 1989, Haney 1991, Day 1992, Ribic et al. 1992). Fronts tend to be areas of enhanced productivity and concentration of both zooplankton and larval fishes and squids (e.g., Owen 1981, Munk et al. 1995, Sabatés and Olivar 1996), and seabirds appear to be "physical oceanographers" that are highly efficient at locating such structures.

In addition to the practical applications of learning about the at-sea ecology of seabirds in the area where most of the mortality occurred, understanding the causes for temporal and geographic variation in seabird distribution at sea is one of the greatest challenges facing marine bird researchers. Understanding such variation also is important in determining why and how seabirds may or may not recover from injury such as that following an oil spill: after all, the sea is where they secure food, not only for themselves but also for any young that they produce. In particular, identifying those oceanographic processes that result in variation in ecology, behavior, reproduction, or some other life-history parameter is required for identifying processes that affect, for example, population trends and recovery from injury and for managing seabird resources effectively. Such an emphasis is being used quite effectively by the APEX studies, which are being funded by the Trustee Council.

The strength of this proposed study is that it will be used to develop an understanding of those processes that cause variation in the at-sea distribution and abundance of seabirds and that it will lead to a long-term data set that will be examined for the study of variation, yet will cost little because of our ability to use a ship of opportunity for sampling and an extensive oceanographic data set for interpreting our data. Most importantly, this study will collect data on a large suite of seabird species (and, to a lesser extent, marine mammals), including several species that were impacted by the oil spill.

B. Rationale/Link to Restoration

This study will be valuable because it will identify causes and sources of variation in the at-sea distribution and abundance of seabirds. It also will describe natural variation in at-sea populations of seabirds, so that realistically measurable recovery criteria can be developed. Third, it will examine the seasonal and interannual importance to seabirds of oceanographic

frontal structures, which tend to concentrate not only marine organisms and their seabird predators, but also floating pollutants such as oil and marine debris (Bourne and Clark 1984).

This study will collect ecological data on a diverse suite of seabird resources that the *Exxon Valdez* Oil Spill Trustee Council concluded were injured by the spill (*Exxon Valdez* Oil Spill Trustee Council 1998), including common loon, cormorants (any or all of three species), common murre, pigeon guillemot, marbled murrelet, and Kittlitz's murrelet. In addition, a large suite of other seabird species also would occur (and, hence, would be sampled) in the study area. These and the GLOBEC data will be used to examine ecological processes and their effects on variations in the distribution and abundance of seabirds. Hence, this study will examine major ecological questions such as why productivity at all trophic levels in the Northern GOA is anomalously high (see the GLOBEC proposal in Appendix 1) and will assess the natural variation of the system, particularly with respect to temporal and geographic variation in the distribution and abundance of seabirds in the Northern GOA. Further, the overall goals of the GLOBEC program are (1) to understand the effects of climate variability and climate change on the distribution, abundance, and production of marine organisms and (2) to incorporate this knowledge into diagnostic and prognostic models (Appendix 1). Hence, identifying these relationships may help in the future prediction of seabird distribution, abundance, and productivity in the face of global change, thus enhancing our ability to manage these seabird resources. In addition, determining the natural variation of the system, particularly with respect to seabird abundance, will enable us to measure better what constitutes "recovery" of a species (i.e., take into account the natural "noise" in the system). Finally, this study also will be able to collect supplementary data on the distribution and abundance of marine mammals, some of which (e.g., killer whale) were found to have been injured by the spill (*Exxon Valdez* Oil Spill Trustee Council 1998).

C. Location

This study will be conducted in the open waters of the continental shelf of the northern GOA, from off of Aialik Bay to off of Montague Island (possibly as far east as Hinchinbrook Entrance). Because Seward is the home port for the cruises, it will be the primary community that will realize financial benefits from this study. To our knowledge, no communities will be affected by this project other than financially.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Community involvement will encompass the use of Seward as a home port for the research cruises; this is the home port of the R/V *Alpha Helix*, which is the University of Alaska's oceanographic research vessel. When requested, we will provide articles and photographs for the Trustee Council Newsletter and will be available to make public presentations of our study at appropriate forums. (We already have assisted Jody Seitz of Cordova with an interview about Kittlitz's Murrelets for public radio stations throughout the spill-affected area.) These articles and presentations will disseminate information on the objectives and major findings of this study to the general public.

Our understanding is that seabirds on the open continental shelf of the Northern GOA play no role in subsistence use by local Natives in Prince William Sound (M. Vlasoff, pers. comm.). We

would, however, draw on any local information that is available on these species on the open shelf and, especially, to be able to collect samples from any seabirds that are killed there for subsistence use.

PROJECT DESIGN

A. Objectives

The overall goal of this study is to understand better the causes of temporal (seasonal and interannual) and geographic (cross-shelf) variation in the distribution and abundance of seabirds (and, secondarily, marine mammals) in the Northern GOA shelf. Specifically, it aims to relate quantitatively this variation in seabird abundance and distribution to oceanographic parameters, including the thermohaline, chemical, and biological structures of the Northern GOA shelf. The specific objectives of the proposed research program are:

1. To measure and describe temporal (seasonal and interannual) and geographic (cross-shelf) variation in seabird distribution and abundance on the Northern GOA shelf.

2. To relate these patterns of temporal and geographic variation to patterns of contemporaneously collected physical and biological characteristics.

3. To examine the ecological importance to birds of fronts at the outer edge of the Alaska Coastal Current and at the shelf-break.

4. To relate the observed natural variability in seabird populations to an assessment of recovery.

5. To summarize and analyze historical data for evaluation of temporal and geographic variation in seabird distribution and abundance.

B. Methods

This study proposes using a ship-of-opportunity to collect at-sea transect data that will be used to examine the distribution and abundance of seabirds on the shelf of the Northern GOA during 6 cruises/year for 2 consecutive years. These data will be collected as standard at-sea transect samples as developed by the USFWS and others.

The GLOBEC cruises will be conducted during six periods of biological interest in the region:

- March (upward migration of oceanic zooplankton to surface layers);
- April (spring phytoplankton bloom);
- May (maximal biomass of oceanic copepods in surface layers);
- July (juvenile salmon first enter the sea);
- October (juvenile salmon prepare to leave the shelf and enter the Alaska Gyre); and
- December (minimal biological activity).

Each cruise has budgeted enough time to sample the Seward Line of standardized oceanographic stations, which have been sampled nearly continuously for >20 years, plus additional station

lines. These latter station lines are laid out between the Seward Line (which lies off the mouth of Resurrection Bay) and eastern Montague Island and include (so far) lines south from Cape Fairfield, Cape Suckling, and Cape Cleare, two lines off of the southern entrance of Montague Strait, and two lines south from central and eastern Montague Island. This oceanographic sampling is envisioned to be adjusted to some extent for conditions that are met on each particular cruise; however, the Seward Line always will be sampled on each cruise.

Through the GLOBEC program, we will have access to the following oceanographic data:

- CTD (conductivity, temperature, and depth) data collected at a series of fixed stations that are 10 km apart on the inner half of the shelf and 15 km apart on the outer half;
- ADCP (Acoustic Doppler Current Profiler) data on water-column velocity profiles of currents (continuously collected);
- Through-hull surface property values of sea-surface temperature, salinity, and fluorescence (continuously collected);
- Nutrients and primary productivity (collected at a series of fixed stations);
- Zooplankton and micronekton species composition and biomass collected with CalVET, MOCNESS, and bongo nets (collected at a series of fixed stations);
- Hydroacoustically measured biomass of zooplankton and micronekton (continuously collected); and
- Biomass, species composition, and energy content of fishes (primarily salmon, but also forage fishes) collected with MOCNESS and mid-water trawls (collected at a series of fixed stations; the mid-water trawling will be conducted during the July and October cruises only).

During each cruise, we will sample at-sea densities of seabirds with standardized seabird transects (Tasker et al. 1984, Gould et al. 1989, van Franeker 1994). The preferred method is the "snapshot method," which has less bias in density estimates of flying birds, particularly tubenosed birds (albatrosses, fulmars, shearwaters, petrels, and storm–petrels), than do other methods (van Franeker 1994). (Tubenosed birds are common in the sampling area at certain times of the year [Day, unpubl. data].) Transects will be 300 m wide as the ship moves ahead in a fixed and known direction at a fixed and known speed. Then, for analyses, we will calculate the density of birds for each transect by dividing the total count by the total area sampled (trackline length × 0.3 km total width). Initial ("raw") transect units in the field will be 5 min long, with data recorded by minute, as the ship travels between each pair of fixed oceanographic stations or runs between station lines. This is the approximate scale at which the finest-scale data (hydroacoustic biomass of zooplankton) of interest will be collected by the GLOBEC study. Then, for later analyses, these "raw" transect samples can be collapsed into larger "analytical" transect units, depending on the scales at which the other oceanographic data are summarized; because they will have been collected by the minute, the data can be analyzed by minute, if necessary. Such a flexible data collection/analytical program will enable us to examine the distributional data at the scales at which we find oceanographic features of interest (also see Haney and Solow 1992).

We will evaluate three primary hypotheses about seabirds, with additional hypotheses generated by the results of the field work.

H_o 1: There is no temporal (seasonal and interannual) variation in seabird distribution and abundance; if there is, it is independent of seasonal and annual variation in physical and biological oceanographic features.

This is the primary line of investigation of the GLOBEC study and will be an emphasis of this study. We will use the transect data in a series of analyses that will test whether there is seasonal and (in subsequent years) interannual variation in seabird distribution and abundance. As described above, we will test the temporal data at the scales that are most appropriate (i.e., pooling the raw data into larger analytical data sets as needed). At this time, we envision analyzing for temporal differences with a three-way MANOVA on ranked (if necessary) data, with habitat (i.e., water mass), season, and year as the treatments and the species or functional groups as the dependent variables. If pseudoreplication appears to be a problem with the data sets (see Hurlbert 1984), we might explore testing for differences with paired-sample tests (e.g., MANOVAs that use differences in densities between sampling periods as the sampling unit). These tests that use changes in numbers of birds may be used in a "before-after" type of analysis to examine changes in abundance among seasons and years (Stewart-Oaten et al. 1986, Murphy et al. 1997). The use of changes in densities (rather than testing with actual densities) between periods (with 1998 being labeled the "before" period and subsequent years being the "after" periods) results in independent data sets that minimize problems caused by pseudoreplication (Stewart-Oaten et al. 1986, Wiens and Parker 1995).

To examine whether there are relationships between seabird distribution and abundance and physical/biological oceanographic features, we will work with the GLOBEC researchers to use their data products for determining which scales to use in the analyses. First, we will plot seasonal (and interannual) variations in various oceanographic measurements and seabird distribution and abundance and interpret trends visually. Second, we will use a multivariate technique (e.g., MANOVA, MANCOVA, PCA) to test for relationships between multiple oceanographic measurements (e.g., water-column structure; distance to pycnocline; biomass of zooplankton, micronekton, and fishes) and abundance measurements of multiple seabird species. We envision conducting these analyses on two seabird data sets: individual species and functional groups (guilds). In terms of the latter, we will assign each species to functional groups involving primary feeding method (e.g., surface feeding, pursuit diving) and primary prey type (e.g., zooplankton, fishes, squids) before conducting the analyses.

H_o 2: There is no geographic (cross-shelf) variation in seabird abundance; if there is, it is independent of geographic variation in physical and biological oceanographic features.

This is the secondary line of investigation of the GLOBEC study. We will use the transect data in a series of analyses that will test whether there is geographic variation in seabird distribution and abundance. As described above, we will test the geographic data at the scales that are most appropriate. We will use the oceanographic data to stratify the cross-shelf zone into a series of oceanographic habitats that can be used to test for differences in seabird distribution and abundance. Such habitat stratification has been used successfully in many other seabird–oceanography studies (e.g., Wahl et al. 1989, Haney 1991, Day 1992). At this time, we predict that there will be at least three habitat strata: the Alaska Coastal Current (extending from shore to ≤25 km offshore), the mid-shelf region (whose ecology is poorly understood at this time), and the oceanic region (from around the shelf break to over the continental slope and including at least part of the Alaska Stream). Our suspicion at this time is that, because densities of

zooplankton and larval fishes are higher in the Alaska Coastal Current than in surrounding areas (Incze and Ainaire 1994, cited in Napp et al. 1996; Napp et al. 1996), seabird densities during the spring and summer will be higher in that habitat stratum than in other habitats.

Again, we will use the GLOBEC data products for determining which scales to use in the analyses. We will plot cross-shelf variations in various oceanographic measurements and seabird abundance and interpret differences visually. We also will test for differences in habitat use with a multi-factor MANOVA on ranked (if necessary) seabird data. As described in the temporal tests (above), habitat would be one of the factors included in the MANOVA. We also will use the guild data in a similar multi-factor MANOVA.

H_o 3: There is no association between seabird abundance and the location and strength of oceanographic fronts (particularly those at the outer edge of the Alaska Coastal Current and at the shelf-break); if there is, it is independent of geographic variation in physical and biological oceanographic features.

We specifically will investigate the importance of these fronts to seabirds on a seasonal and interannual basis. We will use the GLOBEC data products for determining which scales to use in the analyses. We will plot cross-shelf variations in various oceanographic measurements and seabird distribution and abundance and interpret differences visually. We also will test for relationships between seabird abundance and the distance from the center of each front with correlation analyses (e.g., Spearman rank correlation, which does not assume linearity of a relationship; see Day 1992: 36–45).

In addition to the hypothesis testing, we will use the seabird data to conduct power analyses. These analyses will examine the questions: "Given the variance in the data and the sampling scheme that is set up, how small a change in seabird abundance can we detect?" and "Given the variance in the data, how many samples would we need to detect an X% change in abundance?" These calculations will be made at the end of the study, with all three years of data combined.

Although it will not be a primary focus of our study, we also will be able to collect supplementary data on the distribution and abundance of marine mammals. These data will be collected concurrently with the seabird data. Because the emphasis will be on seabird data, however, we probably will be unable to collect marine mammal data on standardized surveys. Instead, we will record any marine mammals seen out to the horizon. Such opportunistic data provide relative numbers that are adequate for interannual comparisons, however (Baretta and Hunt 1994).

One other focus of the GLOBEC program is the use of retrospective analyses to synthesize all available historical data from the area of interest. We propose working with Glenn Ford of Ecological Consulting, Inc., in FY99 to conduct retrospective analyses of all available at-sea data from this region. These data are archived in the USFWS "Pelagic Seabird Database," which is located in Anchorage. Dr. Ford has been instrumental in reworking, standardizing, and merging several old databases into this large database. This work will consist of (1) extracting data from the region from Aialik Bay eastward to Hinchinbrook Entrance and south to ~150 nm offshore; (2) analyzing temporal characteristics of these historical data; and (3) manipulating this data set into a form that can be used for comparison with the newer data collected for this study.

As an example of the kinds of data that will be available for this study, Figure 1 shows the vertical structure of the water column along the Seward Line during the first GLOBEC cruise in October 1997. In these plots, inshore is on the left side of each plot. There are three primary features along this line: (1) the Alaska Coastal Current from Stations 1 to 3, with a strong salinity and density front at its outer edge; (2) the inner edge of the large Alaska Stream from Stations 9 (the shelf break) to 13; and (3) the poorly understood and sluggish Mid-shelf Water between these two large current systems. In addition, the fluorescence and density fields suggest that there is surface convergence (downwelling) between Stations 3 and 4, around Station 11, and possibly around Station 7.

Figure 2 shows an example of data that we were able to collect on the same GLOBEC cruise. The plot is of uncorrected seabird abundance along the Seward Line, which is the primary sampling location for this study. Data points represent individual 5-min transects and are uncorrected for sampling area; because they have not been proofed or corrected and because a few data are off-transect records, these results should be considered to be preliminary at this time. From the individual plots, one can see (1) the concentration of all birds of all species combined at the microscale surface convergence between Stations 3 and 4 and in what is probably the shelf-break front at the inner edge of the Alaska Stream (top); (2) the concentration of fork-tailed storm-petrels in what is probably the shelf-break front at the inner edge of the Alaska Stream (middle); and (3) the concentration of Dall's porpoises in the outer edge of the Alaska Coastal Current and in the front separating that current from the mid-shelf water (bottom). Hence, these preliminary results suggest that there is extensive geographical variation in total seabird abundance and in the abundance of at least some individual species.

Figure 3 shows another example of data along the Seward Line that we were able to collect on the same GLOBEC cruise. In these plots, one can see: (1) the concentration of northern fulmars in the Alaska Coastal Current, in the microscale convergence between Stations 3 and 4, and near what may be a small front near Station 12 (top); (2) the concentration of common murres in the Mid-shelf Water, with peak numbers occurring at the microscale convergence between Stations 3 and 4 (middle); and (3) the non-overlapping distribution of the tufted puffin, which was restricted to the outer shelf and (primarily) the Alaska Stream (bottom). These latter two distributions raise the possibility that there is some sort of ecological segregation in preferred prey (i.e., preferred prey for each species occurs in different areas) or segregation between the two species by spatially separation of at-sea distributions at this time of the year; however, many more data need to be collected before such a hypothesis can be evaluated.

Although not shown here, data from the March and April 1998 cruises showed dramatic differences from the October 1997 cruise (Day, unpubl. data). For example, species diversity along the Seward Line was high (21 species) in October 1997 but low (only ~8 species) in March 1998 and increasing (~15 species) in April 1998. (The data have not been proofed or analyzed yet, so numbers are not exact.) In addition, species evenness clearly had changed over the intervening 5–6 months, in that the October distribution of common murres was restricted to the inner half of the shelf in October, whereas they had become dominant across the shelf and probably represented ~75% of all birds seen in March and ~50% of all seen in April across the entire Seward Line. In addition, they occupied essentially the entire shelf in March and April, whereas tufted puffins were absent at that time, having moved farther offshore in to the deep North Pacific. Clearly, there are oceanographic and ecological reasons for such seasonal and

geographic changes in both species diversity and the abundance and distribution of individual species.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

We will have free use of a research vessel that is being used by the Institute of Marine Sciences (IMS), University of Alaska, Fairbanks, for the GLOBEC studies. All field and office work will be conducted by ABR, Inc. The Trustees Council will need to pay an outside agency for a Program Manager and for general administration. (These management costs will be funded directly from NOAA to the agency, which is how our other Trustee-funded contract was set up. Hence, that management money is not listed on the enclosed budget.) In addition, we presently are asking for some support from the USFWS for help in defraying some of the logistical costs of data collection in the unfunded first year of this study (i.e., FY98).

SCHEDULE

A. Measurable Project Tasks for FY99 (October 1, 1998-September 30, 1999)

Mar 1999:	First cruise (emphasis: upward migration of oceanic zooplankton)
Apr 1999:	Second cruise (emphasis: spring phytoplankton bloom)
May 1999:	Third cruise (emphasis: maximal biomass of oceanic copepods)
July 1999:	Fourth cruise (emphasis: juvenile salmon first at sea)
Oct 1999:	Fifth cruise (emphasis: juvenile salmon prepare to leave the shelf)
Dec 1999:	Sixth cruise (emphasis: minimal biological activity)
Mar-Dec 1999:	Keypunch data and QA/QC (after each cruise)
Oct 1999–Mar 2000:	Retrospective analysis of historical data
Dec 1999–Jan 2000:	Data analysis
Jan-Apr 2000:	Preparation of Annual Report
January–February 2000:	Presentation of paper at scientific meeting
15 April 2000:	Submit Annual Report

B. Project Milestones and Endpoints

1. "To measure and describe temporal (seasonal and interannual) and geographic (cross-shelf) variation in seabird distribution and abundance on the Northern GOA shelf." Densities will be estimated and will be tested for seasonal and geographic differences during each year of the study (FY99–00). Interannual differences will be tested during each year of the study (FY99–00).

2. "To relate these patterns of temporal and geographic variation to patterns of contemporaneously collected physical and biological characteristics." Relationships will be tested, both among seasons within years and during the same season among years, during each year of the study (FY99–00).

3. "To examine the ecological importance to birds of fronts at the outer edge of the Alaska Coastal Current and at the shelf-break." Relationships between the location of fronts and the

abundance of seabirds will be tested, both among seasons within years and during the same season among years, during each year of the study (FY99–00).

4. "To relate the observed natural variability in seabird populations to previous assessments of impact and recovery." At the end of the study, analysis of variability and power calculations will be done for each year separately and for all years of the study combined (i.e., FY00).

5. " To summarize and analyze historical data for evaluation of temporal and geographic variation in seabird distribution and abundance." Data will be extracted from existing public databases (USFWS), and data will be summarized and analyzed during the first year of the study (FY99). This work will be conducted with Dr. Glenn Ford (presently a Trustee-sponsored researcher) of Ecological Consulting, Inc., as a subcontractor.

C. Completion Date

Sampling for the project will be completed in FY00. Data analysis and preparation of the Final Report and publications will be completed in FY00.

PUBLICATIONS AND REPORTS

We will submit Annual Reports during each year of the study. Each report will be submitted to the Chief Scientist no later than 15 April of the year following data collection and will cover data collected during that year. Those reports also will synthesize and compare results for that year and previous years. After the final year of data collection, we will submit a Final Report that will synthesize and compare results from all years of the study and will prepare a series of manuscripts reflecting the results of our studies. We envision that these manuscripts generally will be written with one or more of the GLOBEC researchers as co-authors.

PROFESSIONAL CONFERENCES

We plan to attend scientific conferences in FY99 and FY00. At this point, we plan to present one paper each year that will discuss the results of testing of one or more of the above hypotheses. The most probable meetings that we will attend will be those of the Pacific Seabird Group, which usually are held in December or January.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

We hope to be able to integrate the results of this study with those of the SEA study and the APEX study. We are particularly interested in an oceanographic comparison with the major findings of the SEA study and in a comparison with the findings of the APEX study about interannual variation in energy content of fishes and subsequent variation in reproductive effort and performance of seabirds. Our understanding is that those studies will be in a wind-down phase by the time this project begins, so the chances for extensive interaction and integration may be small. On the other hand, we will have a great opportunity to build on their findings.

The NSF oceanographic study GLOBEC is co-funding this proposed study. It will provide an oceanographic platform (at the cost of several thousand dollars/day) and an extensive set of oceanographic data that also would cost many hundreds of thousands of dollars to collect.

This project will be valuable in that it will provide a better understanding of causes for temporal and geographic variation in the distribution and abundance of seabirds in the Northern GOA. Further, this study will be used, not just to examine distribution and abundance of these seabird species, but to examine the effects of ecological processes on variations in that distribution and abundance of these seabirds. Finally, it will describe the natural variation of the system, particularly with respect to seabirds, enabling us to know better what natural variation in patterns of abundance are. Knowing this variation will enable researchers to predict better what sorts of differences might be detected in the wake of a large ecological perturbation, such as the *Exxon Valdez* oil spill. Further, knowing this variation may affect interpretations of what constitutes "recovery" of a species (i.e., if determining recovery is an objective, one need to know what is the natural "noise" in the system is, since impact analysis involves comparing "signal-to-noise" ratios).

Although the *Exxon Valdez* Oil Spill Trustee Council expressed interest in this study in FY98, funding was not allocated for the first year of this project. Because of the importance of collecting as many data as possible so that the time-series is as extensive as possible, ABR has funded three cruises of data collection so far (October 1997 and March and April 1998), and ABR (and possibly the USFWS) will be funding the remaining four cruises of data collection in 1998. Hence, ABR (and possibly the USFWS) will have invested a great deal of money and time in co-funding this study. (Any co-funding from the USFWS will pay only for logistics and travel; hence, all personnel costs will be borne by ABR and by lost salaries of the individual scientists that are collecting the data.) Hence, in addition to the strong co-funding component in the form of ship-of-opportunity sampling coming from NSF, there will be a strong co-funding component coming from ABR, the individual scientists involved in this study, and possibly the USFWS. That way, however, we will have the strongest and most complete data set available for testing these hypotheses.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

This is the first year of a proposed 2-year project. Hence, there are no proposed changes in this first year. However, the tentative budget for FY00 will include an annual increase of 5%, to cover estimated inflationary increases, as we have done on previous Trustee projects. In addition, the FY00 budget will include additional costs associated with the production of a Final Report and with the production of a manuscript (1.5 months of time for the PI and 0.25 months for the assistant). Finally, these costs do not include money for management of this project by an outside agency.

Please note that the budget for FY99 includes additional time and money for analyses of the extensive data set that already will have been collected in 1997 and 1998. Additional time also has been budgeted in both years for coordination and synthesis of oceanographic information that will help to determine the direction of some of the analyses. This coordination will occur with other investigators on the GLOBEC study. Finally, the FY99 budget includes money for

retrospective analyses, which will be conducted by Ecological Consulting, Inc., in coordination with the Principal Investigator.

PRINCIPAL INVESTIGATOR

Robert H. Day, Ph.D.
ABR, Inc.
P.O. Box 80410
Fairbanks, AK 99708-0410
PH: 907-455-6777
FAX: 907-455-6781
E-mail: bday@abrinc.com

PRINCIPAL INVESTIGATOR AND KEY PERSONNEL

Dr. Robert H. Day will be the Principal Investigator for the project. Bob has conducted research on seabirds, marine ecology, impacts of marine pollution, and marine conservation topics in Alaska and the North Pacific since 1975. His research topics have included the biology of poorly known seabirds in Alaska; the ecology of seabirds at sea in relation to oceanography (the topic of his Ph.D. dissertation); the ingestion of plastic pollutants by seabirds in Alaska; the mortality of seabirds in the high-seas drift-gillnet fishery of the North Pacific; and the distribution, abundance, and decomposition of plastic pollution and other marine debris in the North Pacific. Recently, he conducted several years of research on impacts of the *Exxon Valdez* oil spill on habitat use by marine-oriented birds and on bird communities (sponsored by Exxon Company, USA) and on the ecology of Kittlitz's Murrelet (sponsored by the *Exxon Valdez* Oil Spill Trustee Council). Dr. Day also has provided expert consultation to the USFWS as a member of the Spectacled Eider Endangered Species recovery Team.

Dr. Day is employed by ABR, Inc. (formerly Alaska Biological Research, Inc.). ABR is an Alaskan-owned small business—headquartered in Fairbanks since its formation in 1976—that specializes in environmental research and services. During two decades of operation in Alaska, ABR has served a variety of clients, including private industry, state and federal government agencies, and the University of Alaska. During this time, ABR has developed a reputation for conducting objective research that provides the basis for sound management decisions. ABR remains committed to the goals of providing timely, accurate, and cost-effective information to those who manage or develop our natural resources.

OTHER KEY PERSONNEL

Dr. Day probably will be assisted in these studies by Debora Nigro, who has nearly 10 years of experience in seabird research in Alaska. Her most recent work has been three years' worth of studies on Kittlitz's murrelets in Prince William Sound. Previously, she conducted several years of research on impacts of the *Exxon Valdez* oil spill on habitat use by marine-oriented birds and on bird communities in Prince William Sound and the Kenai Peninsula (sponsored by Exxon Company, USA) and assisted with studies of marbled murrelets and studies of long-term population changes of seabird and marine mammal species in Prince William Sound (sponsored by the USFWS and the *Exxon Valdez* Oil Spill Trustee Council). As a result of those studies, she has become highly experienced in the study of seabirds at sea.

LITERATURE CITED

Baretta, L., and G. L. Hunt, Jr. 1994. Changes in the numbers of cetaceans near the Pribilof Islands, Bering Sea, between 1975–78 and 1987–89. Arctic 47: 321–326.

Bourne, W. R. P., and G. C. Clark. 1984. The occurrence of birds and garbage at the Humboldt Front off Valparaiso, Chile. Marine Pollution Bulletin 15: 343–344.

Day, R. H. 1992. Seabirds at sea in relation to oceanography. Ph.D. Thesis, University of Alaska, Fairbanks, AK. 135 pp.

Exxon Valdez Oil Spill Trustee Council. 1998. Invitation to submit restoration proposals for federal fiscal year 1999. Unpublished notice prepared by *Exxon Valdez* Oil Spill Trustee Council, Anchorage, AK. 64 pp. + appendices.

Ford, R. G., M. J. Bonnell, D. H. Varoujean, G. W. Page, H. R. Carter, B. E. Sharp, D. Heinemann, and J. L. Casey. 1996. Total direct mortality of seabirds from the *Exxon Valdez* oil spill. Pages 684–711 *in* S. D. Rice, R. B. Spies, D. A. Wolfe, and B. A. Wright, eds. Proceedings of the *Exxon Valdez* Oil Spill Symposium. American Fisheries Society, Bethesda, MD. Symposium No. 18.

Gould, P. J., and D. J. Forsell. 1989. Techniques for shipboard surveys of marine birds. U.S. Fish and Wildlife Service, Fish and Wildlife Technical Report 25: 1–22.

Haney, J. C. 1985a. Band-rumpled Storm-Petrel occurrences in relation to upwelling off the coast of the southeastern United States. Wilson Bulletin 97: 543–547.

Haney, J. C. 1985b. Wintering phalaropes off the southeastern United States: application of remote sensing imagery to seabird habitat analysis at oceanic fronts. Journal of Field Ornithology 56: 321–333.

Haney, J. C. 1986a. Seabird affinities for Gulf Stream frontal eddies: responses of mobile marine consumers to episodic upwelling. Journal of Marine Research 44: 361–384.

Haney, J. C. 1986b. Seabird segregation at Gulf Stream frontal eddies. Marine Ecology Progress Series 28: 279–285.

Haney, J. C. 1987. Ocean internal waves as sources of small-scale patchiness in seabird distribution on the Blake Plateau. Auk 104: 129–133.

Haney, J. C. 1991. Influence of pycnocline topography and water-column structure on marine distributions of alcids (Aves: Alcidae) in Anadyr Strait, Northern Bering Sea, Alaska. Marine Biology 110: 419–435.

Haney, J. C., and P. A. McGillivary. 1985a. Aggregations of Cory's Shearwaters (*Calonectris diomedea*) at Gulf stream fronts. Wilson Bulletin 97: 191–200.

Haney, J. C., and P. A. McGillivary. 1985b. Midshelf fronts in the South Atlantic Bight and their influence on seabird distribution and seasonal abundance. Biological Oceanography 3: 401–430.

Haney, J. C., and A. R. Solow. 1992. Analyzing quantitative relationships between seabirds and marine resource patches. Pages 105–161 *in* D. M. Power, ed. Current ornithology. Plenum Press, New York, NY.

Harrison, N. M., G. L. Hunt, Jr., and R. T. Cooney. 1990. Front affecting the distribution of seabirds in the northern Bering Sea. Polar Research 8: 29–31.

Hunt, G. L., Jr., K. O. Coyle, S. Hoffman, M. B. Decker, and E. N. Flint. 1996. Foraging ecology of Short-tailed Shearwaters near the Pribilof Islands, Bering Sea. Marine Ecology Progress Series 141: 1–11.

Hurlbert, S. H. 1984. Pseudoreplication and the design of ecological field experiments. Ecological Monographs 54:187–211.

Loggerwell, E. A., and N. B. Hargreaves. 1996. The distribution of sea birds relative to their fish prey off Vancouver Island: opposing results at large and small spatial scales. Fisheries Oceanography 5 (Supplement 1): 163–175.

Mehlum, F., G. L. Hunt, Jr., Z. Klusek, M. B. Decker, and N. Norlund. 1996. The importance of prey aggregations to the distribution of Brunnich's Guillemots in Storfjorden, Svalbard. Polar Biology16: 537–547.

Mehlum, F., N. Nordlund, and K. Isaksen. 1998. The importance of the "Polar Front" as a foraging habitat for guillemots *Uria* spp. breeding at Bjørnøya, Barents Sea. Journal of Marine Systems 14: 27–43.

Munk, P., P. O. Larsson, D. Danielsen, and E. Moksness. 1995. Larval and small juvenile cod *Gadus morhua* concentrated in the highly productive areas of a shelf break front. Marine Ecology Progress Series 125: 21–30.

Murphy, S. M., R. H. Day, J. A. Wiens, and K. R. Parker. 1997. Effects of the *Exxon Valdez* oil spill on birds: comparisons of pre- and post-spill surveys in Prince William Sound, Alaska. Condor 99: 299–313.

Napp, J. M., L. S. Incze, P. B. Ortner, D. W. Siefert, and L. Britt. 1996. The plankton of Shelikof Strait, Alaska: standing stock, production, mesoscale variability, and their relevance to larval fish survival. Fisheries Oceanography 5 (Supplement 1): 19–38.

Owen, R. W. 1981. Fronts and eddies in the sea: mechanisms, interactions, and biological effects. Pages 197–233 *in* A. R. Longhurst (ed.), Analysis of marine ecosystems. Academic Press, New York, NY.

Piatt, J. F., and R. G. Ford. 1996. How many seabirds were killed by the *Exxon Valdez* oil spill? Pages 712–719 *in* S. D. Rice, R. B. Spies, D. A. Wolfe, and B. A. Wright, eds. Proceedings of the *Exxon Valdez* Oil Spill Symposium. American Fisheries Society, Bethesda, MD. Symposium No. 18.

Piatt, J. F., C. J. Lensink, W. Butler, M. Kendziorek, and D. R. Nysewander. 1990. Immediate impact of the 'Exxon Valdez' oil spill on marine birds. Auk 107: 387-397.

Ribic, C. A., D. G. Ainley, and L. B. Spear. 1992. Effects of El Niño and La Niña on seabird assemblages in the Equatorial Pacific. Marine Ecology Progress Series 80: 109–124.

Sabatés, A., and M. P. Olivar. 1996. Variation of larval fish distributions associated with variability in the location of a shelf-slope front. Marine Ecology Progress Series 135: 11–20.

Schneider, D. 1982. Fronts and seabird aggregations in the southeastern Bering sea. Marine Ecology Progress Series 10: 101–103.

Schneider, D. C., N. M. Harrison, and G. L. Hunt, Jr. 1990. Seabird diet at a front near the Pribilof Islands, Alaska. Studies in Avian Biology 14: 61–66.

Stewart-Oaten, A., W. W. Murdoch, and K. R. Parker. 1986. Environmental impact assessment: "pseudoreplication" in time? Ecology 67: 929–940.

Tasker, M. L., P. H. Jones, T. Dixon, and B. F/ Blake. 1984. Counting seabirds at sea from ships: a review of methods employed and a suggestion for a standardized approach. Auk 101: 567–577.

Van Franeker, J. A. 1994. A comparison of methods for counting seabirds at sea in the Southern Ocean. Journal of Field Ornithology 65: 96–108.

Wahl, T. R., D. G. Ainley, A. H. Benedict, and A. R. DeGange. 1989. Associations between seabirds and water-masses in the northern Pacific Ocean in summer. Marine Biology 103: 1–11.

Wiens, J. A., and K. R. Parker. 1995. Analyzing the effects of accidental environmental impacts: approaches and assumptions. Ecological Applications 5: 1069–1083.

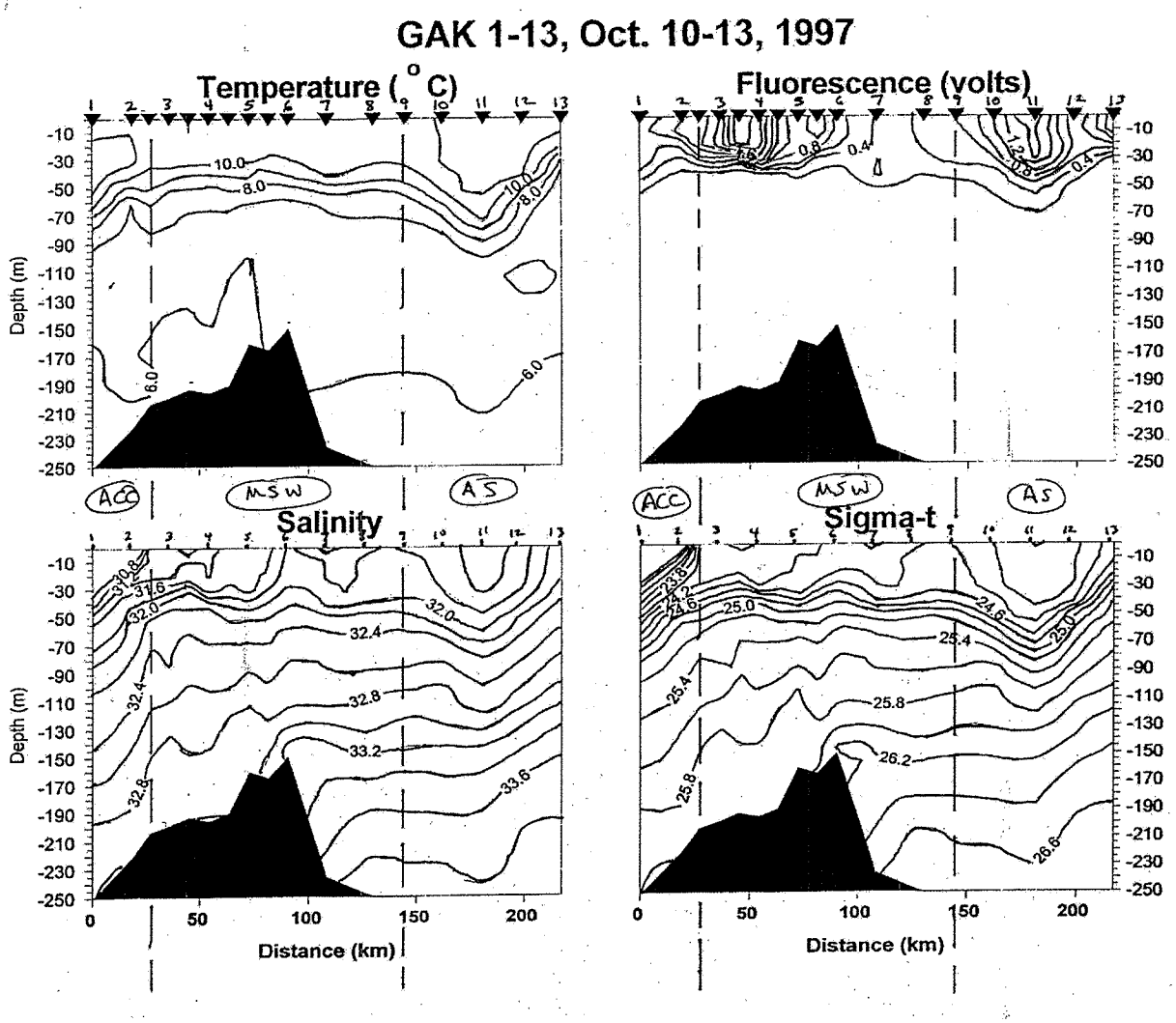


Figure 1. Vertical cross-sections of temperature, salinity, density (sigma-t), and fluorescence along the Seward Line, October 1997 (T. Weingartner, University of Alaska, Fairbanks, unpubl. data). Data are plotted with inshore on the left end of the plots. Abbreviations are: ACC = Alaska Coastal Current; MSW = Mid-shelf Water; AS = Alaska Stream.

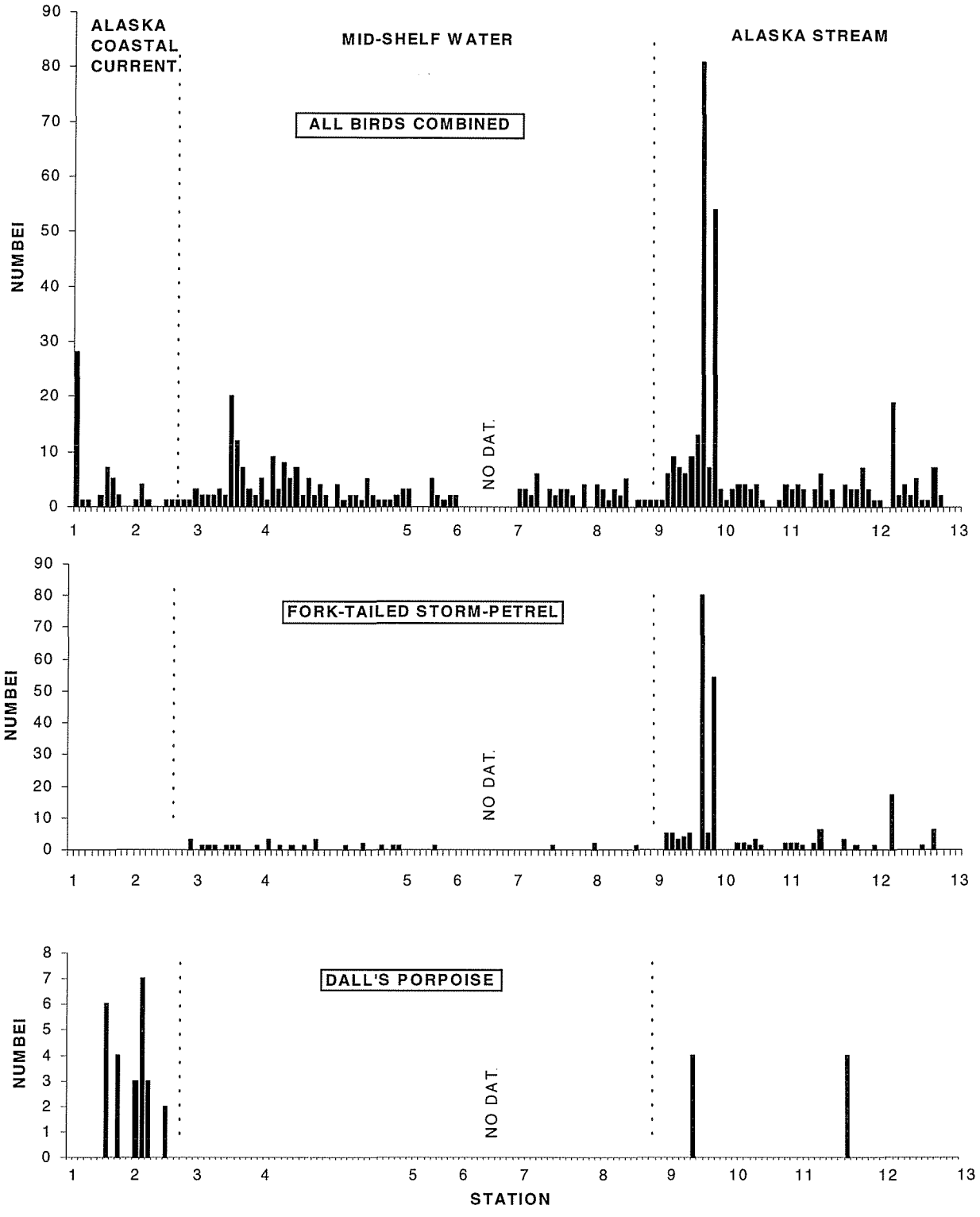


Figure 2. Cross-shelf distribution and abundance of all seabird species combined, fork-tailed storm-petrels, and Dall's porpoises a0long the Seward Line, October 1997. Data are preliminary and are not to be cited.

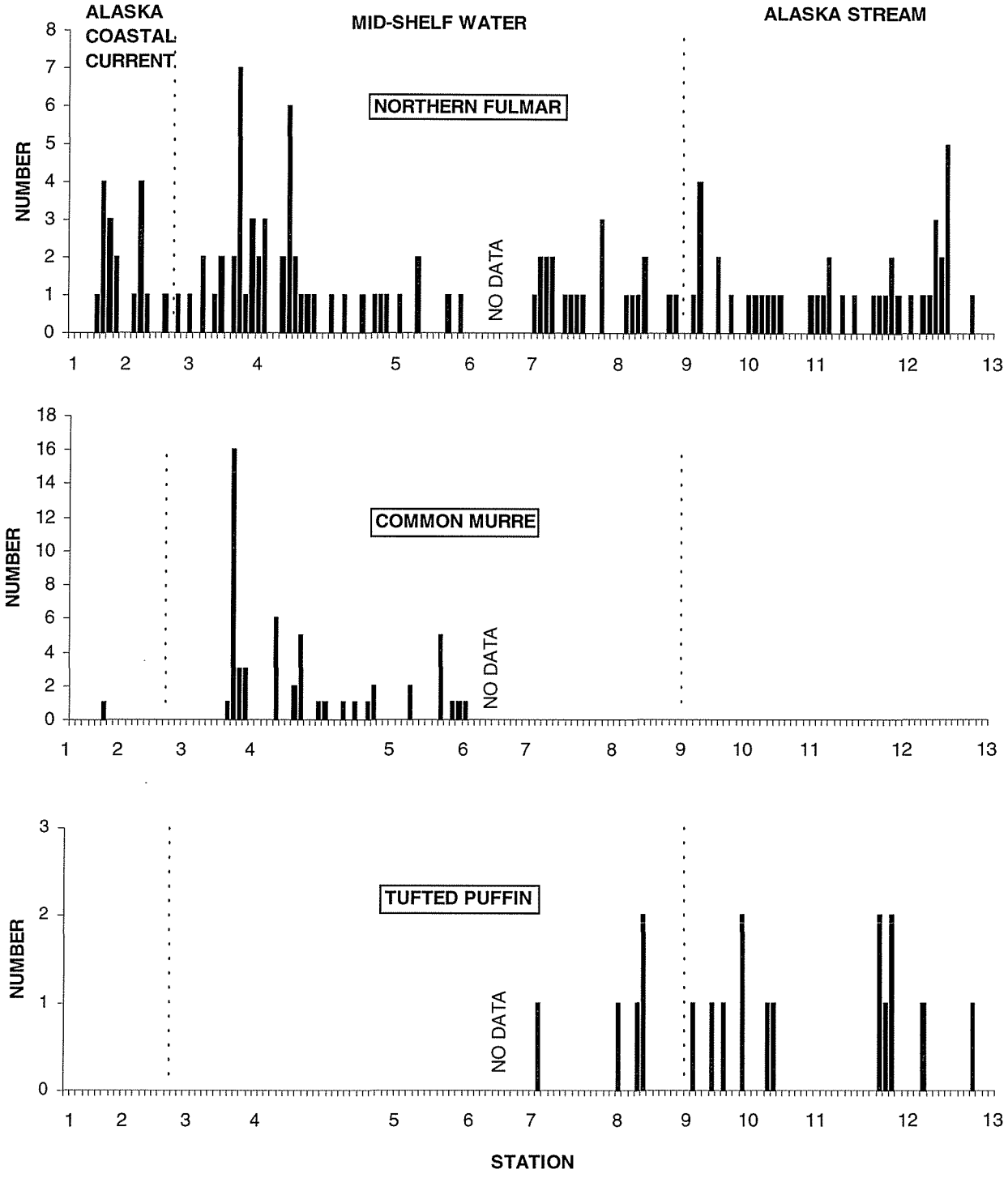


Figure 3. Cross-shelf distribution and abundance of northern fulmars, common murres, and tufted puffins along the Seward Line, October 1997. Data are preliminary and are not to be cited.

APPENDIX 1. "GLOBEC" PROPOSAL SUBMITTED TO NSF BY INSTITUTE OF MARINE SCIENCES, UNIVERSITY OF ALASKA, FAIRBANKS

1. INTRODUCTION

Climate change and its potential effects on ecosystems are of international concern. In response to this issue the Global Ocean Ecosystem Dynamics (GLOBEC) program addresses the physical and biological interactions linking ecosystem alterations to climate change. The GLOBEC program goals are: 1) to understand the effects of climate variability and climate change on the distribution, abundance and production of marine organisms, and 2) to incorporate this understanding into diagnostic and prognostic models. To achieve these goals the U.S. GLOBEC Scientific Steering Committee prepared the Northeast Pacific Implementation Plan (U.S. GLOBEC Report Number 17, 1996) outlining the required studies for the U.S. west coast and Alaska. One aspect of this plan involves the development of a long-term monitoring program. This proposal describes a monitoring program for the northern Gulf of Alaska (GOA) in accordance with the GLOBEC implementation plan.

The GOA shelf supports a diverse ecosystem that includes several commercially important fisheries such as crab, shrimp, pollock, salmon and halibut (OCSEAP Staff, 1986; Anon., 1993). In aggregate these stocks imply that the gulf is among the world's largest fisheries, with annual catches exceeding 300 g 1000 m^{-2} (Brodeur and Ware, 1992). The mechanisms that underlie this high productivity are not known and, in fact, are somewhat enigmatic because the GOA shelf is a coastal "downwelling" shelf. By contrast, the rich fisheries along the eastern boundaries of the Pacific Ocean are supported by vigorous, wind-driven coastal upwelling whereby the euphotic zone is regularly replenished with nutrients advected from depth.

Intriguingly, the relative dominance of the commercially important fish species changed in the mid-1970s: crab and shrimp declined while salmon and groundfish populations increased (Albers and Anderson, 1985; Blau, 1986; Hollowed et al., 1994; Thompson and Zenger, 1994; Francis and Hare, 1994). These population shifts coincided with the beginning of a decadal North Pacific change in the atmosphere and ocean (Trenberth and Hurrell, 1994). From the human perspective these alterations required the commercial fishing industry to invest substantially in infrastructure adjustments so as to remain economically viable. Subsequent changes in this ecosystem followed in the 1980s with substantial declines in populations of sea lions (Merrick et al., 1987) and puffins (Hatch and Sanger, 1992). Dramatic though this "regime shift" was, Parker et al. (1995) show evidence that the abundance of halibut and other commercially important species varies on decadal time scales in conjunction with northern North Pacific Ocean temperatures (e.g., Royer, 1993). These correlations and the regime shift suggest that the GOA ecosystem is sensitive to climate variations on time scales ranging from interannual to interdecadal; however, the specific mechanisms linking climate to ecosystem alterations are unknown. Elucidation of these mechanisms requires an understanding of the seasonal cycle of the principal physical, chemical and biological variables. To date such a description is largely lacking for the GOA shelf.

Our monitoring plan will obtain a multi-year data set that will lead to a better understanding of the seasonal cycle and interannual variability in the physical-chemical structures and biological productivity of this shelf. It will include occupation of station GAK1, for which there exists a 26-year CTD time series (Royer, 1996). Further, our program is designed to yield information essential in guiding: 1) the interpretation of historical data sets that will be used by investigators in retrospective studies, 2) the design of a cost-effective long-term monitoring program, and 3) the design of process specific studies necessary to develop ecosystem models for this shelf. As outlined in Section 3, our monitoring program is formulated around several specific objectives. In Section 2, we provide background information on the GOA shelf which summarizes the present state of knowledge about the GOA ecosystem.

2. BACKGROUND

2.1 Physical Oceanography

The alongshore flow on the shelf and slope of the GOA is in the cyclonic sense on average (Reed and Schumacher, 1986). Flow over the continental slope consists of the Alaska Current, a relatively broad, diffuse flow in the north and northeast GOA, and the Alaskan Stream, a swift, narrow, western boundary current in the west and northwest GOA (Figure 1). Together these currents comprise the poleward limb of the North Pacific Ocean's subarctic gyre and provide the oceanic connection between the GOA shelf and the Pacific Ocean. Reed and Schumacher (1986) suggest that flow in the Alaskan Stream is relatively constant year round. However, Musgrave et al. (1992) and Okkonen (1992) show that sometimes the Alaskan Stream captures large eddies or forms prominent meanders and Royer (1981a) suggests that the seasonal signal in baroclinic transport is less than 10% of the mean flow. In the northeast gulf, the "Sitka Eddy" (Tabata, 1982) occasionally forms and slowly propagates westward across the GOA. To the extent that these low-frequency features impinge on the shelfbreak they could contribute to the shelf circulation and exchange of water masses.

The most striking feature of the shelf circulation is the Alaska Coastal Current (Figure 1), a swift (0.2–1.8 m s^{-1}), coastally constrained flow, typically found within 35 km of the coast, (Royer, 1981b; Johnson et al., 1988; Stabeno

et al., 1995). This current persists throughout the year and circumscribes the GOA shelf for at least ~2500 km from where it originates on the northern British Columbia shelf (or possibly the Columbia River depending on the season) to where it enters the Bering Sea in the western gulf (Figure 1). In contrast to the coastal current, the shelf flow between the offshore edge of the coastal current and the shelfbreak is weaker and more variable (Niebauer et al., 1981). The source of this variability is uncertain, but potential mechanisms include separation of the coastal current as it flows around coastal promontories (Ahlnes et al., 1987), baroclinic instability of the coastal jet (Barth, submitted; Mysak et al., 1981) or meandering of the Alaska Current along the shelfbreak (Niebauer et al., 1981).

The dynamics of the basin and the shelf are closely coupled to the Aleutian Low pressure system. Storm systems propagate eastward into the GOA and are blocked by the mountain ranges of Alaska and British Columbia. Thus the regional winds are strong and cyclonic and the precipitation rates are very high. The positive wind-stress curl forces cyclonic circulation in the deep GOA, while on the shelf these winds impel an onshore surface Ekman drift and establish a cross-shore pressure gradient that forces the Alaska Coastal Current. The high rates of precipitation, which can be as great as 8 m yr^{-1}, cause an enormous freshwater flux (~20% larger than the average Mississippi River discharge) that feeds the shelf as a "coastal line source" extending from southeast Alaska to Kodiak Island (Royer, 1982). The seasonal variability in winds (represented in Figure 2 as the upwelling index) and freshwater discharge (Figure 2) are large. The mean monthly "upwelling index" at locations on the GOA shelf is negative in most months, indicating the prevalence of coastal convergence (e.g., this index is a measure of the strength of cyclonic wind stress in the GOA). As implied by Figure 2, cyclonic winds are strongest from November through March and feeble or even weakly anticyclonic in summer when the Aleutian Low is displaced by the North Pacific High (Royer, 1975; Wilson and Overland, 1986). The seasonal runoff cycle (Figure 2) exhibits slightly different phasing from the winds: it is maximum in early fall, decreases rapidly through winter when precipitation is stored as snow, and attains a secondary maximum in spring due to snowmelt (Royer, 1982).

The shelf hydrography and circulation vary seasonally and are linked to the annual cycles of wind and freshwater discharge. Figure 3 contrasts the cross-shore salinity structure (which mimics density on the GOA shelf) in April and September, 1983. In April, the stratification and the offshore front, defined here to be the surface intersection of the 32.0 isohaline, are relatively weak. By contrast, in September a 25 km wide wedge of strongly stratified water lies adjacent to the coast and is bounded on the offshore side by a prominent front. Royer et al. (1979) showed that surface drifters released on the shelf seaward of the front drifted onshore in accordance with Ekman dynamics. Upon encountering the front the drifters moved in the alongfront (e.g. ~westward) direction consistent with the geostrophic tendency implied by the cross-shore density distributions of Figure 3. Royer et al. (1979) hypothesized that ageostrophic offshore spreading of the dilute surface layer occurred on the inshore side of the front. In their analysis of currents measured inshore of the front, Johnson et al. (1988) found that this is indeed the case and that surface offshore flow was positively (and significantly) correlated with discharge.

These studies imply that near-surface waters converge from either side of the front. This pattern of cross-shelf circulation would tend to accumulate plankton which might then attract foraging fish. Moreover, the front and region inshore of it might be an area of enhanced productivity because entrainment (Royer et al., 1979; Johnson et al., 1988) and/or frontal instability (Barth, submitted) could resupply the surface layer with nutrients from depth. Royer (1979) also showed that monthly coastal sea level variations at Seward are in-phase with, and have nearly the same amplitude as, the local dynamic height. This was not expected given the difference in sampling techniques: the sea level records were sampled hourly and then averaged into monthly means, whereas the dynamic heights were from hydrographic measurements at a single station occupied several months apart. Further, Royer (1979) found that sea-level and precipitation anomalies were well-correlated. These results suggest examining the relationship between monthly or seasonal characteristics of the cross-shelf dynamic height gradients, winds and freshwater discharge. A firm relationship among these factors may allow the calculation of alongshelf baroclinic transport (on monthly or longer time scales) from a single hydrographic station or mooring at the coast. The result would be enormously useful for model evaluation (and perhaps data assimilation) and in retrospective studies. The alongshore transport appears to be important in advecting zooplankton to important juvenile fish foraging areas (see Section 2.3).

Figure 3 also indicates that near-bottom salinities are higher in fall than spring. Xiong and Royer (1984) showed that, on average, maximum bottom salinities occur in fall and are nearly coincident with minimum surface salinities and maximum inshore stratification (Figure 4). Although the surface waters are diluted by coastal discharge (which peaks in fall), the source of the high salinity water is the onshore intrusion of slope water (Figure 5) in response to the seasonal relaxation (or reversal) in downwelling (Royer, 1975, 1979).

Royer's (1996) analysis of monthly anomalies from the GOA shelf shows very low-frequency (interdecadal) variations in bottom water salinity that imply interannual variability in the onshore flux of slope water and/or

differences in slope water properties. We argue below that these differences likely result in differences in the onshore flux of nutrients to the GOA shelf.

2.2. Primary Productivity and Nutrient Cycles

There are few primary production measurements from the GOA and those that exist are from widely varying locations and times. While Sambrotto and Lorenzen (1986) and Parsons (1986) concluded that the largest production rates occur on the shelf, there are no data on interannual variability. A nearly complete lack of nutrient data, particularly from the shelf (Reeburgh and Kipphut, 1986), is an additional limitation to understanding production. The major nutrient source to the shelf is probably the deep ocean because nutrient concentrations in the coastal runoff are very low (Sambrotto and Lorenzen, 1986). Such low concentrations are not unexpected given the steep, mountainous coastline and the extensive snowfields. The shelf euphotic zone, especially in inshore waters, probably becomes nutrient depleted, but we emphasize that this is speculation at this time (Reeburgh and Kipphut, 1986).

Although little is known about surface nutrient concentrations, there are suggestions of large year-to-year differences in subsurface nutrient concentrations. Incze and Ainair (1994) showed large interannual differences in nutrient concentrations at depths >150 m along one section in Shelikof Strait (in the western GOA) occupied each spring between 1985–1989. Because of the unique bathymetry of this area, it is unclear if these differences apply to other GOA shelf regions. However, the interannual salinity variations shown by Royer (1996) imply variability in deep water nutrient concentrations, as indicated from the WOCE P17N section of May–June 1993. These nutrient data are the only synoptic deep ocean and shelf nutrient data available for the northern GOA. Figure 6 shows the salinity-NO_3 relationship using data from between 125 and 450 m depth at stations within the Alaskan Stream and on the western shelf. This depth interval covers the range of bottom water salinities observed by Royer (1996) and Xiong and Royer (1984). The correlation appears to be good and we note that a change in salinity from 32.0 to 33.0 involves nearly a doubling in the NO_3 concentration. If salinity-macronutrient relationships can be statistically quantified for the shelf, then it might be possible to use the 26-year salinity time series from GAK1 as a proxy for subsurface nutrient concentrations.

2.3 Zooplankton

Zooplankton are a critical link in the transfer of energy from primary producers to apex predators. Any process influencing the abundance and distribution of zooplankton can ultimately impact on fisheries. Zooplankton are therefore a critical component of any monitoring study that attempts to relate long-term climate variations to fish production.

The zooplankton community on the shelf of the Gulf of Alaska is dominated by a combination of oceanic and neritic herbivorous and omnivorous copepod stocks (Cooney, 1986a, 1986b; Incze et al., 1996). The major oceanic species include *Neocalanus plumchrus*, *N. flemingeri*, *N. cristatus*, *Eucalanus bungii* and *Metridia pacifica*. Neritic taxa are dominated by *Pseudocalanus* spp. and *Calanus marshallae*, with lesser amounts of *Acartia* spp., *Centrapoges abdominalis* and *Calanus pacificus*. In addition to copepods, a number of micronektonic species contribute substantially to the overall density of forage for fish on the GOA shelf. The euphausiid species include primarily *Thysanoessa inermis*, *T. spinifera* and *Euphausia pacifica*, with lower densities of *Thysanoessa raschii*, *T. longipes*, *T. inspinata*, *Tessarabrachion oculatum* and *Euphausia pacifica*. Amphipods include *Cyphocaris challengeri*, *Parathemisto pacifica*, and *Primno macropa* (Incze et al., 1996). Oceanographic conditions affecting the transport and production of these taxa influence their absolute and relative densities and distribution over the shelf, and thus their availability to fish predators.

During spring and summer, 25–78% of the copepod biomass over the shelf is dominated by the oceanic species complex (Cooney, 1986a, 1986b; Incze et al., 1996). The distribution of oceanic relative to neritic copepods is determined to a large extent by cross-shelf transport (Cooney, 1986a) and water mass type (Incze et al., 1996; Napp et al., 1996). Although most of the copepod biomass in lower Shelikof Strait occurred consistently in the Alaska Coastal Current from 1986–1989, there was a fourfold (3–12 g C m^{-2}) interannual variation in maximum biomass (Incze et al., 1996; Napp et al., 1996). Zooplankton biomass on the shelf outside of Prince William Sound in May 1996 varied by up to an order of magnitude, with maximum values occurring in the shelf water offshore of the Alaska Coastal Current (Figure 7).

In addition to late copepodid stages of the major copepod taxa, the early naupliar stages are the primary forage for the first-feeding larval stages of a variety of fish. Based on water temperature, copepod development rates and flow rates of the Alaska Coastal Current, copepods producing the major cohort of naupliar stage larvae available to first-feeding pollock larvae in Shelikof Strait originated during February–March on the shelf off of Prince William Sound and east of GAK1 (Napp et al., 1996; Incze and Ainaire, 1994). Nauplii consumed by first-feeding fish larvae

are produced primarily by the neritic zooplankton community. Therefore, pre-bloom conditions on the north central GOA shelf may crucially influence survival of larval fish further downstream (west and south) near Kodiak Island.

No data are available on interannual differences in zooplankton biomass for the north central GOA shelf. However, a multi-year data set of zooplankton settled volumes measured during April and May near Ester Island, in the southern end of Prince William Sound, is available. The zooplankton community in the southern sound is influenced primarily by advection from the GOA shelf. Cooney (pers. comm.) found a significant positive correlation (Figure 8) between the logarithm of the average settled zooplankton volume for April and May and the average of the upwelling index off Hinchinbrook Entrance (Figure 2). There are a number of possible explanations for the above correlation. Oceanic species of the genus *Neocalanus* dominate zooplankton biomass in April and May, suggesting that anomalously weak springtime downwelling may enhance subsurface onshore transport of oceanic copepods from the shelfbreak. Alternatively, weakened downwelling may permit advection of nutrients onshore and into the photic zone during the spring months, thereby elevating primary production and providing a more continuous and abundant food supply to herbivorous zooplankton. An anomalously positive April–May upwelling index implies reduced wind stress, precipitation rates, cloud cover and possibly higher air temperatures. All these variables influence upper ocean stratification through wind mixing, surface heat flux and coastal discharge. Stratification influences the vertical distribution of plant cells and, along with light availability, influences primary production rates. These physical variables, through their influence on phytoplankton food quality and/or abundance, would affect zooplankton.

If cross-shelf advection is a major source of zooplankton biomass on the shelf, then conditions that enhance zooplankton biomass at the shelfbreak should also enhance shelf zooplankton densities when favorable onshore transport conditions occur. Comparisons of zooplankton densities in the GOA between 1956–1962 and 1980–1989 revealed a doubling in average biomass around the GOA perimeter since the early 1960s (Brodeur and Ware, 1992). The reason for this increase is uncertain. However, suggested hypotheses include greater primary productivity due to a rise in winter wind stress and elevated summer winds, increasing the speed of the subarctic current and displacing it northward, further into the GOA during the 1980s (Brodeur and Ware, 1992). A positive correlation between zooplankton densities and surface salinities (Frost, 1983; Wickett, 1967) implies stronger vertical mixing (Brodeur and Ware, 1992), leading to enhanced new production and better feeding conditions for herbivorous zooplankton. Primary production rates were apparently 3–4 times higher in the GOA in 1987–1988 than earlier measurements indicated (Welschmeyer et al., 1993). Although Welschmeyer et al. (1993) attributed the differences to methodology, the zooplankton and wind data cited above suggest that there might have been real decadal variation in annual production rates.

A doubling of the salmon production between the 1950s and 1980s (Rogers, 1987) indicates that salmon benefited from elevated zooplankton densities. The major environmental shift suggested by the collapse of the crustacean fishery and its replacement by a groundfish fishery in the late 1970s and early 1980s (see Introduction) could also be a consequence of enhanced zooplankton biomass because the early life history stages of demersal fishes feed on zooplankton.

2.4 Fish

The epipelagic zone of the Northeast Pacific Ocean provides the energy of production for five Pacific salmon species that spawn and are harvested in Alaskan waters. Since the 1920s, abundance of salmon in Alaska has undergone one complete cycle, with high levels in the 1930s, low in the 1960s, and a return to high abundance in the 1980s. This relatively long-term cycle may be related to harvest practices, changes in freshwater spawning habitats and changes in the marine environment. Several indicators suggest the marine environment may be a factor in abundance cycles, and that the present exceptionally high abundances of salmon may reflect long-term climatic changes that have affected the planktonic production system of the Northeast Pacific Ocean. For example, since the mid-1970s water temperatures have increased (Royer, 1989), primary and secondary production levels are higher (Brodeur and Ware, 1992), and growth rates of salmon are declining (Helle and Hoffman, 1995). Several of these indicators appear to have conflicting trends, especially the observation that salmon growth rates are declining while secondary production has increased. Processes that may be responsible for these observations include physical effects such as variability in oceanographic features that concentrate prey or the energetic demands of higher water temperatures, and biotic effects such as density dependent growth associated with competitive interactions among planktivorous fishes. Presently there is no clear understanding of what processes are controlling salmon production in the Northeast Pacific Ocean.

In the marine environment, salmon coexist with a variety of other planktivorous fishes and invertebrates. Non-salmonid species that co-occur with juvenile salmon include sablefish (*Anoplopomna fimbria*), rockfishes (*Sebastes* spp.), walleye pollock (*Theragra chalcogramma*), herring (*Clupea harengus*) and capelin (*Mallotus villosus*)

(Carlson et al., 1996). In addition, a group of diel-migrating mesopelagic fishes, such as myctophids, may be important nocturnal planktivores in near-surface waters. Inclusion of non-salmonid species in marine monitoring studies should provide increased opportunity to observe patterns important in the production of planktivorous fishes.

Typically, high latitude fishes store energy during spring and summer, whereas in the winter they reallocate energy to maintenance and reproduction (Smith et al., 1988, 1990). Juvenile salmon in the Gulf of Alaska seek feeding areas that sustain the rapid growth needed to avoid predators and gain maturity. Certain oceanographic parameters, such as fronts, currents and temperatures, play important roles in zooplankton productivity and aggregation. The effects of food limitation may be subtle and measures of feeding variability require diagnostic tools that are sensitive enough to see small differences in fish condition. Measures of whole-body energy content provide a standardized and accurate measure of fish health and growth. The amount of energy stored by fishes during seasonal growth periods has been used to determine if populations are food limited (Diana and Salz, 1990), and is an important parameter in energetics models (Wang and Houde, 1994). This approach requires documentation of energy content at the start and end of the period of interest. For this reason, YOY (young of the year) fishes are especially interesting, as they are assumed to have started the season of growth (typically spring and summer) at the same point, with very little energy. Measuring the energy storage of YOY fishes in mid-summer and end of summer should indicate how conditions in that year affected the productivity of salmonids and other planktivorous fishes.

3. PROJECT OBJECTIVES

Although decadal-scale shifts are evident or implied in physical oceanographic, zooplankton and fisheries data sets, the connections among these ecosystem components on the GOA shelf are poorly understood. GLOBEC is an integrated program involving retrospective analyses, monitoring, modeling and process studies designed to improve our understanding these connections. The general objective of our monitoring plan is to better understand the temporal (seasonal and interannual) and cross-shelf variations in the thermohaline, chemical and biological structures of this shelf. At the same time our data will help: 1) interpret historical data sets that will be used by investigators in retrospective studies, 2) design a cost-effective long-term monitoring program, 3) identify particular processes that would serve as the basis for follow-on GLOBEC process studies scheduled to begin in year four of the GLOBEC Program for the GOA shelf (U.S. GLOBEC, 1996), and 4) provide boundary conditions and/or hindcast data sets for modeling studies.

As a practical approach to achieving these generic goals we have identified the following specific objectives that guide our sampling and analysis:

1. determine the seasonal (and interannual) changes in the cross-shelf distribution of temperature, salinity, mixed-layer depth, light transmission, photosynthetically active radiation (PAR), and the concentration of chlorophyll and nutrients;
2. determine the statistical relationship between seawater salinity and nutrient concentrations on the GOA shelf and slope;
3. use water mass properties (temperature, salinity, and DO) to determine the offshore depth of upwelled water observed on the shelf;
4. determine the relationship between anomalies of dynamic height and the cross-shelf dynamic height gradient, wind, and freshwater discharge on seasonal time scales;
5. determine seasonal chlorophyll concentration and primary productivity responses to cross-shelf thermohaline structure and nutrient enrichment processes;
6. determine quantitatively and taxonomically the seasonal and cross-shelf distribution of zooplankton in relation to oceanographic features and the distribution and concentration of chlorophyll;
7. determine quantitatively the summer-fall distribution of juvenile salmonids and other small planktivorous fishes in relation to oceanographic features and the distribution of zooplankton;
8. determine the seasonal and cross-shelf energy content of small pelagic fishes, especially young of the year (YOY) salmonids, examine energy content in relation to oceanographic features, zooplankton density and composition, and existing laboratory measures of energy storage capacity; and
9. quantify the diets of small pelagic fishes, especially YOY salmonids, as a function of season and cross-shelf position and compare these diets with oceanographic features, zooplankton density and composition.

4. APPROACH

4.1 General Considerations

To attain these objectives we will sample the physical, chemical and biological parameters on identical time and space scales with the protocols developed by the GLOBEC SSC (U.S. GLOBEC, 1996). We will occupy 13 stations on the Seward Line (Figure 9) that extends across the shelf break from the coast at Seward to within the Alaska Stream. The bottom depth at most stations along this line is from 200 to over 1500 m which will allow deep ocean nutrient data to be collected. The Seward Line was frequently occupied in the 1970s as part of the Outer Continental Shelf Environmental Assessment Program (OCSEAP), so historical hydrographic data are available for comparison with our results. Six cruises per year are requested so that we can capture the seasonal cycle in the important physical and biological variables. We will sample in February/March when zooplankton migrate from depth at the shelf break and begin to be advected onshore, in April during the spring phytoplankton bloom, in May when the biomass of oceanic copepods is maximum, in July and October when YOY salmon are on the shelf, and in late November/early December when we expect biological activity to be minimal. Our sampling methods follow the protocols specified in the implementation plan (see Table 5 of U.S. GLOBEC, 1996), however, we will not sample particle size spectra using a through-hull system, deploy drifters, or observe marine birds and mammals. Under separate submission, J. Napp of NOAA/NMFS Alaska Fisheries Science Center (Seattle) is proposing to measure particle size spectra with an instrument that would be deployed with our CTD while on station. R. Day (Alaska Biological Research, Inc., Fairbanks), a seabird biologist long involved in regional seabird studies, will propose to the Exxon Valdez Oil Spill Trustee Council (EVOS) to make mammal and seabird observations during our cruises.

All oceanographic observations will be made from the R/V *Alpha Helix*, whose home port is Seward; therefore transit time to the Seward Line will be negligible. A fishing vessel configured for mid-water trawling will be chartered for two cruises in July and early October to sample YOY salmonids and juvenile fishes. The trawl vessel will work in conjunction with the R/V *Alpha Helix* so that measurements of oceanic parameters and zooplankton are obtained concurrently, thus ensuring that the data sets are compatible in time and space. The remaining four cruises (February/March, April, May and November/December) will involve only oceanographic and zooplankton sampling. We expect to spend 36 days per year at sea; with each cruise of 6 days duration. The ocean sampling should actually require ~3 days and the excess time reflects weather day budgeting. Should these days not be needed we will use the extra time to sample additional cross-shelf transects east of the Seward Line or we will occupy 25 hour time series stations.

4.2 Physical, Chemical and Phytoplankton

Shipboard hydrography will be done by Weingartner and Royer. Measurements will include CTD (Seabird 9/11 with redundant temperature and conductivity sensors), fluorometry, PAR, transmissivity, and discrete bottle samples for nutrients, chlorophyll, and dissolved oxygen, at a station spacing of ~10 km on the inner half of the shelf and at ~15 km intervals over the outer half. Continuous through-hull measurements of surface temperature, salinity, and fluorescence; and water column velocities determined with an acoustic Doppler current profiler (ADCP) will be included. The R/V *Alpha Helix* carries a 300 kHz ADCP system that can bottom track over the continental shelf. The ADCP velocity profiles and through-hull surface property values are displayed in real-time and these will help identify the location and width of the Alaska Coastal Current and the front. Together with the hydrographic cast data, these data will be used to adjust the CTD station locations during each cruise to optimize sampling for the features of interest and to guide the fish and zooplankton sampling.

The physical parameters (including transmissivity and PAR) obtained from the CTD will be used to examine seasonal and cross-shelf distribution of water masses and to aid in interpreting the distribution of biological variables. We will also compute dynamic heights and baroclinic transports for use in the retrospective study described below. The ADCP data from a single occupation of a transect, as proposed here, are not easily amenable to detiding. However, the M_2 tide is the dominant tidal constituent on this part of the GOA shelf with an amplitude of ~0.1 m s^{-1}. The dominant velocity signal on this shelf is the Alaska Coastal Current. The magnitude of both the mean speed and typical subtidal-frequency variability of the Alaska Coastal Current is several times greater than the tidal signal. To the extent that weather permits, sampling along additional transects might permit us to apply tidal removal procedures (Candela et al., 1992) to the ADCP data. The continuous ADCP and surface measurements will be used to examine small scale physical features that might be of biological importance. These parameters, when analyzed in conjunction with hydroacoustic data, are especially helpful in interpreting zooplankton patches (Coyle and Cooney, 1993; Coyle et al., 1992).

Retrospective studies of the hydrographic and climatic variability done in conjunction with this pilot monitoring program will give it spatial and temporal contexts. These studies will also determine if future monitoring can be accomplished through the use of more generally recorded environmental factors such as coastal tidal height; wind;

barometric pressure; air temperature; precipitation; cloudiness; remote sensing of sea surface temperature, color and altimetry; and volunteer observing ship measurements of ocean temperatures.

The data from the monitoring program will be added to the existing GAK1 hydrographic time series (http://www.ims.alaska.edu:8000/GAK1), which will then be the focus of the retrospective analyses. This will provide a history beginning in 1970 of the temperature and salinity variability at GAK1; from this history, changes in the density structure, mixed layer depth, heat and salt content, and dynamic height will be determined. The relationships between dynamic height and sea level observed by Royer (1979) will be reexamined using the additional 18 years of data to determine if the dynamic height and baroclinic transport on the shelf can be derived from tidal height data.

The relationship between the mixed layer depth and both sea level measurements and freshwater discharge will be examined. The regional hydrology model of Royer (1982) will be used in the retrospective studies to calculate the coastal discharge from records of air temperature and precipitation, since there is little monitoring of such fresh water flux in the GOA. The variability of the mixed layer depth is especially important to studies of primary and secondary production, since it can affect the vertical fluxes of nutrients and the depth of phytoplankton distribution (Mann and Lazier, 1991). The ability to hindcast the mixed layer depth from the freshwater discharge model would permit determination of the mixed layer depth variability back to 1931, the earliest date of the climatic records used by the model. The mixed layer depth record could then be compared to fisheries data sets during this period, such as salmon catches.

To place the Seward Line measurements in a spatial context, the historical hydrographic data for this shelf will be reexamined along with the XBT and BT data available for the region from the WOCE (World Ocean Circulation Experiment) Volunteer Observing Ship (VOS) program. More than five years of VOS coverage is now available. Interdecadal time scales will be addressed through the use of sea surface temperatures (available from Scripps since 1947), Sitka air temperatures (since 1828), upwelling indices (from the Pacific Oceanographic Group/NOAA since 1946), the North Pacific Index (from NCAR since 1900) and oceanographic buoy data (from NOAA since ca. 1975).

Whitledge is responsible for nutrient and primary productivity measurements. Nutrients will be analyzed onboard using an Alpkem Rapid Flow Analyzer (Whitledge et al., 1981) and will conform to WOCE standards (Gordon et al., 1993). Chlorophyll *a* concentrations will be measured at all stations to calibrate the *in vivo* fluorescence profiles. The samples will be collected from CTD upcasts using the rosette sampler. Extracted chlorophyll *a* will be determined fluorometrically on board ship (Parsons et al., 1984). Extracted chlorophyll samples will also be used to calibrate the flow-through fluorometer by collecting discrete samples periodically from the through-hull sampling system.

Daily measurement of primary production rates will be estimated for large (>20 µm) and small (<20 µm) size classes by the modified ^{14}C-uptake technique (Evans et al., 1987). Primary production estimates well be made at 4–6 stations along the Seward Line. Water samples inoculated with 20 µCi ^{14}C-labeled sodium bicarbonate will be incubated in 1-liter polycarbonate bottles under natural light, using an on-deck incubator. Following the incubations, both light and dark samples will be filtered and purged of labeled inorganic carbon. The residual ^{14}C activity will be determined by liquid scintillation counting to assess organic carbon release rates. Hourly and daily estimates of primary production rates will be calculated for each sampling site. Concurrent assessments of phytoplankton nutrient utilization will be performed using nutrients (nitrogen, phosphorus and silicate) and trace metals. Emphasis will be placed on iron enrichments in order to assess potential effects on primary productivity rates. Particulate carbon and nitrogen samples will be obtained for each productivity sample.

4.3 Zooplankton

Coyle will perform the zooplankton work. Zooplankton samples will be collected with a 25 cm diameter CalVET net (Smith et al., 1985) equipped with General Oceanics digital flowmeters and 0.16 mm mesh nets. The CalVET net has the following advantages over a ring net for obtaining integrated zooplankton samples: 1) it can be hung on the CTD cable, allowing for quick and efficient deployment of gear; 2) a CTD record can be obtained concurrently with the zooplankton sample; 3) the net can be equipped with flowmeters to estimate sampling efficiency; and 4) the sample is small, thus requiring a minimum of splitting during analysis. The CalVET net will sample small, abundant zooplankton, especially early copepodid stages of calanoids (e.g., Coyle et al., 1990).

A 0.7 m bongo net with 0.5 mm mesh and a depth recorder with an on-deck readout will be towed double obliquely from the surface to within 10 m of the bottom. The bongo net will sample large calanoids, micronekton and larval fish. It will be equipped with a General Oceanics digital flowmeter to estimate volume filtered.

Copepod nauplii will be sampled with a 10-liter Niskin bottle at four depth intervals in the upper mixed layer. The entire contents of the bottle will be filtered through a 0.05 mm mesh bag net.

All samples will be preserved in 10% formalin for later processing. As directed, separate samples will be collected, preserved in alcohol, and stored for future genetic analysis (U.S. GLOBEC, 1996). The formalin-preserved samples will be split with a Folsom splitter, consecutive fractions will be sorted for abundant taxa, and the material will be identified to the lowest taxonomic category possible. The copepods and euphausiids will be staged and the sex ratio of adults determined.

Preservation of zooplankton with formalin can markedly affect dry weight biomass estimates (Steedman, 1976; Omari and Ikeda, 1984). Because the amount of loss can vary with respect to taxa, formalin concentration, pH, duration of preservation and animal:liquid ratio, the amount of weight loss due to preservation cannot be predicted. However, minimal changes occur in copepod wet weight biomass due to formalin preservation with respect to wet weight estimates of fresh material (Omari, 1970). We will therefore measure the blotted wet weight of the formalin preserved specimens to estimate biomass. The wet weight of highly variable taxa (euphausiids, amphipods, chaetognaths, etc.) will be estimated for each sample. Average wet weight will be measured and used to estimate biomass of taxa of a constant size (e.g. copepod copepodid stages). Large gelatinous zooplankton will be counted, species composition determined and volume measured, and then discarded at sea. Data analysis will be done using an INGRES database and FORTRAN, with calls to IMSL libraries or SAS statistical packages.

Acoustic data will be collected with a Hydroacoustic Technology Inc. (HTI) model 244 split-beam system at 38, 120 and 200 kHz and a single beam at 420 kHz. The system includes a 38 kHz 10° split-beam transducer, a 120 and a 200 kHz 6° split-beam transducer, and a 420 kHz 6° single beam transducer. This frequency range should permit us to estimate densities of fish, micronekton and large calanoids. We have chosen relatively narrow beam transducers to ensure that discrete targets can be isolated for target strength measurements. We will not deploy a split beam 420 kHz transducer due to the difficulty of isolating discrete targets at reasonable ranges with high frequency transducers. The transducers will be towed beside the vessel at 6 knots in a dead-weight tow body about 4 m from the hull and 2 m below the surface. The system will collect simultaneous 20 and 40 log R data for both target strength and integration. Data will be integrated at 30–60 second time intervals and at 1 m depth intervals to produce horizontal and vertical estimates of volume scattering. All return signals are corrected for sound cone spreading and absorption of sound by seawater. Additional corrections for system calibration are applied before writing the averaged voltages to computer files. GPS positions from the ship's navigation system will be written to each record before writing the data to disk, thus permitting accurate integration of bioacoustic data with ADCP and sea surface data. All raw data will be written to digital tape, both to back the data and to permit re-analysis of selected sections during post processing. The systems will be calibrated using standard target procedures before and after each cruise (Traynor and Ehrenberg, 1990).

A 1-m^2 MOCNESS net equipped with 500 mm mesh nets will be fished during day and night, concurrently with acoustic measurements at selected sites, to identify and sample zooplankton and micronekton targets in the scattering layers. The MOCNESS system is equipped with nine nets which can be opened and closed electronically from the deck. The system simultaneously collects data on salinity, temperature, fluorescence, depth, net angle, volume sampled, time and GPS position. All data are written to a computer for later processing. The MOCNESS is fished off the stern and will sample mid-water layers from 5 m below the surface to 10 m above the bottom. MOCNESS samples will be analyzed as described above.

4.4 Fish

Haldorson and Paul are responsible for the fish studies. Planktivorous fish distribution will be assessed using a mid-water trawl equipped with a net-monitor system that provides real-time location of the net in the water column. Most of the net sampling will be at locations where the acoustic equipment has identified the presence of fishes. Acoustic sampling may not be able to identify near-surface fishes; consequently, a series of three near-surface mid-water trawl samples will be collected randomly at each of the fixed stations on the transect lines.

Once caught, fish larger than about 50 mm will be identified in the field. We will sort samples to species and measure all fish, unless net hauls contain large numbers of individuals of some species. In the case of large catches we will randomly subsample and measure 100–200 individuals of each species. Length-stratified subsamples of all fish species will be frozen and returned to the laboratory for condition and energetics studies. A second series of length-stratified subsamples will be preserved in formalin for diet studies. As directed by GLOBEC, other samples will be collected, preserved in alcohol, and stored for future genetic analysis (U.S. GLOBEC, 1996).

In the laboratory the fish will be partially thawed, just enough for handling, but not enough to lose fluids. Otoliths will be removed and stored in glycerine. The stomach will be opened and the contents removed and placed in 10% formalin. The standard length, wet weight, dry weight, whole body energy content and condition factor [CF = g wet wt x 100/(cm standard length)^3] will be determined for each individual. After freeze drying, the bodies will be placed in a convection oven at 60°C until they reach a constant weight. Individual wet and dry weight values

will be used to calculate the moisture content. Dried tissues will be ground in a mill and caloric content measured by bomb calorimetry.

Condition is assessed by examining weight as a function of length. Techniques range from application of indices, such as the Fulton condition index, to comparisons of length-weight regression parameters. We will use a Fulton condition index to compare individuals of the same species in the same age class. We will also compare slopes of length-weight regressions, especially when the size range of specimens is wide enough to render the Fulton-type indices unreliable. Length-weight regressions using analysis of covariance provide the most robust approach to comparing condition among samples (Cone, 1989).

Feeding of salmonids and other planktivorous fishes will be quantified by analyses of stomach contents from formalin-preserved specimens. Ten to 15 individuals from each species-age class-sample site will be processed. The specimens will be measured for fork and standard length, and weighed. Stomachs will be excised and the contents removed and weighed. Stomach contents will be sorted and counted by prey type, with sample splitting in the case of exceptionally high numbers of prey. Prey will be identified to the lowest feasible taxon. Weight of prey types will be estimated by measuring all or a subsample of items, and using size-weight relationships from the literature.

5. SIGNIFICANCE OF THE RESEARCH AND RELATION TO OTHER PROGRAMS

The research proposed here is the first interdisciplinary program designed to understand seasonal and interannual changes in the physical-chemical structures of the Gulf of Alaska shelf and their relationship to zooplankton and planktivorous fish, especially juvenile salmon. The mechanisms that support the high productivity of this shelf are unknown and puzzling because the GOA shelf is a "downwelling" system. By providing us with an understanding of seasonal variability from an interannual perspective, this monitoring program is critical to elucidating the specific mechanisms fueling production on this downwelling shelf. The results from the research proposed here will enable us to better define a suite of easily measured variables useful in ecosystem monitoring in the future. In conjunction with the results from similar programs along the North American west coast, this set of variables will contribute towards a better understanding of the marine system of the Northeast Pacific Ocean and its response to changes in climate.

The following is a list of existing and planned programs with which data and information gathered by our monitoring program will be shared:

1) Weingartner has submitted a proposal under an ONR Broad Agency Announcement to the National Ocean Partnership Program, to deploy a buoy that would collect hourly bottom pressure, temperature and conductivity data throughout the water column, PAR and fluorescence data in the upper 50 m, and wind velocity, air temperature and pressure at the sea surface at station GAK1. The buoy will serve as a platform for additional sensors in the future and as the foundation of a long-term monitoring platform. J. Napp's shipboard measurement program is designed in part to guide the future incorporation of an acoustic sensor for zooplankton monitoring on the GAK1 mooring. The buoy will transmit data via Argos in real-time. Data from the mooring will be valuable in guiding sampling during this program and in future GLOBEC process studies on the GOA shelf. The buoy data will complement this proposal by providing information on the shorter period variability that we cannot address with the sampling plan proposed here.

2) We will compare our monitoring data from the northern shelf with measurements by the Canadians (E. Carmack, IOS, Sidney) from the British Columbian shelf in the southeast GOA. This comparison will improve our understanding of the spatial domain over which observed variations occur.

3) B. Finney (University of Alaska) is proposing to use paleorecords and stable isotopes to examine historical biological production in the GOA. We will provide him with samples of chlorophyll, fish, and zooplankton from our surveys for characterization of present-day seasonal isotopic composition of organisms on this shelf.

4) Three of us, Paul, Coyle, and Haldorson, are involved with the EVOS-supported SEA (Sound Ecosystem Assessment) and APEX (Alaska Predator Ecosystem Experiment) projects. These programs are examining primary production rates and the abundance and distribution of zooplankton, herring, YOY pink salmon, YOY pollock and other forage fish during spring and summer in Prince William Sound. Although the above studies are limited primarily to the sound and will end in 1998, the involvement of our research staff in the EVOS programs will facilitate scientific collaboration and integration of the resulting data sets gathered by EVOS and the monitoring program proposed here. The resulting integration of effort will substantially contribute to our understanding of coastal processes on the GOA shelf as a whole.

5) Our program complements the Ocean Carrying Capacity (OCC) program conducted by NMFS's Auke Bay Lab. The OCC program will work primarily in southeast Alaska, thereby extending the GOA spatial coverage. Haldorson is an external PI on the OCC program and will provide salmonid otoliths to OCC investigators along with size and condition data from those specimens.

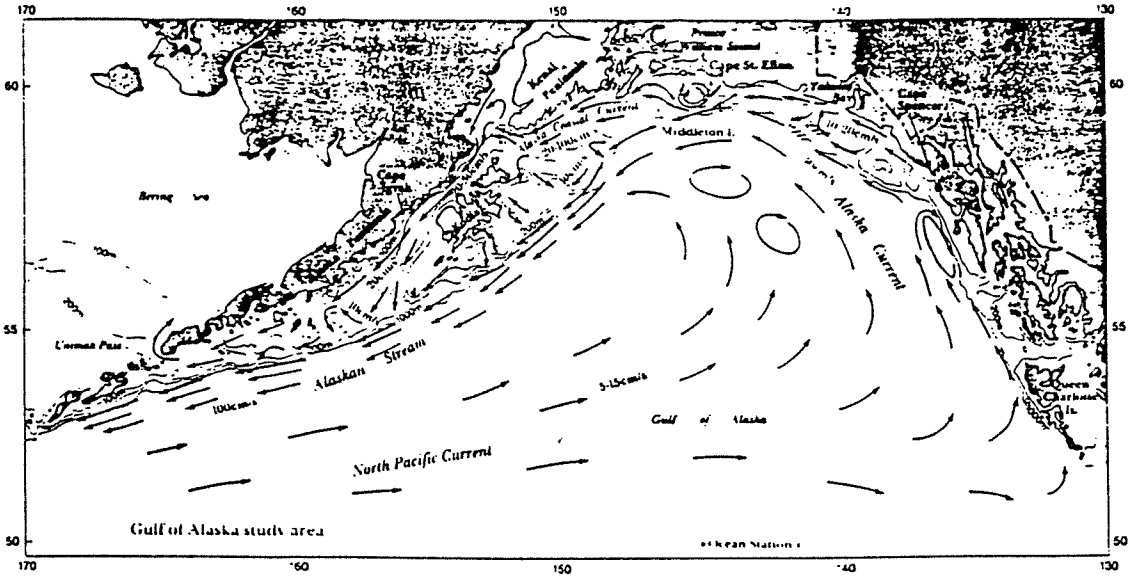


Figure 1. Schematic circulation of the Gulf of Alaska. (from Reed and Schumacher, 1986)

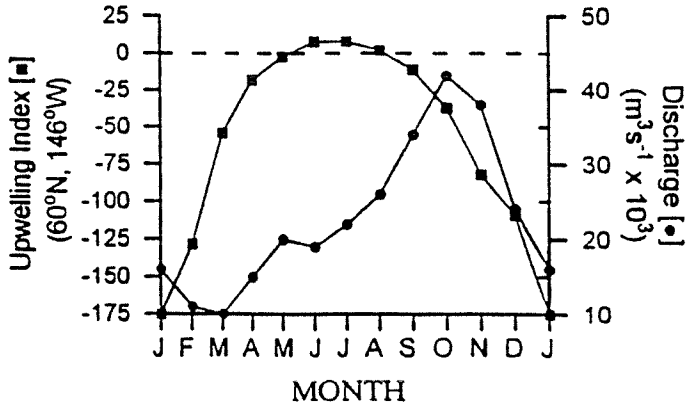


Figure 2. Mean monthly values of the upwelling index (from 1965–1992) and the estimated freshwater discharge (from 1930–1992) into the GOA using the hydrology model of Royer (1982).

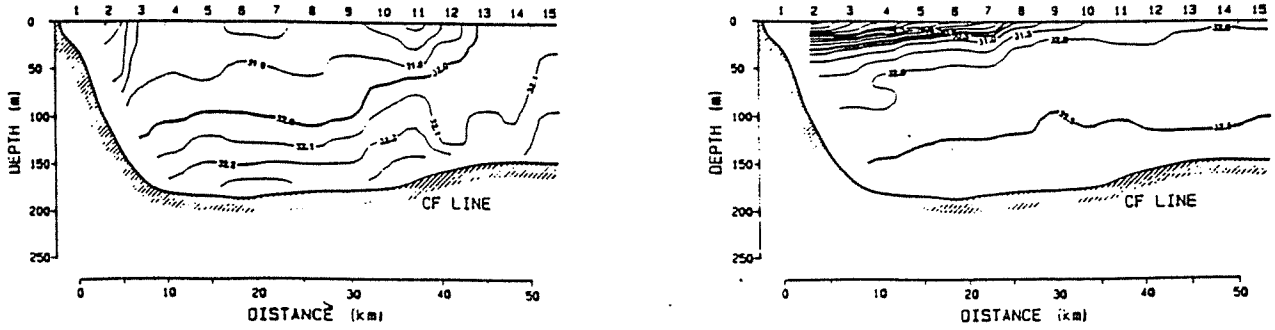


Figure 3. Cross-shelf salinity distribution in 1983; April (left) and September (right). (from Johnson et al., 1988)

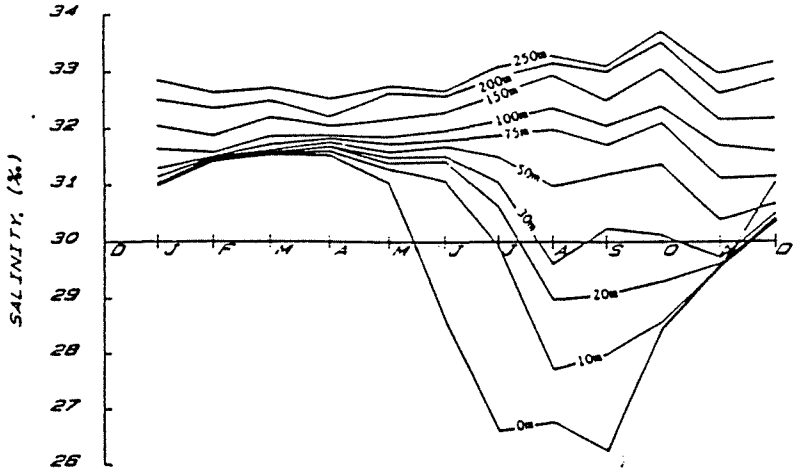


Figure 4. Mean monthly salinity at selected depths at GAK1 from 1970–1983. (from Xiong and Royer. 1984)

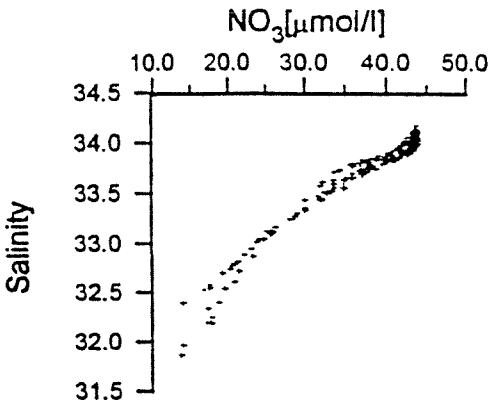


Figure 5. Vertical section of salinity along the Seward Line for winter (left and summer (right) showing inshore intrusion of saline water in summer. (from Royer, 1975)

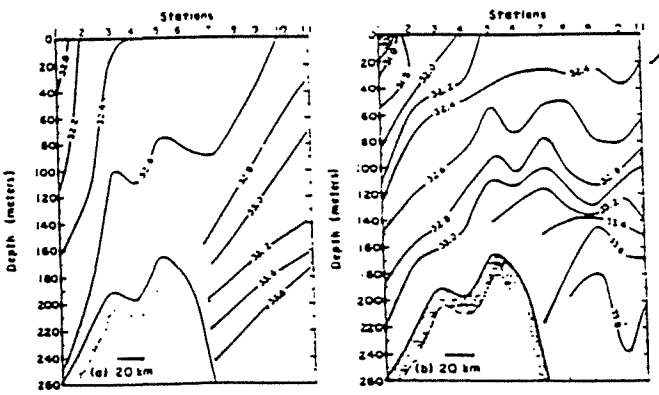


Figure 6. Salinity-NO_3 relationship from Alaska Stream and western GOA shelf stations occupied during WOCE P17N. Only data between 125 and 450 m are plotted.

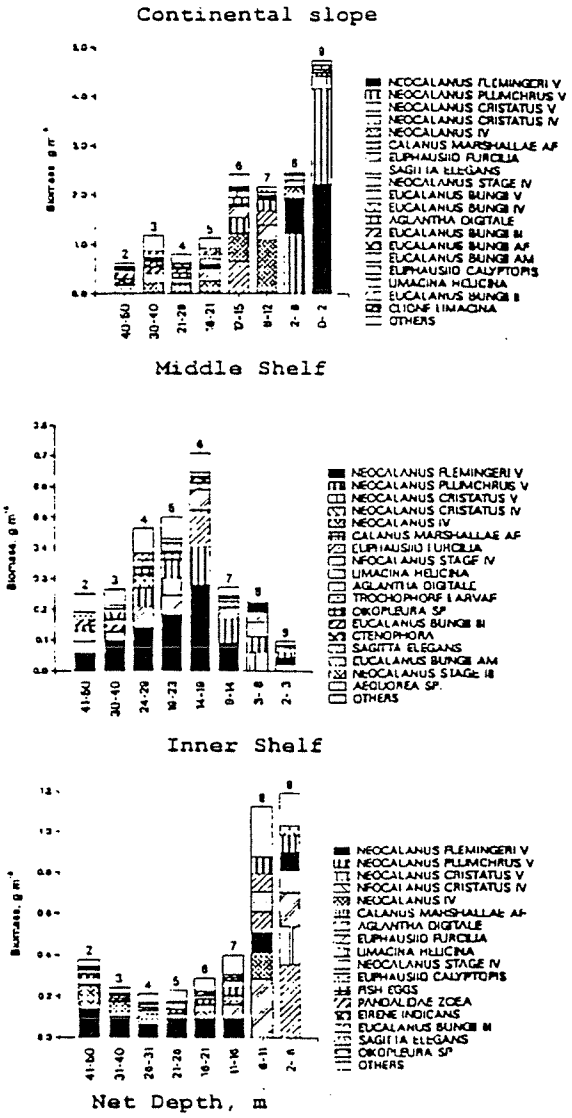


Figure 7. Zooplankton abundance and taxa at various locations across the north central GOA shelf. The data were collected in May, 1996.

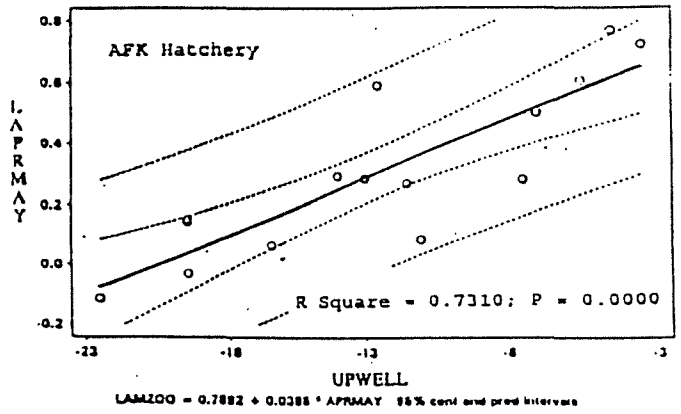


Figure 8. Regression plot of the logarithm of the April–May averaged phytoplankton settled volume against the April–May average upwelling index. (T. Cooney, pers. comm.)

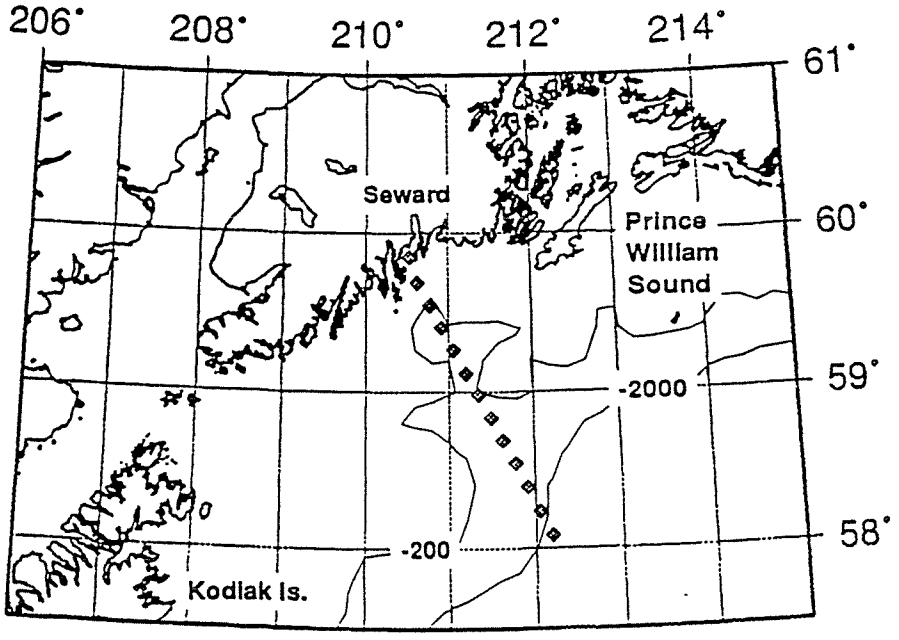


Figure 9. Location of the Seward Line with nominal locations of the proposed CTD and water sampling stations included (depths are in meters).

REFERENCES CITED

Ahlnes, K., T. C. Royer and T. H. George, Multipole dipole eddies in the Alaska Coastal Current detected with Landsat thematic mapper data. *J. Geophys. Res.*, **92:** 13041–13047, 1987.

Albers, W. D. and P. J. Anderson. Diet of pacific cod, *Gadus macrocephalus*, and predation on the northern pink shrimp, *Pandalus borealis*, in Pavlof Bay, Alaska. *U.S. Fish. Bull.*, **83:** 601–610, 1985.

Anonymous. Our Living Oceans. Report on the status of U.S. Living Marine Resources. U.S. Dept. Commerce, NMFS, 1335 East-West Highway, Silver Spring, MD 20910, 156p., 1993.

Barth, J. A., Mesoscale variability of a buoyancy-driven coastal current: The Alaska Coastal Current. *J. Geophys. Res.*, (submitted).

Blau, S. F., Recent declines of red king crab (*Paralithodes camstchatica*) populations and reproductive conditions around the Kodiak Archipelago, Alaska. *Can. Spec. Publ., Fish. Aquat. Sci.*, **92:** 360–369, 1986.

Brodeur, R. D. and D. M. Ware. Long-term variability in zooplankton biomass in the subarctic Pacific Ocean. *Fisheries Oceanog.*, **1:** 32–38, 1992.

Candela, J., R. C. Beardsley and R. Limeburner, Separation of tidal and subtidal currents in ship-mounted acoustic Doppler current profiler observations. *J. Geophys. Res.*, **97:** 769–788, 1992.

Carlson, H. R., K. W. Myers, E. V. Farley, H. W. Jaenicke, R. E. Haight and C. M. Guthrie III, Cruise report of the F.V. GREAT PACIFIC survey of young salmon in the North Pacific – Dixon Entrance to western Aleutian Islands – July-August 1996. (NPAFC Doc. 222), Auke Bay Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, 50p., 1996.

Cone, R. S., The need to reconsider the use of condition indices in fishery science. *Trans. Amer. Fish. Soc.*, **118:** 510–514, 1989.

Cooney, R. T., The seasonal occurrence of *Neocalanus cristatus*, *Neocalanus plumchrus* and *Eucalanus bungii* over the northern Gulf of Alaska. *Cont. Shelf Res.*, **5:** 541–553, 1986a.

Cooney, R. T., Zooplankton. In: The Gulf of Alaska. Physical Environment and Biological Resources. D. W. Hood and S. T. Zimmerman (eds.), MMS/NOAA, Alaska Office, Anchorage, OCS Study MMS 86-0095, pp. 285–303, 1986b.

Coyle, K. O. and R. T. Cooney, Water column sound scattering and hydrography around the Pribilof Islands, Bering Sea. *Cont. Shelf Res.*, **13:** 803–827, 1993.

Coyle, K. O., G. L. Hunt, Jr., M. B. Decker and T. J. Weingartner, Murre foraging, epibenthic sound scattering and tidal advection over a shoal near St. George Island, Bering Sea. *Mar. Ecol. Progr. Ser.*, **83:** 1–14, 1992.

Coyle, K. O., A. J. Paul and D. A. Ziemann, Copepod populations during the spring bloom in an Alaskan subarctic embayment. *J. Plankton Res.*, **12:** 759–797, 1990.

Diana, J. S. and R. Salz, Energy storage, growth, and maturation of yellow perch from different location in Saginaw Bay, Michigan. *Trans. Amer. Fish. Soc.*, **119:** 976–984, 1990.

Evans, C. A., J. E. O'Reilly and J. P. Thomas, A Handbook for the Measurement of Chlorophyll and Primary Production. BIOMASS Scientific Series, Vol. 8, 114p., 1987.

Francis, R. C. and S. R. Hare, Decadal-scale regime shifts in the large marine ecosystems of the North-east Pacific: a case for historical science. *Fish. Oceanogr.*, **3:** 279–291, 1994.

REFERENCES CITED

Frost, B. W., Interannual variations of zooplankton standing stock in the open Gulf of Alaska. In: From year to year: interannual variability of the environment and fisheries of the Gulf of Alaska and eastern Bering Sea. W. S. Wooster (ed.). Univ. Washington, Seattle, pp. 146–157, 1983.

Gordon, C., A. A. R. Jennings and J. M. Krest, A suggested protocol for continuous flow automated analysis of seawater nutrients (phosphate, nitrate, nitrite, and silicic acid) in the WOCE Hydrographic Program and the Joint Global Ocean Fluxes Study, Oregon State University, Chem. Ocean. Group Tech. Report 93-1, 51p., 1993.

Hatch, S. A. and G. A. Sanger, Puffins as samplers of juvenile pollock and other forage fish in the Gulf of Alaska, *Mar. Ecol., Prog., Ser.*, **80:** 1–14, 1992.

Helle, J. H. and M. S. Hoffman, Size decline and older age at maturity of two chum salmon (*Oncorhynchus keta*) stocks in western North America, 1972–1992, In: Climate Change and Northern Fish Populations, R. J. Beamish (ed.), *Can. Spec. Publ., Fish. Aquat. Sci.*, **121:** 243–250, 1995.

Hollowed, A. B., C. W. Wilson, E. Brown and B. A. Megrey, Walleye pollock, In: Stock Assessment and Fishery Evaluation Report for the 1995 Gulf of Alaska Groundfish Fishery, North Pacific Fishery Management Council, P.O. Box 103136, Anchorage, AK 99510, 1994.

Incze, L. S. and T. Ainaire, Distribution and abundance of copepod nauplii and other small (40–300 mm) zooplankton during spring in Shelikof Strait, Alaska, *Fish. Bull.*, **92:** 67–78.

Incze, L. S., D. W. Siefert and J. M. Napp, Mesozooplankton of Shelikof Strait, Alaska: abundance and community composition, *Cont. Shelf Res.*, **17:** 287–305, 1994.

Johnson, W. R., T. C. Royer and J. L. Luick, On the seasonal variability of the Alaska Coastal Current, *J. Geophys. Res.*, **93:** 12423–12437, 1988.

Mann, K. H. and J. R. N. Lazier, Dynamics of Marine Ecosystems, Biological-Physical Interactions in the Oceans, Blackwell Scientific Publications, Boston, 466p., 1991.

Merrick, R. L., T. R. Loughlin and D. G. Calkins, Decline in the abundance of the northern sea lion, *Eumetopia jubatus*, in Alaska, 1956–86, *U.S. Fish. Bull.*, **85:** 351–365, 1987.

Musgrave, D., T. Weingartner and T. C. Royer, Circulation and hydrography in the northwestern Gulf of Alaska, *Deep-Sea Res.*, **39:** 1499–1519, 1992.

Mysak, L., R. D. Muench and J. D. Schumacher, Baroclinic instability in a downstream varying channel: Shelikof Strait, Alaska, *J. Phys. Oceanogr.*, **11:** 950–969, 1981.

Napp, J. M., L. S. Incze, P. B. Ortner, D. L. W. Siefert and L. Britt, The plankton of Shelikof Strait, Alaska: standing stock, production, mesoscale variability and their relevance to larval fish survival, *Fish. Oceanog.*, **5 (suppl. 1):** 19–38, 1996.

Niebauer, H. J., J. Roberts and T. C. Royer, Shelf break circulation in the northern Gulf of Alaska, *J. Geophys. Res.*, **86:** 13041–13047, 1981.

Okkonen, S. R., The shedding of an anticyclonic eddy from the Alaskan Stream as observed by the GEOSAT altimeter, *Geophys. Res. Lett.*, **19:** 2397–2400, 1992.

Omori, M., Variations in length, weight, respiratory rate and chemical composition of *Calanus cristatus* in relation to its food and feeding, In: Marine Food Chains, J. H. Steel (ed.), Univ. California Press, Berkeley, CA, pp. 113–126, 1970.

Omori, M. and T. Ikeda, Methods in Marine Zooplankton Ecology, John Wiley & Sons, New York, 1984.

REFERENCES CITED

OCSEAP Staff. Marine fisheries: Resources and environments In: The Gulf of Alaska. Physical Environment and Biological Resources. D. W. Hood and S. T. Zimmerman (eds.), MMS/NOAA, Alaska Office. Anchorage. OCS Study MMS 86-0095. pp. 417–459. 1986.

Parker. K. S., T. C. Royer and R. B. Deriso. High-latitude climate forcing and tidal mixing by 18.6-year lunar nodal cycle and low-frequency recruitment trends in Pacific halibut (*Hippoglossus stenolepis*), In: Climate Change and Northern Fish Populations. R. J. Beamish (ed.). *Can. Spec. Publ., Fish. Aquat. Sci.*, **121:** 449–459. 1995.

Parsons. T. R., Ecological relations. In: The Gulf of Alaska. Physical Environment and Biological Resources. D. W. Hood and S. T. Zimmerman (eds.). MMS/NOAA. Alaska Office. Anchorage, OCS Study MMS 86-0095. pp. 561–570. 1986.

Parsons. T. R., Y. Maita and C. M. Lalli. A Manual of Chemical and Biological Methods for Seawater Analysis. Pergamon Press. Oxford. 1984.

Reeburgh. W. S. and G. W. Kipphut, Chemical distributions and signals in the Gulf of Alaska. its coastal margins and estuaries. In: The Gulf of Alaska. Physical Environment and Biological Resources. D. W. Hood and S. T. Zimmerman (eds.). MMS/NOAA. Alaska Office. Anchorage. OCS Study MMS 86-0095. pp. 77–91. 1986.

Reed. R. K. and J. D. Schumacher. Physical oceanography. In: The Gulf of Alaska. Physical Environment and Biological Resources. D. W. Hood and S. T. Zimmerman (eds.), MMS/NOAA, Alaska Office. Anchorage. OCS Study MMS 86-0095. pp. 57–76. 1986.

Rogers. D. E., Pacific salmon. In: The Gulf of Alaska. Physical Environment and Biological Resources. D. W. Hood and S. T. Zimmerman (eds.). MMS/NOAA. Alaska Office. Anchorage. OCS Study MMS 86-0095. pp. 561–476. 1986.

Royer. T. C., Seasonal variations of waters in the northern Gulf of Alaska. *Deep-Sea Res.*, **22:** 403–416. 1975.

Royer. T. C., On the effect of precipitation and runoff on coastal circulation in the Gulf of Alaska. *J. Phys. Oceanogr.*, **9:** 555–563. 1979.

Royer. T. C., Baroclinic transport in the Gulf of Alaska. Part I. Seasonal variations of the Alaska Current. *J. Mar. Res.*, **39:** 239–250. 1981a.

Royer. T. C., Baroclinic transport in the Gulf of Alaska. Part II. Freshwater driven coastal current. *J. Mar. Res.*, **39:** 251–266. 1981b.

Royer. T. C., Coastal freshwater discharge in the Northeast Pacific. *J. Geophys. Res.*, **87:** 2017–2021. 1982.

Royer. T. C., Upper ocean temperature variability in the northeast Pacific Ocean: is it an indicator of global warming? *J. Geophys. Res.*, **94:** 18175–18183. 1989.

Royer. T. C., High-latitude oceanic variability associated with the 18.6 year nodal tide. *J. Geophys. Res.*, **98:** 4639–4644. 1993.

Royer. T. C., Interdecadal hydrographic variability in the Gulf of Alaska. 1970–1995. *EOS. Trans. AGU.* **77:** F368. 1996.

Royer. T. C., D. V. Hansen and D. J. Pashinski. Coastal flow in the northern Gulf of Alaska as observed by dynamic topography and satellite-tracked drogued drift buoys. *J. Phys. Oceanogr.*, **9:** 785–801. 1979.

Sambrotto, R. and C. J. Lorenzen. Phytoplankton and primary production. In: The Gulf of Alaska, Physical Environment and Biological Resources. D. W. Hood and S. T. Zimmerman (eds.), MMS/NOAA, Alaska Office, Anchorage, OCS Study MMS 86-0095, pp. 249–282, 1986.

Smith, P. E., W. Flerx and R. P. Hewitt. The CalCOFI vertical egg tow (CalVET) net. In: An egg production method for estimating spawning in pelagic fish: application to the northern anchovy *Engraulis mordax*, R. Lasker (ed.), NOAA Technical Report, NMFS 36, U.S. Dept. Commerce, Washington, DC, pp. 23–33, 1985.

Smith, R. L., A. J. Paul and J. M. Paul. Aspects of energetics of adult walleye pollock, *Theragra chalcogramma* (Pallas), from Alaska. *J. Fish. Biol.*, **33:** 445–454, 1988.

Smith, R. L., J. M. Paul, and A. J. Paul. Seasonal changes in energy and the energy cost of spawning in Gulf of Alaska Pacific cod. *J. Fish. Biol.*, **36:** 307–316, 1990.

Stabeno, P. J., R. K. Reed and J. D. Schumacher. The Alaska Coastal Current: continuity of transport and forcing. *J. Geophys. Res.*, **100:** 2477–2485, 1995.

Steedman, H. F., Zooplankton fixation and preservation. UNESCO Press, Paris, 1976.

Tabata, S., The anticyclonic, baroclinic eddy of Sitka, Alaska, in the Northeast Pacific Ocean. *J. Phys. Oceanogr.*, **12:** 1260–1282, 1982.

Thompson, G. G. and H. H. Zenger, Pacific cod. In: Stock Assessment and Fishery Evaluation Report for the 1995 Gulf of Alaska Groundfish Fishery, North Pacific Fishery Management Council, P.O. Box 103136, Anchorage, AK 99510, 1994.

Traynor, J. J. and J. E. Ehrenberg, Fish and standard-sphere target-strength measurements obtained with a dual-beam and split-beam echo-sounding system. *Rapp. P.-v. Reun. Cons. int. Explor. Mer.* **189:** 325–335, 1990.

Trenberth, K. E. and J. W. Hurrell, Decadal atmosphere-ocean variations in the Pacific. *Clim. Dyn.*, **9:** 303–319, 1994.

U.S. GLOBEC, U.S. GLOBEC Northeast Pacific Implementation Plan, U.S. GLOBEC, Scientific Steering Committee Coordinating Office, Dept. Integrative Biol., Univ. California, Berkeley, CA 94720-3140, Report Number 17, 60p., 1996.

Wang, S. B. and E. D. Houde, Energy storage and dynamics in bay anchovy *Anchoa mitchilli*. *Mar. Biol.*, **121:** 219–227, 1994.

Welschmeyer, N. A., S. Strom, R. Goericke, G. DiTullio, M. Belvin and W. Petersen, Primary production in the subarctic Pacific Ocean: project SUPER. *Prog. Oceanog.*, **32:** 101–135, 1993.

Whitledge, T. E., S. C. Malloy, C. J. Patton and C. D. Wirick, Automated nutrient analyses in seawater, Brookhaven National Laboratory Formal Report BNL51398, Upton, New York, 216p., 1981.

Wickett, W. P., Ekman transport and zooplankton concentration in the North in the North Pacific Ocean. *J. Fish. Res. Board Can.*, **24:** 581–594, 1967.

Wilson, J. G. and J. E. Overland, Meteorology, In: The Gulf of Alaska, Physical Environment and Biological Resources, D. W. Hood and S. T. Zimmerman (eds.), MMS/NOAA, Alaska Office, Anchorage, OCS Study MMS 86-0095, pp. 31–54, 1986.

Xiong, Q. and T. C. Royer, Coastal temperature and salinity observations in the northern Gulf of Alaska, 1970–1982. *J. Geophys. Res.*, **89:** 8061–8068, 1984.

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

Budget Category:	Authorized FFY 1998	Proposed FFY 1999	LONG RANGE FUNDING REQUIREMENTS					
			Estimated FFY 2000	Estimated FFY 2001	Estimated FFY2002	Estimated FFY 2003	Estimated FFY 2004	Estimated FFY 2005
Personnel	$0.0	$174.6						
Travel	$0.0	$12.5						
Contractual	$0.0	$20.7						
Commodities	$0.0	$0.5						
Equipment	$0.0	$0.0						
Subtotal	$0.0	$208.3						
Indirect	$0.0	$0.0						
Project Total	$0.0	$208.3	$250.2	N/A	N/A	N/A	N/A	N/A
Total Personnel Hours *	0	2,844						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:
ABR,Inc. has used **Hourly Rates** instead of **Monthly Costs.** The hourly rate shown is an all inclusive rate. ABR, Inc. requested permission from EVOS Trustee Council and received verbal permission from **Sandra Schubert** on April 4, 1997 to substitute fully burdened hourly rates for monthly costs and indirect costs.

Full-Time Equivalents (FTE's) have been changed to fully burdened Total Personnel Hours.

Break Down of Project Costs for FY 98

Report Writing	$350
Publications	$0
Professional Conferences	$1,900
Workshop Attendance	$1,640
NEPA Compliance	$ 0
Community Involvement	$ 0

1999

Project Number: 99287
Project Title: **Seabird-Oceanographic Relationship in the Northern Gulf of Alaska, (GLOBEC)**
Name: **ABR, Inc.**

FORM 4A
Non-Trustee
DETAIL

Prepared: 4/13/1998

4/14/98

Personnel Costs:				* Hours	* Hourly		Proposed
Name		Position Description		Budgeted	Costs	Overtime	FFY 1999
Ritchie	R	Principal		4.0	$100.00	$0	0.4
Murphy	S	Research Coordinator		16.0	$94.00	$0	1.5
DeLong	T	Office/Contracts Manager		12.0	$69.00	$0	0.8
Day	R	Senior Scientist I		1344.0	$75.00	$0	100.8
Nigro	D	Research Biologist I		1220	$48.00	$0	58.6
Smith	M	GIS Specialist		108.0	$57.00	$0	6.2
Zusi-Cobb	A	Graphics Technician/GIS		76.0	$51.00	$0	3.9
Harshburger	D	Word Processor/Administrative Assistant		48.0	$39.00	$0	1.9
Staff		Clerk		16.0	$29.00	$0	0.5
			Subtotal	2844.0	N/A	0	
						Personnel Total	$174.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1999
EVOS Meetings in Anchorage (FAI_ANC)	370	1	3	160	0.9
Technical Review Meeting in Anchorage (FAI-ANC)	370	1	2	160	0.7
Travel to/from Cruises (FAI-ANC)	370	11	22	160	7.6
Bus (ANC-Seward)	80	11			0.9
Scinetific Meeting	1,000	1	5	160	1.8
Fee (5%) on Travel Costs					0.6
				Travel Total	$12.5

1999

Project Number:
Project Title: **Seabird-Oceanographic Relationship in the Northern Gulf of Alaska, (GLOBEC)**
Name: **ABR, Inc.**

FORM 4B
Personnel
& Travel
DETAIL

Prepared: 4/13/1998

Contractual Costs:	
Description	Proposed FFY 1999
1 Subcontract to Ecological Consulting, Inc.	17.5
2 Field Laptop Lease (6 weeks @ $125/week)-No 5% Fee on ABR Equipment Lease	0.8
3 Phone/Fax/Modem	0.5
4 Printing/Off-Site Photocopying	0.9
5 Fee (5%) on Contractual Costs (excluding ABR Equipment Lease)	1.0
Contractual Total	$20.7

Commodities Costs:	
Description	Proposed FFY 1999
1 Misc. Gear and Supplies	0.5
2 Fee (5%) on Commodity Costs	0.0
Commodities Total	$0.5

1999

Prepared: 4/13/1998

Project Number:
Project Title: **Seabird-Oceanographic Relationship in the Northern Gulf of Alaska, (GLOBEC)**
Name: **ABR, Inc.**

FORM 4B
Contractual & Commodities DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1999
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units
1 Library reference books	
2 Computer Resources	
3 GIS/Digitizing Station (s)	2
4 Office Space	
5 Equipment Storage	
6 Binoculars	2
7 Cameras	2

1999

Project Number:
Project Title: **Seabird-Oceanographic Relationship in the Northern Gulf of Alaska, (GLOBEC)**
Name: **ABR, Inc**

FORM 4B
Equipment
DETAIL

Prepared: 4/13/1998

STATUS OF BLACK OYSTERCATCHERS IN PRINCE WILLIAM SOUND AFTER THE *EXXON VALDEZ* OIL SPILL

Submitted Under the BAA

RECEIVED
APR 14 1998
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	99289
Restoration Category:	Research
Proposer:	ABR, Inc.
Lead Trustee Agency:	NOAA
Cooperating Agencies:	
Alaska Sea Life Center	No
Duration:	2nd year, 2-year project
Cost FY 99:	$217,400 (including publication costs)
Geographic Area:	Prince William Sound
Injured Resource:	Black oystercatcher

ABSTRACT

This study is designed to assess the status of the breeding population of black oystercatchers in Prince William Sound (PWS) 9 (1998) and 10 (1999) years after the *Exxon Valdez* oil spill. Year 1 studies for this project are scheduled for summer 1998, but preliminary results from that initial monitoring effort will not be available until later in FY98. Because the extent and focus of the Year 2 effort are contingent upon the findings of Year 1, this proposal primarily represents an estimate of the level of effort that would be required to more thoroughly examine persistent impacts to the breeding population of oystercatchers in PWS.

INTRODUCTION

Black oystercatchers (*Haematopus bachmani*) are conspicuous denizens of intertidal and supratidal habitats throughout southcentral Alaska (Isleib and Kessel 1973), a region that was affected by the *Exxon Valdez* oil spill (EVOS). Because much of the long-term damage from EVOS was manifested in the intertidal zone (Day et al. 1995, 1997; Stekoll et al. 1996; Murphy et al. 1997), and because black oystercatchers are obligate users of the intertidal zone throughout the year, they potentially were among the most vulnerable of all birds to both acute and chronic effects of this oil spill. Indeed, virtually all bird studies following the oil spill identified black oystercatchers as having been negatively impacted (Klosiewski and Laing 1994; Day et al. 1995, 1997; Sharp et al. 1996; Andres 1997; Murphy et al. 1997). Acute effects in the form of mortality (9 carcasses were recovered; EVOS Trustee Council 1996), region-wide population declines (Murphy et al. 1997), and oiled eggs (none were found in 1989; Sharp et al. 1996) did not appear to be substantial, however, suggesting that oystercatchers were adept at avoiding direct contact with oil. On the other hand, sublethal effects due to habitat degradation and disturbance from clean-up activities were substantial, and clear signals from these impacts were evident in post-spill assessments of use of oiled habitats by oystercatchers (Klosiewski and Laing 1994; Day et al. 1995, 1997; Andres 1997; Murphy et al. 1997) and assessments of the performance of the breeding population (Andres 1994a, 1994b; Sharp et al. 1996). Overall, there perhaps was greater consensus among the various studies on the existence of impacts to this species than for any other bird species identified as negatively impacted by EVOS.

The focus of this study is to examine aspects of the life history (e.g., phenology and productivity) of oystercatchers that potentially were adversely affected by oil spill. We are examining the same population of breeding oystercatchers that was studied during 1989–1993. If persistent impacts are identified in Year 1 (1998), Year 2 will entail a more thorough examination of the breeding ecology of this population. Without knowing what, if any, persistent impacts will be identified in Year 1, however, it is not possible to predict the exact focus of Year 2 efforts. If no substantial impacts are detected in Year 1, this Year 2 proposal will be scaled back to cover dissemination of Year 1 results and conclusions (i.e., conferences and publications). If persistent impacts are identified in Year 1, we propose that the Year 2 field season be lengthened to 45 days and the crew doubled to 4, compared to the Year 1 effort. Year 2 then will focus on those life-history parameters that were identified by Year 1 studies and previous researchers as having been negatively impacted by the oil spill. Data analyses will focus on comparisons of previously oiled sites with unoiled sites and on among-year analyses.

NEED FOR THE PROJECT

A. Statement of Problem

The black oystercatcher currently is identified on the Trustee Council's official list of injured resources as "injured with recovery unknown" (EVOS Trustee Council 1998). Despite the known vulnerability of this species and the impacts identified by various studies after the spill, research and monitoring were curtailed prior to resolution of this species' recovery. Although reoccupancy of previously oiled habitats has been demonstrated by several studies (Andres 1994a, 1997; Day et al. 1995, 1997; Sharp et al. 1996; Murphy et al. 1997), impacts associated with reproductive performance of black oystercatchers in Prince William Sound (PWS) still were evident when studies were terminated in 1993. Hence, recovery of all aspects of breeding functions of this population has not been documented, primarily because of the termination of

studies in 1993. In addition, the marine bird abundance surveys, which acquired abundance and distribution data on black oystercatchers across all of PWS as recently as summer 1996, indicated that there were no significant signs of recovery for this species (Dave Irons, USFWS; pers. comm.).

B. Rationale/Link to Restoration

This study will evaluate the status of recovery of black oystercatchers in western PWS. To determine whether black oystercatchers have recovered from the effects of EVOS, it will be necessary to evaluate the status and reproductive performance of the breeding population in formerly oiled areas and to compare those parameters with those of black oystercatchers from nearby unoiled areas. Because black oystercatchers are conspicuous birds that are ubiquitous in PWS during summer and have readily identifiable breeding territories, they are an ideal species for conducting a cost-efficient but thorough examination of spill-related effects on the breeding population. In addition, existing pre-spill (Irons et al. 1988) and post-spill (Andres 1994b; Day et al. 1995, 1997; Sharp et al. 1996; Murphy et al. 1997) data provide the basis for quantitatively addressing both population-level and reproductive recovery. Because black oystercatchers use some of the most heavily oiled habitats in PWS and prey on invertebrates, such as blue mussels (*Mytilus trossulus*), that are known to have been impacted by the spill (Highsmith et al. 1996), this proposed study also will provide indirect evidence of the status of recovery of other organisms and communities that inhabit the intertidal zone in PWS.

C. Location

We propose to conduct this study in western PWS, with field work planned for Knight, Green, Little Green, Channel, and part of Montague (Port Chalmers) islands. These sites are the same as those studied by Sharp et al. (1996) and Andres (1994b). Thus, we propose to study the same population of black oystercatchers for which all of the impacts on the reproductive performance have been identified.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

In FY99, we will charter a boat from a local PWS community. When requested, we will provide articles and photographs for the Trustee Council Newsletter and will be available to make public presentations of our study at appropriate forums.

Opportunities for community involvement in this project include:

1. Chartering boats from PWS residents;
2. The Principal Investigator will be available to present highlights of the research program to PWS communities; and
3. The Principal Investigator will write an article for the Trustees newsletter each year during the life of the project.

PROJECT DESIGN

A. Objectives

The overall goals of this proposed research program are to provide an in-depth assessment of the status of the breeding population of black oystercatchers in PWS and to evaluate whether these birds have recovered from the previously identified impacts of EVOS. The effort described here for Year 2 of the study assumes that significant persistent injury to the breeding population was identified in Year 1 of this study. Year 1 represents a modest effort intended to evaluate efficiently but thoroughly the status of black oystercatchers with respect to the claims of injury made to date. Year 2 represents a more focused and intensive investigation based on Year 1 findings. If lack of impact or evidence of recovery can be demonstrated based on Year 1 data, Year 2 simply will entail publishing the results of Year 1 in a peer-reviewed journal and presenting the results of the study at an appropriate conference(s).

Assuming that significant persistent injuries are identified in Year 1, we propose to collect data on black oystercatchers during the breeding season in western PWS and to compare these data between oiled and unoiled territories and regions and with data collected in previous years. The specific objectives of this study are:

1. To evaluate the breeding status of adult black oystercatchers during nesting.

2. To document the phenology of breeding events.

3. To measure the dimensions and estimate the volume of black oystercatchers eggs.

4 To assess the hatching success of black oystercatchers.

5. To estimate the mortality rate of black oystercatchers chicks.

6. To measure rates of development of black oystercatcher chicks.

B. Methods

This study proposes to evaluate the status of recovery of black oystercatchers during the breeding season in southwestern PWS. We propose to conduct 45 days of sampling from late May/early June to mid-July that would overlap with most of the nesting and brood-rearing period for oystercatchers in this region. Project personnel will live on a berthing vessel; survey work primarily will be conducted from a 12–15 ft inflatable skiff. Four biologists will conduct the field work, which will entail 3 distinct periods of activity, each of which will take approximately 10 days to complete.

1. ***Nesting Surveys***—Two sets of nearshore boat surveys will be conducted from late May/early June to ~10 June to locate all breeding pairs of black oystercatchers in the study area. Established nests will be located and checked for clutch size, phenology (egg floating technique; Alberico 1995), egg volumes (calculated from length and width measurements, following Andres 1994b). Intertidal and supratidal and habitat characteristics will be evaluated and recorded at each nest site.

The second nesting survey will be begun immediately after the initial survey, to find new nests or second nests of pairs that had failed in their initial attempt, to check on the status of known nests, and to collect data at any nest sites not located during the first visit. We anticipate that the earliest nesters will have hatched young and begun brood-rearing late in the nesting surveys.

2. ***Hatching Success Survey***—During the hatching period, we will opportunistically monitor hatching success (i.e., number of young hatched) at as many nest sites as possible. Because we anticipate that hatching will occur over a period of up to 2 weeks, we will move among the nests in a sequence based on estimated hatching dates (as derived from floating eggs). Numbers of chicks hatched at each site will be determined, and nest contents will be inspected for signs of predators. Any unhatched eggs will be collected for future analyses.

3. ***Brood Surveys***—Brood surveys will commence as soon as chicks are known to be at least 7 days old. During these survey, we will capture, band, and measure developmental rates (mass, exposed culmen length, flattened wing length, and diagonal tarsus length) for individual chicks. Feather development will be assessed to help with aging the brood (following Prater et al. 1977). Chicks also will be photographed for comparative aging after the field season. Although we will not be able to band and acquire growth measurements for all chicks in the study area, we will monitor chick survival at all nests in the study area. We then will revisit the brood-rearing areas where the chicks were banded and capture and recapture as many chicks as possible. Optimally, recaptures of individuals will occur 7–10 days after the initial measurements were taken. Growth measurements again will be taken for all captured chicks, and feather development will be reassessed. Again, all nests in the study area will be visited to locate the brood and assess chick survival.

All surveys will be conducted by slowly driving a skiff 20–50 m from shore and counting and mapping the locations of all black oystercatchers seen during the survey. We carefully will observe the birds to determine whether any already are banded. All oystercatchers seen will be classified as "single," "non-nesting pair," or "nesting pair." We will locate nests by beaching the boat and searching the supratidal area on foot. When nests are found, we will count and measure the eggs and record habitat data, both at the nest sites and within the breeding territories ($\geq$100 m on either side of the nest). Habitat characteristics that will be recorded include: (1) shoreline substrate (e.g., bedrock, bedrock/ rubble, boulder/ cobble, pebble, gravel, sand); (2) intertidal and supratidal slope at the nest site (0–30°, 31–60°,and 61–90°); and (3) qualitative descriptions of intertidal flora and fauna. Supratidal habitats will be classified according to a hybrid classification system that we derived from Kessel (1979) and Viereck et al. (1986) specifically for use in PWS (Day et al. 1997).

When appropriate, field methods will follow those used by Andres (1994b) and Sharp et al. (1996). For example, measurements of eggs and chicks will closely follow the protocols outlined by these researchers to ensure comparability of data collection among years. Estimates of egg volumes and instantaneous change in bill length and body mass also will be calculated with the same formulas used by these researchers.

During the hatching period, we will use spotting scopes to observe nest sites from a distance, being careful not to attract predators to newly hatched chicks. Glaucous-winged Gulls, in particular, are a concern in this regard (pers. obs.), and we will be extremely careful during this

and subsequent visits to avoid providing opportunities for predators to snatch young birds. Numbers of young will be counted to determine hatching success. Known hatching dates will be used to calibrate the egg-floatation data. For nests that we do not directly observe during hatching, we will count young in the brood-rearing territory and inspect nest sites. These observations, coupled with clutch-size data, should allow us to estimate hatching success accurately for all nests in the study area.

During brood-rearing surveys, we will visit all nests in the study area to assess chick survival. At a subsample of the nests, a variety of capture techniques will be employed, depending on the habitat. In rocky habitats, we probably will have to locate chicks that are hiding among the rocks and capture them by hand or with a small net. Along sandy beaches, we may be able to herd chicks into enclosures. All captured birds will be banded with USFWS aluminum bands and unique combinations of color bands for identifying individual young on subsequent visits. (Robert Ritchie of ABR, Inc., has a Master Banding Permit, and we will become subpermitees on this permit if the project is funded.)

Data analysis will focus on comparing data on abundance, distribution, reproductive performance, and growth of black oystercatchers between previously oiled and unoiled territories and areas and with data collected in previous years. Habitat information may be used to stratify the nesting data and, if injury to this species is ongoing, to aid in designing more in-depth investigations in Year 2. Our Year 1 analyses will address the following hypotheses:

H_o *1*: The ratio of breeding pairs to nonbreeding pairs of black oystercatchers does not differ between oiled and unoiled areas or among habitats in PWS.

H_o *2*: Egg volumes of black oystercatchers do not differ between oiled and unoiled areas or among habitats in PWS.

H_o *3*: Hatching success of black oystercatchers does not differ between oiled and unoiled areas or among habitats in PWS.

H_o *4:* Chick survival rates do not differ between oiled and unoiled areas or among habitats in PWS.

H_o *5:* The rate of chick development does not differ between oiled and unoiled areas or among habitats in PWS.

H_o *6:* The phenology of nesting events does not differ between oiled and unoiled areas or among habitats in PWS.

H_o *7*: The abundance and distribution of black oystercatchers in the study area in 1999 does not differ from that recorded during previous years, including prior to the spill.

Analyses of differences between oiled and unoiled sites will be accomplished with two-sample tests (t-tests or Mann-Whitney tests, depending on the distribution of the data). We will analyze differences among sites and among habitats with two-way analysis of variance, so that the separate effects of habitat and oiling can be evaluated. Specifically, we will assess whether there are differences in reproductive performance among habitats and will determine whether habitat and oiling are correlated in any way. Among-year analyses will be dependent on acquiring data from previous investigators and will examine differences in the amount of change with time between oiled and unoiled sites by using paired differences (e.g., 1989 egg volumes minus 1999

egg volumes; see Andres 1994b) in two-sample tests (t-tests or Mann-Whitney tests) where appropriate. Differences in the distribution of oystercatcher nests among sites will be tested with multi-factor analysis of variance.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

We will cooperate with other researchers to the greatest extent possible. Shared logistics in 1998 are to include using a USFWS-chartered barge to ship fuel and supplies out to the Sound. We are amenable to pursuing other cost-saving alternatives to our proposed study plan.

We will contract a 32–50 ft boat from Whittier or Valdez to provide a berthing vessel for our crew. All field and office work will be conducted by ABR, Inc. The Trustee Council will need to fund an outside agency for a program management and general administration.

SCHEDULE

A. Measurable Project Tasks for FY99 (October 1, 1998–September 30, 1999)

March 1999	Attend 10th anniversary oil spill conference
April–May 1999:	Arrange logistics (boats, equipment, etc.)
May 28–July 13 1999:	Conduct field sampling
July–August 1999:	Keypunch data and QA/QC
September–October 1999:	Data analysis
November 1999–April 2000:	Preparation of Final Report
November 1999–April 2000:	Preparation of peer-reviewed publication

B. Project Milestones and Endpoints

1. "To evaluate the breeding status of adult black oystercatchers during nesting." This objective will be addressed during field work in summer 1999. Analyses and reporting will commence in late summer; thus, all work associated with this objective will be completed in FY99.

2. "To document the phenology of breeding events." This objective will be addressed during field work in summer 1999. Analyses and reporting will commence in late summer; thus, all work associated with this objective will be completed in FY99.

3. "To measure the dimensions and estimate the volume of black oystercatchers eggs." This objective will be addressed during field work in summer 1999. Analyses and reporting will commence in late summer; thus, all work associated with this objective will be completed in FY99.

4 "To assess the hatching success of black oystercatchers." This objective will be addressed during field work in summer 1999. Analyses and reporting will commence in late summer; thus, all work associated with this objective will be completed in FY99.

5. "To estimate mortality of black oystercatchers chicks." This objective will be addressed during field work in summer 1999. Analyses and reporting will commence in late summer; thus, all work associated with this objective will be completed in FY99.

6. "To measure rates of development for black oystercatcher chicks." This objective will be addressed during field work in summer 1999. Analyses and reporting will commence in late summer; thus, all work associated with this objective will be completed in FY99.

C. Completion Date

Sampling for the project will be completed in FY99. Data analysis and preparation of the Final Report will be completed by 15 April 2000. The proposed budget for Year 2 was designed to accommodate a four-person field crew that might, for example, conduct detailed behavioral observations of brood-rearing oystercatchers or habitat analyses to try to identify impediments to recovery. It should be noted, however, that the Year 2 budget represents an estimate for an expanded study, and the results of Year 1 may not warrant that expansion. If we detect no evidence of continued injury during Year 1, we will propose that Year 2 simply entail producing a Final Report and preparing a manuscript for publication in a peer-reviewed journal.

PUBLICATIONS AND REPORTS

We will submit a Final Report detailing the findings of the two-year study. This report will be submitted to the Chief Scientist no later than 15 April 2000. We will prepare a manuscript for publication in a peer-reviewed journal (e.g., *The Auk*) that will present the results and conclusions of the 2-year research program.

PROFESSIONAL CONFERENCES

We will prepare a paper for presentation at the *Legacy of an Oil Spill: 10 Years after* Exxon Valdez conference (March 1999) based on Year 1 findings.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Although our study is not an integrated component of the Nearshore Vertebrate Predator Program, the data that we collect on black oystercatchers will be of value to the these other investigators for its indications of intertidal recovery and health.

PROPOSED PRINCIPAL INVESTIGATOR

Stephen M. Murphy
ABR, Inc.
P.O. Box 80410
Fairbanks, AK 99708-0410
PH: 907-455-6777
FAX: 907-455-6781
E-mail: smurphy@abrinc.com

PRINCIPAL INVESTIGATOR

Mr. Stephen M. Murphy will be the Principal Investigator for the project. Mr. Murphy has conducted research in Alaska since 1977 and has 17 years of experience designing research programs for assessing the effects of human activities on wildlife. He has studied black oystercatchers in Prince William Sound (1998), coastal habitats in southcentral Alaska, shorebird migration and nesting ecology on the Copper River Delta, waterfowl ecology in interior Alaska, and the impacts of human disturbance on seabirds, waterfowl, shorebirds, raptors, marine mammals, and caribou in a variety of studies throughout the state. Recently, he was the Co-Principal Investigator for assessing the effects of the EVOS on birds and mammals in PWS and along the Kenai Peninsula for Exxon Company, USA. Mr. Murphy has co-authored six peer-reviewed publications on the effects of the EVOS on birds (Day et al. 1995, 1997a, 1997b; Wiens et al. 1996, in review; Murphy et al. 1997).

Mr. Murphy has been employed by ABR, Inc. (formerly Alaska Biological Research, Inc.), for 17 years and serves as the company's Research Coordinator. ABR is an Alaskan-owned small business—headquartered in Fairbanks since its formation in 1976—that specializes in environmental research and services. During two decades of operation in Alaska, ABR has served a variety of clients, including private industry, state and federal government agencies, the University of Alaska, and the EVOS Trustee Council. During this time, ABR has developed a reputation for conducting objective research that provides the basis for sound management decisions. ABR remains committed to the goals of providing timely, accurate, and cost-effective information to those who manage or develop our natural resources.

OTHER KEY PERSONNEL

Mr. Todd Mabee has conducted biological research in Alaska for five years, including shorebird studies on the Yukon-Kuskokwim Delta and on the Arctic Coastal Plain of Alaska. Todd most recently completed his Master's research of the nesting ecology of Killdeers and Piping and Snowy plovers. Todd has experience in observing, trapping, and monitoring shorebirds under various field conditions, during both the breeding and migratory seasons. His field skills have been used by ABR biologists on studies ranging from sea otter and seabird studies in Prince William Sound to caribou surveys on the North Slope and migration studies in interior Alaska, central USA, and southern Colorado.

In addition to his experience with ABR, Todd has conducted shorebird research with the National Biological Service on the migration and breeding biology of Pectoral Sandpipers. For those studies, Todd trapped sandpipers during spring migration in Texas and Missouri, in addition to conducting nesting studies on the Arctic Coastal Plain of Alaska. Todd's extensive research experience also includes working on brown tree snakes in Guam, tropical flora and fauna in Australia, and, most recently, songbird inventories in the Rocky Mountains.

LITERATURE CITED

Alberico, J. A. R. 1995. Floating eggs to estimate incubation stage does not affect hatchability. Wildlife Society Bulletin 23: 21–216.

Andres, B. A. 1994a. *Exxon Valdez* oil spill injury to black oystercatchers—a final note. Paper presented at the Alaska Bird Conference and Workshop, Cordova, Alaska, 4–6 May 1994. Abstract.

Andres, B. A. 1994b. The effects of the *Exxon Valdez* oil spill on black oystercatchers breeding in Prince William Sound, Alaska. *Exxon Valdez* Oil Spill State/Federal Natural Resources Damage Assessment Final Report (Bird Study Number 12/ Restoration Study Number 17). U.S. Fish and Wildlife Service, Anchorage, AK. 26 pp.

Andres, B. A. 1997. The *Exxon Valdez* oil spill disrupted the breeding of black oystercatchers. Journal of Wildlife Management 61: 1322–1328.

Day, R. H., S. M. Murphy, J. A. Wiens, G. D. Hayward, E. J. Harner, and B. E. Lawhead. 1997a. Effects of the *Exxon Valdez* oil spill on habitat use by birds along the Kenai Peninsula, Alaska. Condor 99: 728–742.

Day, R. H., S. M. Murphy, J. A. Wiens, G. C. Hayward, E. J. Harner, and L. N. Smith. 1995. Use of oil-affected habitats by birds after the Exxon Valdez oil spill. Pages 726–761 *in* P. G. Wells, J. N. Butler, and J. S. Hughes, editors. *Exxon Valdez* oil spill: fate and effects in Alaskan waters. Special Technical Publication 1219, American Society of Testing and Materials, Philadelphia, PA.

Day, R. H., S. M. Murphy, J. A. Wiens, G. C. Hayward, E. J. Harner, and L. N. Smith. 1997b. The effects of the *Exxon Valdez* oil spill on habitat use by birds in Prince William Sound, Alaska. Ecological Applications 7: 395–415.

Exxon Valdez Oil Spill Trustee Council. 1998. Invitation to submit restoration proposals for federal fiscal year 1999. Unpublished notice prepared by *Exxon Valdez* Oil Spill Trustee Council, Anchorage, AK. 64 pp. + appendices.

Highsmith, R. C., T. Rucker, M. S. Stekoll, S. M. Saupe, M. R. Lindeberg, R. N. Jenne, and W. Erickson. 1993. Impact of the *Exxon Valdez* oil spill on intertidal biota. Pages 212–237 *in* S.D. Rice, R. B. Spies, D. A. Wolfe, and B. A. Wright, editors. Proceedings of the *Exxon Valdez* Oil Spill Symposium. American Fisheries Society Symposium No.18.

Irons, D. B., D. R. Nysewander, and J. L. Trapp. 1988. Prince William Sound waterbird distribution in relation to habitat type. Unpubl. Rep., U. S. Fish and Wildlife Service, Anchorage, AK.

Isleib, M. E., and B. Kessel. 1973. Birds of the North Gulf Coast-Prince William Sound region, Alaska. Biological Papers of the University of Alaska 14: 1–149.

Kessel, B. 1979. Avian habitat classification for Alaska. Murrelet 60: 86-94.

Klosiewski, S. P., and K. K. Laing. 1994. Marine bird populations of Prince William Sound, Alaska, before and after the *Exxon Valdez* oil spill. Unpublished *Exxon Valdez* Oil Spill State and Federal Natural Resources Damage Assessment Final Report, prepared for *Exxon Valdez* Oil Spill Trustees Council, Anchorage, AK, by Migratory Bird Management, U.S. Fish and Wildlife Service, Anchorage, AK. 89 pp.

Murphy, S. M., R. H. Day, J. A. Wiens, and K. R. Parker. 1997. Effects of the *Exxon Valdez* oil spill on birds: comparisons of pre- and post-spill surveys in Prince William Sound, Alaska. Condor 99: 299–313.

Prater, A. J., J. H. Marchant, and J. Vourinen. 1977. Guide to the identification and aging of Holarctic waders. British Trust for Ornithology, Field Guide No. 17. Maund & Irvine Ltd., Tring, Hertforshire, United Kingdom.

Sharp, B. E., M. Cody, and R. Turner. 1996. Effects of the *Exxon Valdez* oil spill on black oystercatchers. Pages 748–758 *in* S.D. Rice, R. B. Spies, D. A. Wolfe, and B. A. Wright, editors. Proceedings of the *Exxon Valdez* Oil Spill Symposium. American Fisheries Society Symposium No. 18.

Stekoll, M. S., L. Deysher, R. C. Highsmith, S. M. Suape, Z. Guo, W. P. Erickson, L. McDonald, and D. Strickland. 1996. Pages 177–192 *in* S.D. Rice, R. B. Spies, D. A. Wolfe, and B. A. Wright, editors. Proceedings of the *Exxon Valdez* Oil Spill Symposium. American Fisheries Society Symposium No. 18.

Viereck, L. A., C. T. Dyrness, and A. R. Batten. 1986. The 1986 revision of the Alaska vegetation classification. U.S. Department of Agriculture, Institute of Northern Forestry, Fairbanks, AK.

Wiens, J. A., T. O. Crist, R. H. Day, S. M. Murphy, and G. D. Hayward. 1996. Effects of the *Exxon Valdez* oil spill on marine bird communities in Prince William Sound, Alaska. Ecological Applications 6:828–841.

Wiens, J. A., T. O. Crist, R. H. Day, S. M. Murphy, and G. D. Hayward. In review. Multivariate analysis of the effects of the *Exxon Valdez* oil spill on marine bird communities. Journal of Applied Ecology.

1999 EVOS TRUSTEE COUNCIL PROJECT BUDGET

Budget Category:	Authorized FFY 1998	Proposed FFY 1999	LONG RANGE FUNDING REQUIREMENTS					
			Estimated FFY 2000	Estimated FFY 2001	Estimated FFY2002	Estimated FFY 2003	Estimated FFY 2004	Estimated FFY 2005
Personnel	$59.9	$143.2						
Travel	$3.5	$6.2						
Contractual	$10.8	$66.9						
Commodities	$0.9	$1.1						
Equipment	$0.0	$0.0						
Subtotal	$75.1	$217.4						
Indirect	$0.0	$0.0						
Project Total	$75.1	$217.4	N/A	N/A	N/A	N/A	N/A	N/A
Total Personnel Hours *	1,016	2,324						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:
ABR,Inc. has used **Hourly Rates** instead of **Monthly Costs.** The hourly rate shown is an all inclusive rate. ABR, Inc. requested permission from EVOS Trustee Council and received verbal permission from **Sandra Schubert** on April 4, 1997 to substitute fully burdened hourly rates for monthly costs and indirect costs.

Full-Time Equivalents (FTE's) have been changed to fully burdened Total Personnel Hours.

Break Down of Project Costs for FY 99

Report Writing	$380
Publications	$1,050
Professional Conferences	$850
Workshop Attendance	$720
NEPA Compliance	$0
Community Involvement	$0

1999

Prepared: 4/13/1998
1 of 1

Project Number: 99289
Project Title: **Status of black oystercatchers in Prince William Sound after the *Exxon Valdez* oil spill**
Name: **ABR, Inc.**

FORM 4A
Non-Trustee
DETAIL

4/14/98

Personnel Costs:				* Hours	* Hourly		Proposed
Name		Position Description		Budgeted	Costs	Overtime	FFY 1999
Ritchie	R	Principal		4.0	$100.00	$0	0.4
Murphy	S	Research Coordinator		648.0	$94.00	$0	60.9
DeLong	T	Office/Contracts Manager		16.0	$69.00	$0	1.1
Mabee	T	Research Biologist II		670.0	$52.00	$0	34.8
Staff		Research Biologist II		270.0	$52.00	$0	14.0
Zusi-Cobb	A	Graphics Technician/GIS		32.0	$51.00	$0	1.6
Staff		Technician III		644.0	$45.00	$0	29.0
Harshburger	D	Word Processor/Administrative Assistant		24.0	$39.00	$0	0.9
Staff		Expediter / Field Specialist		16.0	$29.00	$0	0.5
			Subtotal	2324.0	N/A	0	
						Personnel Total	$143.2

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1999
EVOS Meetings in Anchorage (FAI_ANC)	370	1	3	160	0.9
Technical Review Meeting in Anchorage (FAI-ANC)	370	1	2	160	0.7
Travel to/from Cruises (Fairbanks to Valdez)	480	5	0	160	2.4
Charter Flight (Valdez to Prince William Sound)	630	3			1.9
Fee (5%) on Travel Costs					0.3
				Travel Total	$6.2

1999

Prepared: 4/13/1998

Project Number: 99289

Project Title: **Status of black oystercatchers in Prince William Sound after the *Exxon Valdez* oil spill**

Name: **ABR, Inc.**

FORM 4B
Personnel
& Travel
DETAIL

Contractual Costs:	Proposed
Description	FFY 1999
1 Boat Charter (45 days @ $1365 per day)	61.4
2 ABR Spotting Scopes (3.67 scope-months @ $185 per month)	0.7
3 Phone/Fax/Modem	0.2
4 Printing/Off-Site Photocopying	0.4
5 Page costs for publication (1 paper @$1,000/paper)	1.0
6 Fee (5%) on Contractual Costs (excluding ABR Equipment Lease)	3.2
Contractual Total	$66.9

Commodities Costs:	Proposed
Description	FFY 1999
1 Misc. Gear and Supplies	1.0
2 Fee (5%) on Commodity Costs	0.1
Commodities Total	$1.1

1999

Prepared: 4/13/1998

Project Number: 99289
Project Title: **Status of black oystercatchers in Prince William Sound after the *Exxon Valdez* oil spill**
Name: **ABR, Inc.**

FORM 4B
Contractual & Commodities DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1999
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units
1 Library reference books	
2 Computer Resources	
3 GIS/Digitizing Station (s)	2
4 Office Space	
5 Equipment Storage	
6 Binoculars	2
7 Cameras	2

1999

Project Number: 99289
Project Title: **Status of black oystercatchers in Prince William Sound after the *Exxon Valdez* oil spill**
Name: **ABR, Inc**

FORM 4B
Equipment
DETAIL

Prepared: 4/13/1998

Project Title: Hydrocarbon Data Analysis, Interpretation, and Database Maintenance for Restoration and NRDA Environmental Samples Associated with the *Exxon Valdez* Oil Spill

Project Number:	99290
Restoration Category:	
Proposer:	Bonita D. Nelson and Jeffrey W. Short NMFS, Auke Bay Laboratory ABL Program Manager: Dr. Stan Rice NOAA Program Manager: Bruce Wright
Lead Trustee Agency:	NOAA
Cooperating Agencies:	None
Alaska SeaLife Center:	No
Duration:	Service Ongoing
Cost FY 99:	58.9
Cost FY 00:	58.9
Cost FY 01:	35.0
Cost FY 02:	35.0
Cost FY 03:	35.0
Geographic Area:	Not Applicable
Injured Resource/Service:	Maintenance of the Trustee hydrocarbon database, archival of environmental samples, interpretative services

ABSTRACT

This project is a continuation of the NRDA and Restoration database management, sample storage, and interpretive service. New data will continue to be incorporated into the Trustee hydrocarbon database. Updated summary report for investigators and managers will be produced along with an electronic copy of the data for all data queries. A database for pristane sample collection and analysis information will be maintained and a database will be initialed for fatty acid/lipid class composition sample collection and analysis for ABL Trustee funded projects.

INTRODUCTION

The Auke Bay Laboratory provides data and sample archiving services for all samples collected for hydrocarbon analysis in support of *Exxon Valdez* Trustee Council projects. These data represent samples collected since the oil spill in 1989 to the present and include environmental and laboratory Response and Restoration data as well as Subsistence data. Additionally, we provide interpretive services for the hydrocarbon analyses. Currently, the database contains results of the hydrocarbon analysis of more than 13,000 samples and collection information from more than 47,000 sediments, tissues, water, or oil samples. The primary purpose of this project is to maintain the integrity of the database, incorporate new data and continue hydrocarbon data interpretive services. This year we are proposing to include the task of maintaining a Pristane database and generate a fatty acid/lipid class database for Trustee funded projects at the Auke Bay Laboratory. The second purpose is to make the results of the hydrocarbon analyses available to principal investigators, resources managers and to the public. This service is expected to have activity through synthesis period of the next two years. The third purpose of this project is to maintain the integrity of archived samples in freezers many of which have not yet been analyzed for hydrocarbons.

The Trustee hydrocarbon database not only contains sample collection and hydrocarbon analyses information, but also has data concerning sample shipping and location information as well as lists of other database identifiers (such as species and location codes). A public version of this database containing the sample collection and environmental hydrocarbon sample analyses was released in 1996 (*Exxon Valdez* Oil Spill of 1989: State/Federal Trustee Council Hydrocarbon Database 1989-1995 -EVTHD) . Updating the database is an on-going program, samples from Chenega cleanup (98291) and Subsistence database were added in 1998, stream sediment data (97194) and pink salmon data (97076) were added in 1997 and additional Chenega samples as well as samples collected from mussel beds are projected to be added in 1999.

The hydrocarbon interpretive service is designed specifically for investigators and managers. This includes: (1) identification of the probable sources of the hydrocarbons observed in the samples, (2) evaluation of new hydrocarbon data for evidence of systematic bias, (3) hydrocarbon data editing according to consistent criteria. Recently interpretation has grown to include identification of potential hydrocarbon sources (e.g. coal) for the background hydrocarbon signal in PWS. This is a continuation of project 98290 and previously funded under TS#1, 93090, 94290, 95290, 96290 and 97290.

NEED FOR THE PROJECT

A. Statement of Problem

The Trustee hydrocarbon database is a dynamic structure which requires updating and maintenance. Currently, the database contains an inventory of the Trustee hydrocarbon sample

collection and provides for retrieval of hydrocarbon analyses by principal investigators and managers. This project is designed to provide easy access to the Trustee hydrocarbon database and ensure the accuracy of the data. The volume of data contained in the database suggests that other users will benefit from access, particularly as more data is added (Chenega project; oiled mussel bed project) and as more synthesis products are produced (salmon and herring).

B. Rationale/Link to Restoration

Archiving of the Trustee hydrocarbon sample data will ensure that these data are available to principal investigators, government agencies, and the interested public on a timely basis. The database allows direct comparison of restoration and NRDA data, and contains an inventory of hydrocarbon samples and information about their collection, storage and analysis. The continued use of the methods for hydrocarbon data evaluation and interpretation developed for the *Exxon Valdez* NRDA samples will insure direct comparability of future with previous samples. This will substantially increase the probability that temporal trends in these data will be detected when actually present. Principal investigators will be able to get assistance with chemical interpretation of hydrocarbon results from their project or other projects that relate to their project when needed. Since most investigators are not chemists, this type of assistance is usually required for proper interpretation of hydrocarbon results. Application of the petroleum weathering model developed under this project (Short and Heintz, 1997) has been used to compare coal samples and Katalla seep with Prince William Sound background samples, and has identified coal as the "biologically non-available source, in contrast to researchers sponsored by EXXON, who have identified the source as Katalla seep oil.

C. Location

While this project resides at the Auke Bay Laboratory, Juneau , Alaska, the service provided serves the entire spill area.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Community involvement includes and extends beyond the spill area. Science centers, public schools, native corporations, universities, environmental organizations and other concerned groups will have access to the database with guidelines on how the data can be used.

PROJECT DESIGN

A. Objectives

1. Continue maintenance of the Trustee hydrocarbon database by updating the database with new information and continue the sample archiving procedures developed under NRDA.

2. Continue interpretation of hydrocarbon data, including new data produced for principal investigators and resources managers and for syntheses products as needed.

3. Maintain Pristane database for Trustee funded projects as well as initiate Fatty Acid/Lipid Class Composition Database for Trustee funded projects located at Auke Bay Laboratory.

4. Provide a new software product for the publicly accessible database which includes hydrocarbon samples analyzed through 1998.

5. Extend the use of the petroleum weathering model by using it as a tool for identifying potential sources of petroleum that contribute to the background signal identified in Constantine Harbor.

B. Methods

Data associated with hydrocarbon samples are added to the existing Trustee hydrocarbon database. The samples and data currently reside at the Auke Bay Laboratory of NMFS. Incoming samples are inventoried and stored in laboratory freezers, and sample collection information is entered into the database. Samples are released for hydrocarbon analysis after ABL receives a written request from the responsible project leader. Hydrocarbon data, reported by the analytical laboratory, are matched to the sample collection information and all the data are checked for errors and electronic copies are sent to principal investigators or other requesters. An updated version of the public release of the database will be developed in Visual Basic software using *Exxon Valdez* Oil Spill of 1989: State/Federal Trustee Council Hydrocarbon Database 1989-1995 (EVTHD) as a template and will include data collected from Trustee funded projects including sampling and analytical quality control procedures .

The petroleum weathering model developed under this project has been used to reject the hypothesis that the hydrocarbons comprising the background PAH source are derived from the Katalla oil seep. Analysis of sediment and mussel samples collected from locations near the Katalla oil seep as well as coal deposits east of PWS supports the conclusion that PAH derived from coal characterize the background hydrocarbon signal. We will continue developing this argument in FY99 by demonstrating the generality of the weathering model with other oil sources and the absence of a similar weathering process in coal.

The Auke Bay Laboratory will continue to keep all environmental samples collected for hydrocarbon analysis under all phases of the oil spill process frozen in locked storage.

The pristane database will be maintained in ACCESS software. Information from samples collected under Trustee project 195 will be combined with data from the Trustee hydrocarbon database where applicable to provide a complete data set of pristane related information.

The fatty acid/lipid class database will be generated in current database software.

C. Contracts and Other Agency Assistance

No contracts are anticipated

SCHEDULE

A. Measurable Project Tasks for FY99

Samples will be stored and data analyzed throughout fiscal year. Release of the updated public version of the database software: Exxon Valdez Oil Spill of 1989: State/Federal Trustee Council Hydrocarbon Database 1989-1995.

B. Project Milestones and Endpoints

April 15: Annual report in the form of updated release of hydrocarbon data software.

The primary objective of this project is to provide an ongoing service, consequently there are few set milestone dates or endpoints.

C. Completion Date

This is an ongoing service project to be completed when samples are no longer collected for hydrocarbon analysis and the Trustee Council terminates this service.

PUBLICATIONS AND REPORTS

The public release of the hydrocarbon database for projects funded in FY98 will be available 15 April, 1999 in the form of the annual report.

PROFESSIONAL CONFERENCES

One meeting is required, an annual Quality Assurance Control meeting attended by ABL's Senior Analytical Chemist. The results of an international calibration exercise by participant is reviewed for the integrity and credibility of chemical analyses. This meeting usually occurs in the Washington D.C. area, and is sponsored by National Institute of Standards and Technology (NIST).

NORMAL AGENCY MANAGEMENT

NOAA/NMFS has statutory stewardship for most living marine resources; however, if the oil spill had not occurred, NOAA would not be conducting this project. NOAA/NMFS proposes to make a significant contribution (as stated in the proposed budget) to the operation of this project, making it truly cooperative.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project is a continuation of NRDA database and chemical interpretation work.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

This ongoing service project has no significant project design or schedule differences from the project funded in FY98, it is a continuation of the same service. The project has been downsized, as the input volume has decreased somewhat, although interpretation services will probably increase.

PROPOSED PRINCIPAL INVESTIGATOR

Bonita D. Nelson
NMFS Auke Bay Laboratory
11305 Glacier Highway
Juneau, Alaska 99801
907-789-6071
907-789-6094
bonita.nelson@noaa.gov

PRINCIPAL INVESTIGATOR

Bonita D. Nelson

Education:
BS 1979, University of Illinois, Urbana (Ecology, Ethology , Evolution)
MS 1986, University of Alaska-Juneau (Fisheries)

Other Revelant Experience:
Database manager of the Trustee hydrocarbon data for 4 years. Responsibilities include: supervision of data entry of sample and analytical data; processing and dissemination of data after interpretation by chemist; database management including data retrieval for production of the public versions of the database. Nelson has designed and managed databases as well as analyzed data for the radio telemetry program at the Auke Bay Laboratory for 10 years.

OTHER KEY PERSONNEL

Jeffrey W. Short

Education:
BS, 1972 University of California, Riverside (Biochemisty & Philosophy)
MS, 1982, University of California, Santa Cruz (Physical Chemistry)

Other Experience:
1989 - Present: Established and managed the hydrocarbon analysis facility at ABL to analyze hydrocarbon samples generated by the *Exxon Valdez* NRDA effort (about 20% of these samples were analyzed at ABL).
1989 - 1992 : Principal Investigator, Exxon Valdez project Air/Water #3; Determination of petroleum hydrocarbons in seawater by direct chemical analysis and through the use of caged

mussels deployed along the path of the oil spill.
1991 - 1992 : Principal Investigator, Exxon Valdez project Subtitle #8 ; Development of computer-based statistical methods for global examination of sediment and mussel hydrocarbon data produced for the Exxon Valdez NRDA effort for systematic bias, and for identification of probable sources of hydrocarbons. Ind addition, this project produced both hard-copy and computer display maps of all the sediment and mussel hydrocarbon data.

LITERATURE CITED

Short, J. W., and R. A. Heintz. 1997. Identification of *Exxon Valdez* oil in sediments and tissues from Prince William Sound and the Northwestern Gulf of Alaska based on a PAH weathering model. Environ. Sci. Technol. 31:2375-2384.

FY 99 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel	$58.0	$44.4
Travel	$4.7	$4.2
Contractual	$3.0	$1.5
Commodities	$3.0	$2.0
Equipment		$0.0
Subtotal	$68.7	$52.1
General Administration	$8.0	$6.8
Project Total	$76.7	$58.9
Full-time Equivalents (FTE)	2.2	0.6
Other Resources	$38.2	$15.9

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002
$59.0	$35.0	$35.0

Dollar amounts are shown in thousands of dollars.

Comments:

This project is ongoing to support the maintenance of samples collected for petroleum hydrocarbon analyses; storing and archiving of sample samples; interpretation of chemical data; and release of data to principal investigators and to the public.

NOAA Contribution:

Habitat Senior Research Chemist, J Short, 1 mo @ 8.4K, Fishery Biologist J. Maselko 1mo @ 4.4K, Senior Analytical Chemist, M. Larsen .5 mo @ 3.1 for a total of 15.9K

FY 99

Project Number: 99290
Project Title: The Hydrocarbon Database and Interpretation
Agency: National Oceanic and Atmospheric Administration

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared :4/10/98

FY 99 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1999
Bonita Nelson	Fisheries Biologist/Database Manager	11/2	6.0	5.5		33.0
Marie Larsen	Senior Analytical Chemist	11/6	0.5	6.0		3.0
Jeff Short	Senior Research Chemist	13/4	1.0	8.4		8.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		7.5	19.9	0.0	
					Personnel Total	$44.4

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
Anchorage, Workshop	0.4	2	4	0.2	1.6
Miscellaneous (Car rental, telephone, POV mileage etc.)					0.0
					0.0
Quality Assurance/Quality Control Annual Meeting, 1 Senior Chemist	1.8	1	4	0.2	2.6
National Institute for Standards & Technology					0.0
Washington, DC Annual meeting for analytical performance review					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$4.2

FY 99

Project Number: 99290
Project Title: The Hydrocarbon Database and Interpretation
Agency: National Oceanic and Atmospheric Administration

FORM 3B
Personnel
& Travel
DETAIL

Prepared :4/10/98

FY 99 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed FY 1999
Description	
Disposal of Archived Samples (classified as hazardous materials)	1.5
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$1.5

Commodities Costs:	Proposed FY 1999
Description	
Computer software and hardware upgrades	1.0
Production of updated public information of chemical data	1.0
Commodities Total	$2.0

FY 99

Project Number: 99290
Project Title: The Hydrocarbon Database and Interpretation
Agency: National Oceanic and Atmospheric Administration

FORM 3B
Contractual & Commodities DETAIL

Prepared :4/10/98

FY 99 EXXON VALDEZ TRUST[illegible]UNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Freezer	2	NOAA
Computer - Micron	1	NOAA
Power Supply	1	NOAA

FY 99

Project Number: 99290
Project Title: The Hydrocarbon Database and Interpretation
Agency: National Oceanic and Atmospheric Administration

FORM 3B
Equipment
DETAIL

Prepared :4/10/98

Public Brochure on Archaeology at the Alaska SeaLife Center. Submitted Under the BAA.

Project Number: 99298-BAA

Restoration Category: General Restoration

Proposer: Michael R. Yarborough

Lead Trustee Agency:

Cooperating Agencies:

Alaska SeaLife Center: No

Duration: 1 year

Cost FY 99: $6,200

Geographic Area: Seward

Injured Resource/Service: Archaeological Resources

ABSTRACT

Funding is requested for the publication of a public brochure describing archaeological research undertaken during construction of the Alaska Sealife Center in Seward. The brochure will contain both historic photographs and maps of the Seward water front, and photographs and drawings from the archaeological investigations. It will focus on research at the Lowell Homestead, the earliest American settlement in Seward. This publication would give the general public a sense of what has been learned from archaeology at the SeaLife Center, and an understanding of the richness and importance of heritage resources in the oil spill area.

INTRODUCTION

The Alaska SeaLife Center is owned by the City of Seward and will be operated by the Seward Association for the Advancement of Marine Science. However, because the Trustee Council contributed $25 million toward the project, construction of the center is considered a Federal undertaking and subject to Federal antiquities laws. The effect of the project on significant cultural properties has been as profound as that of other spill-related activities on archaeological sites along the affected coast.

NEED FOR THE PROJECT

A. Statement of Problem

An initial archaeological survey of the SeaLife Center site was done in 1994 during preparation of the project EIS. During the summer of 1995, ground disturbing activities during the first phase of construction were monitored. A limited program of backhoe testing was undertaken in November of 1995 to determine the nature and extent of any cultural remains that could be affected by construction work during phase two. A plan for mitigating the impacts of phase two was implemented during the spring of 1996. Additional archaeological data was recovered in November, 1996, and May, 1997.

During the first phase of construction, a cultural deposit was discovered at the northwest corner of the project site that subsequent archaeological testing and archival research showed to be associated with the late nineteenth and early twentieth century homestead of Frank and Mary Lowell. The homestead was determined eligible for inclusion in the National Register of Historic Places for its "potential to yield information important in history or prehistory" (Bittner 1995).

Frank and Mary Lowell were the first American settlers of the future town of Seward. Frank Lowell was an merchant trader from New England, while his wife Mary was from the Cook Inlet village of English Bay. According to Barry (1986:26), Mary Lowell was born to "a Russian father and Eskimo or Aleut mother." However, B. L. Johnson (1911), a geologist for the U.S. Geological Survey, recorded that she was "half Russian and half Knik Indian."

The Lowell family may have moved to the head of the Resurrection Bay as early as 1884, although Mary Lowell's homestead filing says that she "made settlement" on the claim on August 15, 1888. Frank Lowell abandoned his wife in 1893 and they were divorced in 1895. Mary Lowell and her children continued to live at Resurrection Bay, selling furs once a year to a trading schooner (Johnson 1911) and subsisting by hunting and fishing (Barry 1995:377).

The town of Seward was founded in 1903 by engineers and laborers of the Alaska Central Railroad Company, and by "businessmen who were interested in buying lots at the new townsite" (Barry 1986:53). The Alaska Central Railroad, formed in 1900 by a group of Seattle entrepreneurs, was the first to attempt to build a railroad from the gulf coast into the interior. John Ballaine, secretary and auditor of the corporation, was the driving force behind the venture. Through a rather tangled chain of events, Ballaine ended up owning the entire Seward townsite. Mary Lowell filed a homestead claim in April of 1903 for 160 acres of land that encompassed much of what is now the City of Seward. Soon after Mrs. Lowell filed her claim, Frank Ballaine leased all but ten acres (the waterfront property where the Lowells had their homesite) for $50.00 an acre, with an option to buy the land. In August of 1903, Mary Lowell relinquished the rights to her homestead and they were claimed by Ballaine. Finally, when Ballaine sold his controlling interest in the Alaska Central Railroad in 1904, he retained all of his interests in Seward. Mary Lowell built a new house in the townsite, but she did not have long to enjoy her new prosperity. She died of "consumption" in 1906.

A final report on the archaeology at the SeaLife center is being prepared and will be available later this year. Although it will contain fascinating information on the prehistory and history of the outer Kenai Peninsula coast, late nineteenth century lifeways, and the founding of Seward, this report will be a technical document intended to meet statutory requirements and will not be generally available to, or readily understandable by, the general public.

B. Rationale/Link to Restoration

The primary objective of the proposed project is to make information about the history and cultural heritage of people in the spill area understandable and therefore accessible to a broad segment of the public. A brochure is an inexpensive and effective way of increasing awareness of archaeological resources and restoration efforts. This publication would be available to the people of Seward, village residents, visitors to the area, and other interested individuals.

C. Location

Seward

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

There has been a good deal of community awareness of and interest in the archaeological work at the SeaLife Center. The proposed brochure will present the results of this research to the people of Seward in non-technical language.

PROJECT DESIGN

A. Objectives

1. Interpretation for the general public of archaeological insights gained from research during the implementation of a Trustee Council-funded capital project.

2. Wide dissemination of interesting and understandable information about the history and cultural heritage of the Resurrection Bay and outer Kenai Peninsula coast areas.

B. Methods

The proposed brochure will be 16 to 20 pages in length and include approximately 24 illustrations (photographs and maps). It will be booklet size (approximately 7 by 9 inches), with card stock covers. The composition and layout of the brochure will be accomplished with computer hardware and software available at the offices of Cultural Resource Consultants. The final printing will be done by a local print shop.

The brochure will draw upon technical information in the final archaeological report, although its text will be written so that it can be understood by the general public. It will rely primarily on the illustrations to describe and interpret the significance of archaeological activities of associated with construction of the SeaLife Center. There are, for example, literally hundreds of photographs that illustrate the developmental history of the Seward water front. The earliest of these, taken in 1902 by a member of an Alaska Central Railway survey party, show the Lowell family and their homestead.

The draft manuscript will be submitted to the Trustee Council's Executive Director and Chief Scientist for review. Upon approval by the Chief Scientist and Executive Director, the contractor will reproduce 2,000 copies of the brochure. The Restoration Office will distribute the publication to museums, village councils, schools, and other interested parties within the spill area.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Cultural resource personnel in DOI-NPS and ADNR-SHPO will be invited to review the draft document.

SCHEDULE

A. Measurable Project Tasks for FY 99 (October 1, 1998 - September 30, 1999)

Oct. 1 - Dec. 31: The photographs and drawings for the brochure will be chosen and, if necessary, publication rights will be obtained. The descriptive text and photograph captions will be written.

Jan. 1 - March 31: The composition and layout of the brochure will be completed.

April 1 - June 30: A draft of the brochure will be completed and submitted to the Trustee Council's Executive Director and Chief Scientist for review.

July 1 - Aug. 31: Any necessary revisions will be made and, upon approval of the revised manuscript by the Trustee Council's Chief Scientist and Executive Director, 2,000 copies of the brochure will be printed.

Sept. 1 - Sept. 30: The Restoration Office will distribute the brochure.

B. Project Milestones and Endpoints

Project milestones include:

August 31, 1999: Objective 1. Development of a publication that presents archaeological information gained from research at the Alaska SeaLife Center to the general public.

September 30, 1999: Objective 2. Wide dissemination of interesting and understandable information about the history and cultural heritage of the Resurrection Bay and outer Kenai Peninsula coast areas.

The endpoint of this project, the publication and distribution of the brochure, will be accomplished by September 30, 1999.

C. Completion Date

The brochure will be completed and distributed by September 30, 1999.

PUBLICATIONS AND REPORTS

The project will produce 2,000 copies of the brochure.

PROFESSIONAL CONFERENCES

Not applicable.

NORMAL AGENCY MANAGEMENT

DOI-NPS, the agency responsible for insuring the SeaLife Center's compliance with the National Historic Preservation Act, is not required to produce literature about the project for distribution to the general public.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Beginning with the preparation of the EIS in 1994, archaeological research has been an integral part of the Alaska SeaLife Center project. Publication of a brochure documenting Native heritage and community roots in Resurrection Bay is in keeping with center's dedication to research and public education.

PROPOSED PRINCIPAL INVESTIGATOR

Michael R. Yarborough
3504 E. 67th Avenue
Anchorage, Alaska 99507
Phone: (907) 349-3445
Fax: (907) 349-5562

PRINCIPAL INVESTIGATOR

Michael R. Yarborough, project archaeologist for the Alaska SeaLife Center and principal archeologist for Cultural Resource Consultants, will be responsible for production of the brochure. Mr. Yarborough began working in Alaska in 1974. Prior to joining Cultural Resource Consultants in 1981, he conducted archeological surveys and excavations along the Alyeska Pipeline for the University of Alaska, and worked as an archeologist for the U.S. Fish and Wildlife Service's Alaska Regional Office. During the time that he has been with Cultural Resource Consultants, Mr. Yarborough has completed over 60 archeological projects throughout the state.

OTHER KEY PERSONNEL

None

LITERATURE CITED

Barry, Mary J.
1986 *Seward, Alaska, A History of the Gateway City*, Vol. 1. Privately published.

1995 *Seward, Alaska, A History of the Gateway City*, Vol. 3. Privately published.

Bittner, Judith E.
1995 Letter to Deborah L. Williams, Office of the Secretary, Department of the Interior, October 3, 1995, concerning the Mitigation & Testing Plan, SEW-682. Copy on file, Cultural Resource Consultants, Anchorage.

Johnson, B. L.
1911 Field Notes, Kenai Peninsula, 1911. Unpublished maunscript on file, U.S. Geological Survey library, Anchorage.

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$3.2
Travel		$0.0
Contractual		$3.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$6.2
Indirect		
Project Total	$0.0	$6.2
Full-time Equivalents (FTE)		0.4
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	Estimated FY 2003	

Dollar amounts are shown in thousands of dollars.

Comments: The entire project cost is for a publication. Personnel costs are limited to 1.5 weeks (60 hours) of Mr. Yarborough's salary of $54.00 per hour.

1999

Project Number: 99 298-BAA
Project Title: Public Brochure on Archeology at the Alaska SeaLife Center
Name: Cultural Resource Consultants

FORM 4A
Non-Trustee
SUMMARY

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 1999
	Michael R. Yarborough	Archaeologist	0.4	8.0		3.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	0.4	8.0	0.0	
					Personnel Total	$3.2

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 1999
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$0.0

1999

Project Number: 99__
Project Title: Public Brochure on Archeology at the Alaska SeaLife Center
Name: Cultural Resource Consultants

FORM 4B
Personnel
& Travel
DETAIL

Prepared: 4/13/98

4/13/98

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed FY 1999
Description	
Brochure Printing	3.0
Contractual Total	$3.0

Commodities Costs:	Proposed FY 1999
Description	
Commodities Total	$0.0

1999

Project Number: 99__
Project Title: Public Brochure on Archeology at the Alaska SeaLife Center
Name: Cultural Resource Consultants

FORM 4B
Contractual & Commodities DETAIL

Prepared: 4/13/98

4/13/98

1999 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	

1999

Project Number: 99__
Project Title: Public Brochure on Archeology at the Alaska SeaLife Center
Name: Cultural Resource Consultants

FORM 4B
Equipment
DETAIL

Prepared: 4/13/98

4/13/98

Synthesis of the Scientific Findings from the *Exxon Valdez* Oil Spill Restoration Program

Project Number: 99300

Restoration Category: Research

Proposer: Robert B. Spies, Chief Scientist
Andrew J. Gunther, Asst. Chief Scientist
Applied Marine Sciences
2155 Las Positas Court, Suite S
Livermore, California 94550
Phone: (510)373-7142
Fax: (510) 373-7834
e-mail: spies@amarine.com
gunther@amarine.com

Lead Trustee Agency: DNR

Cooperators: ADF&G
DOI
NOAA
USFS

Alaska Sea Life Center: No

Duration: Third year, 3-year project

Cost FY 99: $75,000

Geographic area: Prince William Sound, Alaska Peninsula, Kodiak Archipelago

Injured resource: All resources in the spill area

ABSTRACT

The results of the many studies sponsored by the Trustee Council have provided an astonishing amount of information on the ecology of the spill area and represent the largest single infusion of data on natural resources in the northern Gulf of Alaska. There is an urgent need to synthesize this information across projects to realize its maximum benefit to the public and management agencies, and to provide a cogent demonstration of the overall value of the Restoration Program. It is the goal of this project to have made substantial progress on such a synthesis in time for the 10-year anniversary of

the oil spill, and to use this synthesis to build the foundation for long-term monitoring in the spill area. The specific objectives involve coordinating work on synthesis products, facilitating the efforts to develop and apply food-web models of the spill area ecosystem, and developing a long-term plan for research and monitoring in the spill area.

INTRODUCTION

The 1989 *Exxon Valdez* oil spill was the largest oil spill in US history and occurred in an environment renowned for its fisheries and wildlife. Documenting damage and recovery of natural resources from the spill required an unprecedented scientific effort that has continued through the present Restoration Program. This effort has included numerous studies of fish, birds, intertidal and subtidal communities, and marine mammals. The 1993 Trustee Council-sponsored Symposium addressed the damage from the oil spill as it was understood at the time. As the Trustee Council approaches the end of the 10-year Restoration Program it is time to consider how all of these scientific studies have: (1) further documented injury and recovery of natural resources, especially for those resources that have been slow to recover, (2) provided insight into the ecology of the marine and coastal ecosystems of the spill area, (3) provided data and information useful for management of natural resources in northern Gulf of Alaska, and (4) provided a predictive understanding of how the ecosystem responds to natural and anthropogenic perturbations. This represents a major synthetic effort that will involve principal investigators, peer reviewers, ecosystem modelers, and management agency personnel. Careful planning, coordination, and facilitation is required to assure the success of such a program.

NEED FOR THE PROJECT

A. Statement of Problem

The Restoration Program produces annual reports, individual technical reports, proposals and workplan documents that are available through the Alaska Resources Library and Information Service (ARLIS). The sheer volume of these documents makes it difficult for those unfamiliar with the program to easily obtain study results. Even those familiar with the program find it challenging to understand the larger picture emerging from the various scientific projects sponsored by the Trustee Council..

There is thus clearly a need for a basic scientific synthesis that (1) integrates findings from different projects to summarize the injury and recovery of resources for the scientific community, (2) documents the expanding understanding of the spill area ecosystem being established by the

large interdisciplinary research projects, (3) uses that understanding to guide the development of mathematical models that will refine our knowledge and establish predictive capability, and (4) contributes to identifying the important features of an ongoing research and monitoring program, including describing a system for managing and archiving environmental data.

B. Rationale/Link to Restoration

Synthesis of the research and monitoring conducted by the Trustee Council will be an important aspect of completing the restoration program. Due to the magnitude of the effort undertaken, integration and synthesis of scientific findings will be essential to provide the public and management agencies with an accessible source of information regarding restoration and recovery of the damages from the oil spill. Synthesis products will also be valuable summaries of the Restoration Program to scientists and members of the public in the future. Finally, these products (and a data management strategy) will be essential as the scientific foundation for any utilization of the restoration reserve for research and monitoring.

Developing more effective linkages between Trustee Council-sponsored science and management efforts is important in order to achieve the Council's goals of enhancing injured resources and services through developing more sophisticated and effective management programs.

C. Location

This work will be conducted by principal investigators in Alaska, by the Chief Scientist in Alaska and California, by a data management consultant to be identified, and by scientific reviewers throughout North America.

Community Involvement and Traditional Ecological Knowledge

Traditional Ecological Knowledge will be appear in the synthesis products to the extent that this knowledge is an essential part of the findings of research and monitoring programs. Although little community involvement is foreseen in the development of synthesis products, the Restoration Notebook Series will likely be of great interest to members of local communities in the oil spill area, as will overall predictions of resource variation (if available) from modeling studies.

PROJECT DESIGN

A. Objectives:

1. Coordinate and facilitate the construction of food web models (Project 99330).

Based upon the results of the modeling workshop conducted as part of project 98300 in Anchorage in January, 1998, it is likely that the Chief Scientist will recommend the continuation of the food web modeling project in FY99 (see project 99330). This project will utilize the results of many different investigators to produce a set of relatively simple models that integrate much of the data developed to date regarding biological populations in Prince William Sound and lower Cook Inlet. These models can then be used to highlight important parameters for which we need more information, and can be used to provide tests of large-scale perturbations in the system (for example, increased recreational fishing pressure on large pelagic species due to the presence of a road to Whittier).

The work conducted to date as part of Project 98330 and 98300 has made it clear that the interactions of the food web modeling group with EVOS PIs must be carefully coordinated. There is a significant sensitivity among principal investigators regarding use of preliminary data by others, and about the effectiveness of simple modeling approaches. In addition, guidance must be provided to the modeling team regarding the scenarios to test with the model. Consistent planning and attention by the Chief Scientist and Science Coordinator are therefore required to successfully construct useful models.

In addition, depending upon the success at validating the predictive capability of the food web models, these models may be valuable new tools for application by management agencies. An active role by the science program will be required to identify the management agencies and personnel that could make use of the models.

2. Oversee the production of integrative scientific papers than synthesize the results of damage assessment and restoration projects.

3. Develop a plan for a long-term research and monitoring program, including an element addressing the management and archiving of data.

The Trustee Council has clearly indicated that one of the purposes of the science program is to enhance injured resources by providing information for improved management. There appears to be a growing consensus for using at least a portion of the restoration reserve account for a long-term research and monitoring program, although the Trustee Council will not make a decision in this regarding until the early fall of 1998.

A preliminary program was described by the Chief Scientist at the Restoration Workshop in January of 1998, and comments were obtained on

this plan from workshop participants. The objective of this task will be to develop from this preliminary plan a complete draft of a long-term research and monitoring program. The maintenance of a data system that provides access to current and archived data will be included as part of the plan.

B. Methods

This project will be coordinated through the Chief Scientist's office using established administrative procedures. Different approaches will be taken to pursue each of the objectives.

1. Coordination and Facilitation of Food Web Modeling

The methods used in facilitating and coordinating the development of these models are very straightforward, and essentially involve establishing and maintaining adequate communication among all parties. The modelers and their technical staff members must be made aware of which research groups have data of interest, what publications already exist, how to effectively contact these organizations, and the identity of the key contacts. Existing principal investigators must be acquainted with the goals of the modeling program, the extent and magnitude of their participation and cooperation that is expected, the commitment of the restoration program to the fair and professional use of unpublished or preliminary data.

The first major watershed of the modeling program in FY99 will be a workshop to be held in October of 1998 at which the preliminary results of the food web models constructed during FY98 will be presented and discussed. Based upon the review of this product, it is anticipated that the process used in FY98 to model PWS will be applied to the lower Cook Inlet region. The Chief Scientist will coordinate the interactions between the modeling team and managers in PWS as the model developed in FY98 is refined and applied to management questions in the PWS region.

2. Production of scientific synthesis papers

There are more potential synthesis papers to produce than the restoration program has the time and resources to support. In FY98, three major synthesis papers were started: (1) a description of the damage assessment and restoration process that reviews the evolution and rationale of the restoration program and derives general themes and ideas to be applied in other restoration programs, (2) a synthesis of the results of damage assessment and restoration studies of fishery resources, or (3) a synthesis of the results of damage assessment and restoration of intertidal resources and the species trophically dependent on the intertidal. It is anticipated that these papers will be submitted for publication in FY98, and in FY99 the final editing

and publication will occur. The Chief Scientist will endeavor to obtain reprints or preprints to be made available at the 10-year anniversary, although the long lead time for review publications may make that difficult to accomplish.

There also may be a need to respond to scientific critiques of the restoration program in the literature. These responses have been mostly completed, although there may be more to develop in the future.

The Chief Scientist will also work closely with any principal investigators being funded independently to produce synthesis papers. Proposal were funded in this regard by the Trustee Council in FY98 for salmon (98329) and coastal habitat (98325) and similar proposals for other resources are likely to be submitted for FY99.

3. Developing a long-term research and monitoring program

The starting point for this plan will be the preliminary proposal presented by the Chief Scientist at the Annual Workshop in January 1998, which was prepared at the invitation of the Executive Director. The first step of further development of the plan, which will occur in FY98, is to modify it based upon the comments provided in the break-out sessions conducted during the meeting. The next step is to prepare a complete draft of the proposal, which will identify (1) a set of parameters for long-term ecosystem monitoring as defined by the needs of managers, the discoveries of the researchers, (2) the spatial and temporal frequency of sampling, as dictated by our understanding of ecosystem variability and the economics of long-term funding, and (3) a description of how existing or planned monitoring programs might be able to gather the necessary data.

In addition, this task should develop a set of objectives for a data system to support this program. This will be accomplished by:

a) developing an inventory of data sets and data collection and storage systems currently in use by Trustee Council-sponsored projects. The inventory prepared by project 96089 will be the starting point for this effort.

b) prepare a brief synopsis of the type of data systems currently in use by large-scale monitoring programs around the nation that might serve as models for such a program in the northern Gulf of Alaska.

c) prepare a summary of existing data systems covering natural resources in the spill area, with specific focus upon avoiding duplication of effort on behalf of any Trustee Council-sponsored program.

d) review the experience of the Restoration Program with maintaining the hydrocarbon database (an ongoing project managed by NOAA's Auke Bay Laboratory).

Based upon the results of (a)-(d) and other steps identified above, a draft long-term research and monitoring plan will be delivered to the Executive Director from the Chief Scientist for review by the Public Advisory Group, the Restoration Work Force, and other stakeholders.

C. Cooperating agencies, contracts and other agency assistance.

The cooperation of the following agencies are clearly key to the success of this effort: Alaska Department of Fish and Game, National Oceanographic and Atmospheric Administration/National Marine Fisheries Service, Department of the Interior (Biological Resources Division of the U.S. Geological Survey and the U.S. Fish and Wildlife Service). Principal investigators of many past and ongoing research and monitoring programs, and modeling project personnel, will also be key cooperators in this project. Contracts and consulting agreements will be renewed or established for scientific reviewers involved in the project.

SCHEDULE

A. Measurable Project Tasks for FY99

1. Successful planning, preparation, and implementation of the workshops to (1) review preliminary results of the food web models developed by project 98300 for Prince William Sound, and (2) specify model parameters for the food web model of lower Cook Inlet to be prepared by project 99330.

2. Completion of three synthesis manuscripts for publication in scientific journals.

3. Develop a draft plan for long-term research and monitoring to be delivered to the Executive Director from the Chief Scientist for public review

B. Project Milestones and Endpoints

1. Finalize list of invitees to the Cook Inlet food-web modeling workshop sponsored by Project 98330 (December 1998)

2. Finalize agenda for Cook Inlet food web modeling workshop (February 1999)

3. Conduct Cook Inlet food web modeling workshop (March 1999)

4. Submit synthesis papers to scientific journals (October 1998)

5. Prepare a brief synopsis of the type of data systems currently in use by large-scale monitoring programs around the nation that might serve as models for such a program in the northern Gulf of Alaska (January 1999).

6. Draft report describing a long-term research and monitoring program for integrating science and management submitted to Executive Director (August 1999)

C. Completion Date

This project is scheduled for completion in FY99, although might be continued depending upon the needs of the Trustee Council and the Executive Director.

PUBLICATIONS AND REPORTS

At least three scientific synthesis papers are expected, with the drafts of these documents submitted to journals early in FY99. A draft report describing a long-term research and monitoring program will be completed for public review.

NORMAL AGENCY MANAGEMENT

This exercise is dealing with some of the end products of the oil spill scientific research program is clearly outside the scope of normal agency management.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This purpose of this project is to coordinate and integrate many of the activities of the Restoration Program.

Principal Investigators

Robert B. Spies, Ph.D.
Andrew J. Gunther, Ph.D.

FY 99 EXXON VALDEZ TRUST COUNCIL PROJECT BUDGET

October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$24
Travel		$9
Contractual		$12
Commodities		$9
Equipment		$0
Subtotal	$0.0	$54
Indirect		$21
Project Total	$0.0	$75
Full-time Equivalents (FTE)		0.3

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2000	Estimated FY 2001	Estimated FY 2002

Dollar amounts are shown in thousands of dollars.

Other Resources

Comments:

FY 99

Prepared:

Project Number: 99300
Project Title: Synthesis of Scientific Findings from the Exxon Valdez Oil Spill
Name: Applied Marine Sciences

FORM 4A
Non-Trustee
SUMMARY

October 1, 1998 - September 30, 1999

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 1999
						0.0
A. Gunther	Assistant Chief Scientist		4.0	6094.7	NA	24,378.8
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		4.0	6094.7	0.0	
					Personnel Total	$24,378.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
PWS workshop					0.0
Gunther (Oakland/Anchorage RT)	600.0	1	4	125.0	1,100.0
Peterson (Moorehead City/Anchorage RT)	1000.0	1	4	125.0	1,100.0
Mundy (Portland/Anchorage RT)	600.0	1	4	125.0	1,500.0
					0.0
Cook Inlet Model Development Workshop (Gunther)	600.0	1	5	125.0	1,225.0
					0.0
Data System Assessment					0.0
Gunther (Oakland/Anchorage/Cordova RT)	750.0	1	5	155.0	1,525.0
Data management consultant (??/Anchorage/Cordova RT)	1200.0	1	10	155.0	2,750.0
					0.0
					0.0
				Travel Total	$9,200.0

FY 99

Project Number: 99300
Project Title: Synthesis of Scientific Findings from the Exxon Valdez Oil Spill
Name: Applied Marine Sciences

FORM 4B
Personnel
& Travel
DETAIL

Prepared:

October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed
Description	FY 1999
Subcontract for assistance with data system assessment	12,000.0
Contractual Total	$12,000.0

Commodities Costs:	Proposed
Description	FY 1999
shipping & communications ($75/month for 12 months)	900.0
journal reprints of three papers (@$1000 for 300)	3,000.0
page charges (for long synthesis papers)	5,000.0
miscellaneous	250.0
Commodities Total	$9,150.0

FY 99

Prepared:

Project Number: 99300
Project Title: Synthesis of Scientific Findings from the Exxon Valdez Oil Spill
Name: Applied Marine Sciences

FORM 4B
Contractual & Commodities DETAIL

October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	

FY 99

Project Number: 99300
Project Title: Synthesis of Scientific Findings from the Exxon Valdez Oil Spill
Name: Applied Marine Sciences

FORM 4B
Equipment
DETAIL

Prepared:

KODIAK ISLAND BOROUGH
MASTER WASTE MANAGEMENT PLAN

Project Number:	99304
Restoration Category:	General Restoration
Proposer:	Kodiak Island Borough
Lead Trustee Agency:	State of Alaska Department of Environmental Conservation
Cooperating Agencies:	None
Alaska Sealife Center:	No
Duration:	Phase II, 2 Year Project
Cost FY 99:	$1,798,355
Cost FY 00:	$0
Cost FY 01:	$0
Geographic Area:	Kodiak Island
Injured Resource/Service:	Intertidal and subtidal organisms, harlequin ducks, black oystercatchers, sea otters, harbor seals, and other seabirds, shorebirds, and marine mammals. The services most likely to benefit are subsistence and recreation, both of which are affected by the adverse environmental and visual effects of pollution.

ABSTRACT

This project is designed to address marine pollution derived from land based sources and waste management practices of the remote communities of Kodiak Island. A Master Waste Management Plan developed in Phase I addressed community-based sources of marine pollution and resulted in 4 recommended initiatives. Phase II EVOS funding will provide a portion of the funding needed to implement the recommendation selected by the communities as the highest priority: Systems Development: *Fixing What is There.* This comprehensive initiative of systems development will provide capital improvements to existing waste management systems, and will promote local responsibility.

INTRODUCTION

This project is designed to address marine pollution derived from land based sources and waste management practices of the remote communities of Kodiak Island. This project recognizes that participation by local communities in the decision making process is fundamental to the long-term success of the project. Therefore, Phase II continues the proactive community involvement generated during Phase I. This is a unified regional effort among the seven remote coastal villages of Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, Port Lions, and the Community of Chiniak; the Kodiak Area Native Association (KANA); and the Kodiak Island Borough (KIB) to produce and implement a waste management plan that identifies solutions to the most pressing pollution problems for the coastal villages.

Communities on Kodiak Island generate a large number of waste streams that may be entering, degrading, and preventing the recovery of the *Exxon Valdez* spill area. Examples of these waste streams include used oil from vessels and other sources, sewage discharges, household hazardous wastes, and windblown garbage and/or leachate from community landfills. Many of the communities currently lack the resources – for planning, equipment, training, and development of infrastructure – to manage their wastes in an environmentally sound manner. As a result, wastes generated within the communities represent a chronic source of pollution that not only hinders full recovery of the marine environment but also has a negative impact on the general "quality of life".

This project is designed to mitigate marine pollution and thereby restore vital injured resources in the coastal villages of the Kodiak Island Borough. This will lead to significant reduction in marine pollution in the areas surrounding the villages and contribute to the increased recovery of injured resources as well as lost or reduced services including subsistence activities, commercial fishing, and recreation and tourism opportunities. Addressing the waste management issues identified in the Kodiak Island Borough coastal villages will support the mission of EVOS Trustees to protect our marine environment, restore injured resources, and mitigate damage from the *Exxon Valdez* Oil Spill.

The Kodiak Island Borough project is modeled after the Sound Waste Management Plan project that was made possible through funding from the *Exxon Valdez* Oil Spill Trustee Council (EVOS). This project, however, with its focus on the villages, the involvement of the Borough, and its somewhat different set of environmental problems makes it a unique effort.

The project is structured around the Island-Wide Waste Management Plan Committee ("the Committee") comprised of at least one representative from each of the villages, the Borough, KANA, Alaska Department of Environmental Conservation, and the US Coast Guard. During Phase I, the Committee met five times from November 1996 through December of 1997 to identify and prioritize problems, develop solutions, and to identify and pursue funding for the solutions from a variety of sources including federal, state, and local governmental agencies, non-profit organizations, and private businesses. Two documents were produced as the project developed – *Inventory of Pollution Sources and Problems* and *Alternatives Analysis and Potential Funding Sources*. The focus of the project evolved during the course of the Phase I effort and resulted in the completion of a *Kodiak Island Borough Master Waste Management Plan* that summarizes Phase I findings and recommendations.

The Master Waste Management Plan includes recommendations for the implementation of four waste management initiatives:

1) A Borough-Wide Utility Council: *Establishing a Resource for Collaborative Problem-Solving*,
2) Systems Development: *Fixing What is There*,
3) Community and Environment Curriculum Development: *Building an Environmental Consciousness*, and
4) Local Waste Management Implementation: *Community-Level Planning and Organization*.

Based on the priorities established by village representatives in Phase I, Phase II EVOS funding will be used to begin implementation of the second initiative, Systems Development: *Fixing What is There.* This initiative will provide not only capital improvements to existing waste management systems, but will further promote local responsibility. This will be accomplished through in-depth, hands-on training of a group of village residents with interests and aptitudes for operations and maintenance of wastewater, solid waste, and used oil/household hazardous waste systems. This project initiative will begin in FY99 and will be completed by FY00.

At the same time, the first, third and fourth initiatives, A Borough-Wide Utility Council: *Establishing a Resource for Collaborative Problem-Solving*; Community and Environment Curriculum Development: *Building an Environmental Consciousness*; and Local Waste Management Implementation: *Community-Level Planning and Organization,* will begin with funding from a variety of other sources. These initiatives are critical in the development of the project to introduce and emphasize an ethic of environmental stewardship in the community and establish and implement the procedures for ongoing community-based waste management systems within each village. Additionally, the Borough-Wide Utility Council will promote sharing of resources and collaboration among villages to maximize the ability of remote communities to be self-reliant.

These four initiatives are the successful result of community participation at the grass roots level.

This project will be complete in FY00, with the implementation of all four initiatives. However, this is of course a perpetual project – a project that will be continued by the communities' involvement in on-going planning and improvement of waste management processes to enhance village sanitation and in turn increase the recovery and maintenance of healthy marine environments.

SUMMARY OF PROJECT INITIATIVES

PHASE I RECOMMENDATIONS	PURPOSE	START DATE	COST	FUNDING
1) A Borough-Wide Utility Council: *Establishing A Resource for Collaborative Problem-solving*	To establish a permanent administrative entity to coordinate shared resources and management of system improvements in the coastal villages	August 1998	$269,000	• Funding will be received from the communities • Funding will be requested from the Administration for Native Americans (ANA)
2) Systems Development: *Fixing What is There*	To provide capital improvements to existing waste management systems and promote local responsibility.	September 1998	$2,222,000	• $1.8 million has been allocated from Exxon Valdez Oil Spill Trustees • Balance to be determined
3) Community and Environment Curriculum Development: *Building an Environmental Consciousness*	To introduce and emphasize an ethic of environmental stewardship in the community	January 1998	$180,000	• $145,000 will be received from the Kodiak Area Native Association (KANA) in EPA and IHS funds • $35,000 will be requested by KANA from ANA
4) Local Waste Management Implementation: *Community-Level Planning and Organization*	To establish and implement procedures for ongoing community-based waste management systems within each village	August 1998	$168,000	• Funding will be received from the communities. • Funding will be requested from ANA

NEED FOR THE PROJECT

A. Statement of Problem

This project is designed to address the problem of marine pollution generally, and with special emphasis on restoring injured resources, protecting the marine environment, and mitigating damage from the Exxon Valdez Oil Spill. Communities on Kodiak Island generate a large number of waste streams that may be entering, degrading, and preventing the recovery of the *Exxon Valdez* spill area. Examples of these waste streams include used oil from vessels and other sources, sewage discharges, household hazardous wastes, and windblown garbage and/or leachate from community landfills. Many of the communities currently lack the resource – for planning, equipment, training, and development of infrastructure – to manage their wastes in an environmentally sound manner. As a result, wastes generated within the communities represent a chronic source of pollution that not only hinders full recovery of the marine environment but also has a negative impact on the general "quality of life".

In Phase I of the project each of the villages were visited and contacts made to ascertain existing waste management problems and uncover pollution issues potentially affecting marine resources. Because of the willing participation of many village residents, especially the participants in the Kodiak Island Village Environmental Council as well as City and Tribal Council staff, it was possible to identify the following findings:

1. Raw sewage is being discharged onto the land and into surface waters in several communities.
2. Used oil from boats, diesel generators, and vehicles is accumulating in the villages with a high potential for improper disposal, including discharge to the marine environment.
3. Improved waste management practices are needed for economic development.
4. Oil fuel tanks present a potential hazard.
5. Septage facilities and methods have an impact on health and marine resources.
6. Scrap metal removal is recommended to prevent release of associated contaminants and build an environmental ethic.
7. Household hazardous wastes should be kept out of village landfills.
8. Watershed protection is important.
9. Operations and Maintenance training is needed for local village technical staffs.
10. Landfill operations planning can improve the function, longevity, and visual quality of disposal sites.
11. Drainage control at landfills is needed to prevent leachate production.
12. The solution to bear encounters includes, but is not limited to, improved landfill operations.
13. Waste management activities need a sustainable source of funding.
14. Local responsibility is needed for successful waste management.
15. Raising pollution prevention awareness is key to promoting local responsibility.
16. Recycling of consumer packaging materials to off-island sources is not likely to be financially self-supporting.

This project is designed to mitigate marine pollution and thereby restore vital injured resources. Addressing these issues will have an enormous impact on the marine pollution derived from land-based sources and waste management practices of the remote communities of Kodiak Island. This will lead to significant reduction in marine pollution in the areas surrounding the villages and contribute to the increased recovery of injured resources as well as lost or reduced services including subsistence activities, commercial fishing, and recreation and tourism opportunities.

B. Rationale/Link to Restoration

- **Why Should This Work Be Done?**

This project will improve human and environmental health in the KIB coastal villages while enhancing the protection of the recovering marine environment. Addressing the waste management issues identified in the Kodiak Island Borough coastal villages will support the mission of EVOS Trustees to protect our marine environment, restore injured resources, and mitigate damage from the Exxon Valdez Oil Spill. The seven participating communities have limited resources to collect and properly dispose of village wastes, which adversely affect the quality of nearby marine waters through runoff, leachate, and in some cases, wastes that are discharged directly into marine waters. Chronic marine pollution places added stress on fish and wildlife resources and thereby may delay the recovery of resources injured by the oil spill.

Today the remote coastal villages of Kodiak Island Borough depend on (a) subsistence resources, (b) commercial fishing, and increasingly, (c) tourism for their livelihood. Each community has unique resources whose protection is key to the health and livelihood of the residents. These resources include community drinking water sources, subsistence food sources, commercial resources such as fishing, local recreational areas, and state and federal parks, forests, and refuges. These resources, the village residents, and marine life are all harmed by inadequate waste management practices.

(a) Subsistence: Kodiak Borough residents rely on traditional subsistence food sources including deer, ducks, shell fish (e.g., clams, chitin), octopus, salmon, halibut, berries, and sometimes, marine mammals for a significant portion of their diet. In some cases, these subsistence resources are adjacent to waste management facilities or potential pollution sources such as sewage outfalls, landfills or fuel tank farms. Petroleum from fuel spills, bilge water discharged at sea, or cleaning solvents discharged through the sewer outfall can impair reproduction or otherwise decrease the population of fish or animals used for food. Contaminants discharged to soil or water adjacent to the food resources can cause decreases in the quantity of the resource. Protection and enhanced recovery of these resources is vital to the livelihood of the coastal village residents.

(b) Commercial Fishing: Commercial fishing is a major factor in the economic health of Kodiak Borough communities, because fishing is the primary source of income for many residents. However, the quantity of fish can be decreased by pollution. Although laws and regulations prohibit ocean discharge of pollutants, the lack of alternative disposal facilities and cost of those that do exist results in discharges of bilge water, used oil, and trash at sea.

(c) Tourism and Recreation: Protection of land or waters used for recreational uses is essential because appeal is decreased by trash, stained soils, distressed vegetation and/or the absence of wildlife. The economic benefits of tourism will flow to those communities that have visual appeal. These resources include local recreational areas in the village as well as state and federal parks, forests and refuges.

- **Addressing Recovery**

The recovery of resources and maintenance of a healthy marine environment in the areas surrounding the coastal villages will be addressed in three ways.

- **First**, a systems approach has been used for identification of waste management problems and prospective solutions. Without the strong community participation demonstrated by Kodiak's participating villages during Phase I, an accurate assessment of problems would not have been possible. Continued use of community participation in decision making, implementation and maintenance of the systems approach will assure long term solutions.

- **Second**, solutions have been sought that maximize sharing of resources between villages and encourage collaboration. Sharing resources is economically prudent for remote villages with limited resources. Sharing resources also has the added advantage of encouraging the villages to work together as a team rather than as individual or fragmented entities.

- **Finally**, solutions have been provided for community self-reliance and self-determination. By becoming self-sufficient during the administration of this project, local villages will be able to maintain their own waste management programs in the future. By addressing waste management issues in these areas, recovery of injured resources and lost or reduced services will be significantly increased. These approaches are described below.

- **Accomplishments that will contribute to achieving objectives**

Systems Approach

Waste management involves the implementation of a system – a complex arrangement of activities and materials, and works when it provides for the needs of the community effectively. In order to be effective, all the system components and relationships between components provide a useful role in the operations. System components can be mechanisms of transport, storage or processing facilities, money, and the people who are the generators of waste and operators of the system. All components are necessary to provide for a successful system, and all activities must be coordinated. By focusing on resources to bolster the weaknesses of the present system, the reliability of the system as a whole can be improved. Successful implementation of the systems proposed here will assure greater success in restoring injured resources, protecting the marine environment and mitigating damage from the oil spill.

Shared Resources – *Collaboration Among All Communities*

By working together in a collaborative fashion, implementing waste management solutions will be easier and less costly. These villages have small populations, no more than a few hundred people in any case, and in this remote environment, there are generally few hands available to do the work of operating local governments, and little money to accommodate the needs of the communities. Prioritization of the use of community time, money and energy sometimes means that important and useful tasks get deferred in spite of the best intentions of the community.

One means of overcoming the constraint of having limited resources is to pool the available resources to provide a larger base to draw upon. This can be done in the villages by sharing equipment and expertise among neighboring villages, or collaborating with other villages for mutual problem solving. This process has already started through initiatives such as the Kodiak Island Village Environmental Council and the Kodiak Island Village Utilities Council and will be expanded through the Borough-Wide Utility Council.

Atmosphere of Self-Reliance and Self-Determination

In rural Alaska villages many decisions involving the lives of local residents are made by outsiders, often government agencies. Many decisions regarding the development of the Kodiak Island Borough coastal villages are being made by KANA, KIB, or the School District in Kodiak; or by State and Federal agencies in Anchorage, Juneau, or in Washington, D.C. As a result, local people have learned to depend on the activities and decisions of outsiders. Only by re-establishing control of community systems locally can those systems be effective. The best approach to complete and strengthen waste management systems in these villages is to stimulate local responsibility and institute local control to the greatest extent possible. Thereby, communities can build an atmosphere of self-reliance that will extend beyond the grants that are currently sponsoring many community efforts, including the development of waste management plans and systems. Phase I of this project provided a good model for local decision-making and planning standards for Phase II.

The objectives of this project were developed to enhance protection of the marine environment while improving human and environmental health in KIB communities. Because the two are interdependent, addressing weaknesses in the present systems and building functional systems for waste management in these coastal villages will in turn increase recovery and enhance protection of the marine environment. The development and enhancement of these systems will be supported and sustained by the education, training and planning of the communities emphasizing an ethic of environmental stewardship. Enhancing village-based technical capabilities and community self-determination and involvement will help to ensure sustaining waste management systems for clean and healthy village and marine environments.

C. Location

This project will be undertaken on a regional scale primarily as a unified regional effort among the following remote coastal villages of Kodiak Island:

- Akhiok
- Chiniak
- Karluk
- Larsen Bay
- Old Harbor
- Ouzinkie
- Port Lions

All project efforts will be undertaken in these remote coastal villages, and all benefits will be realized by these seven communities. In addition, the collaborative efforts of these villages will be enhanced and supported by other area organizations with concern for healthy village and marine environments including the Kodiak Island Borough, Kodiak Area Native Association, private organizations and local, state and federal governmental agencies, non-profit organizations, and private businesses.

In addition to activities within each village, the newly-created Borough-Wide Utility Council will be headquartered in one of the coastal villages.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

- **General**

Throughout this project, community involvement and traditional ecological knowledge has been essential to the development of the Waste Management Master Plan, and will be key in the implementation of the plan in Phase II. All findings and recommendations incorporated in the Plan have evolved with input from each of the villages. Phase I of the project began with trips to each village to develop an understanding of existing and potential pollution problems from first-hand observation and discussions with local residents. Over the course of 13 months, at least five community meetings were held to ensure that all those with interest in the project could speak with members of the project team, voice their concerns and provide their input and observations. Representatives from all of the villages participated in these meetings as well as members of the project team. It has been the approach of these project decision-makers that the most effective way to strengthen waste management systems is to stimulate local responsibility and institute local control to the greatest extent possible.

- **Keeping Communities Involved and Informed with Non-Technical Communications**

The villages involved in the project will be informed of project activities and given the opportunity to provide input through the formation of a Borough-Wide Utility Council. This Council will be a resource for collaborative problem-solving, information exchange, and development of regional solutions. It will effectively be the liaison between the technical team and community members, and will assure that communities fully understand the systems being developed in their communities. Utility system improvements will be coordinated through the Council on an area-wide basis.

This Council will be a combination of two existing informal groups – the Kodiak Island Village Environmental Council (KIVEC) and the Kodiak Island Village Utility Council (KIVUC). Although these two local groups have successfully brought communities together to discuss local planning issues in a non-technical manner, their limited funding, staff and administrative strength have made it difficult for them to deal as effectively with waste management issues as they would like. The new Borough-Wide Utility Council will encompass and expand the focus of KIVEC and KIVUC to provide more time and resources for information sharing and exchange. It will also provide a recognized administrative structure, with formal membership and support from both tribal and city governments. The successful development of this borough-wide resource for collaboration will be the key to the implementation of other project initiatives.

- **Traditional and Local Knowledge**

Project information also will be communicated to the villages through community environmental education and planning initiatives by the Council. These initiatives will take place through broad-based, widespread resident participation in environmental education and planning processes. The curriculum will be developed in conjunction with the Council, the school district, and village tribal council leaders, and will focus on village environmental issues and village resident roles in the waste management process. Special effort will be made to obtain the input of Elders and community residents in the areas of curriculum development and planning.

- **Local Hire**

Local hire and resources will be used to the greatest extent possible for the acquisition of technical knowledge, equipment, and other project resources. The "biggest bang for the buck" to implement the Waste Management Plan can be achieved by developing a network of support and resources for waste management operations in all of the villages. A key component of the systems development is to establish a network of local operations and maintenance specialists within each village with the knowledge, tools, equipment, budget and motivation for the village waste management systems to perform well and reliably. The long-term objective includes creating a program to retain the necessary skills and experience in the villages and continually improve them to ensure continued protection of local marine environments. In addition, local resources for the project will be pooled by sharing equipment and expertise among neighboring villages, and/or collaborating with other villages for mutual problem solving. This process has already started through initiatives such as the Kodiak Island Village Environmental Council and the Kodiak Island Village Utilities Council.

PROJECT DESIGN

During Phase I, two committee meetings held in late 1997 specifically addressed the prioritization of the four main recommendations made to date. These recommendations of Phase I became the Objectives of Phase II.

A. Objectives

Objectives for the Phase II Kodiak Island Borough Waste Management project include the following four initiatives:

A Borough-Wide Utility Council: *Establishing a Resource for Collaborative Problem-Solving*

Systems Development: *Fixing What's There*
(Wastewater Treatment, Solid Waste, Used Oil and Household Hazardous Waste)

Community and Environment Curriculum Development: *Building an Environmental Consciousness*

Local Waste Management Implementation: *Community-Level Planning and Organization*

Kodiak Island village residents selected the second initiative, **Systems Development: *Fixing What is There*** as the highest priority for EVOS funding. Therefore, the requested funds will be used exclusively for systems development. Funding for the other objectives will come from the Kodiak Area Native Association, the communities, and other sources.

B. Methods

The project objectives for FY99 EVOS funding focus on establishing a resource for collaborative problem-solving and pooling of resources, and fixing the current waste management systems in the villages. The effect of accomplishing these objectives will be to shift control and responsibility for community-based waste management systems from outside agencies to the communities. Following is a description of specific actions to be taken to achieve these objectives.

Objective 1: A Borough-Wide Utility Council: *Establishing a Resource for Collaborative Problem-Solving*

Historically, the six remote communities of Kodiak Island have lacked a forum to meet and discuss waste management problems, exchange information, and develop regional solutions. For the Waste Management Master Plan project, KANA convened the Kodiak Island Village Environmental Council (KIVEC) to discuss issues and priorities for waste management system problems at a regional level. The KIVEC has been effective in getting communities together and significant issues onto the table for discussion.

Formation of Utility Council

KIB villages have also established the Kodiak Island Village Utility Council (KIVUC) to provide technical support for a variety of utilities concerns. In the past, the KIVUC sporadically has obtained funding to address specific problems, including contracting with ADEC for two years to provide a remote maintenance worker, arranging for installation of Powerstat devices for Akhiok and Karluk, and undertaking other projects as funding allows. Currently, it operates on a sporadic ad-hoc, volunteer basis that is dormant without specific project funding.

The Borough-Wide Utility Council is envisioned as a combination evolving from the two existing councils. The council will expand to provide more time and resources for information sharing and exchange, as well as provide a recognized administrative structure, with formal membership and support from both tribal and city governments. Utility system improvements would be coordinated through the council on an area wide basis.

As envisioned, this Council will be the next step to strengthen and formalize the work of the existing informal groups. With a full-time director and legal structure, the council will be positioned to empower the communities, support community projects, and provide ongoing project administration.

Utility Council Goals

The specific goals of the Borough-Wide Utility Council objective are to provide:

1. A forum for collaboration to solve problems.
2. A permanent resource for coordination between KIB communities and between communities and outside agencies.
3. An administrative center to manage the business aspects of utility operations.
4. A resource for technical and utility expertise.

The successful development of this borough-wide resource for collaboration will be key to the implementation of the remaining three initiatives.

Utility Council Activities

A preliminary list of activities for this objective is shown below to provide an overview of the Utility Council program and show the value that will be provided by the program to each community and their efforts to sustain on-going waste management and implementation.

- Council members and organizational roles will be identified and formal membership established.
- A mission statement will be formulated, and articles of incorporation and by-laws drafted.
- A legal structure for the entity will be determined.
- The Borough-Wide Utility Council will be incorporated as a non-profit entity.
- A full-time Manager for the Council will be hired.
- Community meetings will be held to develop community involvement and to share and exchange resources and information.
- Board and leadership training will be provided to the Council.
- Council activities will be identified and prioritized.
- Allocation of resources will be determined and utility system improvements coordinated.
- Initial business planning will be completed.
- Programs for on-going leadership training and business planning will be developed.

Funding

Funding for this objective will come from the remote communities of Kodiak Island and the Kodiak Area Native Association, through an ANA implementation grant. The communities will provide in-kind contributions including participants' volunteer labor, while KANA funding will provide for Council staff, travel and Council administrative costs.

Objective 2: Systems Development: ***Fixing What is There***

The objective of the **Systems Development** initiative is to establish a network of operations and maintenance specialists within each KIB village that has the knowledge, tools, equipment, budget, and motivation to make the waste management systems perform reliably and well. The long-term objective includes creating a program to retain the necessary skills and experience in the villages and continually improve them. The participation of the KIB communities in developing and carrying out these objectives was recognized by the community-planning group as particularly important to the success of the entire project.

During Phase I of this project, Members of the Island-Wide Waste Management Plan Committee met five times between November of 1996 and December of 1997. This Committee consisted of 12 individuals (and 5 substitutes) from the seven communities of Akhiok, Chiniak, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions, and all decisions made were made by these village representatives. Representatives from Montgomery Watson, the U.S. Coast Guard, the Alaska Department of Environmental Conservation, Kodiak Area Native Association, and the Kodiak Island Borough also sat on this Committee, serving advisory roles.

At the conclusion of the 13 months during which this Committee met and studied the waste management situation in their area, the following five main components to **Systems Development** were defined:

(A) **Waste Water** - the primary purpose is remedial maintenance of existing community waste water systems. ($57,816)

(B) **Solid Waste I** - the primary purpose is to upgrade and improve land fills and disposal sites and solid waste management. ($1,038,144)

(C) **Used Oil and Household Waste** - the primary purpose is to construct and install storage/disposal facilities and equipment. ($498,651)

(D) **Solid Waste II** - the primary purpose is the collection of household solid waste. ($312,042)

(E) **General** - the primary purpose is general community spill response, systems maintenance and repairs. ($290,432)

At their September 29, 1997 and December17, 1997 meetings, the Committee then evaluated the priority of these five main components with special emphasis on what the community representatives identified as the most important needs of their communities. Their priorities are as follows:

Community Priorities of Systems Development Components

Priority #1	Solid Waste I
Priority #2	Used Oil and Household Waste
Priority #3	General
Priority #4	Waste Water
Priority #5	Solid Waste II

Based on this significant input from the communities themselves, the priorities for the requested EVOS funding will be Solid Waste I, Used Oil and Household Waste and General.

Training Groups

The program consists of a comprehensive operations and maintenance training program for maintenance workers selected from each village, plus the equipment, spare parts and tools necessary for the work. The program focuses on development of handbooks for training and will involve the training group fixing the malfunctioning waste management systems in each village.

As envisioned, each village will hold a competitive selection for several community residents to be trained as operations and maintenance workers. Waste management systems operations are carried out differently in each community and flexibility is required to tailor the structure of the training to the needs of the community.

The formalized, hands-on training program will consist of the training group under the guidance of an experienced specialist to troubleshoot and fix existing problems in the KIB communities.

Training Curriculum

The curriculum will consist of, at a minimum, achieving a thorough grasp of the following aspects of waste management operations and maintenance:

1. Read and understand existing drawings
2. Troubleshoot problems in facilities and equipment
3. Identify and order spare parts
4. Compile and be responsible for complete tool kit
5. Clean and maintain tools and parts
6. Have, read and understand maintenance manuals or checklists
7. Have, read and understand operations manuals or checklists
8. Develop a preventative maintenance program
9. Identify and plan for routine maintenance requirements
10. Inventory planning and control
11. Budgeting and prioritization
12. Keep maintenance logs and budgets
13. Routine systems inspections
14. Identify suppliers and vendors for unmet needs for parts and services
15. Develop a work ethic that is responsive to the needs of the community
16. Work alongside peers from other KIB villages
17. Meet and talk with system designers, experts and other resources from outside Kodiak
18. Identify, evaluate and contract outside experts, when needed
19. Provide feedback to the community on waste management issues
20. Develop standard safety and environmental practices

Training Activities

Based on community priorities, the requested EVOS funding will be used to pursue components for Solid Waste I, Household Waste, and General. A preliminary list of activities for each of the waste management systems is shown below to provide an overview of the training program and show the value that will be provided by the program to each community and their surrounding marine environments.

Solid Waste I

1. Consolidate materials at landfill, make structural improvements to improve drainage and operations (e.g., trench for depositing solid waste, install a burn box)
2. Identify source of cover material
3. Improve road access and fence landfill
4. Obtain and post signage directing residents in the proper procedures at the landfill (e.g., where to deposit solid waste, areas for household hazardous waste, scrap metal, etc.)
5. Develop an operations plan for the landfill
6. Perform all tasks associated with the plan (e.g., collection, temporary storage, put solid waste into cell, bum, compact and cover)
7. Community education starting with scrap metal marshaling and recycling to create an environmental awareness and immediate, noticeable improvement in the community.

Used Oil and Household Hazardous Waste

1. Build or set up a household hazardous waste and used oil collection facility
2. Develop a streamlined operations plan, including safety and regulatory issues
3. Develop a preventative maintenance checklist to routinely change oil and filters, etc.
4. Practice all items on the operations and preventative maintenance plan
5. Purchase and install additional used oil burners and smart ash burners
6. Install any new, uninstalled oil burner systems
7. Identify appropriate disposal for oily rags, filters, oily water, etc.
8. Identify transportation and disposal facilities for collected materials
9. Formalize used oil storage area and transfer procedures
10. Rig piping and pumps to streamline used oil transfers at existing systems
11. Remove hazardous materials from the scrap metal and transfer to the household hazardous waste facility for transportation and disposal or recycling
12. Set up a hazardous materials waste posting and exchange, and information area for alternative products
13. Develop standard operating procedures that minimize spillage at the bulk fuel tanks and at the home tanks or systems
14. Oversee bulk fuel loading and unloading operations
15. Interface with DCRA and ADEC to prioritize the Kodiak Island bulk fuel storage systems for upgrade
16. Perform monthly fuel inventory to demonstrate that fuel tanks are not leaking
17. Complete HAZWOPER training
18. Procure and maintain spill response materials

General

1. Purchase spill response equipment and spare parts
2. Develop spill response plan
3. Compile community tool kit
4. Maintain tools and parts
5. Routine systems inspections
6. Budgeting and prioritizing

As evident from the list of subjects, many of the most urgent waste management problems will be fixed by the trainees during the training program. This approach fixes frustrating, reoccurring waste management problems in each village using local labor. It builds a network of trained experts in each village and encourages ongoing collaboration between KIB villages, so that when a system breaks, the local experts can bring in additional assistance from other villages.

Funding

Funding for this objective will come primarily from proposed EVOS funding. The Borough-Wide Utility Council will pursue additional funding sources to pursue the final priority areas of Wastewater and Solid Waste II.

Objective 3: Community and Environment Curriculum Development: *Building an Environmental Consciousness*

Community and Environmental Curriculum Development will take place through a close association between the school district and village tribal council leaders. This special curriculum will introduce and emphasize an ethic of environmental stewardship in the community. Closely related would be the development and encouragement of citizenship among village children, providing insight into the way that their community functions. The curriculum development will take place through a close association between the school district and village tribal council leaders.

In the long run, the community and environment curriculum could assist in identifying prospective utility system operators and managers, leading to mentorships.

Since local teachers are fully committed to existing duties, a teacher (or teachers) with specialized expertise would travel from village to village introducing the community environmental systems curriculum, working with the local tribal councils and teaching staff to optimize the interaction with students and residents in each village. The close and extended contact will allow the teacher to build trust and develop a level of communication that is impossible for day visitors and substitute teachers.

Curriculum

The curriculum will be developed in conjunction with the Utility Council and local tribal councils and will focus on issues germane to local village life such as: the hydrologic cycle; use of water and the production and disposal of wastewater; health hazards from exposure to pollutants; protection of subsistence resources; generation, collection, and disposal of garbage; definition and handling of hazardous materials; energy use and conservation; duties and responsibilities of citizens and government; and (for older children) costs and cost recovery mechanisms for waste management systems.

Educational Goals

The specific goals of the Community and Environmental Curriculum Development objective are to create:

- An ethic of environmental stewardship will be introduced and emphasized in the communities.
- Citizenship among village children, providing insight into the way that their community functions, will be developed and encouraged through a close association between the school district and village tribal council leaders.
- Prospective utility system operators and managers will be identified, leading to mentorships.

Educational activities

A preliminary list of activities for this objective is shown below to provide an overview of the planning program and show the value that will be provided by the program to each community and their efforts to sustain on-going environmental education.

- A community environmental curriculum will be developed.
- 7 villages will be introduced to the community environmental systems curriculum.
- Community and environmental projects will be developed in 7 schools.
- Environmental demonstration projects will be introduced in 7 schools.

Funding

Funding for this objective will come from the remote communities of Kodiak Island and the Kodiak Area Native Association, through existing EPA and Indian Health Services grants and a proposed ANA planning grant. The communities' in-kind contributions will include participants' volunteer labor and administrative costs such as meeting space, while KANA EPA funding will provide for teachers and travel and the proposed ANA grant will fund actual curriculum development.

Objective 4: Local Waste Management Implementation: ***Community-Level Planning and Organization***

The Waste Management Implementation program establishes and implements the procedures for on-going community-based waste management systems within each village. The objective is a broad-based, collaborative process for addressing critical on-going waste management issues, as well as to develop a long-term waste management action plan for each village that can and will be sustainable.

Community Participation

Unlike public participation processes in government based planning, community initiatives require full-scale participation from all village residents. Public participation in government processes involves providing the opportunity for public comment and input. On the other hand, the process required to engage village residents actively in sustaining on-going effective waste management requires broad-based, widespread resident participation, with the first step being to engage community members. This process will allow the village members themselves, not outside agencies, and not only village leaders, but all members of the village to have a role in the process and be a part of the village goals.

In order to accomplish the objective of establishing and implementing on-going community-based waste management systems, a necessary starting point will be to engage the villages in the process and provide an action plan for development.

Planning Goals

The specific goals of the Local Waste Management Implementation objective are:

- To establish and implement the procedures for on-going community-based waste management systems within each village.
- To develop a broad-based, collaborative process for addressing critical on-going waste management issues.
- To develop a long-term waste management action plan for each village that can and will be sustainable.
- To engage village residents in the public planning and organization process.

To discuss the following issues:

Technical Issues

- Watershed protection (e.g. zoning, ordinances)
- Ranking of waste management against other community priorities
- Allocation of community funding for waste management
- Environmental oversight for projects implemented in and around the community
- Participation in regional transportation initiatives

Community Issues

- How do community waste management priorities fit into overall community priorities?
- What resources will the community commit to on-going management and implementation of waste management systems?
- What community factors, including business environment, capital, infrastructure, education, quality of life, and natural resources, must be considered in the waste management planning process?
- What community problems, needs and assets must be considered in the waste management planning process?
- How does the community sustain resident support for the ideas and projects outlined during the community waste management planning process?

Planning Activities

A preliminary list of activities for this objective is shown below to provide an overview of the planning program and show the value that will be provided by the program to each community and their efforts to sustain on-going waste management planning.

- Village residents will prioritize environmental concerns against other village issues and opportunities, both short and long-term. This allows the village to prioritize waste management goals that fit the village needs and to choose methods of achieving those waste management goals that are compatible with their level of commitment and their vision of the village's future.
- Village resources will be identified and allocated to environmental concerns and other waste management issues as village members feel is most appropriate.

- Village residents will identify regional activities and on-going initiatives for further local implementation, and/or identify additional local waste management priorities and activities. A written action plan will be developed for each village.

Funding

Funding for this objective will come from the remote communities of Kodiak Island and the Kodiak Area Native Association, through an ANA planning grant. The communities will provide in-kind contributions including participants' volunteer labor and administrative costs such as meeting space, while KANA funding will provide for meeting facilitators, travel and planning supplies.

C. Cooperating Agencies, Contracts, and Other Assistance

The State of Alaska Department of Environmental Conservation is the Lead Trustee for this project and is charged with overseeing the overall project progress.

SCHEDULE

A. Measurable Projects Tasks for FY 99 (October 1, 1998 – September 30, 1999)

September 1 - October 5, 1998	Hire Waste Management Coordinators
October 5 - November 5	Village reconnaissance trips for coordinators Collect as-built records for village facilities Confirm community participants Inventory facilities, equipment, tools, and parts
November 5 - 19	Finalize workshop schedule and equipment needs list
November 19 - December 17	Prepare RFP for HHW/Used Oil Facility Design
December 17 - January 28, 1999	Solicit contractor for HHW/Used Oil Facility Design
March 11 - April 8	Solicit contractor for shotrock/landfill cover
April 1 - May 31	Septic system maintenance
May 1 – Sept 30	Construction of HHW/Used Oil Facilities
July 1 - August 31	Shotrock production; landfill grading and fencing
September 1 - October 31	Scrap metal marshalling/HHW collection
November 11 - January 13, 2000	Solicit Contractor for HHW/scrap removal
September, 2000	Program evaluation and draft final report

B. Project Milestones and Endpoints

October 5, 1998	Waste Management Coordinators hired
November 19, 1998	First meeting of community participants in Kodiak
December 20, 1998	Issue RFP for HHW design contractor
February 11, 1999	Draft Landfill Operations Plans complete
February 11, 1999	Select HHW design contractor
March 11, 1999	Second meeting of community participants
March 11, 1999	Issue RFP for landfill cover/shotrock contractor
April 8, 1999	Select landfill cover/shotrock contractor
June 30, 1999	HHW facilities complete
September 1, 1999	Landfill grading and cover stockpiles complete
November 1, 1999	Scrap metal marshalling, processing, and inventory complete
March 11, 1999	Third meeting of community participants
November 11, 1999	Issue RFP for HHW collections contractor
January 13, 2000	Select HHW collections contractor
June 30, 2000	HHW removed from all communities

C. Completion Date

While this project will be completed by September, 2000, this is a perpetual project -- a project that will be continued by the communities' involvement in on-going planning and improvement of waste management processes to enhance village sanitation and in turn increase the recovery of and maintain healthy marine environments.

PUBLICATIONS, REPORTS AND PROFESSIONAL CONFERENCES

It is anticipated that the processes used in this project by the villages will be well documented so that the knowledge gained may be used for continuous improvement of waste management practices. In addition, an annual project report and a final report upon completion will be presented to the communities and all parties involved, as well as submitted to the funding entities.

Project findings and results will be presented to interested parties in the Kodiak area through the Kodiak Area Native Association and Kodiak Island Borough.

NORMAL AGENCY MANAGEMENT

Not applicable.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

- **Other Restoration Efforts**

This project is an effort that does not affect and benefit only one specific community, but is a unified regional effort among the remote coastal villages of Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions, the Community of Chiniak; the Kodiak Area Native Association (KANA); and the Kodiak Island Borough (KIB) to produce and implement a waste management plan that identifies solutions to the most pressing pollution problems for the coastal villages. The restoration efforts of these seven villages and other concerned entities are a coordinated and integrated effort to increase the effectiveness of village waste management practices and the recovery of their surrounding environments.

In addition, this project is modeled after the Sound Waste Management Plan project that was made possible through funding from the Exxon Valdez Oil Spill Trustee Council (EVOS). All efforts have been made to use existing knowledge gained from that project. However, the Kodiak Island Borough project's focus on the villages, the involvement of the Borough, and the somewhat different set of environmental problems, make it a unique effort.

- **Other Funding Efforts**

In Phase I of the project, a number of prospective funding sources were identified for Phase II of the project for waste management planning, education, training and operational projects. The highest potential grant sources for Phase II of the project (other than EVOS), included the Administration for Native Americans, the U.S. Environmental Protection Agency, U.S. Department of Housing and Urban Development, State of Alaska Department of Natural Resources, and State of Alaska Department of Environmental Conservation. These potential funding sources will also be pursued to create a diverse pool of funding with which to implement all four initiatives of the project.

Project in-kind support will be provided by the six remote communities of Kodiak Island including:

<u>Personnel</u>
- Community planning and organizational meetings
- Borough-Wide Council Meetings
- Supplemental Salaries
- Volunteer Labor

<u>Facilities</u>
- Land for siting facilities
- Use of heavy equipment
- Space for community planning and organizational meetings

<u>Administration</u>
- Workspace, communications, support services
- Ongoing operation and maintenance of existing and new facilities

The Kodiak Area Native Association will provide funding, from existing EPA and Indian Health Service grants, for the environmental curriculum development objective to support teacher and travel costs. Additionally, KANA will submit a grant proposal to the US Department of Health

and Human Services, Administration of Native Americans to support formation and implementation of the Borough-wide Utility Council, development of environmental curriculum materials and to implement Local Waste Management planning.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

There have been no changes in the project plan for the Kodiak Island Borough Waste Management project. Phase I of this project was completed in FY98 with the development of the final Kodiak Island Borough Waste Management Plan and Phase II of the project entails the implementation of that plan.

PROPOSED PRINCIPAL INVESTIGATOR

Jerome M. Selby, Mayor
Kodiak Island Borough
710 Mill Bay Road
Kodiak, Alaska 99615
Tel: (907) 486-5736
Fax: (907) 486-9376

LITERATURE CITED

Montgomery Watson, *Kodiak Island Borough, Inventory of Pollution Sources and Problems*, April 7, 1997

Montgomery Watson, *Kodiak Island Borough Alternatives Analysis and Potential Funding Sources*, August 7, 1997

Montgomery Watson, *Kodiak Island Borough Master Plan for Waste Management Final Report*, March 2, 1998

FY 99 EXXON VALDEZ TRU[illegible]E COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Budget Category:	Authorized FY 1998	Proposed FY 1999
Personnel		$260,728.0
Travel		$92,000.0
Contractual		$1,420,627.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$1,773,355.0
Indirect		$25,000.0
Project Total	$0.0	$1,798,355.0
Full-time Equivalents (FTE)		18.0
Other Resources		$617,000.0

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002		

Dollar amounts are shown in thousands of dollars.

Comments: The Kodiak Area Native Association will contribute $145,000 for Community and Environment Curriculum Development from existing EPA and Indian Health Service grants. Kodiak Island Borough communities will contribute wages and administrative costs for community leaders participation in Curriculum Development, community level planning and organization and the Borough-Wide Utility Council. Additionally, the Kodiak Island Borough has requested only $25,000 in indirect administrative costs, less than 2% of the total requested funds, and well below its approved indirect rate. The Kodiak Area Native Association will apply to the Administration for Native Americans for $472,000 in funding for the Borough-Wide Utility Council, community and environmental curriculum development, and community level planning and organization.

FY 99

Prepared: 3/15/98

Project Number: 99304
Project Title:Kodiak Island Borough Waste Management Project II
Name: Kodiak Island Borough

FORM 4A
Non-Trustee
SUMMARY

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted		Overtime	FY 1999
Vacant	Village Maintenance Workers		23.0	5215.0		119,945.0
Vacant	Waste Management Coordinator		23.0	6121.0		140,783.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		18.0	11336.0	0.0	
					Personnel Total	$260,728.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1999
Village Maintenance Workers - 6 Villages to Kodiak for 3 Meetings	300.0	21	108	120.0	19,260.0
Waste Management Coordinator	251.0	72	556	98.0	72,560.0
Village Representative - Chiniak to Kodiak for 3 Meetings	0.0	0	6	30.0	180.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$92,000.0

FY 99

Prepared: 3/15/98

Project Number: 99304
Project Title: Kodiak Island Borough Waste Management Project II
Name: Kodiak Island Borough

FORM 4B
Personnel
& Travel
DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

Contractual Costs:	Proposed
Description	FY 1999
Upgrade Landfill inc. excavating, material consolidation & removal, permitting, incinerators, signage, fencing, burn boxes, etc	902,727.0
Construct HHW Sheds	332,500.0
Purchase Used Oil and HHW Equipment	60,900.0
Develop HHW Ops Plan/Regulatory Document	10,500.0
Purchase Spill Response Equipment	14,000.0
Develop Spill Response Plan	17,500.0
Purchase Tools and Parts	52,500.0
Specialized Technical Services	30,000.0
Contractual Total	$1,420,627.0

Commodities Costs:	Proposed
Description	FY 1999
There are no commodities costs for this project.	
Commodities Total	$0.0

FY 99

Prepared: 3/15/98

Project Number: 99304
Project Title: Kodiak Island Borough Waste Management Project II
Name: Kodiak Island Borough

FORM 4B
Contractual & Commodities DETAIL

FY 99 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1998 - September 30, 1999

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1999
There are no new equipment purchases for this project.			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	

FY 99

Project Number: 99304
Project Title: Kodiak Island Borough Waste Management Project II Name: Kodiak Island Borough

FORM 4B
Equipment
DETAIL

Prepared: 3/15/98