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TRUSTEE COUNCIL
ADMINISTRATIVE RECORD

COMMUNITY-BASED HARBOR SEAL MANAGEMENT AND BIOLOGICAL SAMPLING

Project Number:	98244
Restoration Category:	General Restoration
Proposer:	Alaska Native Harbor Seal Commission
Lead Trustee Agency:	Alaska Department of Fish and Game
Cooperating Agencies:	
Alaska SeaLife Center:	
Duration:	3rd year, three year project
Cost FY 96:	128,500
Cost FY 97:	114,900
Cost FY 98:	87,200
Cost FY 99:	0.0
Cost FY 00:	0.0
Cost FY 01:	0.0
Cost FY 02	0.0
Geographic Area:	Prince William Sound, Cook Inlet, Kodiak, Alaska Peninsula
Injured Resource/Service:	Harbor seals; subsistence

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ABSTRACT

This project continues work supported through previous harbor seal restoration projects. A biological sample collection program, implemented in FY96 and expanded in FY97, in Prince William Sound, lower Cook Inlet, and Kodiak Island will continue. Village-based technicians will be selected by the Alaska Native Harbor Seal Commission (ANHSC) and trained to collect samples and transport these samples to Anchorage or Kodiak for further sampling and analysis. The ANHSC will organize a two-day workshop, produce and distribute a newsletter, and coordinate the biological sampling program.

INTRODUCTION

The goal of this continuing project is to support collaboration between subsistence hunters of harbor seals, scientists, and resource management agencies to assess the factors which are affecting the recovery of the harbor seal population of the oil spill area and to identify ways to reduce these impacts. In FY 94 (Project 94244) and FY 95 (95244), the Trustee Council provided funding for the Alaska Department of Fish and Game, Division of Subsistence, to compile available data, collect additional information, and to organize workshops and community meetings with scientists and subsistence users. Participants in the workshops concluded that the lack of a formal organization which represents subsistence users of harbor seals is a major impediment to communication between scientists and hunters and to the inclusion of subsistence hunters as full partners in harbor seal research and restoration. To fill this gap, Alaska Native participants in the harbor seal restoration workshop of March 2, 1995 voted to form an Alaska Native Harbor Seal Commission. In FY 96, Project 96244 assisted the ANHSC by providing it with funds to organize two workshops held in conjunction with commission meetings and to produce and distribute two newsletters and other communications. Another workshop took place under Project 97244 in March 1997.

A second consensus point reached at the workshops was that subsistence hunters are in an excellent position to assist in scientific studies through providing biological samples from subsistence-taken animals. A goal of 96244 was to test the practicality and effectiveness of a community-based harbor seal biological sampling program, designed and administered cooperatively between the University of Alaska, the Alaska Native Harbor Seal Commission, and the Department of Fish and Game. In FY 97, this program was expanded to collect samples from the Kodiak Island area and add Valdez to the sample communities in Prince William Sound. An additional goal is to assist the ANHSC to develop a long-term operating plan for biological sampling independent of restoration funds.

Another consensus point reached at the workshops was that there needs to be a cooperative exchange involving the traditional knowledge and skills of subsistence hunters and the research efforts of western scientists. In order to facilitate this exchange, the Division of Subsistence organized a traditional knowledge database (called "Whiskers!") which incorporates the available information about harbor seals. The Division demonstrated the database at the Restoration Workshop in January 1996 and at ANHSC workshops in March 1996 and September 1996. It was also distributed to subsistence users, resource managers, and scientists through an askSam read-only program. In FY 97, the database was updated through key respondent interviews in the Prince William Sound and lower Cook Inlet communities. The collection of TEK will not be a featured objective in FY 98, although information collected during other activities will be incorporated into the data base. The collection and application of TEK is a featured component of proposed new project entitled "Community-based Harbor Seal Research."

Finally, this project will support other restoration projects proposed for FY 98 and beyond, such as the Marine Mammal Ecosystem Study (\001, \064), the Community Involvement and Traditional Knowledge Project (\052), and the Youth Area Watch (\210), as well as a newly proposed project for FY 98, "Community-based Harbor Seal Research." The project will also contribute to the Trustee Council's recovery objectives for subsistence by facilitating involvement of subsistence users in the restoration process.

NEED FOR THE PROJECT

A. Statement of Problem

The harbor seal populations of Prince William Sound and the northern Gulf of Alaska were in decline before the oil spill for unknown reasons. The spill injured these populations, adding to the decline, and they are not recovering. Harbor seals are a primary subsistence resource in the Alaska Native communities of the oil spill region. Subsistence harvests of harbor seals have declined in many of communities since the spill because of the reduced population size and voluntary efforts on the part of hunters to limit their harvests to aid in recovery. In order to assess these efforts and to identify measures which subsistence users could take to further assist in harbor seal restoration, the Trustee Council funded projects in FY 94 and FY 95 to compile existing data, collect additional information, organize meetings of scientists and subsistence users, and develop recommendations for hunters. Two workshops took place. Among other things, participants at the workshops recognized that without a formal organization representing subsistence hunters of harbor seals, it was unlikely that a consensus on recommendations could be developed or that a dialogue between hunters and scientists could be maintained. Workshop participants stressed that strong involvement of hunters in research activities and management decisions was an essential ingredient in any plan for harbor seal recovery, as is the involvement of traditional knowledge in research efforts. Several other proposed restoration projects will examine the potential causes of the harbor seal population decline and lack of recovery, including mortality caused by humans. The need exists to follow through on the workshop recommendations to support these harbor seal restoration efforts.

B. Rationale/Link to Restoration

The recovery objective for harbor seals states that recovery will have occurred when harbor seal population trends are stable or increasing. Based on findings from two workshops which involved scientists and subsistence users of harbor seals (conducted under Projects 94244 and 95244), meeting this recovery objective will be enhanced by continuing dialogue between scientists and subsistence users, involving subsistence hunters in research efforts, involving traditional knowledge in scientific studies, and collaborating in the development of recommendations for subsistence hunters about how they can assist in harbor seal recovery. For example, subsistence hunters can provide substantial information about the winter location and abundance of seals, the condition of seals taken for subsistence purposes, and seal behavior. This project will implement the recommendations of the workshops by supporting the activities of the newly formed Alaska Native Harbor Seal Commission, funding a workshop and community meetings which review data and hypotheses, collecting and organizing traditional knowledge, developing a biological sampling program, and providing other technical support to the Alaska Native Harbor Seal Commission.

The FY 96 and FY 97 Work Plans included research projects to monitor seal population trends and conduct research to discover why harbor seals are not recovering. These are likely to continue in FY 98. Assessing parameters that affect marine mammal abundance and health requires access to and examination of animals or tissues. Marine mammals are inherently difficult to study and the collection and examination of tissues is further complicated by legal limitations imposed by federal protective measures and permitting procedures. Sacrificing animals for research purposes is either undesirable or illegal, and beachcast carcasses are often too decomposed to be of value. A potentially invaluable source of fresh specimens exists in Alaska, where coastal Alaska Natives still legally use marine mammals for subsistence or handicraft purposes.

For a harvest sampling program of this nature to succeed, it is important that:

1. Local people support the program and its goals, be involved in the sample collection, understand the significance of the data to be collected, be willing to store and ship samples from villages to a central receiver, and be trained and willing to record data and collect samples as instructed.

2. Samples must be easily collected, stored and shipped; may be subsequently sub-sampled by lab technicians; must be analyzed in due time; and results returned to villages.

Furthermore, over the last several years, the Trustee Council has attempted to involve spill-area communities more fully in the restoration process. The biosampling effort is a prime example of this involvement and collaboration.

C. Location

The biological sampling portion of the project will include the Prince William Sound communities of Cordova, Chenega Bay, Valdez, and Tatitlek; the lower Cook Inlet communities of Seldovia, Port Graham, and Nanwalek; and two Kodiak Island communities, Akhiok and Old Harbor. Other communities that will receive information from the project and may be included in the ANHSC Workshop include Seward, Ouzinkie, Kodiak, Port Lions, Larsen Bay, Karluk, Chignik Bay, Chignik Lagoon, Chignik Lake, Ivanof Bay, and Perryville.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Community and subsistence user involvement in the restoration process and in harbor seal recovery is a central purpose of this project. A primary goal is support of the activities of the Alaska Native Harbor Seal Commission. With project funds, the ANHSC will organize a two-day workshop for representatives of oil spill area communities which use harbor seals for subsistence purposes conducted in conjunction with an ANHSC meeting. The ANHSC will also organize community meetings to inform hunters of restoration activities, harbor seal research, and ANHSC functions. These meetings can serve as a means to develop subsistence hunter involvement in ongoing research efforts. The ANHSC will also produce a newsletter. As part of the biological sampling effort, the ANHSC will select technicians (most of whom will be subsistence harbor seal hunters) in participating communities. These technicians will be trained by a marine mammals biologist to collect biological samples. Subsistence hunters will supply the samples and will be trained through the use of an instructional video (produced in FY 96), and through hands-on instruction as needed. Also, participants in the Youth Area Watch Project (\210) will be included in project activities, including community technician training sessions and the workshop.

PROJECT DESIGN

A. Objectives

The primary premise upon which this project is based is that restoration of harbor seal populations will be facilitated by involving subsistence users in research and management activities, and through facilitating the involvement of traditional knowledge in scientific studies. Key to the success of this effort is support for the activities of the Alaska Native Harbor Seal Commission. Specific objectives include to:

1. Continue a community-based program to collect biological samples and other information from harbor seals in Prince William Sound and the northern Gulf of Alaska involving hunters from Cordova, Tatitlek, Chenega Bay, Valdez, Seldovia, Port Graham, Nanwalek, Akhiok, and Old Harbor. Specific sub-objectives include:

a. Train local technicians and hunters in biological sample collection procedures
b. Operate the program to maximize sampling for efficiency and coordination with other harbor seal projects
c. Evaluate the program's effectiveness and develop a more long-term funding plan.

2. Collect biological samples and other information from harbor seals harvested by subsistence hunters in 9 communities: Tatitlek, Chenega Bay, Valdez, Cordova, Seldovia, Port Graham, and Nanwalek, Akhiok and Old Harbor. Provide these samples to researchers for analysis.

a. Collect information about the number, sex, approximate age and place and date of harvest for harbor seals taken in each village
b. Collect biological samples to be analyzed in cooperation with other harbor seal projects, including blubber, whiskers, skin, female reproductive tracts, and stomachs
c. Store samples in a community freezer and periodically ship samples to Anchorage or Kodiak for further processing and distribution for analysis

3. Utilizing the services of the Alaska Native Harbor Seal Commission, communicate information about results of harbor seal studies to hunters and scientists on a regular basis through community meetings, workshops, and newsletters.

a. Conduct a two-day workshop, in conjunction with a meeting of the ANHSC, which includes hunters from oil spill communities, harbor seal biologists, and agency representatives, to review recent findings about harbor seals and discuss important issues
b. Conduct one community meeting per year in each of communities participating in the biological sampling program for hunters and scientists to review and exchange scientific information and traditional knowledge
c. Produce an informational newsletter describing results of harbor seals studies, ongoing harbor seal research, and community involvement

4. Collaboratively produce recommendations for subsistence users of harbor seals which derive from study findings and the discussions at community meetings and workshops

a. These recommendations will be based on traditional knowledge, contemporary observations, and scientific findings
b. Recommendations will be developed at workshops and community meetings.

5. Evaluate the program's effectiveness and develop a more long-term funding plan for ANHSC activities and the biological sampling program

6. Coordinate with the Youth Area Watch Program (Project /210) to involve participants in that program in biological sampling and workshops

B. Methods

Objectives 1 and 2: Biological Sampling Program

For Objectives 1 and 2, the Biological Sampling Program, the following procedures will be used:

1. Training. As part of Project 96244 (and revised as part of 97244), a marine mammal biologist, Kate Wynne of the University of Alaska, and Vicki Vanek, a veterinarian with the Division of Subsistence (ADF&G) compiled protocols, synthesized these into useable formats, developed data forms, labels, and sampling kits, and incorporated instructions for their use into a training program. In FY 98, these materials will be revised as appropriate.

Instruction. Sampling requires instruction or training of community-based sampling technicians, who ideally are also subsistence seal hunters. Any new village-based technicians will attend a full-day sampling training session in Kodiak or Anchorage in which Wynne or Vanek will: provide a detailed explanation of project goals, and significance and use of data to be collected; distribute sampling kits; explain and demonstrate sampling techniques and use of equipment; and distribute written and graphic instructional materials to take to villages. An alternative is for Vanek to travel to the community to train a replacement.

Other hunters will be informed of program objectives and specified sampling requirements through communication with village technicians and other project personnel and through written, graphic, and video instructional materials. If hunters or technicians need additional "hands on" training, Vicki Vanek of the Division of Subsistence or other division personnel may be available to travel to the communities to provide this assistance.

2. Training materials.

Manual: This was produced in FY 96. It includes step-by-step diagrams and a visual guide. It is waterproof and is included in the sampling kit. In FY 97, the manual is being converted into a computerized format that can be easily updated, modified with regional information, and include some photos. Labor is also involved in laying out, laminating, and binding each book.

Examples: If a seal is available, at the training session participants work on an actual animal, filling in data forms and labels. Otherwise, the training relies on slides and the training video.

Video. In FY 96, a training video was produced by ADF&G, incorporating footage shot at the two training sessions. It has been distributed to the technicians trained at these sessions. The video includes: project rationale and objectives; footage of current research and population declines; significance and use of data to be collected; demonstrations of how to fill in data forms and labels; demonstrations how to use sampling kit and supplies; demonstrations of where and how to remove tissues from animals; and demonstrations of how to sub-sample, bag, and label tissues.

3. Sample collections

Technicians. There is a village-based technician in each participating community, whose responsibilities are to take samples from seals taken by themselves or participating hunters, record data as requested, assure access to freezer and sampling supplies, notify Wynne or Vanek when supplies are low or freezer is nearly full, and load and ship coolers with samples to Anchorage or Kodiak.

Key hunters. Ideally at least two hunters per village provide subsistence taken seals from which the technicians take samples, and record data as requested.

Sample size and distribution: It is difficult to predict the number of samples that may be collected in this program annually or by community, but we have assumed an average of 10 animals per community while designing the sampling strategy and estimating project costs.

Tissues to be collected. A minimal sample can be collected by technicians in each village with relative ease and subsequently sub-sampled in Anchorage or Kodiak to provide the suite of tissue samples required. We have trained and asked technicians and hunters to record information about harvest location and animals' sex, evidence of tags or markers, and standard measures of length and girth. Technicians are trained to collect the whole head (with hide and blubber intact); stomach (after tying off both ends), samples of liver, heart, and kidney; and female reproductive tract. Although collecting the reproductive tracts and claws is highly desirable, it is realistic to assume they will be collected opportunistically only from those hunters willing to dedicate extra effort required to collect them.

Sampling procedure.

Step 1. In the community: village technician receives sample from the hunter, or works with an animal they have taken themselves. The data form is filled out by hunters in the field and in the community by the technicians, or by youth from the Youth Area Watch project. The data form is placed inside the specimen bag with samples for village-based storage. Technicians have a kit that includes supplies adequate for sampling of 10 animals. Among the items in each kit are 1) ziploc sampling bags for collection of the head, stomach, and tissues, 2) large garbage bags in which to place the sample bags collected from each animal, and 3) data forms and specimen labels. The head, stomach, and tissues will each be individually bagged in a two gallon ziploc bag. All these sample bags are placed in one large garbage bag along with the specimen label from the bottom of the data form. The specimen bag and the data form are placed in a freezer without sub-sampling, the technician contacts Kate Wynne (for Kodiak villages), Vicki Vanek (for Prince William Sound and lower Cook Inlet villages) or the ANHSC when a full shipment has accumulated, and then sends the samples to Kodiak or Anchorage.

Step 2. Kate Wynne in Kodiak receives samples and stores them at the Fisheries Technology Center; or, Vicki Vanek receives samples in Anchorage and stores them at ADF&G. Periodic sub-sampling efforts occur as depicted in Fig. 1. Subsamples from each seal are repackaged into individual bags and labeled, specifying organ and origin; tied securely, refrozen, and shipped to the appropriate laboratory (see Fig. 1).

Data collection.

Data are recorded on forms which will allow for standardization of data with other harvest-sampling programs. Sample label and freezer log forms have been developed to assure adequate sample tracking. Each animal receives a unique number that is tied to the UAF Museum Archive numbering system.

Sample analysis.

The attached Figure 1 provides a summary of the research programs involved in the tissue analysis. It is expected that participating scientists will acknowledge in any reports and publications the role of the ANHSC in facilitating the biological sampling program.

Data management and reporting

Biological data collected from this program are managed and maintained in a data base using software that is easily translated or integrated with software used by other agencies and organizations. This database is centrally maintained (initially by ADF&G) and a summary of the samples collected and analyzed will be included in the project's annual and final reports to the Trustee Council, with copies to pertinent agencies, such as NMFS. Additionally, ADF&G (Vanek) will collate the results of the sample analysis into a readily understandable newsletter, that will be provided to all the project participants.

Summary: Proposed responsibilities of each cooperating group for Objectives 1 and 2:

Kate Wynne, University of Alaska, will:

1. Compile protocols, develop data forms and sampling kits, and incorporate instructions for their use into a training program (this was completed in FY 96; appropriate revisions will take place in FY 97).
2. Synthesize technical information into "user friendly" data forms, labels, and sampling kits
3. Conduct a one-day training workshops in Kodiak, attended by two community technicians, ANHSC staff, and agency personnel
4. Receive samples from village-based technicians from the Kodiak area, process samples in Kodiak, and ship samples to participating researchers for analysis
5. Contribute to statewide database of biological data maintained by ADF&G
6. Participate in the Alaska Native Harbor Seal Commission workshop

7. Help collate results of sample analysis (provided by various researchers) into a readily understandable newsletter
8. Work with ADF&G to integrate these results with information contained in the traditional knowledge data base being updated for this project
9. Write a brief summary of the project for inclusion in the interim and final reports for the Trustee Council

Vicki Vanek of the Alaska Department of Fish and Game, Division of Subsistence will:

1. Assist Wynne in appropriate revisions to the instruction manual
2. Help answer community facilitators' questions
3. Train new community assistants (replacements) if necessary
4. Receive samples from village-based technicians from the lower Cook Inlet and Prince William Sound, process samples in Anchorage, and ship samples to participating researchers for analysis
5. Maintain database of biological data
6. Collate the results of the sample analysis into a readily understandable newsletter.

The Alaska Native Harbor Seal Commission will:

1. Identify and subcontract with 9 community technicians
2. Purchase sampling kits and distribute kits and other supplies to village-based technicians
3. Set up air freight accounts for shipping samples
4. Communicate study findings through workshops, community meetings, and the production of two workshop summaries

Objectives 3, 4, and 5: Communications, Recommendations, and Evaluation

Regarding Objectives 3, 4, and 5, communication of study findings, development of recommendations, project evaluation, and development of a long-term funding plan, is a collaborative effort met through a contract with the ANHSC, which will do the following:

1. Organize one, two-day workshop to be held in conjunction with meetings of the ANHSC. Because the ANHSC is limited to one representative from each region which uses harbor seals (southeast Alaska, the Chugach Region, Cook Inlet, Kodiak, and Aleutian/Pribilofs), participation in the workshop will be expanded to include hunters from spill area communities. This workshop will be modeled after those held under Projects 94244, 95244, 96244, and 97244, which involved review of information by scientists and subsistence hunters. A goal of the workshop is discussion of potential recommendations for subsistence hunters concerning how they can support efforts to restore harbor seal populations.
2. Hold community meetings in the communities involved in the pilot biological sampling project, during which scientists and subsistence hunters review data, traditional knowledge is included in ongoing studies, and any recommendations developed at the workshops are discussed.
3. Writing and distribute a workshop summary which provides overviews of findings from harbor seal research and ANHSC activities.

Also,

4. The Commission co-lead for this project will attend Trustee Council workshops and contribute to Trustee Council's annual and final reports

The Division of Subsistence will provide technical assistance to the Commission as needed.

Kate Wynne, through work on the biological sampling program, will write a report which summarizes the results of analysis of the samples taken as part of this project. The report will be written for a general audience.

Interim and final reports: the Division of Subsistence will prepare interim and final reports for the project overall, with contributions from the collaborating groups.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

A. Kate Wynne, University of Alaska Sea Grant Marine Advisory Program, will be contracted through an RSA with the ADF&G to organize the training and coordinate the sampling components of this project. In FY 98, she will:

1. Revise, as appropriate, protocols, data forms, sampling kits, and instructions for their use that were included in the training program developed in FY 96
2. Receive samples from village-based technicians in Kodiak, process samples in Kodiak, and ship samples to participating researchers for analysis
3. Provide information for the statewide database of biological data maintained by ADF&G
4. Participate in the Alaska Native Harbor Seal Commission workshop
5. Help ADF&G collate results of sample analysis (provided by various researchers) into a readily understandable newsletter
6. Work with ADF&G to integrate these results into the updated traditional knowledge data (Whiskers!)
7. Write a brief summary of the project for inclusion in the interim and final reports for the Trustee Council

Proposed Contract A: Budget

Salary and benefits		
Sampling handling and transfer	0.50 months (0.25 per community)	
Prepare project summary	0.50 months	
Total, salary and benefits (1.0 months)	=	$ 5,600
25% UAF overhead		1,400
Total		7,000

Travel: will be arranged and paid for out of the ANHSC contract

In-kind contribution: The UAF Fisheries Industrial Technology Center will provide facilities at no cost for storing samples in Kodiak and laboratory facilities for Wynne to process samples and send them to participating researchers.

B. In FY 96 and FY 97, a contract was developed with the Alaska Native Harbor Seal Commission to undertake portions of the project. This contract will be amended to include the objectives for FY 98. Tasks for the ANHSC under this contract will include:

1. Purchase sampling kits and distribute kits and other supplies to village-based technicians
2. Set up air freight accounts for shipping samples
3. Identify and subcontract with local community technicians
4. Organize and participate in community meetings in the communities involved in the biological sampling program
5. Prepare brief (letter format) quarterly reports on its activities as related to this project.
6. Attend Trustee Council Workshops and contribute to Trustee Council's annual and final reports
7. Organize a two-day workshop during which, among other things, this project's performance and findings will be evaluated. This will include making all travel arrangements. The workshop will include hunters from the communities involved in the biological sampling program.
8. Prepare a workshop proceedings summary report

Through subcontracts with the ANHSC, community technicians in 9 communities (Cordova, Tatitlek, Chenega Bay, Valdez, Seldovia, Port Graham, Nanwalek, Akhiok and Old Harbor) will do the following:

1. Attend one day training session (if newly hired in FY 98)
2. Collect samples (stomach contents, female reproductive organs, liver, heart, kidney, claws, head)
3. Record information about harvest locations, sex, evidence of tags or markers, length, and girth
4. Label and freeze samples, notify Kate Wynne, Vicki Vanek, or the ANHSC when freezers are full, and load and ship coolers with samples to Kodiak or Anchorage

Contract B: Budget

Personnel	Executive Director for 12.0 months @ $2,000/month	$24,000
Travel	Executive Director travel and travel for workshop participants	15,800
Operational costs		
	phone	2,400
	mailing	1,200
Insurance		1,200
Sampling and freezer supplies, freezer electricity, shipping		4,700
Subcontract, village-based technicians		4,400
15% indirect program cost		8,100
Total		61,800

Note: in kind contributions for the operations of the ANHSC technical assistance from the Chugach Regional Resources Commission (Anchorage), the Alaska Sea Otter Commission (Fairbanks), and the Indigenous Peoples' Council on Marine Mammals (Anchorage).

Subcontract: Village-based Technicians

Training honorarium: $100/day for three new technicians for one day each:	$300
Compensation for taking biological samples of seals	4,050
Total	4,350

Note: it is anticipated that samples will be taken from an average of 10 seals per community, for a total of 90 seals, and that it will take about 3 hours per seal to take samples, store samples, and ship samples. At a rate of $15/hour, this gives: $15 x 3 hours x 10 seals x 9 communities = $4,550.

SCHEDULE

A. Measurable Project Tasks for FY 98

Start-up to October 15:	Update contracts with the Alaska Native Harbor Seal Commission and the University of Alaska; hire technicians
October/November:	Hold training sessions for biological sampling for new community technicians
December to September 1998:	Biological sample collection
February 1998:	Two-day Workshop (Alaska Native Harbor Seal Commission):
March 1998:	Produce and distribute proceedings report (Alaska Native Harbor Seal Commission)
September 1998:	Evaluate third and final year of program

B. Project Milestones and Endpoints

1. Development of sampling program: October/November 1995
2. Production and distribution of Instructional video: March 1996
3. Workshops to train local hunters and technicians in collection procedures: October/November 1995
4. Workshop in conjunction with meeting of Alaska Native Harbor Seal Commission: March 1996
5. Produce and distribute first proceedings report: April 1996
6. Maximize coordination with other programs: ongoing
7. Ship samples to appropriate laboratories for subsequent analysis: ongoing
8. Advise villages and scientists of analytical results when available: ongoing
9. Conduct interviews with hunters to collect traditional knowledge: ongoing
10. Second workshop in conjunction with Commission meeting: September 1996

11. Produce and distribute second proceedings report: September 1996
12. Train new village technicians: November 1996
13. Hold workshop in conjunction with ANHSC meeting: March 1997
14. Demonstrate updated Traditional Knowledge Database: March 1997
15. Produce and distribute proceeding for 1997 workshop: April 1997
16. Annual report: April 15, 1997
17. Complete map database and report: June 1997
18. Evaluate the program's effectiveness and develop a more long-term funding plan: September 1997, September 1998
19. Annual report: April 15, 1998
20. Final project report: April 15, 1999

C. Completion Date

This project should continue as long as the Marine Mammal Ecosystem Research package is underway. Presently, fieldwork and data analysis for this study package are proposed through FY 97, with close-out in FY 98. The biological sampling program should be viewed as a pilot project to continue for a total of three years (FY 96, FY 97, and FY 98) in order to get the system in place and provide enough time for an evaluation of its performance.

PUBLICATIONS AND REPORTS

Annual report April 15, 1997
Annual report April 15, 1998
Final report April 15, 1999

PROFESSIONAL CONFERENCES

No attendance planned for FY 98.

NORMAL AGENCY MANAGEMENT

The Division of Subsistence of the Alaska Department of Fish and Game has no statutory or regulatory responsibilities for marine mammal management. Without this project, marine mammal biologists who are working on harbor seal recovery would lose a key source of biological information on this species. Trustee Council support of the activities of the Alaska Native Harbor Seal Commission is likely to improve management of the injured harbor seal resource by facilitating communications between scientists and subsistence users and providing traditional knowledge to factor in to harbor seal studies. The ANHSC is seeking funding from the National Marine Fisheries Service and Congressional support in accordance with provisions of the Marine Mammal Projection Act to support its long-term activities. Trustee Council support for ANHSC activities at this point enhances the likelihood that this long-term funding will be secured.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will incorporate data on population status, distribution and degree of recovery of harbor seals from the Marine Mammal Ecosystem study package, including restoration project numbers \001 and \064. It will also draw on the results of research conducted by the Division of Subsistence under a contract with the National Marine Fisheries Service to monitor subsistence harvests. The project will provide information to researchers working on harbor seal restoration projects and facilitate their work with Alaska Native hunters. The project will provide biological samples from subsistence-taken harbor seals to address potential health and nutritional problems that may be impeding harbor seal recovery, for projects \001 and \064. Participants in the Youth Area Watch project (\210) will be invited to participate in community technician training sessions and attend the workshop.

Several programs exist to sample tissues from harbor seals from the spill area. As noted above, we will make every effort to coordinate our efforts with these programs to minimize the burden and confusion of hunters and communities, maximize logistical efficiency, collect comparable or standardized data whenever possible, and limit the likelihood of duplication of efforts. The National Marine Fisheries Service has expressed interest and may have funding available to expand this pilot program in subsequent years. This agency may also have funds available to perform analysis of samples as part of its normal agency management functions. Additionally, NMFS will assist with coordinating the harbor seal sampling and testing programs.

Additional funding for the operations of the Alaska Native Harbor Seal Commission has been sought from the National Marine Fisheries Service and the U.S. Congress. Such funding would support more extensive activities for the Commission across the entire range of the harbor seal in Alaska. As of April 1997, a congressional appropriation to support basic commission functions (office, accounting, travel to conferences) was being administered through NMFS. The ANHSC received a Title VIII ANILCA grant to assist in the development of co-management plans.

Also, the traditional knowledge database component of this project will directly support efforts under Project Number \052 to integrate traditional knowledge of injured resources more broadly into restoration efforts and scientific studies. This will include a model for database organization and training in uses of the database. In turn, Project \052 has, among other things, developed guidelines and protocols for collecting and using traditional knowledge which will be supportive of the efforts for harbor seal restoration.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

No additions to project objectives or methods of the detailed project description submitted and approved for FY 97 are being proposed. Efforts to collect traditional ecological knowledge are being shifted to a proposed new project, tentatively titled "Community-based Harbor Seal Research.

ENVIRONMENTAL COMPLIANCE

This project is a continuation of Projects 94244, 95244, 96244, and 97244, which were classified as categorically excluded under NEAP guidelines. While this project will collect biological samples from subsistence-taken harbor seals, the sampling effort will not result in any additional takings of seals.

PROPOSED PRINCIPAL INVESTIGATORS

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PERSONNEL

Kate Wynne is a marine mammal biologist with the University of Alaska, stationed in Kodiak. She has extensive experience in working with Alaska Native subsistence hunters. In 96244 and 97244, Ms Wynne was responsible for designing and implementing the biological sampling program objectives in this project, including holding two village based technician workshops, and developing data forms and data management procedures. She will continue these responsibilities in FY 98, with funding support of one month. She will also write a report which summarizes findings from the sampling program, and assist the Alaska Native Harbor Seal Commission in reporting study findings to local communities.

Monica Riedel, an Alaska Native resident of Cordova, is the chairperson of the Alaska Native Harbor Seal Commission. She has extensive experience in marine mammal issues through her work with the Alaska Sea Otter Commission. Ms Riedel is responsible for the ANHSC activities under this project, including identifying and subcontracting with local village technicians, developing subcontracts, and participating in workshops and community meetings.

James Fall is the Regional Program Manager for the Division of Subsistence in Anchorage. Dr. Fall is responsible for overall project performance. He will also coordinate preparation of annual and final reports. No restoration funds are being requested for support of his time on this project.

Vicki Vanek is a Fish and Wildlife Technician with the Division of Subsistence in Kodiak. She holds a Doctor of Veterinary Medicine degree, and has worked on previous Division projects in collecting marine mammal samples and training hunters as well as on the biological sampling tasks of 96244 and 97244. She will be available as needed to assist hunters and community technicians, and will train newly hired technicians. Dr. Vanek will also process samples received from the Chugach Region communities. She will also prepare a newsletter which reports results of the biosampling efforts. One and three quarters months of funding is being requested for her work on this project.

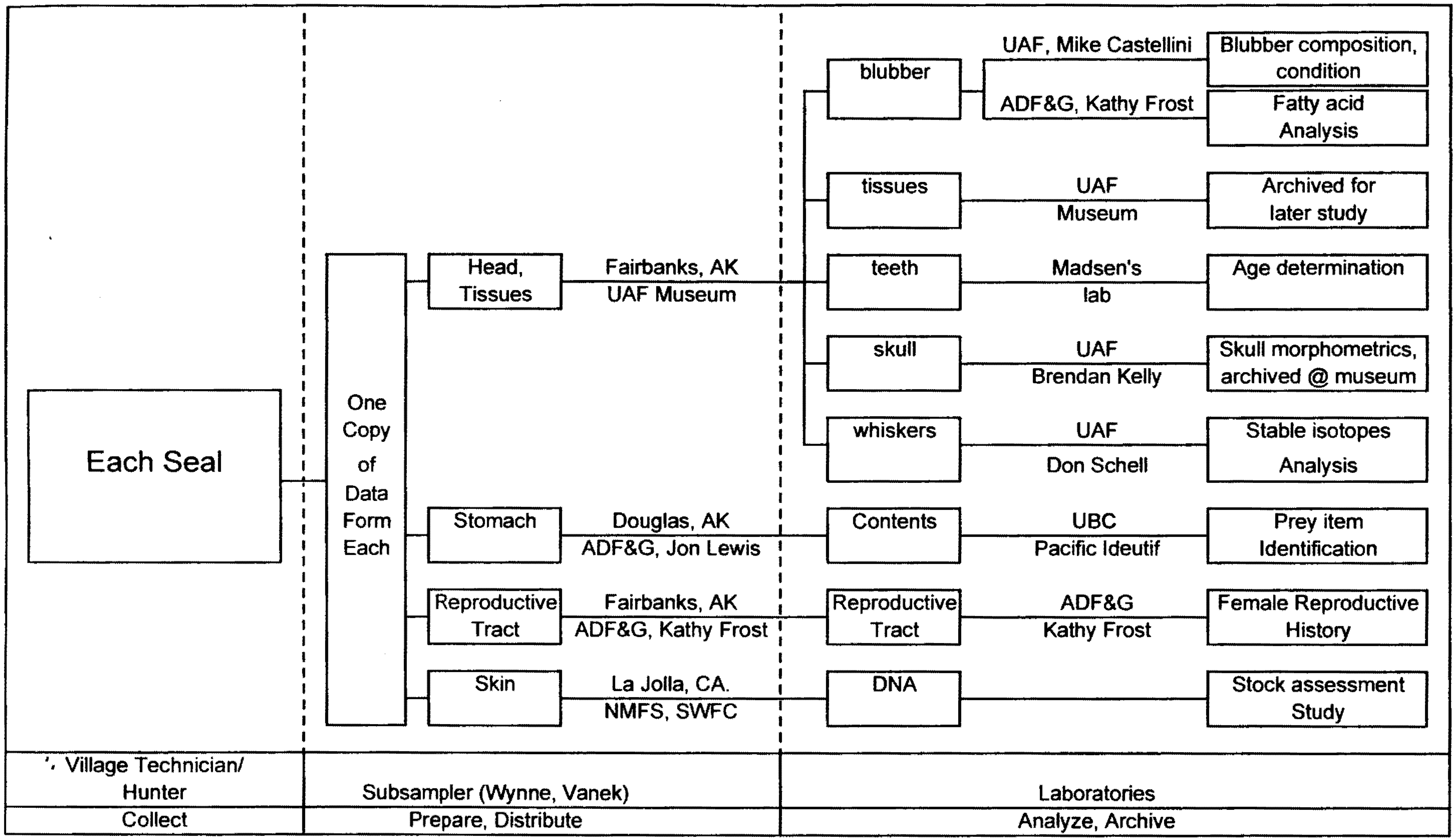

Figure 1. Sample Distribution and Chain of Responsibility

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel	$15.4	$7.2
Travel	$3.9	$3.2
Contractual	$85.7	$69.8
Commodities	$1.2	$1.0
Equipment	$0.4	$0.0
Subtotal	$106.6	$81.2
General Administration	$8.3	$6.0
Project Total	$114.9	$87.2
Full-time Equivalents (FTE)	0.3	0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
	$0.0	$0.0	$0.0	$0.0	

Dollar amounts are shown in thousands of dollars.

Comments:

1998

Prepared:4/10/97

Project Number: 98244
Project Title: Community-based Harbor Seal Management and Biological Sampling
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/11/97

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
Vicki Vanek	Fish and Wildlife Technician III	11F	1.8	4.0		7.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.8	4.0	0.0	
					Personnel Total	$7.2

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Kodiak - Anchorage	0.2	2	4	0.1	0.8
Anchorage - Seldovia/Pport Graham/Nanwalek	0.3	1	3	0.1	0.6
Anchorage - Tatitlek	0.6	1	3	0.1	0.9
Anchorage - Chenega Bay	0.6	1	3	0.1	0.9
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.2

1998

Prepared:4/10/97

Project Number: 98244
Project Title: Community-based Harbor Management and Biological Sampling
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

Contractual Costs:	Proposed
Description	FY 1998
4A Linkage (1) Contract with Alaska Native Harbor Seal Commission	61.8
4A Linkage (2) RSA with University of Alaska	7.0
Air frieght for shipping samples from Anchorage and Kodiak to participating labs	1.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$69.8

Commodities Costs:	Proposed
Description	FY 1998
Shipping supplies and subsampling supplies	1.0
Commodities Total	$1.0

1998

Prepared:4/10/97

Project Number: 98244
Project Title: Community-based Harbor Seal Management and Biological Sampling
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities
DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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

1998

Prepared:4/10/97

Project Number: 98244
Project Title: Community-based Harbor Seal Management and Biological Sampling
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel	$24.0	$24.0						
Travel	$8.2	$15.8						
Contractual	$30.3	$12.4						
Commodities	$2.0	$1.5						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$64.5	$53.7		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
Indirect	$9.7	$8.1						
Project Total	$74.2	$61.8						
Full-time Equivalents (FTE)	6.0	6.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: Indirect = 15% of program costs

1998

Prepared:4/10/97

Project Number: 98244
Project Title: Community-based Harbor Seal Management and Biological Sampling
Name: Alaska Native Harbor Seal Commission

FORM 4A
Non-Trustee
SUMMARY

1998 EXXON VALDEZ TRUSTE UNCIL PROJECT BUDGET
October 1, 1997 - ! ember 30, 1998

Personnel Costs:

Name	Position Description		Months Budgeted	Monthly Costs	Overtime	Proposed FY 1998
Monica Riedel	Executive Director		6.0	4.0		24.0
						0.0
	Note: works half time for 12 months					0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		6.0	4.0	0.0	
					Personnel Total	$24.0

Travel Costs:

Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1998
Juneau - Cordova (workshop)	0.3	1	2	0.2	0.7
Chenega Bay -Cordova (workshop)	0.8	1	2	0.2	1.2
Tatitlek - Cordova (workshop)	0.6	3	6	0.2	3.0
Port Graham, Nanwalek and Seldovia - Cordova (workshop)	0.4	3	6	0.2	2.4
Akhiok, Port Lions, Larsen Bay, and Old Harbor - Cordova (wrksh	0.4	4	8	0.2	3.2
Chignik Lake - Cordova (workshop)	0.9	1	3	0.2	1.5
San Francisco - Cordova (A. Hoover -Miller to workshop)	0.6	1	3	0.2	1.2
Anchorage - Cordova (workshop and restoration workshop)	0.2	2	5	0.2	1.4
Valdez - Cordova (workshop)	0.1	1	2	0.2	0.5
Kodiak - Cordova (Wynne to workshop)	0.3	1	2	0.2	0.7
					0.0
					0.0
				Travel Total	$15.8

1998

Prepared:4/10/97

Project Number: 98244
Project Title: Community-based Harbor Seal Management and Biological Sampling
Name: Alaska Native Harbor Seal Commission

FORM 4B
Personnel
& Travel
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
Phone 12 months @ 200/month	2.4
Postage 12 months @ 100/month	1.2
Insurance	1.2
Elecricity for village freezers	2.2
Subcontracts with community technicians	4.4
Training honorarium: 3 replacements/$100 each = $300	
Sample processing: 9 communities, 10 seals/community, $45/seal = $4050	
Shipping biological samples	1.0
Contractual Total	$12.4

Commodities Costs:	Proposed
Description	FY 1998
Purchase replacement materials for sampling kits (knives, gloves, plastic bags((6 kits)	0.1
Purchase new sampling kits (3 kits @ 120/kit)	0.4
Shipping supplies	1.0
Commodities Total	$1.5

1998

Project Number: 98244
Project Title: Community-based Harbor Seal Management and Biological Sampling
Name: Alaska Native Harbor Seal Commission

FORM 4B
Contractual &
Commodities
DETAIL

Prepared:4/10/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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	

1998

Prepared:4/10/97

Project Number: 98244
Project Title: Community-based Harbor Seal Management and Biological Sampling
Name: Alaska Native Harbor Seal Commission

FORM 4B
Equipment
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel	$7.3	$5.6						
Travel	$0.0	$0.0						
Contractual	$0.0	$0.0						
Commodities	$0.0	$0.0						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$7.3	$5.6		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
Indirect	$1.8	$1.4						
Project Total	$9.1	$7.0		$0.0	$0.0	$0.0	$0.0	
Full-time Equivalents (FTE)		1.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: Indirect for UAF = 25% of program costs

1998

Prepared:4/10/97

Project Number: 98244
Project Title: Community-based Harbor Seal Management and Biological Sampling
Name: University of Alaska

FORM 4A
Non-Trustee
SUMMARY

4/11/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:							
	Name	Position Description		Months Budgeted	Monthly Costs	Overtime	Proposed FY 1998
	Kate Wynne	Research Associate Professor		1.0	5.6		5.6
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
		Subtotal		1.0	5.6	0.0	
						Personnel Total	$5.6

Travel Costs:		Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1998
	Description					
						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

1998

Prepared:4/10/97

Project Number: 98244
Project Title: Community-based Harbor Seal Management and Biological Sampling
Name: University of Alaska

FORM 4B
Personnel
& Travel
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
Contractual Total	$0.0

Commodities Costs:	Proposed
Description	FY 1998
Commodities Total	$0.0

1998

Prepared:4/10/97

Project Number: 98244
Project Title: Community-based Harbor Seal Management and Biological Sampling
Name: University of Alaska

FORM 4B
Contractual &
Commodities
DETAIL

1998 EXXON VALDEZ TRUSTI)UNCIL PROJECT BUDGET
October 1, 1997 - ..ember 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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 a		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	

1998

Prepared:4/10/97

Project Number: 98244
Project Title: Community-based Harbor Seal Management and Biological Sampling
Name: University of Alaska

FORM 4B
Equipment
DETAIL

98247

Kametolook River Coho Salmon Subsistence Project

Project Number:	98247
Restoration Category:	General Restoration
Proposer:	Perryville Village Council
Lead Trustee Agency:	ADFG
Cooperating Agencies:	NONE
Alaska SeaLife Center:	NO
Duration:	2nd year, 6-year project
Cost FY 98	$14.5
Cost FY 99	$14.8
Cost FY 00	$15.1
Cost FY 01	$15.4
Cost FY 02	$15.7
Geographic Area:	Perryville/ Kametolook River/ Alaska Peninsula
Injured Resources/ Service	Subsistence

RECEIVED
APR 11 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

Subsistence users from the remote Alaska Peninsula Native Village of Perryville (Figure 1) have noted significant declines in the coho salmon run in the nearby Kametolook River since the *Exxon Valdez* oil spill (EVOS) in 1989. This project is a continuation of a project funded for one year (1996) through the EVOS criminal settlement. The Trustee Council began funding the project in Federal Fiscal Year 1997. The criminal settlement funded the first year of the project for an assessment team consisting of approximately 4 specialist staff from ADF&G and 2 to 4 local assistants of the Native Village of Perryville, to assess the Kametolook River and determine what method would best be suited to the river in efforts to restore its coho salmon stock to historic levels.

This project would provide funding through FY 2002 for ADF&G to try conservative and safe restoration methods best suited to the rivers salmon stocks as determined in the first year of the project. Instream incubation boxes will be evaluated as the primary restoration tool to rebuild the depressed coho (or possibly chum) salmon stock needed for subsistence in the Kametolook River. Habitat improvements for spawning and rearing habitat will also be considered. Ultimately, some combination of both may be the best approach to restoring salmon as a subsistence resource.

INTRODUCTION

This subsistence project is designed to restore coho (and/or chum) salmon subsistence opportunities in the Alaska Peninsula village of Perryville. The project was initiated during community workshops held by the Subsistence Restoration Planning Team. Workshops in Perryville took place in September 1994 and May 1995. The project was subsequently endorsed by the Perryville Village Council. The project was also discussed and endorsed by the Chignik Regional Planning Team in the spring of 1995 and again in December 1996. Alaska Department of Fish and Game, Division of Commercial Fisheries, westward region staff assigned to the Chignik and Alaska Peninsula regions and the Division of Subsistence, have been involved in the planning and development of the project. In addition, an ADF&G biologist in the Norton Sound Region has provided technical expertise regarding the use of both instream incubator boxes and recirculating water incubators, which have been successful in the Norton Sound Region. Alaska Department of Fish and Game, Division of Habitat and Restoration staff have also been involved with the project, especially with the development of an Environmental Assessment.

In 1996, funding for the evaluation phase of the project was provided through a grant to the Native Village of Perryville by the Alaska Department of Community and Regional Affairs, using EVOS criminal settlement funds. During consultation about this grant, the State members of the Trustee Council requested that a proposal to the full Trustee Council be prepared to support the implementation of the project in subsequent years. This was accomplished and the Trustee Council began funding this project in Federal Fiscal Year 1997.

It has been determined by the assessment team that local salmon stock instream incubator boxes are the best method to help restore Kametolook River coho salmon runs. Applications for ADF&G fish transport permits and a general habitat waterway/waterbody application are being reviewed. The assessment team will work with the Principal Geneticist, Principal Pathologist and Area Management Biologist to have the most safe and satisfactory project possible to help restore coho salmon in the Kametolook River to historic levels.

NEED FOR THE PROJECT

A. Statement of Problem

Since Perryville was founded in 1912, the Kametolook River has provided the community with much of their supply of subsistence coho salmon. Since the *Exxon Valdez* oil spill, Perryville residents have noted that there are fewer and fewer coho salmon in the river. It has become such a problem that many families must travel further away from Perryville to find sufficient amounts of salmon. Their use of these other areas has put additional pressure on fish stocks used for subsistence by the neighboring villages of Ivanof Bay, and the three Chignik villages.

Salmon are very important for Native people of Perryville, and are relied on greatly for their subsistence as well as economic livelihoods. Commercial fishing is the mainstay of Perryville's cash economy, where many residents travel to fish camps in Chignik Lagoon and Chignik Bay in the summer months to commercial fish, as well as to put up fresh sockeye salmon for smoking, canning or freezing. Those people who spend summer months in Chignik return to Perryville in the fall to put up coho salmon that are also smoked, as well as dried. Many other Perryville residents, however, do not commercial fish and stay in Perryville year around. Gradually throughout the summer, they travel to the Kametolook River to catch their year's supply of subsistence salmon which are primarily coho, pink, and chum salmon. (Sockeye, estimated at fewer than 100 adults annually, also spawn in the Kametolook River.)

Division of Subsistence personnel first did research in Perryville in 1984. Starting in 1990, the division has documented concerns by local residents that coho salmon availability in the Kametolook River is far below historical levels. Fish and Game biologists working in the Chignik region believe coho salmon stocks in the Kametolook River might be depressed, but have little data regarding historic or present escapement levels for this small, remote river.

B. Rationale/Link to Restoration

Salmon runs to the Kametolook River have been declining in recent years. Members of the village of Perryville requested the EVOS Trustee Council to fund a restoration project and they asked ADF&G to assist with this project. The cause of the decline in salmon numbers is unknown. A restoration project cannot be successful unless the cause of the decline is understood and the project is "fixing" the "right problem".

An appropriate salmon restoration project will hopefully increase Kametolook River salmon relied on for subsistence by Perryville people back to historic levels. If more fish are available for subsistence, it will not only provide people with more coho and/or chum salmon, but it will also take pressure off of other subsistence resources that were hurt by the spill, such as clams, seals and sea lions, as well as recent declines of local caribou.

C. Location

The remote Native village of Perryville is located approximately 500 air miles southwest of Anchorage on the Pacific side of the Alaska Peninsula. Veniaminof Volcano overlooks the village that is situated directly along the Pacific Ocean coastline with beaches of volcanic black sand. The Kametolook River is located four miles northeast of Perryville, and is easily accessible from the community via ATV, foot, or boat.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The Trustee Council's goal of achieving additional local public involvement in the restoration process is addressed in that Perryville will be a partner with ADF&G biologists in this project. This project has been discussed and endorsed by the Chignik Regional Planing Team and the Perryville Village Council. Through project funds, the Perryville Village Council is responsible for hiring local assistants, and providing necessary logistical support for the operation of this project. The community has also contributed much in terms of local knowledge of the environment, including: historic to contemporary salmon run timing and numbers, subsistence harvest levels over time, identifying physical changes to the Kametolook River over time, helping ADF&G identify spawning and rearing areas, and identify potential characteristics of the river, such as where winter freeze over or spring and fall flooding might occur.

Several residents of Perryville have worked with ADF&G during assessment and implementation phases of the project. In addition, the local assistants will monitor the project throughout the year, when ADF&G will not be present. Local assistants through hands-on involvement have been trained by ADF&G biologists to monitor temperature and water level stations, to monitor the egg incubation box(s), participate in egg takes for seeding the incubation box, transporting eggs to the classroom incubator, and will transport fry to nearby lakes or adjacent rivers (depending on what the Fish Transport Permits allow).

Perryville residents have been kept informed about the progress of the project through the Village Council and village meetings. During these meetings residents have been informed about salmon run strengths, harvest levels, and rearing and habitat issues. The community has been encouraged to come up with ways that they can contribute toward restoring the coho run, such as developing sanctuaries in coho ripening and spawning areas where people will not fish.

School children have had opportunities to learn, understand and appreciate the complexities of the growth cycle of salmon through the use of a classroom aquarium that is raising coho salmon from egg to fry stages. If the fish resource permits allow, these fry will be released into one of the two landlocked lakes or into the Kametolook River. In addition, when allowed by the teachers and parents, older school children have accompany biologists to the river and nearby lakes to assist with minnow trapping and biological and habitat sampling.

PROJECT DESIGN

The primary goals of the project is to increase the coho and/or chum salmon returns to the Kametolook River, and include the people of Perryville through involvement in the project and education. The method(s) used to accomplish this have been determined in 1996 and

1997 by a team of ADF&G specialists, and local Perryville residents. Funding for the first portion of the project was provided through a grant to the Native Village of Perryville from the criminal settlement funds. Beginning in Federal Fiscal Year 1997 funding has been provided by the Trustee Council. Once an appropriate rehabilitation method is determined by the team and the necessary permits and the Environmental Assessment is approved, this project has the potential to make restoration of salmon in the Kametolook River possible. Similar projects in other regions of Alaska have proven to be successful.

Instream incubation boxes has been one method evaluated. A test incubation box was positioned in a head water tributary of the Kametolook River to use the natural flow of water from the stream to incubate the salmon eggs. This portion of the project has been successful. In a production phase of this project, genetic integrity of the Kametolook River coho salmon would be assured under the guidance of the department's Principal Geneticist. The potential incubation site has water temperatures consistent with natural spawning sites to insure that fry development and emergence occur at the same time as naturally occurring fry. The small scope of this project is not expected to noticeably add any coho salmon to other common property harvest groups (i.e. commercial fisheries).

From similar projects in Norton Sound, it has been found that improved returns were noticeable in about five years. If instream incubators are employed, they will be expected to operate from 1997 through 2002. Since a major expense is in the boxes (materials and installation), and establishing an incubation site, the annual cost of operation and maintenance is not significant.

Other restoration methods to be evaluated will be a recirculating water incubation facility in the village, potential habitat manipulation to create or provide access to better spawning and rearing habitats, and a remote incubation facility.

A combination of methods may be most appropriate.

A. Objectives

There are two main project objectives: the first is community involvement described above, and the second is to restore the coho and/or chum salmon returns to the Kametolook River and provide local subsistence salmon opportunities. The primary species is coho salmon and secondary species is chum salmon. Phase 1 of the project included a complete assessment of the creeks and rivers habitat in proximity to Perryville and interviews to determine salmon run strength, run timing and physical changes to local drainages. Phase 2 will include installation of large capacity streamside incubation boxes, and continuation of the classroom incubation aquarium and education programs for adults and high school students.

B. Methods

Current Accomplishments/ Assessment Phase

1996 (May 96 through December 96): This phase of the project is funded through the Criminal Settlement.

May, 1996: Three ADF&G assessment team members traveled to Perryville and joined with local assistants to assess the Kametolook River in order to make recommendations for the best restoration efforts. A small instream test incubator box (2 foot square plywood box) was installed at the headwaters of the river. The incubator box was also equipped with a thermograph to aid in determining the potential of the incubation site. Thermographs were also installed at three other habitat monitoring locations along the Kametolook River. Our guides showed us the different stream reaches; at this time, there was no evidence of blockages to adult or smolt migration. Blockage and breaching events apparently occur on a scale of about 2-10 years. We were given the impression that the river has relatively unstable spawning areas with current upstream spawning sites improved from prior years. Young-of-the-year and fingerling coho were observed in several slough habitats and small ponds. Several ponds, deep main-stem pools, side-channel sloughs and spring areas apparently do not freeze solid and would provide over winter rearing habitat. During this trip preliminary investigations were also undertaken for possible stocking of rainbow trout or coho salmon into two landlocked lakes (Sandy and Sicken Lakes) in proximity to Perryville. At the high school we discussed potential education projects such as a classroom salmon aquarium and recirculating egg incubators. (A detailed field trip report is available.)

October, 1996: Three ADF&G assessment team members traveled to Perryville and joined with local assistants to expand the habitat surveys of drainages adjacent to Perryville, to place fertilized eggs in the experimental stream side incubation box and to initiate a cooperative educational program in the Perryville school. Local guides showed us much of the historic and potentially productive reaches of the Kametolook, Three Star and Long Beach Rivers. Long Beach River, although historically productive, presently had no quality spawning or rearing habitat. Three Star River, smallest of the three drainages, had some stable reaches but about half of the discharge had changed course and currently flowed into Long Beach River. Some potential rearing habitat is present while spawning habitat appeared to be limited. Kametolook River currently showed the most salmon spawning and rearing potential. However, this system is dynamic and habitat quantity and quality may change annually.

Minnow trapping was conducted in all three drainages. Rearing and spawning habitat in Long Beach River appeared to be negligible. Three Star River had limited high quality slough habitat and supported juvenile coho salmon and Dolly Varden, spawning habitat appeared to be limited to several short stream reaches. Rearing habitat for juvenile coho salmon in the Kametolook River appeared to be quite abundant while upper stream reaches seemed able to support relatively good numbers of spawning salmon. Several high school students assisted with coho fingerling data collection efforts.

Trap catches and age-classes of juvenile coho salmon are summarized below:

Location	Site	No. Traps	Total Trap Hr.	Catch per Trap-Hour Coho	Catch per Trap-Hour Dolly Varden
Kametolook	Candlefish Slough	4	2.50	36.1	150.5
Kametolook	Fingerling Slough	5	5.40	44.6	10.5
Kametolook	Cross Creek	4	2.16	19.9	34.0
Kametolook	Average			33.4	58.9
Three Star	"Lake"	2	9.09	5.2	16.1
Long Beach	pond	1	0.50	8.0	

Fingerling coho salmon age classes from the Kametolook River-combined:

	Number	Percent
Age 1.0:	45	45.0
Age 2.0:	55	55.0
Total Samples:	100	100.0

A total of 32 adult coho salmon were collected from the Kametolook River during this trip. Few other adult salmon were seen. Genetic and kidney samples, otoliths and scales were taken from each salmon. All observed coho salmon appeared to be recent arrivals to the river and were not ripe; seeding fertilized coho eggs into the incubation box was not possible.

Age class distribution of adult coho salmon from the Kametolook River is as follows:

	Number	Percent
Age 1.1:	9	28.1
Age 2.1:	18	56.3
Age 3.1:	2	6.3
Unknown:	3	9.4
Total Samples:	32	100.0

Adult coho samples from the Kametolook River, sexed from internal observation:

	Male	Female	Unknown	Total
Number	15	16	1	32
Percent	46.9	50.0	3.1	100.0

High school students, in addition to assisting with fingerling sampling, also explained the field trip experience to their fellow students. Each presented some aspect of the field studies and we participated by asking questions and explaining details. We also demonstrated scale reading techniques and presented representative samples of all species collected from the minnow traps. Plans were developed with the fisheries teacher to install and permit a classroom aquarium incubator for coho salmon eggs. (A detailed field trip report is available.)

November, 1996: Two ADF&G assessment team members traveled to Perryville and joined with local assistants to capture and spawn one pair of coho salmon for the incubation box in the Kametolook River. Gillnetting captured about 20 salmon including 4 sockeye, 13 male coho and 3 female coho salmon. Following standard delayed fertilization techniques, the eggs were fertilized and seeded into the incubation box. A thermograph was deployed in the substrate near the largest group of spawning salmon. Although only a one time event, a survey to enumerate spawning coho was conducted. About 75% of all observed coho were located within 1 mile downstream of the incubation box; the remaining 25% were scattered in small groups throughout the remainder of the drainage. The total observed coho escapement was about 100 salmon with no ocean bright salmon observed. The subsistence harvest will probably continue, the observed escapement may be higher than the actual spawning escapement.

At the high school we assembled the aquarium incubator. If the permit is approved, about 250 eggs from the stream side incubator will be transferred to the classroom incubator. (A detailed field trip report is available.)

January, 1997: Two ADF&G assessment team members traveled to Perryville. While waiting in King Salmon for the flight to Perryville we met with the Alaska Peninsula/Becharoff National Wildlife Refuge staff to discuss the Kametolook project and review the draft Environmental Assessment. In Perryville, we joined local assistants and checked the thermograph and staff gauge sites, shocked the incubating eggs, discarding dead eggs, and sorted out about 250 eggs which were transported to the school aquarium. A Fish Transport Permit was approved allowing 250 eggs to be raised in the school aquarium and their release back into the Kametolook River. With the assistance of five high school students we measured physical characteristics of two landlocked lakes as potential coho fry or rainbow trout release sites and collected gravel for alevin habitat in the aquarium. A slide show of the restoration project and discussion of the life cycle of salmon was presented to all Perryville students. We also attended a meeting sponsored by the Village Council where we presented a similar slide show. At the village meeting the restoration project and the school aquarium were discussed as well as the life cycle of coho salmon, the 1996 coho salmon escapement, and potential production from the escapement. (A detailed field trip report is available.)

March-April, 1997: One ADF&G assessment team member drafted an Environmental Assessment of the Kametolook River Coho Salmon Restoration Project which will soon be available for review out side of the assessment team for NEPA compliance.

Potential Restoration Scenarios And Implementation Phase

The evaluation will include a variety of techniques to improve salmon runs in the Perryville area. A complete diagnosis and decision will not be known until after a through review of the projects Environmental Assessment. If the assessment team determines that instream incubation boxes are appropriate for restoration of the coho stock, then the following scenarios are likely to occur for the duration of the project:

First Choice Scenario- If Instream Egg Incubation Boxes are Used:

If it is determined that instream incubation boxes are the best method to restore depressed salmon runs, the project would use Kametolook River coho (or possibly coho and chum) salmon as brood stock and release fry directly back into the Kametolook, Three Star, and Long Beach Rivers, other potential stocking sites include Sandy and Sicken Lakes.

Fish transport permits and a general waterbody application must be approved by ADFG.

Technical assistance is needed in large capacity incubation box construction in the village and installation as well as in fish culture, fish transport, adult enumeration, and coho rearing habitat. ADFG will cover cost and logistics of shipping the materials to Perryville, but not the material costs. The materials can be transported and dropped off in Perryville in early May when a general freight run is made by the M/V Resolution or later in the summer during the ADFG South Peninsula groundfish/crab survey. It will be necessary for someone in Perryville to use their skiff to haul the material from the M/V Resolution to Perryville.

ADFG biologists will determine the potential coho and/or chum salmon rearing habitat and construct and install two incubation boxes (4 foot by 4 foot) capable of supplementing the natural run without exceeding the natural habitat. Take the required number of eggs from Kametolook River coho and/or chum salmon and incubate them in the boxes to increase the egg to fry survival rate (approximately 100,000 eggs per large capacity incubation box). Annually, ADFG biologists will obtain an estimate of the adult coho and chum salmon escapements and subsistence harvests from the Kametolook River.

The process will be repeated annually through FY 2002, at which time the project investigators as well as the community of Perryville will determined if the boxes can be removed or should continue operating. If the team determines that the project should continue beyond 2002, Perryville may look for another source of funds for the last few years of the project.

A Second Possible Scenario:

If after the first year the test incubator box fails, then it is suggested that if the reason for the failure can be solved, then the test incubator box should be given a second try; if the failure can not be determined, then recirculating incubator boxes should be built. These boxes could be set up in a room in Perryville such as the school or the subsistence cultural education center presently under construction (if plumbing is added to the building). The technology for these boxes is somewhat new, but have proven to be successful for streams where instream incubator boxes fail. The major difference is that the eggs are incubated inside a facility rather than in the boxes in the river (the brood stock would still be from the Kametolook River). In the spring, swimup fry must be transported to the river, rather than leaving on their own. This technology requires additional support such as a constant electrical supply for supplying oxygen and cooling water and frequent monitoring of the water quality and quantity. The village project leader would be trained to maintain the box. If recirculating incubator boxes are considered, it is possible that additional funding will be required, since these boxes are more expensive to build and maintain (approximate total cost for 2 recirculating indoor incubators, $40,000.)

A Third Possible Scenario:

If the test box fails (or in combination with boxes), then the project will concentrate on habitat modification such as clearing blocked river channels, in order to provide additional spawning and rearing habitat for both coho and chum salmon. This scenario would likely be more costly than the incubation boxes, and require more assistance from hydrologists, engineers, and the community of Perryville and use of much or all of their heavy duty machinery.

A Fourth Possible Scenario:

If local incubation boxes fail, then another method to restore the coho run would be to find a facility to incubate the Kametolook River eggs to at least the swimup fry stage and perhaps to rear the fry to the smolt stage. Although facilities at Kodiak are closer than Anchorage to Perryville, logistics would favor Anchorage as the incubation and potential rearing location. There are no reliable or cost effective means to transport eggs or fish alive the 500 air miles between Anchorage and Perryville and then to the upper reaches of the Kametolook River for release. This scenario would likely be as cost effective as incubation boxes, but it is doubtful whether eggs, fry or smolt could survive the trip and local employment would be decreased.

Additional Short Term Goals

Education/community involvement: We believe that the best means to rehabilitate the salmon runs in the Perryville area is to educate the villagers through a better understanding of the life cycles and conservation of salmon. We want to assist with an educational process that will focus on teaching the community through the school children. We plan to continue working with the community and teachers and help with this process. Results from all samples will continue to be shared with the school and community.

About February 1, 1997, local assistants transported about 250 eyed eggs from the river test incubation box to the school aquarium. This portion of the project has provided a hands-on opportunity to the students for their salmon studies. A revised Fish Resource Permit may be submitted requesting that progeny from the classroom incubation aquarium be released into Sicken or Sandy Lakes to determine if these lakes are capable of producing salmon for additional fishing opportunities.

The local assistants will also collect monthly observations of environmental conditions at the stream side incubation box and other river locations.

Additional Long Term Goals

Education: In conjunction with all other aspects of this project we will be working with the Village Council to determine what can be done to increase the number of spawning coho salmon. Options to increase the number of spawning coho include: 1) after about October 5, closing the upper portion of the river to all fishing, 2) after about October 5, allowing only the harvest of spawned out coho salmon in the upper river, 3) providing sanctuaries along the entire river reach for resting/ripening coho salmon, 4) making all salmon carcasses used in this project available to local residents, and 5) provide other fishing opportunities.

Other Fishing Opportunities: We expect the stream side incubation boxes, in conjunction with some fishing restraints, to provide sufficient coho salmon to rehabilitate the run within two to three life cycles.

In addition to the coho salmon incubation box a second coho box, if rearing habitat allows, could be added or an incubation box for chum salmon may be included.

Coho fry from the incubation boxes and school aquarium could be stocked in both landlocked lakes (Sandy and Sicken), while the Kametolook, Three Star and Long Beach Rivers could be stocked with both coho or chum salmon fry.

Future Itinerary

<u>November 96 through September 98:</u> One day every month, one or two trained Perryville researchers will return to the thermometer sites and record the temperatures and photograph the area near the thermometers. They will also be responsible for reporting their findings to the ADFG team.

<u>January through April 97:</u> With school investigations complete, revise the Fish Resource Permit to allow for release of the school aquarium fry into the landlocked lakes. Meet with the village council to discuss the project and encourage the community to develop a

harvest plan for in-river fishing. Revise the Fish Transport Permits to allow for release of fry from the stream side incubator into the landlocked lakes (Sandy and Sicken) or adjacent rivers (Three Star and Long Beach). Apply for a general waterbody permit through ADFG Habitat Division to allow installation of the instream incubation boxes.

March/April 97: Review meeting in Anchorage with assessment team to evaluate the project, including production goals, stocking goals, a marking/evaluation plan and incubator performance. Write FY 1998 DPD and EA for NEPA compliance.

May 97: School students will release fry from the aquarium into landlocked lakes or the Kametolook River.

June/July/August 97: Three members of the ADFG research team will travel to Perryville and with the assistance of four local residents, the large capacity incubation boxes will be installed. Sample river and lake habitats for salmon and trout abundance, age and growth data. Issue 1997 salmon subsistence permits.

September 97: Two of the Perryville assistants will travel to Kodiak and work with the Pillar Creek Hatchery personnel for about two weeks to develop skills necessary for egg takes and the incubation box technology.

October/November 97: Three members of the ADFG research team will travel to Perryville and with the assistance of three local residents have a coho salmon egg take. Team members will also evaluate the condition of any landlocked salmon and collect additional samples for genetic and pathology tests.

November/December 97: Update plans and evaluate incubator performance; revise DPD, Fish Transport Permits, and Fish Resource Permits; write annual report.

Annually 1998 through 2002: Evaluate enhanced returns through subsistence harvest reports, evaluate incubator performance and stocking levels, perform egg takes and stocking, update project plan and NEPA, review FTP's and FRP's, provide annual peer review, and write annual reports.

Responses to May, 1996 Comments by Peer Reviewer:

Stream Rearing Capacity. As indicted by the reviewer, it is a reasonable assumption that there is adequate rearing capacity in the Kametolook River drainage to support a larger population of coho salmon because the system was reported to support more fish (a total annual run of approximately 3,000 adult coho salmon) during prior years. Although quantification of freshwater rearing habitat for a particular coho salmon stream is very difficult and imprecise to measure, all of the population characteristics that have been measured to date indicate that there is nothing abnormal about the population structure or the habitat quality (Sanderdock 1991, *in* Groot and Margolis 1991). There is an estimated

4 plus miles of rearing habitat in sloughs and ponds adjacent to the river's main stem and about 6 miles of main stem habitat available for juvenile coho salmon.

Evaluation. Evaluation plans are being developed. These include: estimating the numbers of fish that will be required to be marked and recovered, methodology and feasibility of marking the fry under these conditions and a mark recovery strategy. It is expected that any marking and recovery program will include the local subsistence users; in part, to elicit their direct involvement, but also, to incorporate an educational opportunity for the people as well.

Potential Genetic Alteration. ADFG is highly sensitive to the importance of genetic concerns and the investigators are aware that a Fish Transfer Permit (FTP) or Environmental Assessment will not be issued unless this concern is addressed. The investigators have been working closely with both the ADFG Principal Geneticist, Dr. Jim Seeb, and the Pathology Section to obtain tissue samples from the population for genetic and fish disease analyses. The investigators have a continuing dialog with Dr. Seeb to assure that his egg take guidelines and release strategies will be incorporated into plans for this project.

Comments about "Supplementation Criteria"

Benefits of Supplementation. Successful supplementation (restoration) of the Kametolook River will be a direct benefit for the subsistence people of Perryville. The wild coho stock population will also benefit directly from the restoration action by increasing the overall number of coho salmon in the population. The cost of this technology is very reasonable.

Genetic Risk. The investigators have continuing dialog with Dr. Seeb to assure that egg take guidelines and release strategies will be incorporated into plans for this project. (See item 3, above.)

Mixed-Stock Fisheries. a) There are no known commercial fisheries that target the Kametolook coho salmon stock. There is an unknown, but presumably negligible, likelihood of interception of this stock by commercial fishers that operate in proximity to Perryville. b.) The production goal for this project is not commercially significant.

Monitoring and Evaluation. An evaluation program is being developed. (See above.)

Economic Criteria. This project is intended to benefit the subsistence users of Perryville, therefore, an economic analysis is not pertinent. As the subsistence harvest of coho salmon continues to diminish, however, the users are relying more heavily on other resources, such as Dolly Varden. An alternative goal of this project is to provide other fish (landlocked coho salmon and/or rainbow trout in Sandy and Sicken Lakes) for growth and harvest as a means to divert some harvest effort away from the anadromous Kametolook River coho salmon. In addition, as part of this project, the investigators are assisting with a low-key community information and education program.

Procedural Criteria. The Chignik Regional Planning Team has endorsed this project. The project will not proceed without National Environmental Protection Act (NEPA) compliance, ADFG Fish Transport Permits (FTP), and a ADFG Habitat Permit (General Waterbody Permit). These permits require concurrence by ADFG fishery Management and Habitat Divisions, the Principal Geneticist and the Principal Fish Pathologist as well as Federal approval of the project.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Perryville

Perryville Village Council has hired a local project administrator to track the project, arrange for logistical support, and assist ADFG with field work and long term monitoring of the project. Two additional Perryville residents have been hired (by the Village Council) to work annually, as needed, to assist ADFG and the project administrator with building and hauling materials, site selection, and placement of boxes. In the fall, they will also be hired to assist ADFG personnel with the project identified to be used for rehabilitating the coho salmon run. For example, if instream incubation boxes are used, local assistants will help with capturing adult salmon, taking genetic and pathology samples, removing, fertilizing, and seeding eggs into incubation boxes. Village assistants will also need to continue providing a skiff, and 4-wheelers as needed. The project administrator is responsible for checking the boxes and habitat monitoring sites throughout the winter to insure they are operating efficiently, and safe from natural or human harm. Wages for the three village assistants have been included in the cost of the grant.

For the first months of the evaluation phase, funding for Perryville's participation will be through a grant from the Department of Community and Regional Affairs. In subsequent years, a contract with Perryville will be developed through the Alaska Regional Development Organization or through a sole source contract with ADFG.

Alaska Department of Fish and Game

Several ADFG personnel have provided technical assistance for the project. Personnel responsible for the project include: Jim McCullough, Fish Biologist III for Commercial Fisheries, Kodiak and Lisa Scarbrough, Subsistence Resource Specialist II for Subsistence, Anchorage. Personnel assisting the project include: Dave Owen, Fish Biologist III, Chignik/Kodiak, Bill Hauser, Fish Biologist IV for Habitat and Restoration, Anchorage; Joe Sullivan, Fish Biologist III for Habitat and Restoration, Anchorage, Wayne Dolezal, Habitat Biologist III for Habitat and Restoration, Anchorage and Pete Velsco, Fish Culturist II for Commercial Fisheries, Nome.

Pete has several years of varied experience with instream and recirculating incubation box projects, particularly in Norton Sound. Jim McCullough with ADFG has several years of varied experience with fisheries enhancement and research projects as well as salmon management in the Alaska Peninsula. Dave Owen is Chignik's Area Management

Biologist with several years of experience with fisheries in the Chignik/ Perryville region. Bill Hauser and Joe Sullivan have extensive experience in fisheries restoration and enhancement with the department. Wayne Dolezal is one of the state's leading experts on habitat restoration. Lisa Scarbrough, has been doing subsistence research in the Alaska Peninsula (including Perryville) and Aleutian Island communities for several years. Labor will be provided by ADFG as part of their normal salary, however, transportation costs and per diem will be covered through the grant.

PUBLICATIONS AND REPORTS

Annual reports each April 15, commencing in 1998.

PROFESSIONAL CONFERENCES

None planned at this time.

NORMAL AGENCY MANAGEMENT

This proposed rehabilitation effort is not part of ADFG's normal management responsibilities in the Chignik area.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project is a continuation of Perryville 96-01, funded by DCRA funds from the EVOS Criminal Settlement and Trustee Council project 97247 funded in Federal Fiscal Year 1997.

PROPOSED PRINCIPAL INVESTIGATORS

Jim McCullough, Fish Biologist III
Alaska Department of Fish and Game
Division of Commercial Fisheries and Management
211 Mission Road
Kodiak, Alaska 99615-6399
Phone: (907) 486-1813
Fax: 486-1841

1 Nov 1995 - Present: FB III Regional Resource and Development Biologist. Co-author of the Pillar Creek and Kitoi Bay basic and annual hatchery plans. Voting member of the Kodiak, Chignik and Alaska Peninsula/Aleutian Islands Regional Planning Teams.

Author/Review regional Fish Transport and Fish Resource Permits. Regional Habitat Biologist. ADFG representative to the Kodiak Sensitive Areas Workgroup. Author of Alaska Peninsula Management Area Salmon Escapement Cumulative Counts for River Systems with Weirs, 1986-1996, this one will be updated annually. Coleader of an EVOS project to restore a coho stock for subsistence purposes in the Chignik Area.

30 June 1990 - 1 Nov 1995: FB III Alaska Peninsula Herring and Southeastern District Salmon Management Biologist. Compiled salmon and herring catch data and herring biomass and salmon escapement data which I analyzed to determine opening and closure of the various commercial fisheries as delegated by the Commissioner of ADFG.

16 July 1985 - 31 May 1990: FB II Alaska Peninsula and Aleutian Islands Areas Finfish Research Biologist involved the design, organization, and completion of the annual catch and escapement program.

16 April 1984 - 16 July 1985: FB I Alaska Peninsula Assistant Area Finfish Management Biologist.

June 1980 - 16 April 1984: FB I various work with shellfish and finfish from the Yukon River to the Western Aleutian Islands including a four month position in the Chignik Management Area.

Education: James McCullough received a B.S. from Western Washington State University in 1973, post-graduate work in fisheries at the University of Alaska, Fairbanks, 1980-1981.

Lisa Scarbrough, Subsistence Resource Specialist II
Alaska Department of Fish and Game
Division of Subsistence
333 Raspberry Road
Anchorage, Alaska 99518-1599
Phone: (907) 267-2396
Fax: 267-2450

Lisa Scarbrough has been a subsistence resource specialist with the Division of Subsistence of the Alaska Department of Fish and Game since 1989. She has extensive research experience in the Chignik area, including the village of Perryville. This has included research on the effects of the oil spill on local subsistence patterns. Her work has also involved training residents of the Chignik area communities as research assistants.

OTHERS ASSISTING WITH THE PROJECT

Perryville Traditional Village Council
P.O. Box 101
Perryville, Alaska 99648
Phone: (907) 853-2203
Fax: 853-2230
Chief Community Coordinator- *Jerry Yagie* - Phone: (907) 853-2261

Pete Velsko, Fish Culturist III
Alaska Department of Fish and Game
Division of Commercial Fisheries and Management
Pouch 1148
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Alaska Department of Fish and Game
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Alaska Department of Fish and Game
Division of Commercial Fisheries and Management
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Kodiak, Alaska 99615-6399
Phone: (907) 486-1806
Fax: 486-1841

Chignik Regional Planning Team
Chuck McCallum, Chairman
614 Irving Street
Bellingham, Washington 98225
Phone: (360) 647-5540
Fax: 733-4744

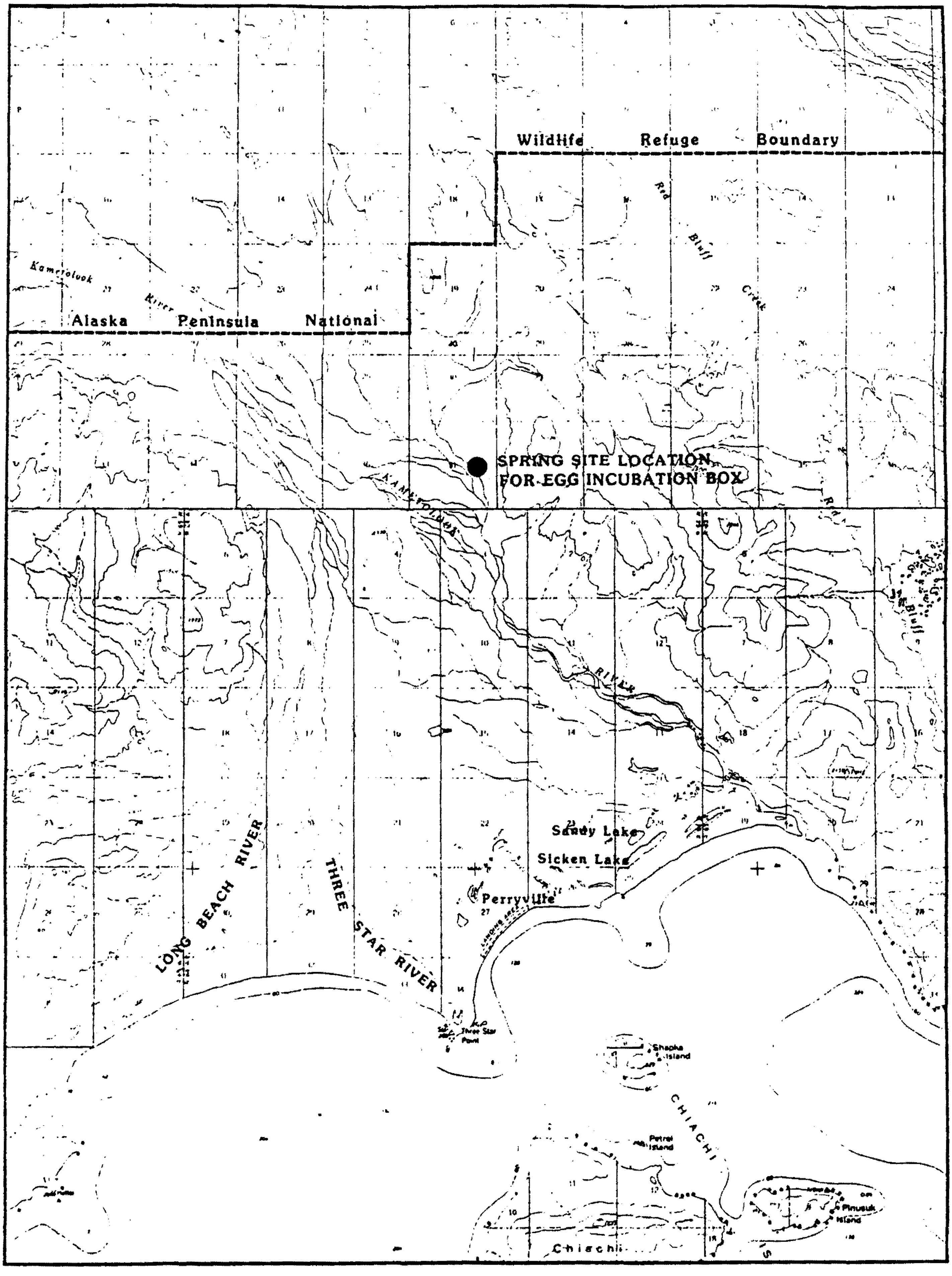

Figure 1. Perryville/Kametolook River Coho Salmon Restoration Project Site

1998 EXXON VALDEZ TRUSTEE ... INCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998					
Personnel	$5.1	$2.6					
Travel	$7.3	$6.4					
Contractual	$11.4	$4.3					
Commodities	$6.0	$0.0					
Equipment	$0.0	$0.5	LONG RANGE FUNDING REQUIREMENTS				
Subtotal	$29.8	$13.8	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003
General Administration	$1.6	$0.7					
Project Total	$31.4	$14.5	$14.8	$15.1	$15.4	$15.7	$0.0
Full-time Equivalents (FTE)	1.0	0.5					
	Dollar amounts are shown in thousands of dollars.						
Other Resources							

Comments: Budget projections for FY 1998 and beyond assume that instream incubation boxes are the only rehabilitation method employed. If the evaluation in FY 1997 identifies other appropriate methods, future budgets will need to be modified to include the cost of these methods. An Environmental Assessment is being drafted so the rehabilitation method will have a wide review. The final evaluation of the project is projected to be FY 2002.

In 1996, this project was funded by Criminal Settlement funds. The budget estimate for 1998 through 2002 under the original Criminal Settlement budget differs from this budget estimate. The reason for additional requested funds is the TC recommended enhanced community involvement and assessment. In response, we added additional assessment trips by ADF&G to Perryville to study the coho spawning and rearing populations and stream habitats, to install water and temperature devices, to install a test incubation box to determine its success, to do minnow trapping, to collect genetic and pathology samples, to install a school aquarium, and to expand the community involvement component of the project. We also added increased training of local villagers by on the job training and propose sending two villagers to Kodiak for two weeks of work experience in a hatchery. After completion of the first year of assessment, the Principal Investigators have been able to develop a more realistic budget estimate than was originally proposed. In addition staff time was added in order to develop and monitor the subcontract with Perryville and provide other staff support for the project.

1998

Prepared: 4/9/97

Project Number: 98247
Project Title: Kametolook River Coho Salmon Subsistence Project
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/9/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs: Name	Position Description	GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1998
L. Scarbrough	Subsistence Resource Specialist II	16F	0.5	5.1	0.0	2.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		0.5	5.1	0.0	
					Personnel Total	$2.6

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1998
Kodiak - Perryville	1.0	2	13	0.10	3.3
Anchorage - Perryville	0.8	2	6	0.10	2.2
Kodiak - Anchorage	0.3	1	6	0.10	0.9
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$6.4

1998

Project Number: 98247
Project Title: Kametolook River Coho Salmon Subsistence Project
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

Prepared: 4/9/97

1998 EXXON VALDEZ TRUSTEE NCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:		Proposed
Description		FFY 1998
4A Linkage	Contract with Native Village of Perryville Perryville wages/gasoline/ATV use	4.3
When a non-trustee organization is used, the form 4A is required.	Contractual Total	4.3

Commodities Costs:		Proposed
Description		FFY 1998
	Commodities Total	$0.0

1998

Prepared: 4/9/97

Project Number: 98247
Project Title: Kametolook River Coho Salmon Subsistence Project
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual &
Commodities
DETAIL

4/9/97

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1998
General maintenance of incubation boxes and egg take equipment	1	0.5	0.5
			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**	$0.5

Existing Equipment Usage: Description	Number of Units	Inventory Agency
instream incubation box	2	ADFG

1998

Prepared: 4/9/97

Project Number: 98247
Project Title: Kametolook River Coho Salmon Subsistence Project
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

1998 EXXON VALDEZ TRUSTEE ICIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998						
Personnel		$4.3						
Travel		$0.0						
Contractual		$0.0						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$4.3	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FYY 2003	
Indirect								
Project Total	$0.0	$4.3	$4.4	$4.5	$4.7	$4.8	$0.0	
Full-time Equivalents (FTE)		2.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: For FY 1998 and beyond, budget assumes that instream incubator boxes will be the only rehabilitation method used. If the evaluation in FY 1998 identifies other appropriate methods, the contract with Perryville will be modified to reflect the needed level of involvement by the local project facilitator and project assistants.

1998

Prepared: 4/9/97

Project Number: 98247
Project Title: Kametolook River Coho Salmon Subsistence Project
Name: Native Village of Perryville

FORM 4A
Non-Trustee
SUMMARY

4/9/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:						
Name	Position Description		Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1998
To be determined	Project Facilitator and Assistants		2.1	2.0	0.0	4.3
						0.0
Note: about 43 days of work anticipated @ about $100/day						0.0
Months and monthly cost estimated to accommodate this						0.0
spreadsheet.						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.1	2.0	0.0	
					Personnel Total	$4.3

Travel Costs:					
Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1998
					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

1998

Prepared: 4

Project Number: 98247
Project Title: Kametolook River Coho Salmon Subsistence Project
Name: Native Village of Perryville

FORM 4B
Personnel
& Travel
DETAIL

[illegible]

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FFY 1998
Contractual Total	$0.0

Commodities Costs:	Proposed
Description	FFY 1998
Commodities Total	$0.0

1998

Prepared: 4/9/97

Project Number: 98247
Project Title: Kametolook River Coho Salmon Subsistence Project
Name: Native Village of Perryville

FORM 4B
Contractual &
Commodities
DETAIL

4/9/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1998
			0.0
			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	

1998

Project Number: 98247
Project Title: Kametolook River Coho Salmon Subsistence Project
Name: Native Village of Perryville

FORM 4B
Equipment
DETAIL

98252

Investigations of Genetically Important Conservation Units of Species Inhabiting the EVOS Area

Project Number:	98252
Restoration Category:	Research
Proposer:	ADF&G
Lead Trustee Agency:	ADF&G
Cooperating Agency:	None
Alaska SeaLife Center:	In Part
Duration:	5 years
Cost FY 98:	$ 241,700
Cost FY 99	$ 300,000
Cost FY 00	$ 309,000
Cost FY 01	$ 318,000
Cost FY 02	$ 327,000
Geographic Area:	Kodiak Island, Resurrection Bay, Gulf of Alaska Spill Area
Injured Resource/Service:	Herring, Commercial Fishing, Rockfish

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EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

This proposal consolidates an array of requests from the commercial fisheries industry for discrete stock research into a single proposal for work that ADF&G would conduct at its Anchorage genetics laboratory. Also, ADF&G proposes to develop experimental fish runs at the Alaska SeaLife Center; these are essential for study of genetics, physiology, or diseases of anadromous fish proposed by University of Montana, University of Alaska, or ADF&G and other principal investigators seeking to conduct research at the Seward facility.

INTRODUCTION

The commercial fishing industry in the Gulf of Alaska spill area underwent radical alterations from the impacts following the 1989 *Exxon Valdez* oil spill (EVOS). Area closures, species closures, and price fluctuations cumulatively affected both the industry and the target species. This proposal is designed to address discrete stock concerns through (1) identification of the stock structure of marine species most affected by fishery alterations including Kodiak Island herring, walleye pollock, and rockfish; and (2) conducting experimental matings at the Alaska SeaLife Center (ASLC) to support the research and findings of other Trustee Council-funded studies.

A. Marine Fish

The understanding of the genetic structure of discrete stocks is a central feature of conservation and restoration of commercially exploited fisheries resources today. ADF&G received Trustee Council support to improve discrete stock management capabilities only within the confines of Prince William Sound and Cook Inlet through study of genetics and ecology. Yet, post-spill changes in stock dynamics and changes in fishing patterns continue to adversely affect commercially valuable marine species in the greater Gulf of Alaska (GOA) spill area. This project, designed to expand ADF&G genetics research into the greater Gulf, was developed in response to specific requests from industry and after consultation with representatives from groups including the Alaska Draggers, Alaska Groundfish Data Bank, North Pacific Processors, and the Chignik Seiners Association.

For example, the rapid post-spill escalation of fishing effort on Pacific herring stock(s) spawning near Kodiak Island has become a conservation concern. The Prince William Sound (PWS) herring fishery underwent a catastrophic decline beginning in 1992. In 1993, the total observed spawning population was less than one-third of preseason predictions, and the average sizes of herring in each age class were some of the smallest on record. Only limited commercial herring fishing occurred. In 1994, as in 1993, the PWS spawning population was below preseason predictions. No recovery was evident in 1995, and based on this, the 1996 commercial fishing season was cancelled. Because of these declines in PWS, commercial effort shifted to stocks spawning near the shores of Kodiak Island.

The observation of potential temporal and spatial isolation leads Kodiak managers to attempt to manage herring harvest based upon discrete stocks. Yet no clear demarcation of stock structure currently exists. Through Trustee Council project 9x165, ADF&G identified a battery of mitochondrial DNA (mtDNA) and nuclear DNA (nDNA) markers that is proving useful to discriminate the structure of PWS stocks; these markers can also be used to elucidate the presence of stock structure in the Kodiak Island spawners.

Similarly, area closures, species closures, and price fluctuations on other species led ADF&G and the fleet to initiate the harvest of walleye pollock as a replacement species in Prince William Sound. Pollock are a major predator species in the northern GOA. Historical assessment data from Kachemak Bay in the northern GOA suggest that pollock have been a dominant fish species in the ecosystem for the past twenty years (Bill Bechtol, ADF&G Homer, personal communication). Though poorly documented, pollock also appear to be a major predator species in PWS. EVOS-funded acoustic surveys conducted by the PWS Science Center (Sound Ecosystem Assessment Project, SEA) showed that pollock are primary predators of pink salmon fry, and to a lesser extent, larval and juvenile Pacific herring and several species of phytoplankton. Pollock spawn primarily from late winter to early spring, but spawning fish may be found year-round. Although peak spawning times and locations are quite consistent within areas, the extent of spawning site fidelity is unknown. The harvest of pollock began in 1995 after the SEA surveys documented commercially viable biomass spawning within the confines of PWS.

This novel harvest of pollock within the three-mile limit of state jurisdiction developed into a controversy also because of conservation concerns; the harvest of GOA pollock is based upon sustainable quotas established through interjurisdictional research and negotiation. The Pacific Fisheries Management Council could add the PWS catch to the GOA quota if PWS pollock form a discrete stock. The PWS catch would need to be subtracted from the quota if discrete stocks do not exist. ADF&G is coordinating efforts with National Marine Fisheries Service and the University of Washington to adapt stock markers for identification of discrete pollock stocks within the GOA.

Finally, during post-spill years, ADF&G documented greatly elevated effort on the sport and commercial harvest of rockfishes. Rockfishes are a diverse group of species belonging to the genus *Sebastes*. Despite the fact that they are often managed as a group, there are over thirty-two species found in Alaskan waters. Rockfish harvests increased four-fold due to closures of the commercial salmon and shellfish fisheries following the EVOS, and harvest rates have remained high in some areas. Because rockfish exhibit extreme longevity, slow growth, and late maturity, depressed populations often recover very slowly, and even with the curtailment of all human use, the impacts and rebuilding of depressed or depleted rockfish populations may continue through several human generations. The Alaska Board of Fisheries has instituted conservation restrictions, but the structure of discrete stocks is currently unknown.

B. Experimental Matings

Components of the genetic and ecological research implemented by the *Exxon Valdez* Trustee Council were hampered by the inability of principal investigators to conduct experimental matings with the organisms. The ASLC now affords opportunities to conduct inheritance studies on Pacific salmon and marine fish.

One example of the need for experimental matings is that numerous novel genetic markers were developed to improve discrete stock management capabilities for Pacific herring and pink and sockeye salmon through Trustee Council Projects 9x165, 9x191, 9x196, and 9x255. Mendelian inheritance for some of these markers is poorly understood, and mating studies will provide the answers necessary to include these in stock identification applications. Additionally, matings with pink salmon are needed to complete the work now underway in the project 9x190 series.

Genetic markers are also potentially available to Trustee agencies from collaborating laboratories conducting research on sister species. The markers available for identification of Atlantic cod stocks (Brooker et al., 1994) appear to be promising for the study of pollock (Paul Bentzen, University of Washington, personal communication). However, use of some of these markers is hampered by the expression of null phenotypes in pollock, and mating studies are needed before data from such loci can be properly included in discrete stock studies.

NEED FOR THE PROJECT

A. Statement of Problem

Post-oil spill alteration of fishing pressure lead to escalated fishing effort on stocks of several marine species including Pacific herring from Kodiak Island, PWS walleye pollock, and rockfishes. These fisheries emerged as they are today as a direct consequence of changing fishery patterns following the *Exxon Valdez* oil spill. Fishery managers trying to facilitate these emerging fisheries need to know the structure of discrete stocks in order to better manage them on a sustained basis.

Also, experimental matings are needed to support genetic and other studies of marine organisms inhabiting the spill area. Currently, ADF&G genetic studies are conducted at the Anchorage laboratory, sometimes at various hatcheries across the state of Alaska, and now in five consulting laboratories in Nova Scotia, Washington, and Montana. Much of this dispersion occurred because of the paucity of wet lab and dry lab space available in the region. Consolidation of the wet-lab projects into one project at the ASLC, using the new fish pass and fish-rearing space, will increase efficiency and cost-effectiveness of the research. The Trustee Council funded project 97197 to construct the fish pass for development of experimental fish runs.

Experimental fish runs developed at the ASLC will support research from other Trustee Council projects as well as projects proposed by University of Alaska. Experimental matings of pollock, herring, pink salmon, cutthroat trout, and Dolly Varden char and other species will be invaluable for documenting the Mendelian inheritance of many of the new gene markers developed through Trustee Council studies.

B. Rationale/Link to Restoration

1. Pacific herring of Kodiak Island

Conservation of herring stocks commercially harvested near Kodiak Island has recently become a concern. The commercial fishery at Kodiak Island has sustained a rapid escalation of fishing effort due to the displacement of the commercial herring fishing fleet in Prince William Sound.

Presently, the herring fisheries around Kodiak Island are managed for a spring (sac roe) season, and a late summer/winter (food and bait) season. Spring sac roe fishery harvest levels are set annually prior to each season. Preseason harvest levels are established for each fishing district based upon previous year's fishery performance and catch data and age composition data collected during test fisheries. Although there are differences among putative stocks of spawning herring based on meristic, morphologic, size-at-age, and age composition data, the underlying genetic basis for these differences is unknown. An additional herring food and bait harvest occurs annually near Kodiak Island during the fall and winter months. By regulation, this harvest may not exceed 10% of the herring sac roe harvest in each district for the previous season, and this harvest likely occurs on mixed stocks, including those of Kamishak Bay which are thought to overwinter in Shelikof Strait.

Incorporating genetically derived population structure is crucial to the success of any fisheries program. The findings of this project will contribute to the conservation and restoration of GOA herring by providing new genetic information for Kodiak fisheries managers to incorporate into harvest management strategies.

2. Commercial fishing (walleye pollock)

Since 1995 a commercial fishery for walleye pollock has been prosecuted in the inner waters of the Gulf of Alaska. The harvests in Prince William Sound, which have occurred primarily near Port Bainbridge and Knight Island, are regulated by ADF&G. The adjacent federal waters of the GOA are managed by the National Marine Fisheries Service (NMFS). Currently, pollock and other groundfish in federal waters of the GOA are assessed through a summer triennial bottom survey conducted by NMFS. ADF&G has based the PWS harvest guideline on summer population assessments. Fish present in the summer in PWS are not assessed by NMFS, and ADF&G has used summer assessment data from SEA to establish guideline harvest levels for PWS pollock. In addition, a cooperative project involving ADF&G, the PWS Science Center and the fishing industry has assessed the pollock spawning population in PWS in the spring. However, the degree of migration and mixing of pollock between PWS and outer GOA waters is unknown. For example, it is not known how these interactions affect the composition of both the commercially fished aggregations and the assessed summer populations.

Successful management of commercial fisheries relies on an understanding of the underlying stock structure. Genetics studies of pollock indicate that heterogeneity exists across large areas, such as between eastern and western Bering Sea. For example, allozyme studies delineated walleye pollock populations from the eastern Bering Sea and Sea of Japan (Iwata 1975a, 1975b). However, early attempts to identify stocks within the southeastern Bering Sea were largely unsuccessful (Grant and Utter 1980). In contrast, a mtDNA study suggested that at least two genetically discrete stocks exist in the eastern Bering Sea, a Donut Hole/Bogoslof Island group and an Adak Island group (Mulligan et al., 1992). That study suggested that the GOA and Donut Hole/Bogoslof Island stocks are more closely related to each other than to the Adak Island population. This may be due to the movement of adult fish from the GOA to the Bering Sea via

Unimak Pass and/or southwestward movement of larval pollock from Shelikof Strait through Unimak Pass. At present, there is insufficient evidence to suggest that gene flow is restricted between the eastern Bering Sea and the western GOA.

The findings of this project will contribute to the conservation of GOA pollock by providing new genetic information for federal and state fisheries managers to incorporate into development of sustainable harvest quotas. Such information will be important to the small fleets that are attempting to restore their livelihood through this displacement fishery.

3. Rockfish

Little information is available on rockfish abundance and composition in the EVOS-impact area. Recently the Alaska Board of Fisheries effected new area management and district boundaries for rockfish and established rockfish guideline harvest caps and set new state management areas that extend to three miles offshore. This project would initiate a genetic study of black rockfish *(S. melanops)*, a species common in both commercial and sport harvests in the oil spill area. Similar genetic studies were useful in documenting gene flow among other species of rockfish (Seeb and Gunderson 1988). Genetic studies which document the population structure within and outside of the study area will be used to identify self-recruiting populations and levels of gene flow in this rockfish species. Black rockfish tend to be sedentary but have pelagic larvae. The extent of gene flow among spawning aggregations in the oil spill area is currently unknown.

Other rockfish (*Sebastes* sp.) would be added in subsequent years as markers are developed.

C. Location

Field research will be conducted primarily within the confines of Prince William Sound, EVOS-affected areas of Kodiak Island, Kamishak Bay, Resurrection Bay, the outer Kenai Coast, and adjacent waters of the Gulf of Alaska. Exact sampling locations will depend on the distribution of commercial and assessment survey efforts on spawning herring and pollock and the distribution of commercial and sport fishing efforts on black rockfish. Sampling outside of Prince William Sound will be conducted by ADF&G area staff as appropriate.

Mating studies will be conducted at the ASLC in Seward. At this time rental fees for research at the Seward facility have not been finalized. Costs for this have not been budgeted and will be determined by negotiations between the Trustee Council and the Seward Association for Advancement of Marine Science. Laboratory sampling and data collection will be conducted at the ADF&G area offices in Cordova and Homer, and the regional office in Kodiak. Laboratory analysis, tissue archiving, and data analysis will be conducted at the ADF&G statewide genetics laboratory in Anchorage.

Because commercial, subsistence and sport harvests of herring, pollock and rockfish represent substantial contributions to local economies, intensive management is expected to benefit all communities in PWS. Restoration efforts can be directed and evaluated through improved fishery management and monitoring.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Components of this proposal were driven by community request. ADF&G is currently grappling with the permitting of funded Trustee Council projects and the evaluation of potential restoration projects and new fisheries in the areas of Kodiak Island, Kenai Peninsula, Alaska Peninsula, and Prince William Sound. Local knowledge from years of fishery management will be used in defining the hypotheses for testing for genetic homogeneity within each species.

Representatives of the fishing industry of PWS and the GOA expressed support for the projects proposed herein, including the North Pacific Processors (Ken Roemhildt, Cordova, Alaska, personal communication); the Alaska Draggers (Jay Stinson, Kodiak, Alaska, personal communication); and Chris Blackburn (Alaska Groundfish Data Bank, Kodiak, Alaska, personal communication). Support includes but is not limited to input on study design, coordination among fishing fleets for acquisition of fishery samples, providing facilities for sample collections, and assisting ADF&G staff with sample collections. The Seward Association for the Advancement of Marine Science (SAAMS) will be consulted to insure projects are consistent with the schedules and processes already in place.

Wherever possible, local-hire will be used to fill positions required for both field sampling and routine laboratory positions. People from the communities in the spill area will have an opportunity to participate in this project as employees of the ADF&G which gives residents priority in hiring for state employment. ADF&G plans to participate in all of the educational and outreach programs scheduled for the Center. In addition, results from this project will be disseminated to the local community through Regional Planning Team meetings.

PROJECT DESIGN

A. Objectives

1. Contribute to the conservation and restoration of GOA herring by providing new genetic information for Kodiak fisheries managers to incorporate into harvest management strategies.

2. Develop new markers and provide genetic information for federal and state fisheries managers to incorporate into development of sustainable harvest quotas for the displacement fishery on walleye pollock.

3. Utilize new genetic markers to test for gene flow among black rockfish inhabiting the oil spill area.

4. Provide experimental runs of fish for use by visiting scientists for projects such as the *Construction of a Linkage Map for the Pink Salmon Genome* (Project 97190).

B. Methods

1. Sampling design

Detailed sampling designs for each of the three marine species are summarized in Table 1.

Pacific Herring

We propose to initiate examination of Kodiak Island herring populations by conducting laboratory analyses of three putative population collections from areas which sustain major fishing effort and commercial harvests. Initially, we propose to obtain samples from Paramanof and Uganik Bays (west side) and Old Harbor (east side) on Kodiak Island. In addition, we propose to sample spawning herring from Kamishak Bay in the northern GOA. A target sample size of 100 individuals will be set; fin clips from individual herring will be preserved in ethanol for the subsequent nuclear (microsatellites) and mitochondrial DNA analyses.

Walleye Pollock

To begin to address stock questions of inner vs. outer GOA walleye pollock, we propose to initiate sample collections and genetics analyses of spawning populations from the inner GOA waters of PWS and from outer GOA waters of Shelikof Strait (N=100 each site). We also will include samples from an outside stock for comparison from the Bering Sea such as Bogoslof Island (N=100). We propose to use a combination of both mtDNA and nuclear DNA approaches (allozymes and microsatellites) to begin to define the population structure of walleye pollock from the EVOS-affected areas of PWS and the GOA. We will also analyze larvae from known crosses to verify the mode of inheritance and to investigate the presence of null alleles in microsatellites.

Black Rockfish

We propose to develop genetic markers to test for panmixia among black rockfish populations inhabiting the greater oil spill area. We will estimate genetic structure and gene flow within the Spill area using analyses of mitochondrial and nuclear DNA. Rockfish samples will be collected from up to five sites from within the EVOS-affected area. During the first year, a target sample size of 100 individuals will be set for each site. Sites will be chosen to maximize the geographic representation within the affected areas. All specimens will be analyzed for mitochondrial DNA and microsatellites. Fin clips from individual fish will be placed in ethanol. Muscle, liver, eye, and heart tissues for allozymes analyses will be collected when convenient for shipment to Washington Department of Fish and Wildlife (WDF&W). WDF&W has been conducting an allozyme survey of black rockfish and has requested specimens from Alaskan waters.

Table 1. Sampling design for genetic analysis of Pacific herring, walleye pollock, and black rockfish.

Species	Genetic Technique	Sampling Locations
Pacific herring	Microsatellite mtDNA	Kodiak Island
Walleye pollock	Microsatellite Allozymes mtDNA	Prince William Sound (Inner Gulf) Shelikof Strait (Outer Gulf) Bogoslof Island (Bering Sea)
Black rockfish	Microsatellite mtDNA	Prince William Sound Resurrection Bay Outer Kenai Coast Kodiak Island

2. Laboratory Analysis

DNA will be extracted using either phenol-chloroform extractions (Sambrook et al. 1989) or a rapid precipitation method (Gentra Systems, Inc. P.O. Box 13159, Research Triangle, N.C. 27709-13159). This process includes: (1) a cell lysis solution to break down cell and nuclear membranes; (2) a Proteinase K digest to denature proteins; (3) an RNase treatment to digest RNA; (4) protein precipitation to remove Proteinase K, RNase, and denatured proteins; (5) isopropanol to precipitate DNA; (6) 70% ethanol to wash DNA; and finally (7) a hydration solution to rehydrate DNA. DNA will be extracted from liver, muscle, and fin clips depending on the available tissue and species. The DNA stocks will be diluted to a final concentration of approximately 100ng/µl for use in the polymerase chain reaction (PCR). After extraction, the DNA will be amplified using species-specific microsatellite and mtDNA primers.

Microsatellite Analysis

Microsatellite primers and PCR conditions for herring will follow those developed by Restoration Study 9x165 Genetic Discrimination of Prince William Sound Herring Populations. The five microsatellite loci (*Cha17, Cha20, Cha63, Cha113, Cha123*) previously found to be informative will be used. Additional *Cha* primers may be incorporated after further evaluation of those currently under development as a part of 97165.

Analysis of walleye pollock microsatellites will be investigated using three approaches as pollock-specific primers are not yet available. First, samples will be screened utilizing existing Atlantic cod primers (*Gmo1, Gmo2, Gmo9, Gmo10, Gmo123, Gmo132, Gmo145*; Brooker et al. 1994). If available in time for this project, the small number of pollock-specific primers developed by the Stanford University under contract to National Marine Fisheries Service (NMFS) will also be surveyed (Dennis Powers, Hopkins Marine Laboratory, Stanford University, Pacific Grove, CA; personal communication). We will also develop additional walleye pollock primers through subcontracting. This approach has proven cost-effective in the past and was utilized in the development of the herring primers through Restoration Study 9x165.

Microsatellite primers from *Sebastes* rockfish species have been recently developed in the laboratory of Dr. Paul Bentzen at the University of Washington. Dr. Bentzen has been an investigator and subcontractor on Restoration Study 9x165 as well as Restoration Study 9x255 Restoration of Kenai River Sockeye Salmon. Dr. Bentzen along with his collaborator, Dr. Peter Wimberger (University of Puget Sound, Tacoma), indicate that they will make the primers available to our laboratory; we anticipate no additional primer development will be necessary.

All microsatellite analyses will be conducted at the ADF&G Genetics Laboratory on either an ABI 377 or ABI 373A automated sequencer. We chose to pursue an automated approach to the analysis of microsatellites as it allows for highly efficient detection of multiple loci in a single lane utilizing a fluorescent four-color dye system (Ziegle et al. 1992; Olsen et al. 1996). One color is devoted to an internal lane standard leaving three colors available for labeling primers.

Band sizes are called automatically from the known standards using the GeneScan Software (ABI Applied Biosystems 1996), and genotypes are assigned using the Genotyper Software (ABI Applied Biosystems 1994). Our laboratory has resolved up to ten loci in a single lane separating loci by size and color.

Mitochondrial DNA

We will restrict our analyses of herring mtDNA variation to the ND1 gene, a region found to be highly polymorphic by Restoration Study 9x165. The primers designed by Cronin et al. (1993) will be used to amplify the gene. Four restriction enzymes, *BanII, CfoI, HinfI, RsaI*, are highly informative with each detecting between four and nine haplotypes in our previous survey of seven Alaskan sites.

Previous studies of mtDNA from walleye pollock have surveyed the entire mitochondrial genome for RFLP variation (Mulligan et al. 1992) and sequenced the control region (Shields and Gust 1995). Rather than follow either of those laborious approaches, we plan to use PCR to amplify specific sections of the molecule similar to our approach in Pacific herring. Initially we will test and optimize the use of primer sets that include but may not be limited to pairs that amplify ND1, ND5/6, and D-Loop. We will test at least ten restriction enzymes on at least two of the more promising fragments. Primer pairs will be chosen from those described by Park et al. (1993), Cronin et al. (1993), and Kocher et al. (1989).

Our approach to the study of mtDNA in black rockfish will be similar to that of walleye pollock. We have already successfully amplified ND5/6, ND3/4, Cytochrome *b*, ND2, 16S rDNA, cytochrome oxidase I, and D-Loop from other *Sebastes* species.

Amplified DNA will be cut with restriction enzymes and electrophoresed on agarose gels. Fragments will be visualized under UV light, and a photographic record will be made of each gel. Since genes which are encoded by the mitochondrial genome are inherited as a single unit (i.e., analogous to linked loci), the restriction sites detected for each enzyme, for all regions examined, will be pooled as composite haplotypes. The frequencies and distributions of these composite haplotypes will then be used to examine the structure of the populations under study.

Allozymes

Allozyme electrophoresis will be conducted on pollock samples following the techniques of (Iwata 1975a, 1975b; Grant and Utter 1980). Allozyme techniques will follow those of Harris and Hopkinson (1976), May et al. (1979), and Aebersold et al. (1987); nomenclature will follow the American Fisheries Society standard (Shaklee et al. 1990). Gels will be scored using on-line scoring programs developed by ADF&G.

3. Statistical Analyses

Nuclear markers (allozymes and microsatellites)

S-plus analytical software (Mathsoft, Inc., Seattle WA) and GENEPOP Version 3.1 (Raymond and Rousset 1995) will be used to calculate allele frequency estimates, to test for conformation of genotype frequencies to Hardy-Weinberg expected frequencies using log-likelihood ratios, calculate genetic distances and heterogeneity among collections, and to estimate gene flow among collections. Sequential Bonferroni corrections (Rice 1989) will be used to adjust significance levels as required. Neighbor-joining (Saitou and Nei 1987), UPGMA, and maximum likelihood trees will be constructed using NTSYS (Rohlf 1993) and PHYLIP (Felsenstein 1993).

Mitochondrial DNA

Nucleotide (π) and haplotype (h) diversity measures (Nei 1987) will be calculated for all collections using the restriction enzyme analysis package (*REAP*; McElroy et al. 1992). These measures estimate the number of nucleotide substitutions per site between DNA sequences (i.e., sequence divergence) and the amount of DNA polymorphism within collections, respectively. To test for heterogeneity among populations, Monte Carlo simulations with 10,000 replicates will be performed (Roff and Bentzen 1989) using the *REAP* analysis program (McElroy et al. 1992). An analysis of the distribution of molecular variance will be made using AMOVA (Excoffier et al. 1992) and utilizing a matrix of Euclidean distances between haplotypes. Haplotype correlation measures are expressed as Φ-statistics. Φ_{ST} is the correlation of random haplotypes within collections relative to that of random pairs of haplotypes drawn from the entire set of collections. Pairwise Euclidean distances will be calculated as the total number of site changes between haplotypes. Φ_{ST} between pairs of populations, a modified coancestry coefficient (Excoffier et al. 1992), will also be calculated as a genetic distance and examined with tree building algorithms as for nuclear markers.

4. Experimental matings and fish runs

A plan for implementing experimental runs of fish will be initiated and developed within the guidelines of ADF&G. Runs of anadromous fish will be small, for experimental purposes only. The plan will address: 1) species to be included, 2) source and timing of broodstocks, 3) schedule for developing the runs, and 4) permit acquisition for stock transfer and fish rearing and release.

Initial efforts will focus on development of a run of pink salmon to support ASLC research proposed by University of Montana. Broodstock will be collected from a local Resurrection Bay source. The release of coho salmon to support general university research will be limited to a subcomponent of the current coho salmon releases conducted by ADF&G in Resurrection Bay. Other experimental matings will be conducted to test the Mendelian inheritance of Pacific herring microsatellite markers developed as a component of project 97165 and Atlantic cod microsatellite markers for use in pollock studies (see above).

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Seward Association for Advancement of Marine Science; UAF Institute of Marine Science (IMS); University of Montana

NORMAL AGENCY MANAGEMENT

This project is not required of ADF&G by statute or regulation.

ADF&G spends approximately $500.0K from State of Alaska general funds annually on genetics studies. Salaries and benefits of principal investigators J. Seeb and L. Seeb are fully covered by these general funds. S. Merkouris is funded for three months from Trustee Council funds and three months by general funds. These funds also support the basic operation of and enhancements to the Anchorage genetics laboratory for ADF&G management projects as well as EVOS projects. These general funds from the legislature are ear-marked for specific projects; although they may be used for leadership of EVOS studies, no general funds are available to institute new research such as this. The *Exxon Valdez* Trustee Council has shouldered the burden of research into the ecology and genetics of species within the spill zone. The studies outlined herein would not have been conducted by the State in the absence of the oil spill.

Commercial Fisheries Management and Development Division scientists perform management-oriented studies to identify conservation units of commercially important resources at the direction of the Director. Funds are limited and generally restricted to major contentious issues facing the Alaska Board of Fisheries. The need for characterization of the genetic structure of the species in this proposal has increased as a direct result of the EVOS either because the species were injured and have not recovered or because their recovery is unknown (*Exxon Valdez* Oil Spill Trustee Council 1996). Understanding of stock structure of these species is critical to fisheries management because it provides managers with the appropriate scale by which to base management decisions aimed at restoring the species to pre-spill abundance.

Once the data have been collected on the genetic structure of the proposed species, they will be useful to the Department for future management and the database will be maintained and updated by the Department after the project funding ends.

The Trustee Council has funded genetic study of injured resources at levels approaching $1,000.0K during many years post-spill. These major projects resulted in an improved knowledge of fisheries resources and provided permanent improvements to resource management.

This project is designed to be a restructuring of these major, short-lived projects into a longer-term project with several minor elements addressing population genetics issues in the spill area. Elements may be modified in future years to address population issues identified through collaborative research at the Alaska SeaLife Center. Additionally, this project offers a core genetics presence to other principal investigators at the SeaLife Center and provides experimental fish runs for long-term research.

SCHEDULE

A. Measurable Project Tasks for FY98

January - April 1997:	Literature review, proposal development
February -March 1997:	Collect pollock tissue samples (NMFS assessment survey crews, area ADF&G staff, commercial fishing vessels)
April 1997:	Collect herring tissue samples (area ADF&G staff)
May - August 1997:	Collect rockfish tissue samples (area ADF&G staff)
Sept. - December 1997:	Recruit and hire ASLC staff
Oct. 1997-Sept. 1998:	Begin protocol development, begin lab analysis of herring, pollock and rockfish samples
December 1997:	Plan 1998 pollock collections
January 1998:	Attend Annual EVOS Restoration Workshop
January - March 1998:	Pollock tissue collections and matings
February - March 1998:	Plan 1998 herring collections
March - April 1998:	Herring tissue collections
April 1998:	Plan 1998 rockfish collections
March - April 1998:	Prepare 99252 proposal
May - August 1998:	Rockfish tissue collections
June - August 1998:	Pink salmon spawning
July-September 1998:	Analyze laboratory data

B. Project Milestones and Endpoints

February, 1998	Experimental pollock matings
April 15, 1998:	Proposal for Project 99252
April, 1998	Experimental herring matings
Sept. 30, 1998:	First pink salmon egg take at ASLC
April 15, 1999:	Reporting 98252, proposal for Project 00252 First Recommendations for herring, pollock, and rockfish management
Sept. 30, 1999:	Egg take for odd-year pink salmon run
April 15, 2000:	Reporting 99252, proposal for Project 01252
Sept. 30, 2000:	First adult returns from pink salmon run
April 15, 2001:	Reporting 00252, proposal for Project 02252
Sept. 30, 2001:	Odd-year return pink salmon

Sept. 30, 2002: Final Report

C. Completion Date

September 30, 2002

PUBLICATIONS AND REPORTS

Annual Reports, annual reporting of significant findings in the peer-reviewed literature

PROFESSIONAL CONFERENCES

Results from one or more elements will be presented at the annual meeting of the American Fisheries Society.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Efforts will be coordinated through regional and area staff of ADF&G as appropriate to design genetics studies that guide the Trustee Council restoration projects, especially those that involve stocking or transport of fish. Special effort will be expended to coordinate with and offer use of the core facility to IMS faculty and NOAA and NBS staff that conduct research at the Alaska SeaLife Center in Seward. Tissue archival and biometric analyses will be coordinated among all Trustee Council projects related to genetics including 98196 and 98165.

Data collection techniques will be coordinated through the inter-agency consortium of laboratories that cooperate on similar projects of conservation genetics of marine fishes in the North Pacific Ocean.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

This is a new project.

PROPOSED PRINCIPAL INVESTIGATORS

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PERSONNEL

James E. Seeb, Principal Geneticist
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EDUCATION: B.S., Biology, 1974, University of Puget Sound
M.S., Fisheries, 1982, University of Washington
Ph.D., Fisheries, 1987, University of Washington

PROFESSIONAL EXPERIENCE:

1990- Principal Geneticist, CFMD Division, ADF&G
1991- Affiliate Associate Professor, University of Alaska Fairbanks
1988-1990 Assistant Professor, Southern Illinois University
1987-1988 Research Assistant Professor, University of Idaho
1982-1986 Graduate Research Assistant, University of Washington
1980-1982 Fish Biologist, Pacific Fisheries Research, Olympia, WA
1978-1980 Fish Biologist, Washington Department of Fisheries

SELECTED PUBLICATIONS:

Seeb, J.E., L.W. Seeb, and F.M. Utter. 1986. Use of genetic marks to assess stock dynamics and management programs for chum salmon. Trans. Amer. Fish. Soc. 115:448-454.

Seeb, J.E., and L.W. Seeb. 1986. Gene mapping of isozyme loci in chum salmon (*Oncorhynchus keta*). J. Hered. 77:399-402.

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Seeb, L. W. C. Habicht W. D. Templin, K. E. Tarbox R. Z. Davis, L. K. Brannian, J. E. Seeb. 1998. Genetic diversity of sockeye salmon (*Oncorhynchus nerka*) of Cook Inlet, Alaska, and its application to restoration of populations affected by the *Exxon Valdez* oil spill. Canadian Journal of Fisheries and Aquatic Sciences. *Accepted and in press.*

Seeb, J. E. C. Habicht, J. B. Olsen, and L. W. Seeb. 1998. An overview of gene detection methods used to study population variation in salmonids. Assessment and Status of Pacific Rim Salmonid Stocks. North Pacific Anadromous Fish Commission, Vancouver B.C. *Accepted and in press.*

Habicht, C., S. Sharr, and J. E. Seeb. 1998. Coded wire tag placement affects homing ability of pink salmon. Transactions of the American Fisheries Society. *Accepted and in press.*

Lisa W. Seeb (L. Wishard), Statewide Geneticist
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EDUCATION:

A.B. Zoology, 1973, University of California, Berkeley
M.A. Zoology, 1977, University of Montana
Ph.D. Fisheries, 1986, University of Washington

PROFESSIONAL EXPERIENCE:

1991-	Statewide Geneticist, ADF&G, Anchorage
1991-	Affiliate Associate Professor, University of Alaska Fairbanks
1988-1990	Assistant Professor, Southern Illinois University
1984-1988	Research Assist. Prof., University of Idaho
1978-1981	Fish Geneticist, Pacific Fish. Research, Olympia WA
1977-1979	Geneticist, National Marine Fisheries Service, Seattle

SELECTED PUBLICATIONS:

Wishard, L. N., J. E. Seeb, F. M. Utter, and D. Stefan. 1984. A genetic investigation of suspected redband trout populations. Copeia 1984(1):120-132.

Seeb, J. E., L. W. Seeb, and F. M. Utter, 1986. Use of genetic marks to assess stock dynamics and management programs for chum salmon. Trans. Amer. Fish. Soc. 115:448-454

Seeb, L. W. and D. R. Gunderson. 1988. Genetic variation and population structure of Pacific ocean perch (Sebastes alutus). Can. J. Fish. Aquat. Sci. 45:78-88.

Seeb, L. W., J. E. Seeb, R. L. Allen and W. K. Hershberger. 1990. Evaluation of adult returns of genetically marked chum salmon, with suggested future applications. American Fisheries Society Symposium 7:418-425

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Seeb, L. W. C. Habicht W. D. Templin, K. E. Tarbox R. Z. Davis, L. K. Brannian, J. E. Seeb. 1998. Genetic diversity of sockeye salmon (*Oncorhynchus nerka*) of Cook Inlet, Alaska, and its application to restoration of populations affected by the *Exxon Valdez* oil spill. Canadian Journal of Fisheries and Aquatic Sciences. *Accepted and in press.*

Seeb, J. E. C. Habicht, J. B. Olsen, and L. W. Seeb. 1998. An overview of gene detection methods used to study population variation in salmonids. Assessment and Status of Pacific Rim Salmonid Stocks. North Pacific Fish Commission, Vancouver B.C. *Accepted and in press.*

C. Susan E. Merkouris, Shellfish and Marine Fishes Project Geneticist
Commercial Fisheries Management and Development
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PROJECT RESPONSIBILITIES: Field coordination, sampling, archiving, contracting, laboratory and data analyses, reporting

EDUCATION:

A.A., 1974, Liberal Arts (Honors), Golden Valley Lutheran College, Mpls., MN
B.S., 1980, Biology and Chemistry, *magna cum laude*, University of Alaska, Anchorage AK

PROFESSIONAL EXPERIENCE:

1991-	Shellfish and Marine Fishes Project Geneticist, CFMD, ADF&G
1989-1991	Lower Yukon Asst. Mgmt. Fisheries Biologist, C.F., ADF&G
1985-1989	Norton Sound Asst. Mgmt. Fisheries Biologist, C.F., ADF&G
1981-1985	Fisheries Biologist, C.F., ADF&G
1979-1981	Fisheries Technician, C.F., ADF&G
1976-1980	Clinical Microbiologist, Norton Sd.Regional Hospital, Nome, AK

SELECTED PUBLICATIONS AND PRESENTATIONS:

Merkouris, S. E. and L. W. Seeb. (accepted pending revisions). Genetic variation of highly exploited Tanner crabs, *Chionoecetes bairdi* and snow crabs, *C. opilio* in Alaska. Submitted to Fishery Bulletin.

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Cronin, M. A., W. J. Spearman, R. L. Wilmot, J. C. Patton, and J. W. Bickham. 1993. Mitochondrial DNA variation in chinook (*Oncorhynchus tshawytscha*) and chum salmon (O. *keta*) detected by restriction enzyme analysis of polymerase chain reaction (PCR) products. Canadian Journal of Fisheries and Aquatic Sciences 50:708-715.

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Kocher, T. D., W. K. Thomas, A. Meyer, S. V. Edwards, S. Paabo, F. X. Villablanca, and A. C. Wilson. 1989. Dynamics of mitochondrial DNA evolution in animals: Amplification and sequencing with conserved primers. Proc. Natl. Acad. Sci. USA 86:6196-6200.

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1998 EXXON VALDEZ TRUSTE UNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998						
Personnel		$123.5						
Travel		$11.5						
Contractual		$28.1						
Commodities		$41.1						
Equipment		$17.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$221.2	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003	
General Administration		$20.5						
Project Total		$241.7	$300.0	$309.0	$318.0	$327.0		
Full-time Equivalents (FTE)		2.7						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:
At this time rental fees for research at the Seward facility have not been finalized. Costs for this have not been budgeted and will be determined by negotiations between the Trustee Council and the Seward Association for Advancement of Marine Science."

1998

Project Number: 98252
Project Title: Investigations of Genetically Important Conservation Units of Species Inhabiting the EVOS Area
Agency: AK Dept. of Fish & Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared:

4/16/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
Kerkvliet	FBI(PCN 7043)	14D	5.0	4.3		21.5
Kretschmer	FBI (PCN 7112)	14B	3.0	3.9		11.7
Vacant	FBI(PCN 7018)	14A	3.0	3.9		11.7
FWTII	FWTII(PCN 5227)	9C	3.0	3.2		9.6
FWTIII	2 positions	11A	3.0	3.3		9.9
SeaLife Center (Seward)						
Vacant	FBIII	18A	6.0	5.0		30.0
Vacant	FWTIII	11A	6.0	3.3		19.8
Vacant	FWTII--2 positions	9B	3.0	3.1		9.3
	Subtotal		32.0	30.0	0.0	
					Personnel Total	$123.5

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Anch to Cordova, full fare	0.22	2			0.4
Anch to Kodiak, full fare	0.22	2			0.4
Anch. to Homer	0.15	1			0.2
Per diem			10	0.15	1.5
Anchorage to Lower 48, Professional Meeting	0.50	1			0.5
Per diem			5	0.15	0.8
					0.0
SeaLife Center					0.0
Seward to Anchorage	0.10	12			1.2
Anchorage to Seward	0.10	20			2.0
Per Diem			30	0.15	4.5
					0.0
				Travel Total	$11.5

1998

Prepared: 2 of 4

Project Number: 98252
Project Title: Investigations of Genetically Important Conservation Units of Species Inhabiting the EVOS Area
Agency: AK Dept. of Fish & Game

FORM 3B
Personnel
& Travel
DETAIL

4/16/97

1998 EXXON VALDEZ TRUSTI)UNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FFY 1998
Pollock primer development	15.0
Freight	1.0
Photography	1.1
Telephone	0.5
DNA Sequencer maintenance contract, equipment repair	5.0
SeaLife Center (Seward)	
Office costs (telephone, copies, etc.)	2.0
Freight	0.5
Broodstock collection	3.0
Rent (to be paid separately by Trustee Council)	0.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$28.1

Commodities Costs:	Proposed
Description	FFY 1998
DNA chemicals (pollock)	10.3
DNA chemicals (herring)	10.3
DNA chemicals (black rockfish)	6.0
Allozyme chemicals	1.8
Plastics (cryovials, disposable pipets, etc.)	0.9
Office supplies	0.3
SeaLife Center (Seward)	
Laboratory setup (glassware, plastics, pipettors, etc.)	6.0
Wet lab equipment	5.0
Office supplies	0.5
Commodities Total	$41.1

1998

Project Number: 98252
Project Title: Investigations of Genetically Important Conservation Units of Species Inhabiting the EVOS Area
Agency: AK Dept. of Fish & Game

FORM 3B
Contractual & Commodities

4/16/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1998
SeaLife Center (Seward)			0.0
Computers	2	3.5	7.0
Laboratory equipment		10.0	10.0
			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		**New Equipment Total**	$17.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1998

Prepared: 4 of 4

Project Number: 98252
Project Title: Investigations of Genetically Important Conservation Units of Species Inhabiting the EVOS Area
Agency: AK Dept. of Fish & Game

FORM 3B
Equipment
DETAIL

4/16/97

98254

Project Title:	**DELIGHT AND DESIRE LAKES RESTORATION**
Project Number:	98254
Restoration Category:	General Restoration
Proposer:	Alaska Department of Fish and Game (ADF&G)
Lead Trustee Agency:	Alaska Department of Fish and Game
Cooperating Agencies:	US Department of Interior (DOI), USGS/Biological Resources, National Park Service (NPS)
Duration:	<1 year (pre-fertilization final report)
Cost FY/97:	$123,100
Cost FY/98:	$11,700
Cost FY/99:	
Cost FY/00:	
Geographical Area:	Delight and Desire Lakes are located on the Outer Gulf Coast of the Kenai Peninsula on the eastern shore of McCarty Fiord of East Nuka Bay.
Injured Resource/Service:	Sockeye salmon/subsistence and commercial fishing.

RECEIVED
APR 11 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT
This project evaluates the quality of the rearing habitat and the feasibility of lake fertilization in Delight and Desire Lakes. Limnological and fisheries data were collected during 1997 (97254), and funding of this project would be for report preparation. Nutrient enrichment has increased the forage base for rearing sockeye salmon fry in other Alaskan lakes (Kyle 1994ab; Kyle et al. 1997). The expected result of nutrient enrichment is larger/more numerous sockeye smolts and a corresponding increase in adult returns. An enrichment program in Delight and/or Desire Lakes would increase lake fertility, which in turn, should accelerate the recovery of the currently depressed sockeye salmon runs in these two lakes. Results from this project will be reviewed by st[illegible] ADF&G, DOI, and NPS to determine the feasibility and merit of implementing nutrient enrichment in these lakes.

INTRODUCTION

The outer district of the Kenai Peninsula has many salmon stocks that are important to the region's salmon ecology as well as the local commercial, sport and subsistence salmon harvests. Sockeye salmon of Delight and Desire Lake are the only wild sockeye salmon found in the outer district that are of commercial importance. Delight and Desire Lakes are located in the East Arm of Nuka Bay approximately 77 km southwest of Seward and 70 km east of Homer. Based on data collected in the 1980s, both lakes are oligotrophic (lakes with low nutrient levels). Delight Lake has a surface area of 2.8 million km^2 and a mean depth of 20 m; Desire Lake has a surface area of 1.8 million km^2 and a mean depth of 14 m. Both lakes have outlet streams that empty into McCarty Fiord. The *Exxon Valdez* oil spill caused heavy oiling to the beaches and near shore waters at the entrance to McCarty Fiord. Light oiling was documented near the outlet streams of Delight and Desire Lakes (ADNR, 1989). Sockeye salmon and lost fishing time has been identified as injured resources and services by the *Exxon Valdez* Trustee Council (EVTC).

NEED FOR THE PROJECT

A. Statement of the Problem

The targeted resource is sockeye salmon of Delight and Desire Lakes. Catches of sockeye salmon in the East Nuka Subdistrict have averaged 5,750 fish since the first return of adult salmon after the 1989 oil spill. This compares to an average annual catch of 23,100 fish for 1971 through 1990. The Aialik Bay sockeye catch has also experienced similar results since 1991. Aialik Bay is also located on the outer coast of the Kenai Peninsula approximately 20 km southwest of Seward and 32 km northeast of Delight and Desire Lakes. The beaches and near shore waters to the entrance of Aialik Bay, including the narrow passages and capes, were heavily oiled during the *Exxon Valdez* oil spill (ADNR, 1989). The average annual harvest for Aialik Subdistrict from 1979 through 1990 was 12,900 sockeye; in comparison, since 1991 (the first year adult sockeye returned from the 1989 smolt outmigration) the average harvest was 1,600 sockeye.

In addition to lost fishing time for the commercial fishery and inadequate adult escapements, the sport and subsistence fisheries may have been effected. Sport fishing effort has expanded in the general area of Delight and Desire Lakes. In fact, the eastern shore of Nuka Bay is a popular location for sport fishing charter operations as well as a popular remote fly-in sport fishery; however, no sport harvest data are available. In addition, there is evidence of historic and recent use of Delight and Desire sockeye salmon for subsistence by residents of Port Graham and Nanwalek (R. Stanek, 1997). The potential benefit from nutrient enrichment would be the restoration of sockeye salmon in Delight and Desire Lakes, as well as an increase in the commercial, sport, and subsistence harvest of sockeye in the East Nuka Bay area.

The FY-97 detailed project description (DPD) contained two phases for this project. Phase one (pre-fertilization phase conducted in 1997) is a comprehensive limnological and fisheries investigation of Delight and Desire Lakes. Phase two would implement a nutrient enrichment program. If phase one reveals that one or both of the lakes would benefit from nutrient enrichment, a financial source other than (or supplement to) oil spill funds would be required to finance the project. Currently, fishery enhancement projects in Lower Cook Inlet are financed by revenue generated by selling fish (cost recovery) caught in special harvest areas designated by ADF&G and the Cook Inlet Regional Aquaculture Association. By expanding the revenue goal through cost recovery additional revenue would become available to fund a new lake fertilization project.

B. Rationale/Link to Restoration

The limnological and fisheries investigations are not being conducted to link oil spill injury to salmon survival (fry or adult) in the East Nuka Bay area. Although no link to damage from the oil spill can be developed for the Delight and Desire Lakes sockeye salmon, this restoration project has potential to accelerate the recovery of these currently depressed stocks. Lake enrichment would provide an increased forage base for rearing sockeye fry and would be expected to produce larger/more numerous sockeye smolts that should lead to increased adult runs.

The FY97 (phase one) investigations included assessment of nutrient levels, primary and secondary production, and the condition and abundance of sockeye smolts in Delight and Desire Lakes. The FY-98 budget will cover the cost of analyzing the data and preparing a report on both lakes that contains results of the FY-97 pre-fertilization investigation, along with historical data from the 1980s. The report will provide information on the current rearing capacity of these lakes, and recommendations on restoration (stocking/nutrient enrichment).

C. Location

Delight and Desire Lakes are located in the East Arm of Nuka Bay (McCarty Fiord) on the Eastern Kenai Peninsula approximately 77 km southwest of Seward and 70 km east of Homer. Communities that would benefit from the proposed project include the villages of Port Graham, Nanwalek and Seldovia as well as Homer and Seward.

COMMUNITY INVOLVEMENT

Land adjacent to Delight and Desire Lakes have recently been transferred from the federal government to the Port Graham Corporation. Pat Norman, president of the Port Graham Corporation, has advocated and supported this project through the Lower Cook Inlet Seiners Association and the Lower Cook Inlet Fisheries Development Association.

PROJECT DESIGN

A. Objectives

The objective of the report funded in this DPD is to provide a comprehensive assessment of the physical, chemical and biological aspects of Delight and Desire Lakes. This assessment will include a description (and interpretation) of the limnology of the two lakes, the historical salmon fisheries data, and recommendations regarding restoration potential (lake fertilization/stocking).

B. Methods

Analysis and data interpretation will follow established (and standardized) procedures used for other similar projects. Sample analysis procedures will follow methods described in Koenings et al. (1987), and nutrient enrichment criteria is described in Koenings et al. (1979).

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Agencies that have been contacted or will be involved in this project include the DOI/USGS Water Resources Section, the National Park Service, Lower Cook Inlet Seiners Association, Lower Cook Inlet Fisheries Development Association, the villages of Port Graham and Nanwalek, and ADF&G Subsistence and Commercial Fisheries Management and Development Divisions. Currently, the only contracts anticipated with the private sector would be contractual services with local air taxi services.

SCHEDULE

A. Measurable project Tasks for FY-98 (October 1, 1997 - September 30, 1997)

1 Oct - 31 Nov 1997:	Data summaries and historical data compilation
1 Dec - 31 Jan 1998;	Preparation of final report and submission for review
1 Feb - 1 Mar 1998:	Revisions of final report

B. Completion Date

The project (report) will be completed March 31, 1998.

PUBLICATIONS AND REPORTS

There are numerous memos and draft reports (from the 1980s) in ADF&G files concerning nutrient enrichment of Delight and Desire Lakes.

PROFESSIONAL CONFERENCES

There are no plans to attend any conferences.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

ADF&G has been and is currently involved in cooperative projects similar to the proposed project in lower Cook Inlet. Research and historical data are available from these projects for use with this proposed project. ADF&G currently operates a lake fertilization program on Leisure Lake in cooperation with the Cook Inlet Aquaculture Association and the Cook Inlet Seiners Association.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Phase two of this project is implementation of nutrient enrichment if the feasibility investigation recommends this type of restoration project. A proposed funding source for phase two would include increasing the revenue goal for one or more of the currently operating special harvest areas located in lower Cook Inlet.

PRINCIPAL INVESTIGATOR

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Experience: From April 1977 to April 1988 Mr. Kyle served as a Project Biologist and later as the Area Biologist for the Division of Fisheries Rehabilitation, Enhancement, and Development of the ADF&G in Soldotna Alaska. Duties included conducting and evaluating various fisheries enhancement and evaluation projects in the Cook Inlet watershed including limnological investigations of sockeye salmon producing lakes, and evaluation of hatchery stocking programs. Also, during the period Mr. Kyle served as a project limnologist for the Limnology Section which involved the collection, analysis, and interpretation of limnological data from sockeye nursery lakes for assessment of rearing capacity and for modeling purposes. Since April 1988, Mr. Kyle serves as the Regional Limnologist for the Limnology Section for ADF&G in Soldotna, Alaska. As the Regional Limnologist for the Southcentral Region comprising of the Interior, PWS, Cook Inlet, and Alaska Peninsula; the primary purpose of this position is the supervision of staff in the coordination, assignment, prioritization, analysis, and review of subordinates work and interagency contract work related to lake fertilization and stocking projects, water quality monitoring projects, and fisheries and limnological research. In addition, the position is responsible for training subordinates, reporting and review of project results for publications and meetings, and administrating state and non-state (contract) budgets. Mr. Kyle has authored/co-authored 41 technical reports and 13 peer-reviewed journal manuscripts dealing with lake fertilization, lake stocking, and in-lake assessments of juvenile sockeye production.

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1998 EXXON VALDEZ TRUSTE UNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998					
Personnel	$91.2	$10.2					
Travel	$0.9	$0.0					
Contractual	$8.2	$0.0					
Commodities	$8.3	$0.0					
Equipment	$0.2	$0.0	LONG RANGE FUNDING REQUIREMENTS				
Subtotal	$108.8	$10.2	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003
General Administration	$14.3	$1.5					
Project Total	$123.1	$11.7					
Full-time Equivalents (FTE)	2.1	0.2					
	Dollar amounts are shown in thousands of dollars.						
Other Resources							

Comments:

This project is designed to assess the productivity of Delight and Desire Lakes and the resident sockeye salmon population through limnological and fisheries investigations conducted in 1997 (97254). This budget is for analyzing the 1997 limnological and fisheries data, and completion of a final report that will make recommendations regarding restoration of sockeye salmon in these two lakes.

1998	Project Number: 98254 Project Title: Delight and Desire Lakes Sockeye Salmon Restoration Agency: AK Dept. Fish and Game	FORM 3A TRUSTEE AGENCY SUMMARY

Prepared: GBK

4/10/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1998
Shields, Pat	Fishery Biologist II	16C	1.5	4.8		7.2
Carslon, Stan	Biometrician II	19D	0.5	6.0		3.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.0	10.8	0.0	[illegible]
					Personnel Total	$10.2

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1998
None					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

1998

Project Number: 98254
Project Title: Delight and Desire Sockeye Salmon Restoration
Agency: AK Dept. Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

1998 EXXON VALDEZ TRUSTEI JNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FFY 1998
None	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed
Description	FFY 1998
None	
Commodities Total	$0.0

1998

Project Number: 98254
Project Title: Delight and Desire Lakes Sockeye Salmon Restoration
Agency: AK Dept. Fish and Game

FORM 3B
Contractual &
Commodities
DETAIL

Prepared: GBK

4/10/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1998
			0.0
None			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

1998

Project Number: 98254
Project Title: Delight and Desire Lakes Sockeye Salmon Restoration
Agency: AK Dept. Fish and Game

FORM 3B
Equipment
DETAIL

'97

98256B

Sockeye Salmon Stocking at Solf Lake.

Project number:	98256b
Restoration Category:	General Restoration
Proposer:	USFS
Lead Trustee Agency:	USFS
Cooperating Agencies:	ADF&G
Duration:	3rd year, 7-year project
Cost FY 1998:	$95.5
Cost FY 1999:	$78.5
Cost FY 2000:	$68.5
Cost FY 2001:	$68.5
Cost FY 2002:	$48.1
Geographic Area:	Prince William Sound
Injured Resource:	Subsistence/Sockeye Salmon

RECEIVED
APR 15 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

This project is designed specifically to benefit subsistence users of Prince William Sound and especially for residents of Chenega Bay. Solf Lake has been recognized for many years as an opportunity to establish a self-sustaining sockeye salmon run. Habitat improvements were made in 1978, 1980 and 1981 to provide access to the lake for anadromous fish. The lake was never stocked and subsequent investigations suggest that it is currently fishless and has adequate zooplankton biomass to support a salmon population. There are two phases to this project: Phase 1 the feasibility phase which began in FY96 has verified the ability of Solf Lake to support a sustainable population of sockeye salmon. Phase 2 plans to initially stock the lake with 400,000 sockeye salmon fry in 1998 and ensure access to Solf Lake for returning adult sockeye salmon.

INTRODUCTION

Subsistence resources and services were injured throughout Prince William Sound as a result of the *Exxon Valdez* Oil Spill. This project proposal continues an investigation of the potential to improve subsistence opportunities through the stocking of sockeye salmon (*Oncorhynchus nerka*) in Solf Lake, Herring Bay, in Prince William Sound (PWS). Solf Lake has been recognized as an opportunity for establishing a self-sustaining sockeye salmon population since the 1960s. The lake now provides an excellent opportunity to establish a replacement fishery to benefit subsistence users in Prince William Sound, particularly for residents of Chenega Bay.

This 1996 project began as a feasibility assessment. In Fiscal Year 1996 (FY96) the Trustee Council funded project 96256 which was a combined proposal to assess the feasibility of establishing a stocking programs at Columbia and Solf Lakes. Interim reports and the proposers recommendations on the feasibility of these two Lakes for stocking were provided to the Trustee Council in the fall of 1996. It was determined that Solf Lake could support stocking levels of as many as 400,000 fry with close monitoring of the effects however a more conservative level of stocking of 100,000 fry is recommended at this time. Brief summaries of the feasibility phase and history of this project are presented in this introduction to assist the Trustee Council with the decision to continue funding the Solf Lake Project.

Although Solf Lake was once accessible to sockeye salmon, an earthquake in the 1930's blocked the existing access (Nickerson, 1978). Solf Lake has two outlets, an eastern one which had provided anadromous access, and a western outlet that was impassable. For many years Dolly Varden have been the only recorded species of fish in Solf Lake. In 1978 the Forest Service removed the barriers from the east channel and created a dam at the western outlet to provide adequate stream flows in the newly improved access channel, allowing access for sockeye salmon. The improvements to the new outlet channel and dam were made in 1980 and 1981 but the system was never stocked with salmon. The feasibility phase of the project (FY96) include investigations of zooplankton and algal biomass, temperature and light profiles, dissolved oxygen and water chemistry as well as an inventory of fish and macro- invertebrate populations and their available habitats.

The improvement structures at the lake's outlets were also evaluated. It was determine that the old structure which dams the impassable western outlet requires extensive reconstruction to provide adequate flow for fish passage at the lakes eastern outlet. This eastern outlet, that would provide fish access to the lake requires reconstruction of the "irrigation type" control dam (planned in FY97) and stream channel modifications. An engineering survey of this channel and subsequent fishway and dam design can be completed once the control structure at the eastern outlet is in place and operational.

The results from the limnology work and water chemistry testing in FY96 were analyzed by personnel from the ADF&G Limnology Lab in Soldotna along with data collected in 1982, 1984, and 1986 to determine if the lake is capable of sustaining a sockeye salmon population and at what level stocking should occur. Only a partial summation of the data is presented in this proposal, a complete report is available upon request from ADF&G.

Stream information was collected by Forest Service Personnel in 1996, the results indicated that Solf Lake and it's tributaries are capable of providing a shoal spawning area within the lake of 10,710 m^2 and 4,258 m^2 in the inlet streams. However spawning success in the inlet stream may be limited by winter low flows. Peak flows in the inlet stream are approximately 333 cfs. with winter low flows estimated to be as low as 0.366 cfs.

Aquatic macroinvertebrate samples from the inlet stream were, analyzed through *Alaska Water Watch: Stream Macroinvertebrates*. Ephemeropteras, Plecopteras and Trichopteras (EPTs) function as the control because of their sensitivity to the environment and water quality. The EPT Index represents the number of EPT families collected. Higher EPT Indexes (>8) are indicative of healthy and diverse systems. The healthier the system, the greater number of EPT families to be found. Solf Stream, lies in the upper mid-range with a EPT index of 8, indicating no diversity problems are likely. Water Quality Assessment (WQA) ratings also based on macroinvertebrate populations delineate relative health. High quality conditions, (rating of 4), denote healthy and diverse systems with clean water. Solf Stream rates as a sustainable system, with a WQA rating of 3.75.

The lake inventory study of 1983 included 239 hours of gillnetting and minnow trapping during which no fish were captured. Subsequent to this initial effort, a total of over 5,500 hours of similar effort resulted in the capture of 9 Dolly Varden ranging in size from 213 to 300 mm. In 1996, 421 hours of effort yielded 114 Dolly Varden ranging from 58 to 230 mm. No other species of fish were captured during this sampling period. For the purposes of supplementation Solf Lake is considered to be a fishless lake. Stream survey results of the 2 outlets indicate that while smolt passage is possible, upstream migration by adults is questionable.

Solf Lake has a surface elevation of 8 m, a surface area of 60.9 ha (150.4 acres), a volume of $25.9 \times 10^6 m^3$ and a mean depth of 42.5 m. With a watershed area of 534 ha. and a calculated annual discharge of $13 \times 10^6 m^3$, Solf Lake has a theoretical water residence time of 2 years. A small percentage of littoral area is evident at the northern (outlet) and southern (inlet) ends of the lake while the east and west shorelines are relatively steep sided.

For the years 1982-1984, 1986, and 1996 the total macrozooplankton biomass averaged 500 mg m^2. Assuming this amount of forage is available each year to sockeye fry and a slope parameter estimate of 2.11, the estimated rearing capacity for smolt production in Solf Lake would be:

500 mg. $m^2 \times 2.11$ = 1,050 kg smolt / km^2
1,050 kg/km^2 x .609 km^2 = 642.5 kg. of Smolt
642,500 g. / 5 g. = 128,500 5 g. Smolt
Assuming a 15% fry to smolt survival this number of smolt equates to 856,667 spring fry.
Assuming a 15% smolt to adult survival this number of smolt equates to 19,275 adults.

Stocking Recommendations by ADF&G: The instability of the macrozooplankton community in barren lakes when faced with predation necessitates stocking programs based on a conservative and gradual approach with close evaluation, and experimenting with stocking strategies that ameliorate significant impacts to the macrozooplankton community. Major reasons for the disparity of response to stocking barren lakes include 1) the inherent low productivity of these lakes; 2) macro zooplankton abundance, composition, and ability to adapt to predation; 3) stocking density; 4) morphometric factors and 5) variability in the indirect effects of predation in individual lakes. Consequently, based on limnological information for the first three years the stocking level in Solf Lake could be 400,000 fry with monitoring of the zooplankton once per month during June-October would be required. After three years of stocking at this level, if the zooplankton community did not show a significant impact, the level could be increased to perhaps 500,000 fry. This level of stocking could be done for another three years with continued evaluation of the zooplankton community.

After stocking has discontinued, based on the available spawning area it is estimated that Solf Lake could sustain a run of approximately 10,000 sockeye without supplementation. An escapement goal of approximately 4,500 fish would be required to fully seed the system without depleting the zooplankton populations, leaving 5,500 sockeye available for harvest.

Solf Lake is included in the Prince William Sound - Copper River Comprehensive Salmon Plan (PWSRPT, 1994) where it is recommended for implementation if funds become available.
In April 1995 the original proposal for this project was presented to the Prince William Sound Copper River Regional Fisheries Planning Team (RPT.) for consideration and approval a Project Checklist has been submitted. On April 7th of this year the Forest Service participated in a teleconference with the RPT and discussed brood stock source, mixed stock issues and stocking levels. The RPT approved the project in concept but recommended a lower level of stocking than the at the 400,000 fry level. The RPT's recommendation was to stock 100,000 fry to achieve the goal of 10,000 adult fish returning to Solf Lake. This reduction was based on meeting the stated objective of the project, and on the probability of very high fry to smolt to adult survival rates during the stocking phase of the project. The RPT also approved the use of the early run Eyak fish as a brood stock.

The Prince William Sound Aquaculture Corporation (PWSAC) has prepared the Fish Transport Permit (FTP) based on using the RPT's recommendations and has included the Solf Lake Project in their Area Management Plan.

NEED FOR THE PROJECT

A. Statement of Problem

Subsistence use of resources in the oil spill area declined following the spill. Although restoration studies have shown that harvest levels have since returned to pre-spill levels in most oil spill communities, Chenega Bay and Tatitlek are exceptions (Seitz and Fall, 1995; Seitz and Miraglia, 1995). These communities showed reduced harvest levels in 1993/94 and an increased reliance on salmon harvests (Seitz and Fall, 1995; Seitz and Miraglia, 1995). Solf Lake provides an opportunity to establish a large replacement fishery that is easily accessible for subsistence users from Chenega Bay. Projects available for the restoration or replacement of lost subsistence services are limited - this proposal would utilize one of the few opportunities available.

This project has determined the feasibility of stocking Solf Lake with sockeye salmon and proposes the steps required to establish a replacement fishery for subsistence use. Based on historical limnological data from the 1980's, and stream survey data collected in 1996 it is reasonable to expect that the lake is capable of supporting a sustainable sockeye population with an adult return of approximately 10,000 fish.

B. Rationale/Link to Restoration

The *Exxon Valdez* Restoration Office's Invitation to submit proposals for FY97 stated that subsistence users are traveling greater distances and must invest more time in subsistence harvesting than they did prior to the spill. Unlike many other oil spill communities, Chenega Bay still shows reduced subsistence harvest levels and a greater reliance on subsistence harvest of salmon (Seitz and Fall, 1995; Seitz and Miraglia, 1995). Solf Lake is located approximately 40 miles from Chenega Bay and provides an opportunity to establish a replacement fishery that is accessible to subsistence users. The lake is a clear water lake with a mean depth of 42.5 m and a surface area of approximately 0.61 km^2 (Barto and Nelson, 1982). Analysis of current data suggest that the lake may support a self sustaining population of 10,000 sockeye with roughly half being available for harvest. Establishing this fishery would directly benefit subsistence users in Western Prince William Sound.

Background. Solf lake has been recognized as an opportunity to re-establish a sockeye salmon run in Prince William Sound for many years. According to Nickerson (1978), "This system had historic runs of sockeye salmon. An earthquake in the 1930's caused blockages of the natural outlet resulting in water flowing over an impassable fall." Since the early 1970's various attempts have been made to reestablish sockeye salmon in Solf Lake. During two years in the early 1970's, ADF&G personnel transported adult sockeye salmon from Eshamy River to Solf Lake (Jackson, personal communication). Unfortunately, necessary stream improvements had not been completed when the transplanted fish returned. The attempt to reestablish the population failed. In 1978, 1980 and 1981, the USFS implemented improvements to the lake and outlet stream. The work consisted of creating a new outlet channel, and a partial dam at the existing outlet. The dam was designed to raise the level of the lake to provide adequate water flow through the newly created outlet. The new outlet channel is less than 100 meters in length with an average gradient of 23 percent. Stocking of the lake never occurred after the habitat improvements because of other priority projects for both the USFS and ADF&G.

ADF&G surveyed Solf Lake in 1985/1986 as part of a lake investigations study. The results of this survey, which included attempts to capture fish, suggest that the lake may be fishless (Pellissier and Somerville, 1987). However 1996 trapping by USFS crews indicated a larger population of Dolly Varden than has been previously observed, but still not significant. These results are also supported by the composition and biomass of the zooplankton populations which were last sampled in 1986 (P. Shields, personal communication 1996). The Pellissier and Somerville (1987) survey also documented that water was flowing through the original outlet where an incomplete seal in the dam structure occurred. Three minor barriers to fish passage were identified in the created outlet channel. The report suggests that if all the outlet flow were directed down the created channel these barriers may disappear.

C. Location

Solf Lake is located off of Herring Bay on Knight Island. The lake is approximately 40 miles by boat from Chenega Bay and 46 miles from Whittier. The lake is unnamed on USGS maps; however, Nickerson (1978), PWSRPT (1983 and 1986) and Barto and Nelson (1982) all refer to the lake as Solf Lake (ADF&G Stream 690). The lake is described in the Anadromous Waters Catalog as number 226-10-16900-0010 (ADF&G, 1992).

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

This project is designed specifically to benefit subsistence users of PWS; therefore, community involvement is an important component for the success of the project. The feasibility phase of this project (FY96) has determined the ability of Solf Lake to support a resident population of sockeye salmon. Contacts with the Chenega Bay community liaison will be maintained throughout the feasibility and implementation phases of this project to discuss what the potential adult sockeye production might be for the lake and project schedules. Opportunities will be identified to include residents of Chenega Bay in habitat improvement work or in the post-stocking monitoring program.

PROJECT DESIGN

A. Objectives

Phase 1. The overall objective of this phase of the project was to determine the feasibility of stocking Solf Lake with sockeye salmon. There are four components to this objective:

1. Determine if Solf Lake can sustain a population of sockeye salmon; (completed).
2. Determine appropriate stocking levels; (completed).
3. Coordinate with PWSAC and Main Bay hatchery to establish an appropriate brood stock and the necessary logistics to begin a stocking program; (completed).
4. Evaluate the existing habitat improvement structures to ensure adequate conditions for adult migration; (to be completed in FY97).

Phase 2. This is the implementation phase of the project. There are three objectives to this phase.

1. Design and construct necessary improvements to the outlet channel and dam to ensure adequate passage for adult salmon migration.
2. Stock Solf Lake with sockeye salmon to produce a self-sustaining population that can provide an adequate subsistence harvest.
3. Monitor zooplankton and smolt out-migration to ensure appropriate stocking levels.

B. Methods

Project 96256 included one season of data collection to determine presence of resident fish and the potential carrying capacity of Solf Lake. A second year of limnological data will be collected in 1997 at Solf Lake and combined with previous data to finalize stocking recommendations. Information collected in 1997 will also identify the habitat improvements needed to establish a sustainable sockeye run and allow for their design. The following section is divided into two parts. Part 1 describes the methods needed to establish a self-sustaining sockeye salmon population. Part 2 describes the possible types of habitat improvements that may be needed to provide access for returning adult salmon. Sampling methods used in 1996 and 1997 are also attached to this proposal as Appendix A.

Part 1. This section outlines the methods to implement a stocking program at Solf Lake.

Interagency Coordination (1997): Close coordination between the USFS, ADF&G, PWSAC and the PWS/CR RPT is mandatory for the success of this project. Prince William Sound is a complex ecosystem and the potential stocking of Solf Lake needs to be considered in perspective with the overall management of the Sound. Interagency coordination has occurred in 1996 and 1997 to identify appropriate brood stocks, determine appropriate stocking levels, meet hatchery-related requirements, and to address mixed-stock fisheries issues.

Stocking Program (1998 to 2002): Appropriate stocking levels and strategies will be determined in coordination with ADF&G and PWSAC using all available data. If the decision is made to stock the lake, fry would be short-term reared at the Main Bay Hatchery and transported to the lake for release. The Eyak and Coghill stocks are identified in the PWS/CR Phase 3 Comprehensive Salmon Plan (PWS/CR RPT, 1994) as potential stocks for Solf Lake. Based on current information, 1998 would be the earliest release date possible, but the actual release time will be dependent upon space availability at Main Bay and/or ice cover and other conditions at the lake. At least four years of fry transplants would be required to establish a sockeye salmon run.

Part 2. This section recognizes that additional work may be needed to provide access to the lake for returning adults. Until the engineering survey is completed in 1997, it is unknown what specific type of work may be needed to ensure salmon have access to Solf Lake.

Monitoring (1998 and beyond): Limnological data will be collected each year of the stocking program to evaluate the affect of the stocking program on the plankton population. This monitoring will include a summer and fall sampling period for water chemistry analysis and monthly zooplankton sampling from May through September. These procedures are described in detail in Koenings et. al. (1987). This would be a reduced sampling design from the one used during the feasibility assessment of the lake.

The success of the stocking program would also be monitored through sampling the fish population during the smolt out migration and during adult escapement. Smolt will be collected by fyke net or weir to estimate the total out migration. Fish will be sampled to determine age, length and weight characteristics which can be used to evaluate the health of the population. Coded wire tags or thermal marking would be used to monitor the adult population. Returning adults will be enumerated at a weir on the outlet stream and if possible with aerial surveys. Scales will also be collected and the age structure of the returning fish will be analyzed.

Solf Lake was visited by ADF&G personnel as part of a PWS lake investigations project in 1985 (Pellissier and Somerville, 1987). Three minor barriers to fish migration were identified in the outlet channel. These barriers were velocity barriers that ranged in size from 1.5 to 2.5 meters. The barriers may potentially be removed through the creation of plunge pools or by installing steeppasses. The report also suggested that the barriers may not exist if more water were in the outlet channel which could be achieved by repairing or rebuilding the dam at the waterfall of the original outlet channel. The actual methodologies used will be dependent upon the results of the habitat evaluation from 1996 and engineering surveys conducted in 1997.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Personnel from the ADF&G Limnology Lab in Soldotna will conduct the limnological data collection. ADF&G will also complete the water chemistry and plankton analysis laboratory work. USFS will conduct the habitat surveys, evaluations of the habitat improvement structures, determine available spawning and rearing habitats, and evaluate the resident fish populations. Coordination will occur with PWSAC to make any necessary adjustments at the Main Bay Hatchery to accommodate additional incubation and short-term rearing. Coordination will also occur with PWSAC to perform any necessary fish culture work and transport the fry to the lake. Interagency coordination is essential to establish a successful population at Solf Lake. The PWS/CR RPT will be involved in assessing opportunities and for developing strategies for the stocking program.

SCHEDULE

A. Measurable Project Tasks for FY98

Oct - June:	PWSAC. rears sockeye to fry at Main Bay.
Oct - Dec:	USFS. complete final design of fishway and dam.
January:	Attend Annual Restoration Workshop.
Jan - April:	USFS. prepare for field season award contracts for logistics.
Jan - April:	USFS. prepare and submit Annual Report and updated DPD.
June:	PWSAC. releases first year of sockeye fry at Solf Lake.
May - July:	USFS. reconstruct dam at old outlet.
May - Sept:	ADF&G. conduct limnological sampling and prepares report.
Aug:	PWSAC. conduct egg take for 1999 stocking at Solf Lake.

B. Project Milestones and Endpoints

Phase 1. The overall objective of this stage of the project was to determine the feasibility of stocking Solf Lake with sockeye salmon. This objective will be completed when limnological samples are collected and analyzed; and mixed-stock fisheries and genetic risk issues are resolved. This objective will be completed in early FY97.

Phase 2. This is the actual stocking phase of the project. With the near completion of Phase 1. and the favorable recommendation stocking is planed to begin in FY98. If the evaluation of the existing habitat structures at Solf Lake indicate that additional work is needed to allow for adequate fish passage, these improvements would have to be made before adult fish are expected to return to the lake in the year 2001. The following is a tentative schedule and measurable endpoints that apply to the two phases of this project.

Oct - Dec. FY97:	Determine appropriate brood stock and potential stocking levels. Coordinate with PWSAC and the PWS RPT for production planning.
Jan. - April FY98:	Apply for necessary permits and hatchery space; complete NEPA process; prepare for field season.
May - July:	Design and implement necessary habitat improvements (if needed).
June/July:	Collect eggs for brood stock.
FY98 - 2002:	Release hatchery-reared fry Monitor zooplankton and smolt out-migration (FY2000 - FY2003) Submit annual reports
FY2001:	Enumerate adult returns

C. Completion Date

The project completion date will be at the end of FY2003.

PUBLICATIONS AND REPORTS

Annual reports and an updated DPD will be submitted during each year of the project.

PROFESSIONAL CONFERENCES

At this time there are no plans to present this project at professional conferences. However a poster board display is planned for presentation at the District Office and at science conferences.

NORMAL AGENCY MANAGEMENT

Given current budgets and agency priorities the opportunity to conduct this project under normal agency management either now or in the near future is unlikely. However, some aspects of the long term maintenance and monitoring of the project, may fall under the normal agency management of other similar structures in PWS. Shared cost proposals for each of the phases of construction and monitoring of this project will be presented in the future project work plans for the Forest Service but given budget fluctuations secure funding is not a certainty.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Initial coordination with ADF&G biologists in Cordova, with the Regional Planning Team, and with PWSAC will continue throughout FY97 to address the mixed-stock fisheries and genetic risk issues that will influence the feasibility of this project. USFS Personnel attend the 1996 summer Regional Planning Team meeting to initialize the necessary coordination. The results from FY96 will be presented to the RPT outlining, potential size of the stocking program and brood stocks. The information will be used to assess the potential effects of this project on local wild stocks and on the commercial fisheries in the area.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

This proposal covers only one of the two locations described in the original proposal 96256. The proposal for the other site, Columbia Lake, was resubmitted as 97256a. This split occurred because the work schedule for FY97 differs substantially between Solf and Columbia Lakes. And that the feasibility study of Columbia Lake determined that it would not be a good candidate for stocking at this time and has since been dropped from further study.

PROPOSED PRINCIPAL INVESTIGATOR

The principal investigator of this project will be the Fisheries Biologist at the Glacier Ranger District of the Chugach National Forest. This position is currently vacant and expected to be filled in FY97. Daniel Gillikin (Fisheries Biological Technician; Glacier Ranger District) is the interim biologist and will coordinate this project for the USFS. until a permanent principal investigator is assigned. Dan will also provide technical support and field coordination of the seasonal employees assisting in data collection and construction for the project.

ADF&G is the cooperating agency on the project. Pat Shields, Fishery Biologist I, will be the principal investigator for the limnological and bathymetry work. Marsha Spafard, Fish and Game Technician III and Denise Cialek, Fish and Game Technician III, will assist in the data collection and laboratory analysis of the limnological data.

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P.O. Box 129
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271-2348
271-3992 (FAX)

Patrick Shields
Limnology Laboratory (ADF&G)
3428 Kalifornsky Beach Rd. #8
Soldotna, AK 99669
262-9368
262-4709 (FAX)

PRINCIPAL INVESTIGATOR

Dan Gillikin, U.S. Forest Service Glacier Ranger District Chugach National Forest. Currently holds the position of Fisheries Technician and acting Fisheries Biologist on the Glacier District. He has eight years of experience as a fisheries technician with Private and Federal Agencies in Washington and Alaska. He is currently the acting Fisheries Biologist for the Glacier District and manages the Districts Fisheries Program. He would work with the project manager and conduct project implementation, environmental compliance, agency coordination, budget management and reporting.

OTHER KEY PERSONNEL

Cliff Fox, U.S. Forest Service Glacier Ranger District Chugach National Forest. Currently holds the position of Resource Staff Officer on the Glacier District. Has 20 years experience in natural resource management with State and Federal Agencies in California, Idaho and Alaska. Has 25 years experience in project planning, implementation, and monitoring. Has multi-resource experience holding positions in fisheries, wildlife, timber, minerals, recreation, fire, real-estate, cultural resources, Forest Planning and environmental coordination. Presently oversees the District's fisheries, wildlife. timber, ecology, minerals and air quality programs. Would be responsible for project oversight during implementation, environmental compliance, agency coordination, budget management and reporting.

Cliff Fox
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PERSONAL COMMUNICATIONS

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Jackson, M., Fish and Game Technician (retired). Alaska Dept. of Fish and Game. Cordova. April, 1995.

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APPENDIX A

Limnological Sampling (1996-1997): Data collection and analysis will include: Algal biomass (chlorophyll a), zooplankton populations (biomass, body-sizes, species composition etc.), temperature and light profiles, dissolved oxygen, and water quality (nutrients) to estimate the potential productivity of the lake. Procedures for the collection of these samples are detailed in Koenings et. al. (1987). Samples would be collected from a minimum of two permanent collection sites every three to four weeks May - September to assess seasonal variation.

Fisheries Sampling (1996): Sampling for fish was intented to determine the presence or absence of a particular species. Age classes, the strength of the different classes, and the condition factor for each particular species will be determined provided representative samples can be collected. Semi-quantitative estimates of relative fish abundance can also be made using catch per unit effort at the time of the survey. The initial sampling techniques included using fyke nets and baited minnow traps to collect fish at different depths throughout the lake and associated streams. Baited minnow traps and larger tyvex traps will be used to sample for fish in the inlet streams. Pelagic regions of the lake will be sampled in a random pattern using a floating fyke net at three to seven meter depths.

Macroinvertabrate Sampling (1996): The main inlet tributaries of Solf Lake were analyzed through *Alaska Water Watch: Stream Macroinvertebrates.* Ephemeropteras, Plecopteras and Trichopteras (EPTs) function as the control groups because of their sensitivity to the environment and water quality. The EPT index represents the number of EPT families collected. Higher EPT indexes (>8) are indicative of healthy and diverse systems. Mid-ranges (2-8), indicates there may be a diversity problem present. Aquatic macroinvertebrate bioassessments were also analyzed by Water Quality Assessment Ratings, (WQAR) determine: health, oxygen content, habitat and species diversity on a scale of 1-4.

Habitat surveys: Surveys will be conducted in 1996 on Solf Lake, and inlet streams to determine the availability of spawning and rearing habitats. Stream surveys will follow a modified Hankin and Reeves (1988) procedure which provides quantitative measurements of habitat types. Stream reaches are divided into habitat types based on flow patterns and channel bed shape (pools, riffles, glides etc). Physical parameters of the habitat types would be measured or estimated and descriptions of substrates and available cover will be recorded. Water residence times will be determined using flow estimates made from the watershed based on procedures described in the Forest Service Water Resources Atlas (Blanchet, 1983). Lake surveys will be focused on developing a shoreline map, identifying potential spawning areas and on available cover for rearing habitat.
Sustainable Sockeye Returns: Are based on the available spawning area times a redd density of 6.7 m^2 and a fecundity of 2,000 eggs / gravid female, and a 1:1 sex ratio. Survival rates assume a 10% egg to fry survival, a 15% fry to smolt survival and a 15% smolt to adult return.

1998 EXXON VALDEZ TRU COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998	PROPOSED FY 1998 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NOAA
Personnel	$16.2	$47.8						
Travel	$2.8	$0.0						
Contractual	$21.5	$26.5						
Commodities	$3.6	$12.1						
Equipment	$2.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$46.1	$86.4		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
General Administration	$3.9	$9.1						
Project Total	$50.0	$95.5		$78.5	$68.5	$68.5	$48.1	
Full-time Equivalents (FTE)	0.0	1.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$0.0	$0.0		$0.0	$0.0	$0.0	$0.0	

Comments: Continuation of 96256B and 97256B.

1998

Project Number: 98256B
Project Title: Solf Lake Stocking
Lead Agency: US Forest Service

FORM 2A
MULTI-TRUSTEE
AGENCY SUMMARY

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel	$16.2	$43.8
Travel	$2.8	$0.0
Contractual	$21.5	$24.0
Commodities	$3.6	$12.1
Equipment	$2.0	$0.0
Subtotal	$46.1	$79.9
General Administration	$3.9	$8.3
Project Total	$50.0	$88.2
Full-time Equivalents (FTE)		0.9
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
	$43.5	$33.5	$33.5	$13.1	

Dollar amounts are shown in thousands of dollars.

Comments:

1998

Prepared: 2 of 9

Project Number: 98256B
Project Title: Solf Lake Stocking
Agency: US Forest Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY
4/14/97

1998 EXXON VALDEZ TRL : COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
	Fish Biologist	GS-9	1.0	5.2		5.2
	Crew Leader	GS-9	4.0	4.3		17.2
	Tech	GS-7	3.0	4.0		12.0
	Tech (2)	GS-5	2.0	3.4		6.8
	Engineer	GS-11	0.5	5.2		2.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		10.5	22.1	0.0	
					Personnel Total	$43.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
					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

1998

Prepared:

Project Number: 98256B
Project Title: Solf Lake Stocking
Agency: US Forest Service

FORM 3B
Personnel
& Travel
DETAIL

4/14/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:		Proposed
Description		FY 1998
Barge Contract	2000/day for 3	6.0
Helo Contract	2000/hour for 5	10.0
PWSAC Contract		3.0
Bucket rental		1.0
Cement truck		3.0
flight time 250/hr for 4 hours		1.0
When a non-trustee organization is used, the form 4A is required.	**Contractual Total**	$24.0

Commodities Costs:		Proposed
Description		FY 1998
Boat Fuel		2.0
Train Tickets	4 ticket for vehicle and 2 for cement truck plus passengers	1.0
supplies	constrtruction materials	6.1
camp food		1.5
camp supplies		1.5
materials		
	Commodities Total	$12.1

1998

Prepared:

Project Number: 98256B
Project Title: Solf Lake Stocking
Agency: US Forest Service

FORM 3B
Contractual &
Commodities
DETAIL

4/14/97

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 1998
			0.0
			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:	Number	Inventory
Description	of Units	Agency

1998

Project Number: 98256B
Project Title: Solf Lake Stocking
Agency: US Forest Service

FORM 3B
Equipment
DETAIL

Prepared:

4/14/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel	$0.0	$4.0						
Travel	$0.0	$0.0						
Contractual	$0.0	$2.5						
Commodities	$0.0	$0.0						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$6.5		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	Estimated FY 2003
General Administration	$0.0	$0.8						
Project Total	$0.0	$7.3		$35.0	$35.0	$35.0	$35.0	$35.0
Full-time Equivalents (FTE)		0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:
This provides for collection and analysis of 10 zooplankton samples collected at Solf Lake. Samples will be collected at five different times throughout 1998 field season.

Estimates for 1999 and beyond include limnological sampling and the operation of a smolt weir at Solf Lake outlet.

1998

Project Number: 98256B
Project Title: Solf Lake Stocking
Agency: ADF&G

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
Pat Shields	FB2	16D	0.5	4.9		2.5
Lab Tech	Analysis of samples		0.5	3.0		1.5
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.0	7.9	0.0	
					Personnel Total	$4.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
					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

1998

Prepared:

Project Number: 98256B
Project Title: Solf Lake Stocking
Agency: ADF&G

FORM 3B
Personnel
& Travel
DETAIL

4/14/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
Air Charter ($250/hour for 6 hours)	2.5
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$2.5

Commodities Costs:	Proposed
Description	FY 1998
Commodities Total	$0.0

1998

Prepared:

Project Number: 98256B
Project Title: Solf Lake Stocking
Agency: ADF&G

FORM 3B
Contractual &
Commodities
DETAIL

4/14/97

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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

1998	Project Number: 98256B Project Title: Solf Lake Stocking Agency: ADF&G	FORM 3B Equipment DETAIL

98263

Project Title: Assessment, Protection and Enhancement of Wildstock Salmon Streams in the Lower Cook Inlet.

Project Number:	97263
Restoration Category:	General Restoration.
Proposer:	Port Graham Corporation
Lead Trustee Agency:	ADF&G
Cooperating Agencies:	None
Alaska SeaLife Center:	No
Duration:	FY97 to FY99
Cost FY 98	$156.2.
Cost FY 99	$65.0.
Geographic Area:	Port Graham Corporation lands on the eastern and southern coasts of the Kenai Peninsula—specifically Scurvy Creek, Windy Creek, Rocky River and Port Graham.
Injured Resource/Service:	Replacement of Lost Subsistence Services.

RECEIVED
APR 15 1997
EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL

ABSTRACT

This project will replace lost subsistence services resulting from the Exxon Valdez oil spill by constructing enhancement projects on the major salmon streams in the Lower Cook Inlet (LCI) oil spill area during Years Two and Three. Protection and Enhancement projects will be implemented using instream fisheries habitat improvement techniques, primarily creation of spawning channels, removing natural barriers to spawning and wall-based rearing structures. PGC management with advice from an ADF&G fisheries specialist, will supervise the project and coordinate with a professional fisheries scientist and resource consultants. Local subsistence users will be employed as technical assistants during the field survey and during construction of the habitat improvement structures.

Please Note: FY97 project contracts between ADF&G, ARDOR-KPB-EDD and PGC were delayed until April 5, 1997.

INTRODUCTION

Subsistence users in the LCI area and specifically the residents of Port Graham are heavily dependent on these four major salmon streams and the salmon they produce for subsistence needs. These major salmon streams and their tributaries will be inventoried and evaluated using existing data including aerial photos, and local knowledge from residents to determine the historic level of runs and the current, depressed level due to EVOS.

Site specific protection and restoration projects will be implemented from the field inventory done in FY 97. PGC management, with advice from an ADF&G fisheries specialist, will supervise the project and coordinate with a professional fisheries scientist and resource consultants. Local subsistence users will be employed extensively for the field and office work.

For several decades fisheries biologists have successfully utilized modifying existing stream structures as a technique to improve habitat conditions for salmon spawning and rearing in Alaska and the Pacific Northwest. Opening up currently dry side-channels and oxbows can be very effective in adding spawning and rearing habitat using, the existing wildstock salmon. These structures will be installed after a through inventory and analysis of the current habitat conditions in the entire watershed and the specific needs of a particular salmon species. This project will primarily target pink, coho and chum salmon and possibly sockeye salmon for habitat enhancement.

For FY 97 Phase One of Project Number 97263 will consist of habitat surveys using local residents from the Native Village of Port Graham under the direction of a professional fisheries biologist. This project will be supervised by Dr. Douglas Martin, formerly of Pentec Environmental. Standardized fisheries habitat survey techniques developed by ADF&G and the USDA Forest Service will be used. The appropriate prescriptions for structural improvement will then be prepared based upon the species and the objectives desired for that stream. Consultation, coordination and approval of ADF&G fisheries professionals will be an important part of this project.

Construction and enhancement are proposed during FY 98 and FY 99 for Phase Two of 97263. These streams are accessible by the Port Graham Corporation Forest Road System and heavy equipment is available from the logging contractors on an extremely cost effective basis. In addition, hand tools and manual labor will be utilized extensively by the local subsistence users when appropriate.

Environmental Assessment (EA) reports, as needed, will be prepared from December 1997 to March 1998.

The emphasis on employing local subsistence users for this project will provide for the high quality protection and enhancement of these valuable resources by the owners and stewards of the land and the users of the subsistence resource.

NEED FOR THE PROJECT

A. Statement of Problem

The loss of traditional subsistence resources and services has been extensively documented in this area. Some subsistence resources may never recover to their pre-oil spill levels. There is a need to substitute and increase the subsistence resources for the residents of LCI using the existing wildstocks of pink, coho and chum salmon. Subsistence harvests remain depressed compared to pre-spill levels. Other species damaged or impacted by the oil spill which would benefit from this project include the marbeled murrelet, the black oyster catcher, the river otter and the harlequin duck. Subsistence will be deemed to be recovered when the local residents have restored confidence of the abundance and safety of this important resource and service This project seeks to replace lost or damaged resources by replacing or enhancing the habitat of wildstocks of salmon important to the people who live in Lower Cook Inlet.

B. Rationale/Link to Restoration

The inventory and assessment of these major salmon producing streams and lakes done in FY 97 will provide the information necessary for the construction of habitat protection and enhancement projects on these streams. This in turn will increase the salmon runs and therefore increase the available subsistence resources. It will compensate and substitute for the damaged and lost resources available to subsistence users in the LCI. The protection and enhancement of these streams will not only aid the subsistence users but also the impacted commercial and sport users.

The policy of the Trustee Council, as stated in the Restoration Plan, is that projects designed to restore or enhance an injured resource: 1) must have a sufficient relationship to the injured resource 2) must benefit the same user group that was injured 3) should be compatible with the character and public uses of the area. This project meets all three portions of the Trustee Council's policy toward restoring or enhancing an injured resource.

C. Location: Lower Cook Inlet

These streams are located in Port Graham drainage and Kachemak Bay, Windy Bay, Rocky Bay on the Kenai peninsula. The project benefits will be felt in the entire Lower Cook Inlet region.

COMMUNITY INVOLVEMENT

This project will have upwards of 60 percent direct involvement of Port Graham residents and other local subsistence users. This project will be the direct responsibility of PGC. Through the training of PGC people for the field and office work, the depth of understanding of the streams and the fisheries resource will be enhanced. This will develop an awareness of the needs for protection and enhancement of these valuable resources.

Port Graham, Nanwalek and Seldovia residents will be consulted as to their local knowledge of these streams and their historic levels of spawning return. Local hire for field work will be used extensively. Study area is remote, extensive use of locals boats and housing will be required. Subsistence use will be inventoried and assessed for pre and post spill utilization.

PROJECT DESIGN

A. Objectives

1. Improve the in-stream spawning and rearing habitat for Coho, Pink and Chum salmon through enhancement projects, e.g. fish ladders, spawning channels, wall-based rearing ponds, etc.

2. Enhance existing wildstocks of salmon to serve as substitution and compensation for the lost and damaged subsistence resources important to the subsistence users of Lower Cook Inlet.

3. Educate and involve the subsistence users in the concepts of fisheries management and wise land stewardship.

4. Consolidate existing information on wildstock salmon habitat and augment with new information from surveys. Enter relevant data into a GIS, when available, for future management.

5. Study historic levels of salmon returns to present returns and extrapolate potential for building runs to historic highs.

6. Improve quality and quantity of wildstock salmon as a subsistence resource in the LCI. Gauge success by comparing returns in next ten years with historic averages.

7. Prepare EA's to address any potential environmental impact. Discuss and coordinate with Federal, State and local agencies. Ensure NEPA compliance. Obtain permits for enhancement projects.

B. Methods

Field: Instream restoration and enhancement will occur during the early summer of 1998. Most salmon in these streams have runs which occur in the late summer to fall and this timing would avoid conflicts with not only the salmon but with the subsistence harvest. Enhancement projects will be coordinated with the ongoing timber sale operators and their equipment. It is anticipated that with the excellent road access and the availability of heavy equipment, that PGC will be able to implement these projects on a cost effective basis. Work crews will be necessary for most projects and will consist of four to five individuals. Projects will include: spawning channel expansion and/or creation, construction of fish ladders or removing impediments to spawning habitat through removals of rock, etc. creation of wall-based structures through exploiting old channels or oxbows for rearing habitat.

All structures or projects will subsequently be mapped using the GIS, with the aid of a GPS. Future monitoring will be critical to assess the rate of success and to determine which objectives have been met or exceeded. Monitoring will continue for ten years conducted by PGC. Final reports and GIS data will be compiled in FY 1999.

C. Cooperating Agencies, Contracts and Other Agency Assistance

ADF&G will be the lead trustee agency. ADF&G will then contract through KPB-EDD who will then contract with the Port Graham Corp. for the entire project. Cooperation will be needed with the EPA for any NEPA compliance necessary and KPB for Coastal Zone Management AMSA Compliance. EA's will be prepared under ADF&G direction. Contracts with heavy equipment or boats, if necessary will be through the Port Graham Corp. Technical assistance from the Alaska Dept. of Fish and Game will be required and sought for all phases of this project. Additional technical assistance will be provided by Dr. Peter Armato of Seward, the lead watershed and coastal ecologist for the National Park Service in southcentral Alaska.

SCHEDULE

A. Measurable Project Tasks for FY 1998

October 1—December: Assemble information, maps & photo data. Coordinate project with ADF&G. Coordinate with fisheries scientist. Begin EA's.

January—March 15: Develop final enhancement plan. Hire personnel, develop construction plans. Consult with users. Complete EA's

April 30—May 15: Train field crews.

May 15—July 1: Conduct habitat enhancement projects in Rocky River & Windy Creek.

October 15: Annual report project. Prepare field construction plan for additional enhancement projects for FY 1999.

B. Project Milestones and Endpoints

September 1997: Finish inventory and assessment.

October 1997: Complete inventory of all streams and lakes. Revisit selected areas designated for development, protection and enhancement projects.

December 1997: Develop project plans for enhancement and protection projects for EVOS funding.Environmental Assessment (EA) reports, as needed, will be prepared from December 1997 to March 1998.

April 1998 : Finalize plan for constructing enhancement projects. Hire contractors and field crews.

April-August 1999 Finish Phase Three of Enhancement Projects and inventory returns on Phase Two projects.

C. Completion Date

September 1999: Complete report and review protection and enhancement projects for effectiveness. Complete plans and request for restoration funding.

Proposed Enhancement Projects:

Woody Debris: Analyze stream reaches with excess woody debris and determine optimum level of debris. Identify stream reaches lacking in woody debris and design segments for introducing woody debris structure.

Fish Ladders: Identify impediments to productive spawning habitat. Design cost-effective fish ladders or other bypasses for fish passage.

Wall-based Rearing Habitat Enhancement: Study opening oxbows, old channels or beaver dam areas to create flow through ponds to mainstream and tributaries for enhancing coho rearing habitat.

Side Channel Enhancement: Study areas of old channels either cut off from mainstream by meandering or the 1964 earthquake. Propose cost-effective reopening for enhancing spawning habitat for all targeted salmon species.

Instream Log Structures: Study modification of stream flow dynamics to enhance spawning and rearing habitat for all targeted salmon species.

PUBLICATIONS AND REPORTS

Annual Reports: Annual Reports will be prepared for each FY. The survey reports, database and accompanying maps will be delivered to ADF&G upon their completion. The final report will be prepared in FY 1999 and will emphasize the subsistence resource enhancement success of this project. EA's will be prepared as needed.

PROFESSIONAL CONFERENCES

The project results will be presented at the appropriate EVOS conferences and technical sessions and other conferences.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will be coordinated with all previous and ongoing ADF&G and PGC/EVOS Projects. Coordination between the Port Graham Corporation, the Port Graham Village Council, ADF&G and the KPB-EDD will be critical for the success of this project.

The results will be used in the Proposed Port Graham Village Council and Port Graham Landowners and Land Use Ethic EVOS projects.

PROPOSED PRINCIPAL INVESTIGATOR

This project will be organized and managed by the following agencies and entities: Dr. Douglas J. Martin will be the principal investigator under the direction of the management of the Port Graham Corporation.

Trustee Agency:	Alaska Dept. of Fish & Game
ARDOR:	Kenai Peninsula Borough Economic Development District Will be the state contracting agency
Contractor:	Port Graham Corporation Patrick Norman-President Walter Meganack, Jr.-Project Manager P.O. Box 5569 Port Graham, Alaska 99603-5569

PERSONNEL

Overall project management will be under the direction of Walter Meganack, Jr. and Pat Norman of the Port Graham Corp.

Dr Douglas Martin, Fisheries Scientist.

Dr. Peter Armato, National Park Service Watershed and Coastal Ecologist.

John L. Hall & Arvid J. Hall of Taiga Resource Consultants will work under PGC as assistant managers and provide technical advice.

LITERATURE REVIEW

Carpenter, Dickson, et. al. 1995,
Exxon Valdez Oil Spill State/Federal Natural Resource Damage Assessment Final Report. Survey and Evaluation of Instream Habitat and Stock Restoration Techniques for wild Pink and Chum Salmon.
Alaska Department of Fish and Game.

Martin, 1996. Fish Habitat and Channel Conditions for Streams on Forested Lands of Coastal Alaska: An Assessment of Cumulative Effects.
Pentec Environmental.

Regional Interagency Executive Committee 1995,
Ecosystem Analysis at the Watershed Scale: Federal guide for Watershed Analysis, Version 2.2. U.S. Government Printing Office.

Stanek, 1985. Patterns of Wild Resource Use in English Bay and Port Graham, Alaska. Alaska Department of Fish and Game.

Sundet & Kuwada, 1994. Stream Habitat Assessment Project: Prince William Sound and Lower Kenai Peninsula, Project No. R-51. Exxon Valdez Trustee Council Restoration and Habitat Protection Planning. Alaska Department of Fish and Game.

Budget Category	Authorized FFY 1997	Proposed FFY 1998
Personnel	$39.3.	$68.9.
Travel	$5.4.	$12.9.
Contractual	$2.5.	$30.5.
Commodities	$3.5.	$1.0.
Equipment	$.0.	$5.0.
Subtotal	$50.7.	$118.3.
Indirect (10%)	$3.5.	$11.8.
Subtotal	$54.2.	$130.1.
GA (20%)	$3.8.	$26.0.
Total	$58.0.	$156.2.
Other Funds		

LONG RANGE FUNDING REQUIREMENTS

Estimated FFY 1999	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
$65.0	$.0	$.0	$.0	$.0	$.0

Dollar amounts are shown in thousands

Comments:

GA will cover %10 for ADF&G and %10 for PGC. KPB-EDD will recieve %10 for indirect.

1998
April

Project Number: 97263
Project Title: PGC Wildstock Salmon Stream Assessment & Enhancement
Trustee: ADF&G

Form 4A
Non-Trustee
DETAIL

Personnel Costs			Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1998
Name	**Position Decription**					
Douglas J. Martin, Phd.	Professional Fisheries Scientist	[redacted]	0.5	12.8	0	$6.4.
Walter Meganack, Jr, Pat Norman	Project Management		2	10	0	$20.0.
John Hall	Land & Resource Consultants		2	9.3	0	$18.6.
Arvid Hall	Land & Resource Consultants		2	8	0	$16.0.
	Technical Assistant		2	2.5	0.5	$5.5.
Peter Amato-NPS			0	0	0	$0.0.
			0	0	0	$0.0.
			0	0	0	$0.0.
			0	0	0	$0.0.
	Admininstrative Support		2	1.2	0	$2.4.
	Subtotal		10.5	43.8	0.5	
					Personnel Total	$68.9.

Travel Costs	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1998
Description					
RT PG-Homer	$60	10	38	$50	$2.5.
RT Seattle-Anchorage	$400	4	20	$100	$3.6.
RT PG-Anchorage	$180	1	46	$100	$4.8.
NPS-Scientist Per Diem			20	$100	$2.0.
					$0.0.
					$0.0.
Subtotal		15	124	300	
				Travel Total	$12.9.

1998 April

Project Number: 97263
Project Title: PGC Wildstock Salmon Stream Assessment & Enhancement
Trustee: ADF&G

Form 4B Personnel & Travel DETAIL

New Equipment Purchases:	Number of Units	Unit Price	Proposed FFY 1998
Description:			
Field Equipment	1	$5.0.	$5.0.
			$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 the placement of an R.		New Equipment Total:	$5.0.

Existing Equipment Usage:		Number of Units	Proposed FFY 1998
Description			
None			
	0	0	
			0

1998 April

Project Number: 97263
Project Title: PGC Wildstock Salmon Stream Assessment & Enhancement
Trustee: ADF&G

Form 4B Equipment DETAIL

EVOS BDGT #4 SS-98 Ctrct&Cmd

Contractual Costs:	Proposed FFY 1998
Description:	
Field Equipment Lease	$5.5.
Heavy Equipment Rental	$25.0.
	$0.0.
	$0.0.
	$0.0.
	$0.0.
	$0.0.
	$0.0.
	$0.0.
	$0.0.
	$0.0.
	$0.0.
	$0.0.
Contractual Total	$0.0.
	$30.5.

Commodities Cost	Proposed FFY 1998
Description	
Office Supplies	$0.5.
Postage	$0.5.
	$0.0.
	$0.0.
	$0.0.
	$0.0.
	$0.0.
	$0.0.
	$0.0.
Commodities Total	$1.0.

1998
April

Project Number: 97263
Project Title: PGC Wildstock Salmon Stream
Assessment & Enhancement
Trustee: ADF&G

Form 4B
Contractual
&Commodities
DETAIL

98269-BAA

Prince William Sound Rockfish Recovery, Submitted Under the BAA

RECEIVED
APR 1 4 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	98269
Restoration Category:	Research
Proposer:	Prince William Sound Science Center Cordova, Alaska
Lead Trustee Agency:	NOAA
Cooperating Agencies:	Alaska Department of Fish and Game
Alaska SeaLife Center:	
Duration:	First year, 5-year project
Cost FY 98:	$ 453.5K
Cost FY 99:	$ 300K
Cost FY 00:	$ 330K
Cost FY 01:	$ 360K
Cost FY 02:	$ 400K
Geographic Area:	Prince William Sound
Injured Resource/Service:	Rockfishes and their Recreational, Commercial and Subsistence Fisheries

ABSTRACT

We will assess recovery of rockfish species and communities in Prince William Sound, subsequent of the *Exxon Valdez* oil spill, occurring from natural recruitment using the demographic data. We will base our investigation from a synthesis of local/tradional knowledge and published information. Non-destructive observation, measurement, and photographic recordings of rockfishes will avoid the limitations imposed by the conventional techniques that have a large fish bias. Double sampling will be used to acquire length-age relations of rockfish with sampling emphasis on pre-recruits to the fisheries. We propose to use closed-circuit rebreather scuba technology to conduct an *in situ* investigation. We will also provide material for other on-going restoration projects. Assessment of post-spill recruitment will indicate how or if natural restoration is taking place which will enable resource managers to implement prudent conservation measures.

INTRODUCTION

Rockfishes constitute a diverse assemblage of species. Thirty-six species of rockfishes in two genera are distributed geographically within the northern Gulf of Alaska coast and Prince William Sound (PWS) area (Love et al. 1996). Rockfishes are important as commercial, recreational and subsistence fisheries species. In Southcentral Alaska, the rockfish recreational catch constitutes slightly more than 50% of the total rockfish catch (Meyer 1992). In the 1990's the recreational rockfish catch has increased, e.g. Hoffmann (1995) determined that the 1994 rockfish catch in the Central Gulf area was 29% greater than the previous ten years. In PWS, the 1994 increase over the previous decade was 54% (Hoffmann, 1995). In PWS the principal recreational catch is due to fishers working from Valdez and Whittier (Meyer 1992, Hoffman 1995) which concentrate their effort in the northwestern and northeastern parts of PWS (Meyer 1992). As northern PWS rockfish stocks have become increasingly depleted, effort will likely expand away from Whittier and Valdez into the spill-affected area thus repressing the natural rockfish restoration processes presumed to be taking place. Since "the original extent of injury and the current recovery status of (these) species are unknown" and "no recovery objective can be identified" (*Exxon Valdez* Oil Spill Trustee Council 1996) for rockfishes, their restoration and future fishing potential are indeterminate, making prudent management decisions difficult.

RESULTS FROM PRIOR WORK

An incipient understanding of PWS rockfish ecology may be found as a result of the Sound Ecosystem Assessment (SEA) project and ADFG reports. Stable isotope data for eight rockfish species sampled in PWS during the SEA project suggest differing affinities for PWS carbon sources and trophic levels (Fig. 1). The relative high affinity for PWS carbon suggests a food base primarily from within PWS unlike some forage fishes and migratory salmonids with greater affinity for Gulf of Alaska carbon (Kline in press) and is consistent with the tendency of some rockfishes to have home ranges (Carlson and Haight 1972, Mathews et al. 1986). Black, dusky, silvergray and greenstripe rockfish had slightly more negative carbon isotopic signatures consistent with a diet including some Gulf of Alaska carbon, e.g., as would be available in pelagic forage species. The latter probably vary in abundance as suggested by evidence from EVOS studies which indicate large interannual variability in Gulf carbon input (Kline unpublished SEA data) and decadal shifts in pelagic bird condition and occurrence of capelin (APEX data). Yelloweye rockfish and shortraker rockfish, important species in the recreational and commercial catches, are high trophic level fishes (Fig. 1), i.e., apex consumers, and thus dependent to a higher degree on higher trophic level prey compared with fishes that utilize zooplankton as a portion of their nutritional base implicating a greater primary production base requirement. Their slower growth rates, longer life span, homing behavior, and preference for specific habitat make them vulnerable to overfishing (Carlson and haight 1972, Stanley 1986, O'Connel and Funk 1986, Mathews and Richards 1991). Furthermore, some rockfishes may grow slower in PWS than in adjacent areas (Meyer 1992), which may reflect an energetic allocation adaptation to unpredictable environmental conditions (Andrew and Hecht 1996) which are becoming apparent through the SEA project (Kline unpublished).

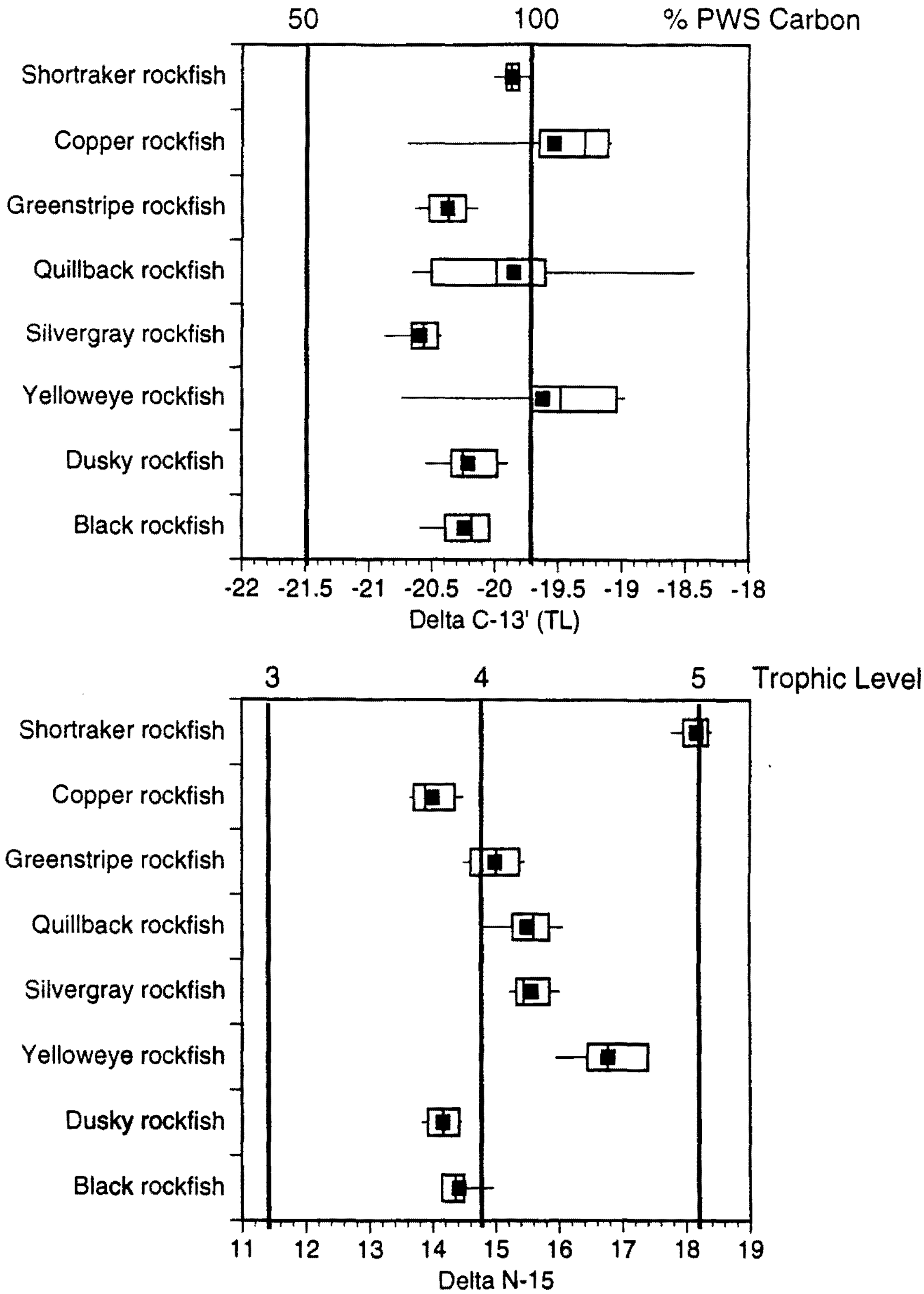

Figure 1. Stable isotope data

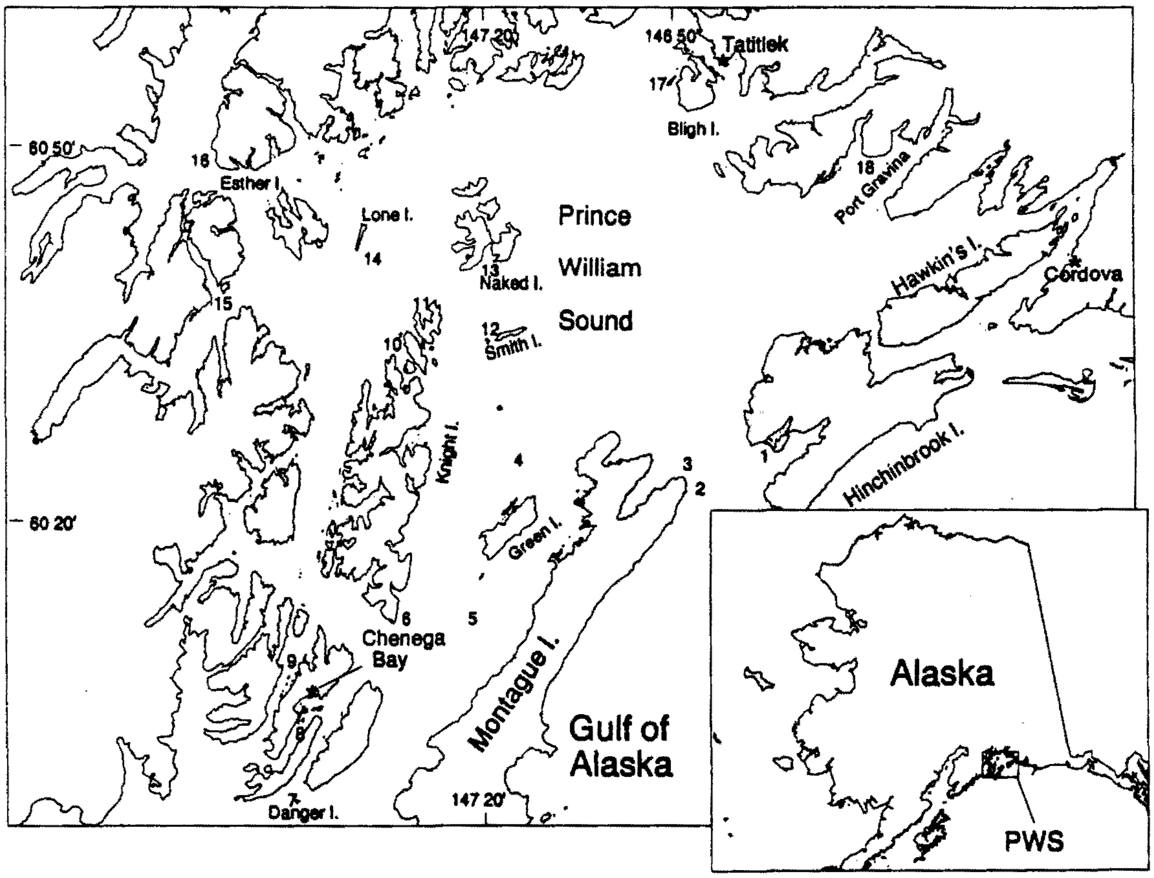

Figure 2. Locations where rockfish have been observed in PWS through sampling in project 320I and from Rosenthal (1980). Species found at the numbered sites are given in Table 1.

Table 1. List of rockfish species found at locations (numbered sites) shown in Figure 2 (Rosenthal 1980 and Kline unpublished) and rockfishes caught by the recreation fishery in PWS (Meyer 1992).

Species	Common Name	Meyer 1992	Rosenthal 1980	SEA-320I
Sebastes melanops	Black rockfish	Y	1,2,3,7	8,13,18
Sebastes paucispinis	Bocaccio	Y		
Sebastes auriculatus	Brown rockfish	Y	other	
Sebastes pinniger	Canary rockfish	Y		
Sebastes nebulosus	China rockfish	Y	2,3,7	5
Sebastes caurinus	Copper rockfish	Y	3	10,15
Sebastes ciliatus	Dusky rockfish	Y	1,2,3,7	11
Sebastes elingatus	Greenstripe rockfish			11
Sebastes variegatus	Harlequin rockfish	Y		
Sebastes alutus	Pacific Ocean perch	Y		
Sebastes emphaeus	Puget Sound rockfish		7	
Sebastes maliger	Quillback rockfish	Y	2,3,7	4,6,11,12, 13,16
Sebastes proriger	Redstripe rockfish	Y		
Sebastes helvomaculatus	Rosethorn rockfish	Y		
Sebastes aleutianus	Rougheye rockfish	Y		
Sebastes zacentrus	Sharpchin rockfish	Y		
Sebastes borealis	Shortraker rockfish	Y		17
Sebastes brevispinis	Silvergray rockfish	Y	7	4,11,17
Sebastes diploproa	Splitnose rockfish	Y		
Sebastes nigrocinctus	Tiger rockfish	Y	2	
Sebastes ruberrimus	Yelloweye rockfish	Y	7	5,9,11,14
Sebastes flavidus	Yellowtail rockfish	Y	1,2,3,7	11

Observations while diving

Rockfishes < 20 cm (i.e., juveniles and those too small to be recruited into the fisheries, cf. Meyer 1992) have been observed in the spill area during scuba dives in 1995 (Kline unpublished) suggesting that recruitment has taken place since the spill.

NEED FOR THE PROJECT

A. Statement of Problem

Rockfishes found dead after the oil spill had ingested oil while others may have suffered from sublethal effects (EVOS Trustee Council 1996). Fishing closers may have led to increased fishing presures on rockfishes (EVOS Trustee Council 1996) which has recently increased dramatically in the northern Gulf area (Hoffmann 1995). Since the recovery status or extent of the injury to rockfishes from the oil spill are unknown and no recovery objective has been identified (EVOS Trustee Council 1996), effects of fishing activities only serve to further confound assesssment of the rockfish situation.

B. Rationale/Link to Restoration

Recent (since the 1989 oil spill) recruitment to rockfish populations would be an indication of recovery from damage due to the oil spill. Given species- and ontogenic-dependent rockfish preferences for bathymetric range, habitat type, homesites, and refuge locations (Bodkin 1986, Carlson and Haight 1972, Jacobson and Vetter 1996, Mathews et al. 1986, Mathews and Richards 1991, O'Connell and Carlile 1993 1994, Richards 1987, Sahher et al. 1995), a careful reconnaissance of suitable habitats with a historical basis for occupancy by rockfishes will provide an indication of the present population status while demographic information will provide an indication of recovery from the oil spill. Since rockfishes are slow growing fish, with species attaining ages beyond 100 years, population demography should reflect both losses of older fish and recovery by recruitment of younger fish.

Variability in oceanographic conditions in PWS, which may be linked to rockfish recruitment (Norton, 1986) and growth rate (Andrew and Hecht 1996), are reflected in stable isotopes measured in fish tissues and their prey organisms (Kline and Paul submitted ms, Kline 1996). A greater understanding of nutritional processes and their relationship to rockfish recruitment will come about through linkages with the on-going SEA project using the stable isotope measurement method. Rockfish juveniles are also important alternate prey for seabirds when zooplankton stocks are not availaible (Ainley et al. 1986) suggesting a recruitment controlling process analogous to the SEA prey-switching hypothesis also affecting rockfishes. Thus, integration with SEA process and monitoring studies through isotopic determinations will have direct application to rockfishes.

If it can be shown that rockfishes are actively recruiting into the spill area, this would provide evidence that rockfish recovery was taking place enabling a reclassification from 'recovery unknown" to "recovering" in the Restoration Plan table: "Resources and Services Injured by the Spill" (EVOS 1996).

C. Location

Prince William Sound

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE (TEK)

Native and Recreational Fishing Communities (TEK component)

Only limited scientific data are available on rockfish abundance in PWS (EVOS 1996) in spite of their importance to a number of user groups. Natives have fished for rockfishes in PWS (J. Seitz pers. comm., formerly of ADFG Subsistence Divsion) and thus may be a source of traditional ecological knowledge (TEK) as well as sport fishers. Data that will be acquired from TEK will be integrated with existing data. TEK data will come through direct contact with Native (with direction from Dr. Huntington and assisstance from Ms. Seitz) and Sportfishing communities in PWS, e.g., a two-generation recreational charter family in Cordova headed by Dan Bilderback. Co-P.I. Williams will collect and synthesize TEK data which will be amalgamated with published accounts (Table 1) including data from the ADFG. He will produce a technical report which will be used as a basis for determining locations where diving surveys will be made.

PROJECT DESIGN

A. Objectives

1. Assess natural restoration PWS rockfish populations through
   comparison of present with historical populations
   demographic study of present populations

2. Determine recruitment patterns in PWS by
   assessing fluctuations in rockfish abundance at specific sites in relation to:
   a. changes in demography
   b. changes in species composition
   c. changes in habitat quality

3. Extend and integrate PWS ecosystem process studies to include rockfishes
   provide biomass information for ecosynthesis modeling effort (Pauly and Pimm EVOS project)
   provide otolith samples to ADFG
   integrate isotopic data with SEA stable isotope database (e.g., isotopic shifts of rockfishes will be compared with other species)

B. Methods

1. Acquire historic distribution of rockfishes in PWS through local knowledge
2. Employ modern *in situ* technology to overcome previous methodological limitations which will include transects from a 20-year-old assessment study (Rosenthal 1980)
3. Determine recruitment patterns of rockfishes in PWS since EVOS using demography

Sampling sites and timing

Surveys will be conducted during August, the peak period of rockfish occurrence in PWS (Rosenthal 1980). We will re-survey sites done by Rosenthal (1980) as well as additional sites based on the TEK report. Sites will be classified as primary or secondary. Primary sites will be surveyed every year wheras secondary sites will be surveyed every two to three years. This will enable us to maintain good continuity at primary sites while expanding spatial coverage with secondary sites. We are planning on three to four primary sites and six to nine secondary sites.

Approach

1. Local knowledge
We will determine dive sites based on an integration of local knowledge from the Native and Sportsfishing Communities, consultation with ADFG and the existing literature. J. Williams will lead this component. He will work with Dr. Henry Huntington (project 052B) and Ms. Jody Seitz. The purpose will be to determine locations in PWS where rockfish have been traditionally caught by Native and sportfishers. The results will be synthesized into a report that will be used for site selection.

2. Validate local knowledge
The compilation of local knowledge will be used in planning the dive component that constitutes the greater part of this project. We will chose dive sites that appear to have been important rockfish habitat prior to the oil spill in addition to the Rosenthal (1980) sites for which historical biomass data are available. In a sense we will validate the prediction that

the sites selected are important rockfish habitat by comparing present populations with historical and published rockfish population studies (e.g., Rosenthal 1980)

3. Diving: the *in situ* stealth technology approach
We plan to use stealth *in situ* technology using divers to observe and quantitatively assess rockfish populations. The stealth technology is available through use of closed-circuit rebreathers (CCR) and described in greater detail in the Diving protocols section.

4. Demography of rockfishes
Rockfish demography will be based on a two-stage sampling approach. Since determination of age necessitates destructive sampling (for the otoliths) which we want to minimize, we will collect only enough samples to establish length-age relationships. The samples will consist primarily of juveniles and pre-assymptotic adults. Our intial goal will be to divide the asymptotic length by 5 to establish sampling bins and then sample a given number of fish per bin. We plan on staring with 5 fish per bin and will increse or decrease as warranted by the outcome of the analysis. Non-destructive sampling for length-age distribution will not be restricted in size. We will attempt to measure every rockfish in a given sampling unit which will be defined by dive-transects. We anticipate conducting multiple dives-transects at each site to facilitate gathering a comphrensive demographic dataset.

Diving protocols

Dive objectives will include acquisition of data depending on dive type as described above, and habitat classification including, (1) location, (2) geomorphology and habitat characteristics, (3) nature of the water (clarity, currents, tidal cycle).

Video transects may have reduced precision compared with visual transects (Davis and Anderson 1989). High-resolution still photography conducted with water-contact optics, as available on the Nikonos RS (Kline 1995), will be our primary tool for photo-documentation of our visual transects, which will be backed-up with digital underwater video. The underwater lasers which will be used for *in situ* measurement will also be used during transects as underwater rangefinders (Tusting and Davis 1993), enabling measuremnt of habitat size. The Dive Tracker system will enable precise transects (Flagg 1997) and hand-held sonar will allow us to use more accurate line-transect methods (O'Connell and Carlile 1993).

1. Dive categories
Dives will be categorized by type according to the dive mission.

Type I: *Transect dives*. Divers will maintain in-line transects. Type I dives will be used to determine fish abundance non-destructively. Diving in a line increases the reliability of the data (O'Connell and Carille 1994). Type I dives will use a non-destructive visual, sonar, and photographic approach for data acquistion (O'Connell and Carlile 1993). Fish observation data will be acquired along transects using a Dive Tracker device while distance measuremnts will come from use of an underwater hand-held sonar device (O'Connell and Carlile 1993).

Type II: *Length-frequency dives*. Type II dives will be used to determine length-frequencies of rockfishes. Diver "A" will make approaches to individual fish to enable a lateral view from close-range. Diver "A" will carry the underwater instrumentation package consisting of a two-laser sizer mounted on a camera. Diver "A"s dive buddy, diver "B" will maintain an in-line course and the direct diver "A" along a dive transect bewteen data acqusition excursions. Diving in-line, which will reduce the chance of re-measuring the fish (O'Connell and Carille 1994), will be maintained using a Dive Tracker device. The Dive Tracker has a data acquistion facility and will be used to collect location data for each fish "sampled." Type II dives will be non-destructive. Data acquistion will be through high-resolution still photography in conjunction with a two-laser sizer and Dive Tracker.

Type III: *Length-age dives.* Type III dives will be used to acquire specimens from which otoliths will be extracted to determine age. Length will first be measured using the methods of type II dives. Then the fish will be caught using a hand net and brought to the surface. The duplicate length measurement will be used to validate the two-laser sizer data. In addition to length and age samples, maturity data and tissues samples will taken for other analysies and EVOS projects including stable isotope analysis, genetic analysis, and gonad samples for ADFG. Type III dives will be destructive in nature and will be the last dives conducted at any site. Revisitation to sites where Type III dives were previously made will be used to assess immigration rate. Type III dives will be conducted only at select sites.

Diving instrumentation

Several devices will be used to facillitate high qualtity *in situ* data acquision:

In situ length determination using two-laser sizer

We will use a two-laser sizer (Tusting and Davis 1993) to accurately measure fish length *in situ*. *In situ* meaurements of rockfishes made with a two-laser sizer more accurately represents the size frequency distribution of rockfish populations compared with that from recreationally-collected samples (Yoklavitch 1993). A two-laser sizer consists of a pair powerful micro-lasers located parallel to the optical axis of the imaging system used to acquire the data. The laser spots serve as a dimensional reference scale that provides the basis for size calculation of the fish. We will pair the two-laser sizer with high-resolution underwater still photography (Kline 1995) and digital video. The two-laser sizer will enable accurate fish length measurements coupled with photo-identification to species level. Additionally, the scale information will be permanently recorded on each photographic frame (Tusting and Davis 1993). The two-laser sizer will be designed to be rapidly interchangeable between more than one underwater camera enabling the exposure of multiple 36 exposure rolls of 35mm film.

In situ data acquisition and logging using the Divetracker

The Dive Tracker is a sonar based navigation and communication system. Navigation is accomplished through sonar triangulation techniques, supplemented with depth information from a pressure sensor on the Diver Station. This provides for position fixes with an accuracy of as good as +/- 0.15 m operating at ranges of up to 500 m. The Dive Tracker Diver Station (DS-1) lets divers obtain *3D position information*, determine range and bearing to waypoints, communicate with other divers and the support vessel (when using a surface unit), *record observations*, and monitor decompression status (including CCR use) and bottom time. The Diver Station provides the diver with multiple instrumentation capabilities in a single box.

Hand-held sonar for *in situ* use

O'Connell and Carlile (1993) successfully used hand-held underwater sonar devices to measure distance to rockfishes while observing them from a submersible. We will use them in the same context but for the purpose for which they were designed - for use by divers. The measure of distance to each rockfish from the transect line is part of the line transect method that more acurately estimates rockfish population size than the transect strip method often used (O'Connell and Carlile 1993).

Diver qualifications

Divers will need to be able to rapidly identify the fish to species requiring a degree of expertise a naive observer may not be able to gain. The observer needs to be not only as qualified in fish biology and advanced scuba technology as the P.I.s are, but also be able to function well under the adverse conditions that we expect to encounter. Both P.I.s have extensive experience and are capable of functioning well in spite of poor conditions. We plan on collaborating with scientific divers from the Alaska Underwater Science Foundation (AUSF) since they are familiar with the local biology, as well as the CCR technology which will greatly increase the probability of success in this project.

Closed-circuit rebreathers and dive safety

With conventional open-circuit (OC) scuba, a diver breathes compressed air from a tank. Exhalations are vented directly into the water. In contrast, CCR divers exhale back into closed-circuit rebreathers (CCR). The scrubber unit inside the CCR chemically removes the CO_2 and oxygen is replaced using various techniques depending on CCR design. The use of CCR is desired to avoid fish behavior modification and increase diver endurance through heat retention and gas mixture optimization. Closed-circuit scuba divers can approach mobile marine animals quite closely. These animals would otherwise be frightened by the bubbles of open-circuit scuba.

CCR diving requires a greater degree of discipline than OC diving (Richardson et al. 1996). Diver surveys would follow dive safety protocols established by the Chief Diver (co- P.I. Bozanic). Dive objectives include acquisition of rockfish data (by dive type) and habitat classification including, (1) location (using the Dive Tracker device), (2) geomorphology, (3) nature of the water (clarity, currents, tidal cycle). Divers will collect rockfish data in 30 to 50m transects (Rosentahl 1980). *In situ* data recording using the Dive Tracker device will enable geo-referencing of data points. Hand nets will be used for collections. Through a regular radio schedule and rendezvous, we will interact with other projects operating in the area.

<u>CCR rationale</u>
Only through direct observation at close range (probably up to ~ 1 m), which is possible using a CCR based stealth approach, will many of the rockfish data be collected (including species identifiaction of juveniles). The following points justify our CCR use:

1. Presence of divers: Although the physical presence of non-destructive sensors (e.g., divers) cannot be avoided, we feel that CCR equipped divers will have far less impact than either conventional OC scuba (" I question the validity of all fish behavioral studies done with scuba because of the demonstrated disturbing effects of the noisy bubbles" - Collette 1996), breathhold diving (extremely limited temporal scope - observation restricted to a few seconds at a time - from when the observed gets situated to make observations and before the observer goes for another breath and which is likely to disturb the subjects) or ROVs (they have their own noise and can create their own unique disturbance as well as that of the tether and its interaction with the water, kelp, rocks and light (shadows)). We feel that CCR will provide the greatest stealth.

Richard Pyle, of the Bishop Museum in Hawaii, has been using CCR for his studies of fish in tropical waters for the past two years. He has noted significant benefits in the use of CCR in his work, including the ability to work in close proximity to the fish under observation with minimal disturbance of their behavior. Pyle (1996, in press) has made numerous observations using CCR that were not otherwise possible. In two years of CCR use, Pyle has observed more fish behavior than his previous 20 years on OC scuba.

Examples are: (1) Sixteen sandbar sharks were seen where never seen before and were approachable up to 0.5m. Pyle switched to OC and returned to the site - they were gone. Pyle went to the surface where he switched back to CCR and they were back when he returned. (2) He has been able to observed surgeonfish spawning behavior. He found that the fish perceived him as part of the natural rock formation and spawned right over him (they normally spawn over rocks using the turbulence to spread the gametes). (3) He was the first to observe lizzardfish spawning. His observations suggest that CCR divers blend in so well to the environment that fish ignore their presence and proceed with their normal behavior.

Duggins (Univ. Santa Cruz) has also used CCRs to approach marine mammals not approachable with OC scuba - sea otters in the Aleutian Islands (S. Jewett, Univ. Alaska Fairbanks, pers. comm.). Marty Snyderman (pers. comm. to J. Bozanic) has greatly increased his ability to approach marine mammals and fishes using CCR over OC scuba. CCR-divers studying cephalopod behavior have had greater success using CCR over OC scuba as well (Hanlon et al. 1982). Hanlon et al. (1982) found that CCR facilitated observations of interactions between species including commensal relationships. Based on these successes we believe that CCR-divers are highly likely to be able to observe predation on pink salmon and make observations that could lead to its solution.

2. *Diver endurance:* With fully-closed rebreathers, the amount of oxygen added equals the amount metabolized, hence CCR dive duration is depth independent. With OC scuba, only a fraction of the oxygen inhaled is metabolized, thus most of the gas transported with the diver is wasted. Furthermore, OC dive times decrease with depth since the number of molecules per unit volume inhaled increases because of pressure. Nitrox (OC scuba using air enriched with O_2, thus percentage $O_2 > 21$ and N_2 is < 79) and CCR use optimizes the breathing mixture reducing the deleterious effects of excess partial pressures of N_2 that result from using compressed air with conventional open circuit (OC) scuba at depth. With OC scuba, the $\%O_2$ and $\% N_2$ is fixed by the mixture provided in the scuba tank. This can be 21% and 79%, O_2 and N_2, respectively, when using compressed air or other mixture as defined by a particular nitrox blend. Nitrox use allows for greater endurance only at moderate depths (20 to 30 m) because of O_2 toxicity-dependent depth limitations. Breathing from a gas mixture fixed by the contents of a tank, i.e., the $\% O_2$ and $\%N_2$, results in a change in the partial pressure of each as with depth as described by Boyle's Law.

Mixed-gas (as opposed to pure O_2-CCR) CCR are designed to operate at a set partial pressure of oxygen by automatically varying the percentage of O_2 in the breathing mixture as a function of diver depth. The control of the partial pressures of gases in the breathing mix effects an optimization that minimizes the dangers that occur from excessive partial pressures of O_2 and N_2 encountered with other forms of scuba. The control of the gas mixture also allows for deeper and longer dives. CCR depth and time equipment limitations will allow for two-hour observations with the ability to follow schools without the severe depth limitations imposed by O_2-CCR, Nitrox or OC scuba.

In addition to optimization of breathing mixture, diver endurance is enhanced by CCR use since the breathing mixture is recycled (minus CO_2 which is chemically removed by the CCR scrubber). The re-circulated breathing mixture retains heat and moisture. Additionally, the chemical reaction that removes CO_2 in the CCR scrubber generates heat compensating for some conductive heat loss. Diver heat retention from CCR use in conjunction with use of argon for dry suit inflation will enable long duration dives (e.g., 2 hr) at the cold water temperatures (~ 0 to 5 °C) encountered in Prince William Sound.

3. Alternative technologies are discussed in comparison with CCR:

CCR vs. ROV

With respect to ROVs, autonomous divers are advantageous because of a capacity for greater spatial coverage in rocky high-relief habitats favored by rockfishes (Rosentahl , Mathews 1986). Divers are less directly dependent on support vessel positioning. Support vessel positioning limits many PWS sites from even moderate sized vessels (e.g. 50 ft) because of safe anchorage needs. Tether management may also limit ROVs in PWS. An ROV may be more limited by currents whereas divers can engage in drift dives when necessary as strong tidal currents are likely in parts of PWS. The rocky nature of important rockfish habitat in PWS may also limit use of an ROV because of the potential of umbilical entanglement. One cannot conduct ROV transects for rockfishes in high-relief rocky habitat (O'Connell and Carlile 1994) which is the prefered habitat type of rockfishes in PWS (Rosenthal 1980). Additionally, it may not be feasible to estimate rockfish density with an ROV (O'Connell and Carlile 1994). We plan on using the Dive Tracker device which will enable us to determine and record positions of fish in 3-D as well as maintain transects. An ROV may be more limited by currents whereas divers can engage in drift dives when necessary as strong tidal currents are common in PWS.

Divers are fully autonomous and can follow any shallow topology while skiffs provide surface support. ROV technology has vision limitations (O'Connell and Carlile 1994). An ROV is video-dependent, whereas divers would use direct vision which enables more detailed observation such as species identification over a wider field of view (O'Connell and Carlile 1994). Reconstructed vision is limited by design and has poor resolution compared with human vision. Video excels only at low light levels given a system with enhanced low light level sensitivity. We plan on using non-intrusive artificial illumination which exploits the insensitivity of wavelengths > 600 nm (red) in fishes (Brett 1957, Munz 1964) to aid in diver vision when needed.

CCR vs. open circuit (OC) scuba

The primary advantage of CCR is the absence of bubble exhaust from the breathing apparatus. Bubble disturbance has a pronounced affect on animal behavior (Collette 1996). Closed-circuit scuba divers can approach mobile marine animals quite closely if the approach is taken slowly. These animals would otherwise be frightened off by the bubbles of OC scuba. Although adult rockfishes are often territorial and will tolerate approach by OC scuba, juveniles are much more skittish making an approach sufficiently close for species identification impossible (Kline, pers. obser.). For example, the P.I. was able to approach juvenile fishes by moving slowly while breath-hold diving (with weights to provide neutral buoyancy). Though the breath-hold approach works, it is difficult and very time-limited because of cold-water equipment (drysuit) encumbrances and the need to hold one's breath. It does demonstrate however, the need to not emit bubbles. Diving without a breathing apparatus, i.e., snorkeling, in addition to being severely limited in terms of available observation time which greatly reduces the potential for predation event observations, will more likely disturb schooling behavior compared with CCR (Hanlon et al. 1982).

OC scuba is limited to a depth of 40m whereas CCR depth limitation can be as great as 150m, depending on the gas mixture. CCR alows for optimal gas mixing and allows for heat retention. Thus depth and time endurance is much greater (~ 3 times) for CCR compared with OC.

CCR vs. fixed unmanned underwater still or video cameras

Unmanned cameras placed on the bottom or moored in the water column may not require the use of divers and can be set up to collect data continuously until the recording medium is exhausted. This approach is limited by spatial coverage that is dependent on (1) lens angle of view, (2) water transmissivity, and (3) the number of cameras/stations. The deployment operation may also modify fish behavior. Furthermore, the desired observations may not occur frequently at a given deployment site. Thus a large number of cameras may be needed to acquire enough data from which statistically valid conclusions could be drawn.

CCR vs. fishing

Sampling with fishing gear has strong size class and species bias (Yoklavitch et al. 1993, Mathews and Richard 1991). Fishing vessels and gear capabilities are especially limited in nearshore rocky habitat of western PWS. The intricate topology either excludes the fishing methods *per se* or allows fish to escape from the gear. *In situ* methods can however, enable fish poulation data collections in otherwise unfishable rocky habitat (Mathews and Richard 1991). Additionally, direct observations may also reveal aspects of fish population structure not attainable by fishing (Yoklavitch et al. 1993).

CCR vs. Submersible

O'Connell and Carlise (1994) have shown the effectiveness of using submersibles for studying adult demersal rockfishes compared with ROV. Submersibles were more effective in maintaining transect courses than ROVs. Likewise divers using the Divetraker device will have the same ability. Submersibles are restricted to currents less than 1.5 knot (NURP) and cannot engage in drift dives as divers can. Submersibles have greater depth capabilites than even CCR but these depths are below those inhabitated by juvenile rockfishes (O'Connell and Carlise 1994). Submersibles may not be able to manuver in kelp habitat and other restricted areas available to divers where rockfishes are expected to be found. Submersibles are more costly and may not be available at the most desirable time for the project.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

ADFG Sport Fish, Subsistence Divisions

ADFG Groundfish, CFMD Division

Dr. Henry Huntington, Jody Seitz (TEK)
Dave Ven Tresca, California Dept. Fish and Game (diving techniques)
Peter Ready, Steam Machines. Inc. (CCR)
Dr. Waldo Wakefield, National Undersea Research Program (laser techniques)
Bob Tusting, Harbor Branch Oceanographic Institution (laser techniques)

SCHEDULE

A. Measurable Project Tasks for FY 98 (October 1, 1997 - September 30, 1998) and beyond

Year 1. (FY 98)	
Dec. 1- Feb. 28:	TEK data gathering
Mar.1 - Apr. 30:	TEK synthesis and reporting
Dec. 1- Apr. 30:	CRR planning and training*
May 1 - Jul. 30:	Cruise planning and vessel bidding
Aug 1 - Aug 21:	Research cruise
Sept. 1 - Nov. 30:	Data processing
Oct. 1 -Oct. 15:	Project review by Chief Scientist: Determine need for expansion of field effort
Year 2. (FY 99)	
Dec. 1 - Apr. 30:	Data synthesis, plan second field season
Mar. 1 - Mar. 28:	Preparation and Dissemination of results at 1999 Anniversary
May 1 - Jul. 30:	Cruise planning and vessel bidding
Aug 1 - Aug 21:	Research cruise
Sept. 1 - Nov. 30:	Data processing
Oct. 1 -Oct. 15:	Project review by Chief Scientist: Determine need for monitoring and protocols
Year 3. (FY 00)	
Dec. 1 - Jan. 30:	Data synthesis
Dec. 1 - Jan. 30:	Preparation for and Dissemination of results at Annual Meeting
Feb. 1 - May 30:	Final report preparation and submission
Jun. 1 - Nov. 30:	Final report revision

* CRR taining will include:

A. CCR-specific instruction from manufacturer (2 weeks travel) which will include classroom (4 days),pool (5 days), and open water sessions (5 days) for a total of 40 hours of required in water tranining.

B. Training dives under supervision of project CCR instructor Bozanic which will include 1 week of confined openwater (in coldwater conditions) and 1 week of drills including practice research sessions testing out equipment and familiarizing personnel with protocols.

Major tasks

1. Pre-survey preparation: Selection of closed-circuit system, closed-circuit training, determination of specific dive site locations in consultation with Mark Willette, bidding of dive vessel
2. Dive survey 21 days inclusive of mobilization (2 days to load and travel to sites) and demobilization(2 days): Real-time results communicated to video survey team via radio/ and face-to face meetings.
3. Reporting results via scientific meetings (Annual Symposium of the American Academy of Underwater Science) and scientific publications.

21-day dive survey cruise tasks.

1. Identify predator species.

2. Determine predator and predation zones (depths , distance from shore, that substrates favor predator or salmon determined by their occurrence).
3. Provide real-time information on location of predators for parallel video study.
4. Evaluate use of closed-circuit scuba for the above purposes and report on results.

Year 2
1. Refine methods and objectives used in year 1 to improve results, 21 day cruise (~ 20 day sampling effort)
2. Continue with refined objectives based on year 1 objectives.
3. Evaluate use of closed-circuit scuba through comparison of two years of work and report on results.

B. Project Milestones and Endpoints

1. Assess natural restoration PWS rockfish populations through
   - comparison of present with historical populations
   - demographic study of present populations

A. Initial field season
B. Second, potentially expanded field season

2. Extend and integrate PWS ecosystem process studies to include rockfishes
   - provide biomass information for ecosynthesis modeling effort (Pauly and Pimm EVOS project)
   - provide tissue and otolith samples to other EVOS projects

3. Assess monitoring needs

C. Completion Date

D. Budget Justification and Matching

1. TEK Component

Personnel:

Williams	3 months for field collection, data analysis, synthesis and reporting
Seitz	1.5 months for field collection and analysis
Huntington	time in project will be *ad lib* and funded in Project 052

Travel:

CDV-WHT	2 trips	(chartered flights)
CDV-VDZ	4 trips	(commercial carrier)
CDV-CHB	2 trips	(chartered flights)
CDV-TAT	2 trips	(chartered flights

Supplies: $200

Experience has shown that it is necessary to pay respondents (J. Seitz, pers. comm.). The participants often like it, but may not always accept reimbursement for their time.

Services: Respondent fee @ $20/hr * 4 hrs avg. * 30 participants = $2,400
(6 charters required for travel)

2. Diving Component

In addition to funding provied by the Trustee Council, this project will use in-kind and matching support dedicated to this project. Greater than one-quarter of the total project support will be from in-kind or other resources.

Personnel:

The estimated effort for each task in months by project investigators is given below (additionally, there will two surface dive tenders/ zodiac drivers for the cruise, 1.5 person-months, and an acoustician: 1 month).

Personnel effort by month for diving component:

Task	Kline	Bozanic	Williams	Hicks	Arnold
CCR Planning	0.25	0.5			
CCR Training	1	1	1	1	1
Vessel Bidding	0.25				
Cruise Planning	0.5	1	1	0.5	0.5
Cruise Execution	0.75	0.75	0.75	0.75	0.75
Data Processing	2	2	5		
Quarterly Reports	0.25				
Annual Report	1	1	1		
Data Synthesis	2	2	2	1	1
Dissemination of Results	0.5	0.5	0.5	0.5	0.5
Project Review	0.5	0.5	0.5		
TOTAL EFFORT	9	8.25	11.75	3.75*	3.75*

* The effort contributed by Hicks and Arnold of the AUSF will be voluntary (matching estimated at $75,000).

Travel:

CCR Training
1 R/T CDV to lower 48 training site which will be determined by CCR chosen (Kline and Williams)
1 R/T to lower 48 training site which will be determined by CCR chosen will be contributed by Bozanic, Hicks, and Arnold (matching estimated at $ 5000)

Research Cruise, Data analysis and synthesis, Annual meeting
3 R/T LA to CDV (Bozanic), 2 R/T Anchor to CDV (Hicks and Arnold)

Reporting
1 R/T AK to lower 48 (Kline),

1 R/T AK to lower 48 (Bozanic), Bozanic will contribute travel costs (matching estimated at $1000)

Services:

Vessel charter (dive support vessel) is estimated at $2000/day for 21 days in 1998 based on previous bidding experience.

Bozanic is paying for his rebreather instructors certification which will enable him to complete the training of project divers beyond that provided the manufacturer (matching estimated at $3000)

Camera equipment rental. Use of Kline's underwater still photographic equipment and Bozanic's underwater digital video equipmen twill have a $1200 and $900 per week rental value. This in-kind matching for the three-week field operation is $6300.

Personal dive gear used on the project will devalue about $1500 per week of use. This in-kind matching for the project will be $7500 (2 weeks of cold-water training and 3 weeks of field operations).

Equipment:

A. Closed-circuit rebreather (CCR)
The cost of CCR is a significant barrier to their use for research (Hanlon et al. 1982) and may be a concern here. We are seeking funding from several sources (PADI Foundation, submitted; OSRI, in preparation for new RFP; NURP, in preparation for 1997 RFP) to finance this portion of the project. Though nine manufacturers of closed-circuit scuba have one or more rebreather models available or in development (Menduno 1995), only those meeting safety criteria set by Chief Diver Bozanic can be used. The CCR units that are applicable to our use must be adaptable to cold water use, which is determined by the design as well as the chemistry used in the CO_2 scrubber. We also have safety criteria greater than that used by the military and require built-in system redundancy and self-bailout. CCR units that are usable for this project have an estimated cost ~ $15K each. Since a dive team would consist of, as a minimum, two similarly-equipped divers per scientific diving protocols (AAUS 1996 Scientific Diving Standards), a minimal equipment investment of $30K would be required. We wish to have four operational CCR.

The CCR manufacturers provide unit-specific training. Training will be required for Kline and Williams. Co-P.I. Bozanic is undergoing formal rebreather instructor training. This training cost ($3000) is being absorbed by him as part of cost sharing. Training of Kline and Williams beyond that provided by the manufacturer will be done by Bozanic.

B. Dive Tracker
The Dive Tracker is a sonar based navigation and communication system. Navigation is accomplished through sonar triangulation techniques, supplemented with depth information from a pressure sensor on the Diver Station. This provides for position fixes with an accuracy of as good as +/- 0.15 m operating at ranges of up to 500 m. The Dive Tracker Diver Station (DS-1) lets divers obtain *3D position information*, determine range and bearing to waypoints, communicate with other divers and the support vessel (when using a surface unit), *record observations*, and monitor decompression status (including CCR use) and bottom time. The Diver Station provides the diver with multiple instrumentation capabilities in a single box. Sold as a package with 200 hour batteries which will enable deployment for full stay at sites.

C. Two-laser sizer
A two laser sizer will consist of two each 15 mW, 635 nM lasers in delrin housing $2200 each, a mounting bracket ~ $1000, underwater recharageable lead-acid battery $500.
TOTAL COST= $5900

Hand-held sonar
$300 Scubapro unit which is available from dive retailers

E. Facilities

PWSSC Facilities
P.I. Kline will provide his underwater single lens reflex photographic equipment (three Nikonos RS 35mm camera bodies, four Nikonos RS water-contact lenses and two Hasselblad EL 70mm cameras in an underwater housings with compensating dome ports. Co-P.I. Bozanic's personal computer will be used to program, upload, and download the CCR and Dive Trackers each day(matching lease value of these items is estimated at $ 500).

AUSF Facilities
The AUSF facilities include the following : Air compressor, inflatable boats, OC breathing apparatus (lease value of these items is estimated at $ 5000)

Matching: Total matching from volunteer time, facility and equipment usage is estimated at $108,300.00 each year.
We anticpate additional matching:
$15K from PADI Foundation (for purchase of a CCR)
$100K from OSRI

PUBLICATIONS AND REPORTS

TEK and annual reports. Scientific publications will be produced starting at year 2.

PROFESSIONAL CONFERENCES

Annual Scientific Diving Symposium of the American Academy of Underwater Science (AAUS)

NORMAL AGENCY MANAGEMENT

None

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Results will be integrated into ecosystem and modeling studies. Results will be shared with Scott Meyer, ADFG Sports Fish, Bill Bechtol ADFG Ground Fish.

PROPOSED PRINCIPAL INVESTIGATOR

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PRINCIPAL and CO-PRINCIPAL INVESTIGATORS

Administration of the project will be the responsibility of the P.I., Kline. He will lead in the scientific tasks. Project Chief Diver will be co-P.I. Bozanic. Bozanic will be responsible for the technical aspects of research diving operations. Co-P.I. Williams will tasked with leading the TEK component, will also participate in the dive component.

Kline is a Research Scientist and Diving Safety Officer (DSO)of the PWSSC Scientific Diving Program, C.V. attached. Kline is a Master Scuba Diver (NAUI) with nearly a decade of diving experience in Alaska. Bozanic is a member of the PWSSC Dive Control Board, is the DSO in two other diving research organizations among other qualifications (see attached C.V.), and has experience in teaching the use of closed circuit scuba as well as numerous other specialties. Bozanic is a past Director of NAUI as well as an instructor trainer (NAUI), cave diving instructor (NSS), and has extensive diving experience (>2400 dives) from Antarctica to Alaska. Both P.I.s have extensive experience in studying fishes underwater from the Arctic to the tropics. For example, Bozanic has conducted underwater surveys of seniorita fish in kelp forests and Kline has observed lakeshore salmon spawning on scuba. Underwater research studies conducted by Bozanic have resulted in the discovery of ~30 species of invertebrates including the naming of an amphipod, *Bahadzia bozanici*, a shrimp, *Agostocaris bozanici*, and a seastar, *Halacea bozanici*, after him by Holzinger (1992), Hindler (1996), and Kensley (1988), respectively.

T. Kline has been actively involved in stable isotope research since 1985. His use of stable isotopes has been in fish ecology with emphasis on salmonid fishes in northern, western, south central and southeast Alaska. His innovative use of the techniques has allowed him to quantify the effect of salmon carcass nutrient input to juvenile sockeye salmon production. This research has been the first to provide direct evidence for the importance of salmon carcasses for juvenile salmon production. He has generated stable isotope models that enable the quantification of different sources of production important in salmon ecosystems. Dr. Kline also led an investigation relating feeding strategies to growth forms in North Slope salmonids. His on-going efforts include collaborations with ADF&G, the North Slope Borough, and BPX. The results of these projects have been presented in numerous scientific papers as well as in public forums (speaking to local groups and classes). T. Kline initiated project 320I which has been the first comprehensive project using natural stable isotopes in Prince William Sound. Through this project he has developed new models and application of natural stable isotope abundance methods. He was the first to provide direct evidence of the importance of carbon from the Gulf of Alaska in Prince William Sound.

John Williams, Fish Biologist, PWSSC, received his Masters degree in Fisheries from Texas A&M University in 1995. While earning his degree, he spent one year conducting field research in a remote are of Venezuela, successfully incorporating native fishermen in his survey of reservoir fish populations. His research has been presented in a variety of forums and is currently under review for journal publication. J. Williams is a certified Rescue Diver, Divemaster and has eleven years of diving experience. He is currently fulfilling a diver-in-training program for cold water research diving to expand his knowledge of diving further. In addition to leading the TEK component, he will be involved with sample and data processing and data management for the diving component and will actively contribute to data synthesis

OTHER KEY PERSONNEL

Affiliate Investigators: Hicks and Arnold, AUSF
Affiliate investigators R. Eldridge Hicks and Charles F. Arnold IV are the Chairman, Board of Directors and Executive Director of the Alaska Underwater Science Foundation, Inc. (AUSF), respectively. Recent and current AUSF projects include a sea lion tagging project with the Alaska Department of Fish & Game, exploration of six submerged cave systems on Prince of Wales Island, Alaska under a grant from the U. S. Forest Service, completion of an unfinished survey of World War II wrecks in the Aleutian Islands (unfunded to date), and an exploratory expedition and survey across the Bering Land Bridge from Cape Prince of Wales, Alaska to Cape Deshnev, Russia. AUSF divers Hicks and Arnold will voluntarily contribute their time in execution of this project. Additionally, they will provide equipment for use on the project including scuba gear, inflatables and an air compressor.

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1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

udget Category:	Authorized FY 1997	Proposed FY 1998						
ersonnel		$195.5						
·avel		$28.3						
ontractual		$79.7						
ommodities		$4.5						
quipment		$69.9	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$377.9		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
ıdirect		$75.6						
Project Total	$0.0	$453.5		$300.0	$330.0	$360.0	$400.0	
ull-time Equivalents (FTE)		33.1						
	Dollar amounts are shown in thousands of dollars.							
)ther Resources								

Comments: $108.3K in matching for FY98 funding should be added to above budget, see DPD for matching breakdown. Additional funding from PADI Foundation $15K (proposal submitted) and OSRI and NURP (proposals planned).

1998

Project Number: 98269
Project Title: Recovery of Rockfishes in Prince William Sound
Name: Prince William Sound Science Center

FORM 4A
Non-Trustee
SUMMARY

1998 EXXON VALDEZ TRUSTEE COUNCI OJECT BUDGET

October 1, 1997 - September 30, 1998

onnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 1998
Kline	Principal Investigator	[redacted]	9.0	7.9		71.1
Bozanic	Co-P.I		9.3	6.8		63.2
Williams	Co-PI 3 months on TEK		11.8	4.2		49.6
Seitz	TEK - tech.		1.5	4.0		6.0
TBD	Field Techs		1.5	3.7		5.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		33.1	26.6	0.0	[redacted]
					Personnel Total	$195.5

el Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
R/T CDV-L48 CCR training, natl meeting	0.8	3	35	0.122	6.7
car rental	0.0	0	19	0.050	1.0
Travel to CDV for cruise, meetings LA to CDV	0.6	4	20	0.141	5.2
Travel to CDV for cruise Anch to CDV	0.2	2	3	0.141	0.8
R/T CDV-Anch Workshops , Review, Project meeting	0.2	6	20	0.141	4.0
R/T CDV-VDZ TEK	0.2	4	8	0.141	1.9
2 charters CDV-WHT TEK	0.9	2	12	0.122	3.3
2 charters CDV-CHB TEK	0.9	2	12	0.122	3.3
2 charters CDV-TAT TEK	0.3	2	12	0.122	2.1
					0.0
					0.0
					0.0
				Travel Total	$28.3

1998

Project Number: 98269
Project Title: Recovery of Rockfishes in Prince William Sound
Name: Prince William Sound Science Center r

FORM 4B
Personnel
& Travel
DETAIL

ared:

4/11/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

ontractual Costs:				Proposed
escription				FY 1998
EK Respondent fees				2.4
Photocopying				0.5
Shipping (including hazmat)				2.0
Communications				0.4
Exposure suit rental				0.9
Dive equip rental				0.9
PWSSC Newtwork Charge				0.5
CCR manufacturers training				4.0
Vessel Charter 21 days @2.5K				52.5
Underwater camera maintenance				0.6
Photo. processing				1.0
Isotopic Analytical @ UAF	N=25/spp	20 spp	500 @ $25	12.5
Isotopic Freeze Drying			500 @ $3	1.5
			Contractual Total	$79.7

Commodities Costs:		Proposed
Description		FY 1998
hand nets (5 @ $100)		0.5
o rings etc		0.1
film		0.5
Sofnolime (CCR scrubber material)		1.0
Oxygen		0.5
Chemicals		0.3
FW gear		0.5
dry gloves		0.5
Rite in rain		0.1
office supplies		0.3
TEK supplies		0.2
	Commodities Total	$4.5

1998

Project Number: 98269
Project Title: Recovery of Rockfishes in Prince William Sound
Name: Prince William Sound Science Center

FORM 4B
Contractual &
Commodities
DETAIL

1998 EXXON VALDEZ TRUSTEE COUN(ROJECT BUDGET
October 1, 1997 - September 30, 1998

-w Equipment Purchases: ɛscription	Number of Units	Unit Price	Proposed FY 1998
Two-laser sizer (see DPD)	1	5.9	5.9
Dive Tracker for multiple day use (see DPD)	1	19.0	19.0
Closed Circuit Rebreathers (see DPD)	3	15.0	45.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
ose purchases associated with replacement equipment should be indicated by placement of an R.		New Equipment Total	$69.9

risting Equipment Usage: ɛscription	Number of Units	

1998	Project Number: 98269 Project Title: Recovery of Rockfishes in Prince William Sound Name: Prince William Sound Science Center	FORM 4B Equipment DETAIL

epared:

4/11/97

98270

Akalura Lake Sockeye Salmon Restoration

Project Number: [redacted] 98270

Project Category: Monitoring and General Restoration - restoration manipulation and enhancement

Proposer: Alaska Department of Fish and Game

Lead Agency: Alaska Department of Fish and Game

Cooperating Agencies: KRAA, USFWS

Duration: First year - FY98 (October 1- September 30); request funding from FY98 through FY05

Cost FY 98: $355,000

Cost FY 99: $360,000

Cost FY 00: $330,000

Cost FY 01: $300,000

Cost FY 02: $220,000

Cost FY 03: $170,000

RECEIVED
APR 11 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Geographic Area: Field work - Akalura Lake, Kodiak Island; Pillar Creek Hatchery, Kodiak Island; data analysis and report writing ADF&G, Kodiak.

Injured Resource/Service: Biological Resource - Not Recovering - Sockeye salmon (Akalura System).

ABSTRACT

This project will restore natural production of Akalura Lake sockeye salmon (***Oncorhynchus nerka)*** through: 1) assessment of the lake rearing environment and determination of juvenile and adult life history parameters limiting sockeye salmon production; and 2) through the use of established restoration techniques to increase juvenile sockeye salmon abundance, survival and adult production.

This project will be contingent upon the estimated number of sockeye salmon smolt emigrating from Akalura Lake in 1997. Akalura Lake sockeye salmon stock will be

considered in the natural recovery phase if approximately 200,000 or more sockeye smolt are estimated in 1997. We propose that this project proceed if less than 200,000 smolt are estimated in 1997.

INTRODUCTION

Sockeye salmon runs to Akalura Lake have, historically, contributed significantly to the Alitak Bay District commercial, subsistence, and sport fisheries which occur on the south end of Kodiak Island. During the last 70 years, total runs (escapement plus harvest) have ranged from <3,000 (1956) to nearly 700,000 fish (1937; Edmundson et al. 1994). Sockeye salmon escapements (1986-1996) have averaged 34,000 since 1986; however, in 1994 and 1995, declined to 14,000 and 2,000 fish, respectively. In 1989, the *Exxon Valdez* oil spill (EVOS) in Prince William Sound contaminated much of the Kodiak Management Area (KMA) salmon fishing grounds (Barrett and Monkiewiez 1989) and caused closures of the commercial fishery. As a result, several sockeye salmon systems experienced escapements in excess of the escapement goals. Within the Alitak-Olga Bay District, in the absence of a fishery, the 1989 sockeye salmon escapement (116,000) into Akalura Lake was nearly twice the desired escapement level (60,000). Contemporary fisheries management programs instituted by the ADF&G provide for meeting fixed system specific biologically based escapement goals which in turn promote maximum sustained yield (MSY) for resource users. Thus, the decline of the sockeye salmon escapement into Akalura Lake to 2,010 fish in 1995 raised concern that the system may be at a production level so low that recovery to levels of MSY may not occur in the near future. The escapement in 1996 increased to 7,898 sockeye; this modest increase does not alleviate concerns of production limitations in the future.

The goal of this project is to restore Akalura Lake sockeye salmon runs to levels which provide the desired escapements plus surplus fish for harvest on a sustained basis (runs of ~100,000, annually). This will be accomplished by assessment of the juvenile rearing environment and identification of juvenile and adult life history parameters that may be currently limiting production. Also, we propose to assess and institute, where feasible, the appropriate established supplemental production techniques to increase smolt survival, and the resultant adult run.

Akalura Lake is located 120 km southwest of the city of Kodiak (57°12' N 154°12' W) on the north side of Olga Bay (Figure 1). The lake outlet drains south into Olga Bay. Akalura Lake has a surface area of 4.9 x 106 m^2, a mean depth of 9.9 m, maximum depth of 22 m, and a total volume of 48.0 x 106 m^3 (Edmundson et al., 1994).

Prior to outmigrating as smolt, juvenile sockeye salmon spend at least one year (up to 3 years) rearing in lakes. During this period of their life history, their primary forage is macrozooplankton. Excessive adult escapement into lakes results in exorbitant production of sockeye fry and taxation of the lakes zooplankton community. This in turn can lead to changes in zooplankton species composition, size and biomass, thereby lowering smolt growth, delaying outmigrations, increasing interspecific competition and lowering overwinter survival (Kyle et al. 1988; Koenings and Kyle 1991). Sockeye salmon smolt studies (EVOS F/S Study

27 - 96258) were initiated in several KMA systems including Akalura Lake in 1990 to monitor changes in smolt size, abundance and age composition in response to the overescapement event in 1989 (Barrett et al. 1993). These studies suggests that from 1990-1993 both smolt size and abundance in Akalura Lake steadily declined. Smolt outmigration estimates revealed a decline from 475,000 (1990) to 89,000 (1992) and size at age for age-1 and age-2 fish decreased by 13 and 30%, respectively, as compared to 1969-1977 (Edmundson et al. 1994). In addition, age composition shifted from predominantly age-2 smolt (>90%), to a larger proportion of age-3 smolt. Such an increase in the proportion of holdovers can indicate a less than optimum rearing environment (Koenings and Burkett 1987; Barrett et al. 1993). In 1994 and 1995 smolt production remained low (170,000 and 134,000), however, age-1 and age-2 smolt size increased to greater than the 1990-1994 average (Swanton et al. 1996). The age composition of smolts outmigrating during 1994-95 seems to have stabilized at about 45% age-1. and 53% age-2. smolts. During 1996 an estimated 245,800 sockeye smolts emigrated from the Akalura Lake system of which 15,600 (6.4%) were age-1. and 228,700 (93.1%) were age-2. smolts. This level of age-2. smolts emigrating (>80% of an annual outmigration) is similar to what was experienced during 1990-93. The growth characteristics (mean length and weight at age) for both age classes were slightly larger than the 1990-95 averages.

Limnological studies conducted in conjunction with smolt monitoring revealed little change in the amount and composition of zooplankton biomass in 1990, the year following the 1989 overescapement (Edmundson et al. 1994). In 1991 and 1992, however, the seasonal mean zooplankton biomass decreased by 70% compared to the 1990 level. Akalura Lake is relatively productive, as evidenced by concentrations of total phosphorus (mean 13 mg L^{-1}) and chlorophyll *a* (mean 4.3 mg L^{-1}). Consequently, lower escapements (~40,000) may have allowed the macrozooplankton community to largely recover under reduced grazing pressure. In 1995, the seasonal mean macrozooplankton biomass was greater (350 mg/m^2) than prior to the overescapement effect (221 mg/m^2) when over grazing was observed (1990 and 1991). This trend appeared to reverse in 1996, when the seasonal mean macrozooplankton biomass was similar to years of overgrazing (195 mg/m^2).

Sockeye salmon production is associated with lake fertility through food-chain linkages (Foerster 1968; LeBrasseur et al. 1978; Hyatt and Stockner 1985; Koenings and Burkett 1987; Kyle et al. 1991). In addition, many sockeye salmon nursery lakes support robust populations of stickleback within the pelagic and littoral zones. Sockeye salmon juveniles and stickleback exhibit considerable dietary overlap and competition for food is considered an important mechanism influencing sockeye salmon production (Rogers 1961; Ruggles 1965; O'Neill and Hyatt 1987). Honnold (1993) conducted hydroacoustic and townet surveys in 1990 and 1991 and found an abundant population of stickleback present in Akalura Lake. As such, juvenile sockeye-stickleback interactions and insufficient forage (zooplankton) have been suggested as factors responsible for the decline in sockeye salmon smolt production (Edmundson et al. 1994).

During 1996 a total smolt enumeration weir was operated from which we derived a conservative estimate of 11,900 adult/sub adult emigrating Dolly Varden char. We feel that this number is conservative as enumerating Dolly Varden was not a study objective. From this information we hypothesized that this number of char overwintering in Akalura lake could be the link as to why smolt population numbers have not responded to pre oil spill levels.

Numerous studies have been conducted on char predation on sockeye salmon smolts (Ruggerone and Rogers 1984), however scant knowledge exists regarding the predation pressure exacted by overwintering Dolly Varden. Ruggerone and Rogers (1992) estimated that rearing coho salmon fry consumed upwards of 50% of the annual sockeye salmon rearing fry from the Chignik Lakes system; it is plausible that this level of predation pressure could be exacted on the rearing sockeye fry of Akalura Lake by the char population..

In 1995 and 1996, sockeye salmon escapements into Akalura Lake were well below the minimum escapement goal (Brodie 1996). This equates to decreased fry recruitment into the lake in 1996 and 1997, and few smolts being produced from 1997-2000. In addition, the 1995 hydroacoustic estimate of fall fry abundance indicated that smolt production would be low in 1996 as well as in 1997. The 1996 smolt outmigration of 245,000 assuming a 15% Smolt to adult survival equates to approximately 36,000 adults returning largely in 1999. Returning adults during 1997-98 should be substantially below minimum desired escapements. As a result, the commercial and subsistence fisheries within the Alitak Bay District may be adversely affected. The increasing smolt abundance trend is encouraging; however; caution should be exercised in regard to natural recovery of the stock. Consequently, restoration planning for this system is extremely important and action may be necessary to enable this system to fully recover. Thus, restoration should proceed if the increasing trend in smolt abundance is not observed in 1997. Specifically, a smolt estimate of less than ~200,000, will indicate poor natural recovery of the stock and will trigger the initiation of restoration activity (see DPD for FY97 project 97251A).

This project will be conducted cooperatively by the Alaska Department of Fish and Game (ADFG), the Kodiak Regional Aquaculture Association (KRAA) and the USFWS. We propose to assess fry recruitment and survival, smolt production, lake rearing capacity and define plans in FY98 to restore sockeye salmon fry production in Akalura Lake. These actions will facilitate restoration of Akalura Lake sockeye salmon production to historic levels.

NEED FOR THE PROJECT

A. Statement of Problem

The intent of this project is to restore Akalura Lake sockeye salmon. The EVOS Trustee Council has designated this resource injured and not recovered. EVOS Project 97258 (sockeye overescapement studies) determined that overescapement into Akalura Lake in 1989, resulted in damage to the rearing environment (Akalura Lake) due to excessive zooplankton grazing by juvenile sockeye salmon. This resulted in decreased smolt and adult production. Recent escapements into Akalura Lake have been well below minimum levels required to sustain natural production. The rearing environment (zooplankton) has recovered, however, smolt production continues to be poor with adult returns projected to remain at very low levels.

B. Rationale/Link to Restoration

This project will provide data needed to assess limits to sockeye salmon production at Akalura Lake and determine the appropriate restoration strategies. Specifically, the project is needed to determine why smolt production has declined and what level of production is needed to efficiently restore the run. The work in FY98 will provide for development of an Environmental Assessment (EA) in cooperation with the USFWS *as* required for NEPA compliance.

C. Location

The project will be undertaken at Akalura Lake, located on the southern portion of Kodiak Island. The project will benefit all communities that utilize the resource for commercial, sport, subsistence, and personal use. This includes the City of Kodiak, and villages of Ahkiok and Old Harbor.

COMMUNITY INVOLVEMENT

Local communities have been and will continue to be involved in the Akalura Restoration Project. This involvement will be facilitated through the Trustee Council, Community Involvement Project process with local facilitator from Kodiak Tribal Council (Hank Eaton), the Spill Area-wide Coordinator (Mary Vlasoff) contacted during the project implementation. The aforementioned individuals, as well as representatives from the Kodiak Area Native Association (KANA), have been informed and have provided input in project development through attendance of the Kodiak Regional Planning Team (KRPT) meeting held in March, 1996. In addition, representatives from the Subsistence Division of ADFG, attended the March KRPT meeting and will be informed on the project status. Traditional and local knowledge of commercial, sport, subsistence and personal use of Akalura Lake sockeye salmon will be incorporated into the project to assist with development of the EA. Also, ADFG and KRAA will hire locally for the project, when possible, to facilitate the use of local knowledge and expertise.

PROJECT DESIGN

A. Objectives

1. Determine the spawner location, distribution, disease incidence and fish culture parameters of Akalura Lake sockeye salmon (FY98; October - June).

2. Estimate the relative abundance and size of juvenile sockeye fry and stickleback populations rearing in Akalura Lake and the overwinter survival and age structure of the juvenile sockeye fry (FY98-FY03; September).

3. Develop the appropriate strategies to restore sockeye salmon production in Akalura Lake and assess NEPA compliance (FY98; November-February).

4. Prepare Pillar Creek Hatchery for the incubation and rearing necessary to support supplemental sockeye salmon production at Akalura Lake(FY98; January-March).

5. Estimate the abundance, overwinter survival, age structure and size of emigrating sockeye salmon smolt (FY98-FY03; May-June).

6. Estimate the abundance of Dolly Varden char emigrating from Akalura Lake (FY 98-FY 00; May-June) and the relative frequency of predation upon sockeye fry during overwintering period (FY 98-99; October, January, April).

7. Estimate the relative abundance, seasonal littoral area use, diet and growth characteristics of wild and supplemental juvenile sockeye salmon during shoal residence (FY98-FY03; June-July).

8. Determine the diet overlap (food chain linkage interaction) between sockeye salmon fry and stickleback in Akalura Lake (FY98-FY00; June-August).

9. Monitor general water chemistry parameters, nutrient levels and primary and secondary production in Akalura Lake (FY98-FY03; May-September).

10. Determine the Akalura Lake sockeye salmon run strength (escapement and harvest) and age structure (FY98-FY03; June-September).

11. Determine the supplemental production necessary, beyond natural juvenile recruitment, to increase overwinter survival and smolt production to optimum levels (equivalent to production from desired escapement of 60,000) ; collect the required number of sockeye eggs from Akalura Lake escapement and produce supplemental juveniles for subsequent release into the lake. (FY98-FY01; September).

12. Determine the effect of supplemental production on the overwinter survival, age and growth of juvenile sockeye presmolt and smolt emigrating from the lake (FY99-FY03; September-June).

13. Determine the effect of supplemental production on the smolt-adult survival and age of returns to Akalura Lake (FY02-FY07).

B. Methods

1. Determine the spawner location, distribution, disease incidence and fish culture parameters of Akalura Lake sockeye salmon (FY98; October - June).

   Akalura Lake sockeye salmon exhibit a bimodal migration, with a small early run spawning in tributaries in May and June and the more abundant, late run fish spawning primarily on lake shoals in late July and August (Edmundson et al. 1994). If escapements remain suppressed as in 1995 (2,010 fish)and 1996 (7,900 fish), further information will be necessary to efficiently locate and collect brood fish in the event that supplemental production is required. Therefore, foot and boat surveys will be undertaken weekly from June through August to enumerate by sex the spawner distribution.

State pathology guidelines require that broodstock used for rehabilitation projects be screened for disease. Akalura Lake sockeye salmon have been screened for incidence of Infectious Hemopoeitic Virus (IHNV) and Bacterial Kidney Disease (BKD) in the past (Follet, personal communication). The most recent information was collected in 1987 and indicated that this stock could be used for "self enhancement." However, more current information is needed to supplement previous results. Thus, 60 sockeye salmon will be collected and ovarian fluid and kidney tissue sampled and analyzed for IHNV and BKD incidence.

The ADFG has ongoing sockeye salmon rehabilitation programs (funded by KRAA) at Laura and Malina Lakes on Afognak Island (Honnold and Edmundson 1993; Kyle and Honnold 1991). These programs required fish culture feasibility studies to allow supplemental production to increase to recommended levels. For example, small scale eggtakes were conducted to assess holding and ripening success, fecundity, and green egg fertilization. Also, incubation and rearing survival information was ascertained (green-to-eyed egg survival, incubation emergence timing, rearing mortality and growth, and stocking information). Similarly, for this project, in FY 98 a small number of pre-spawning adult sockeye will be captured by seining and eggs collected for incubation at Pillar Creek Hatchery (~200,000). Emergent fry will be reared at the hatchery to a size of 0.25 g and stocked into Akalura Lake in 1998. Procedures for broodstock and egg collection, incubation and rearing, and fry stocking will follow the "Sockeye Salmon Culture Policy" of the ADFG as described in the Alaska Sockeye Salmon Culture Manual (McDaniel et al, 1994).

2. Estimate the relative abundance and size of juvenile sockeye fry and stickleback populations rearing in Akalura Lake and the overwinter survival and age structure of the juvenile sockeye fry (FY98-FY03; September).

A hydroacoustic survey will be conducted in October each year to estimate the number and distribution of juvenile fish. Surveys will consist of collecting (recording) data along six transects orthogonal to the longitudinal axis of Akalura Lake. The lake will be divided into three equal areas (A-C), with two transects per area selected randomly. Data will be recorded along each transect at night when juvenile sockeye salmon are more likely to be distributed in the upper to middle part of the water column (Narver 1970; McDonald 1973; Eggers 1978; Simpson et al. 1981; Nunnallee 1983; Burczynski and Johnson 1986; Levy 1987). A BioSonics model-105 echosounder with a model-171 tape recorder interface system with 6/15° dual-beam transducer will be used for each survey. Fish signals will be recorded electronically using a Sony digital audio tape recorder (Model TCD-D10), and on chart paper using a BioSonics model-115 recorder. The specific instrumentation for data acquisition is described by Honnold (1993). Analysis of the recorded hydroacoustic tapes was conducted by BioSonics, Inc. using procedures described by Kyle (1990) and Honnold (1993).

Townetting will be conducted along the axis of the lake at depths where the highest numbers of acoustic targets are observed using a 2 x 2-m townet (Gjernes 1979). A minimum of 3 tows, ranging from 20 to 30 minutes in duration will be conducted during each survey. Fish will enumerated and weighed to the nearest 0.1 g. When greater than 200 stickleback are captured, a random sample of 100 to 150 will be counted and weighed to determine mean fish weight. The total number of stickleback will be calculated by dividing the total biomass by the average weight. Stickleback lengths will be measured from the random sample to the nearest 1.0 mm to assess length frequency. Juvenile sockeye salmon caught will be preserved in 10% buffered formalin for six weeks and then measured for fork length (to the nearest 1.0 mm), weighed to the nearest 0.1 g with the condition coefficient calculated (Bagenal 1978). Ages will be determined after Moser (1969) from scale smears mounted on glass slides using a microfiche projector. Changes in the species composition of tow-net catches will be evaluated to determine if the project is affecting the composition of the resident fish community. Analysis of variance will be used to test for pre- and post- project differences in the proportion of total catch for each species in townet samples. Analysis of variance and multiple comparison tests will be used to test for pre- and post project differences in fall fry condition factor, length, weight for each age group, respectively.

3. Develop the appropriate strategies to restore sockeye salmon production in Akalura Lake and assess NEPA compliance (FY98; November-February).

The initial year of this proposed project will focus on collecting biological data to facilitate the development of restoration strategies to elevate sockeye salmon production in Akalura Lake. We anticipate that supplemental production at some level will be required to enable the system to be self-sustaining in the future. The juvenile and adult monitoring activities, as well as the limnological assessment will be incorporated into a juvenile out stocking plan for ensuing years of the project. Specifically, estimates of zooplankton biomass and wild juvenile abundance will be the criteria used to determine the supplemental stocking level each year. The plan will also address the minimum escapements that will prompt and/or limit the use of supplemental production. Likewise, these criteria will be used to determine when supplemental production is no longer necessary.

The results from EVOS study 97258 and adult monitoring data collected as part of normal agency management (ADFG) will assist with achieving this objective.

An EA will evaluate the various restoration alternatives and specific strategies for rehabilitating Akalura Lake sockeye salmon to assure NEPA compliance.

4. Prepare Pillar Creek Hatchery for the incubation and rearing necessary to support supplemental sockeye salmon production at Akalura Lake(FY98; January-March).

Pillar Creek Hatchery (PCH) was constructed in 1990 near the City of Kodiak, as a State of Alaska incubation and short-term rearing facility (Honnold and Clevenger 1995). The facility was operated by ADFG until 1993, when KRAA began funding portions of it's operation. By 1995, the hatchery was fully funded by KRAA. Several sockeye salmon rehabilitation projects on Kodiak Island (Afognak, Malina, and Laura Lakes) are facilitated by the incubation, rearing, and supplemental stocking of juvenile fry and pre-smolt from PCH. Since PCH has an ongoing sockeye salmon rehabilitation program, the facility will be used for incubation, marking, and rearing for this project. Therefore, in preparation for Akalura Lake supplemental production, PCH will be modified, where required (determined by objective 3). Presently, little space is available at PCH for new projects; therefore, these modifications will be required prior to use of the facility for Akalura Lake restoration. The funding request will provide for initial modifications in FY 98 to allow for proceeding with the project in a timely manner in FY 99. If it is determined, however, during the peer review and NEPA process, that PCH is not required for restoration, spending for modifications will be curtailed. For planning purposes in FY98, the maximum supplemental stocking level is assumed to be 5 million juveniles. The following modifications will be undertaken: 1) incubation module separation to assure isolation of Akalura Lake sockeye eggs from other stocks present in the facility; 2) rearing space expanded to provide for juvenile emergence and short-term and extended rearing; 3) increase hatchery water flow regime to provide for the additional incubation and rearing; 4) upgrade equipment necessary for expanded hatchery maintenance and monitoring (plumbing, oxygen system, electrical, alarm system, transport, and repairs).

Also, net pens, net pen frames, beach seines, weatherports, safety gear and supplies for a remote egg take at Akalura Lake will prepared and staged at PCH.

5. Estimate the abundance, overwinter survival, age structure and size of emigrating sockeye salmon smolt (FY98-FY03; May-June).

A Canadian fan trap (Ginetz 1977) equipped with a live box and perforated plated leads will be operated in the outlet creek to estimate the number of migrating smolt and to sample for AWL information (Swanton et al, 1996). The trap will be operated continuously from early May to mid-June. The trap catch efficiencies will be determined by mark-recapture methods with a minimum of 500 smolt marked and released (Rawson 1984; Swanton et al. 1996). Overwinter survival will be estimated by comparing the number of emigrating smolt to the fall fry estimates from the previous October. Smolts will be anesthetized in a tricaine methanesulfonate (MS-222) solution, measured for length (FL) to the nearest 1.0 mm, and weighed to the nearest 0.1 g. A scale smear will be taken from each measured fish, placed on a glass slide, and aged using a microfiche projector. Analysis of variance will be used to test for pre- and post-project (supplementation) differences in the proportion of total smolt abundance by age class and also for differences in smolt condition (length and weight). Finally, overwinter survival variance will be estimated as described by Seber (1982).

6. Estimate the abundance of Dolly Varden char emigrating from Akalura Lake (FY 98-FY 00; May-June) and the relative frequency of predation upon sockeye fry during overwintering period (FY 98-99; October, January, April).

   Dolly Varden char will be enumerated in conjunction with smolt estimates as described for objective 5. Methodology has not been specifically defined for estimates of predation frequency for this objective; however, Dolly Varden char will likely be captured by gillnetting in Akalura Lake with resultant catches examined for gut content. Gut content analysis will be conducted to identify prey abundance by species.

7. Determine the relative abundance, seasonal use, diet and growth characteristics of wild and supplemental juvenile sockeye salmon during shoal residence (FY98-FY03; June-July).

   Shoal sampling sites will be developed at four locations at Akalura Lake similar to those used previously (Swanton et al. 1996). These sites will be sampled weekly from May through early July using a 15 m x 2 m beach seine with 6 mm stretch mesh. Two sets will be made on opposite sides of a demarcating fence post. The catches from each set will be enumerated by species with TL and weight recorded for sockeye juveniles to the nearest 1.0 mm and 0.1 g, respectively. Analysis of variance will be used to test for pre- and post-project (supplementation) differences in mean CPUE (or other relative abundance indices), and size (length and weight). Additionally, 25 sockeye and stickleback each will be collected for diet analysis (Koenings et al. 1987). Individual fish will be preserved in 10% buffered formalin and AWL data collected. Gut content analysis will be conducted to identify prey abundance by species.

8. Determine the diet overlap (competition) of sockeye salmon fry and stickleback in Akalura Lake (FY98-FY00; June-August).

   The relative abundance of juvenile sockeye and stickleback will be estimated by monthly townet surveys at Akalura Lake from June through August. Townetting, fish enumeration, sizing and other methodology will be conducted as described for objective 2. Additionally, 25 sockeye and stickleback each will be collected for diet analysis in August (Koenings et al. 1987). Individual fish will be preserved in 10% buffered formalin and AWL data collected. Gut content analysis will be conducted to identify prey abundance by species.

9. Monitor general water chemistry parameters, nutrient concentrations and primary and secondary production in Akalura Lake (FY98-FY03; May-September).

   Lake water samples will be collected at two locations (stations) from both the 1 m (epilimnion) and the 10-20 m (hypolimnion) strata using a non-metallic Van Dorn sampler. Approximately eight liters of water will be collected from each depth and filtered and/or preserved at the ADFG office for later laboratory analysis. A portion of the water samples will be refrigerated for general tests and metals, another portion frozen for

Kjeldahl nitrogen and total phosphorus testing, and a final portion filtered through a Whatman GFF glass-fiber filter and frozen for analysis of dissolved nutrients. All samples will be sent to the ADFG Limnology Laboratory in Soldotna for analysis as described by Koenings et al. (1987).

Conductivity (temperature compensated to 25° C) will be measured with a YSI model-32 conductance meter, and pH measured with a Corning model-A specific ion meter. Alkalinity levels will be determined by acid titration (0.02 N H_2SO_4) to pH 4.5 (AHAP 1985). Turbidity, expressed as nephelometric turbidity units (NTU), will be measured using a HF model-DRT100 turbidimeter, and color determined on filtered samples by measuring the spectrophotometric absorbance at 400 nm and converting to equivalent platinum cobalt (Pt) units. Calcium and magnesium will be determined from separate EDTA (0.01 N) titration's after Golterman (1969), and total iron analyzed by reduction of ferric iron with hydroxylamine during hydrochloric acid digestion after Strickland and Parsons (1972). Filterable reactive phosphorus (FRP) will be analyzed by the molybdate-blue/ascorbic-acid method of Murphy and Riley (1962), as modified by Eisenreich et al. (1975). Total phosphorus will be determined using the FRP procedure, after persulfate digestion. Nitrate and nitrite (NO_3 + NO_2) will be assessed as nitrite after cadmium reduction and diazotization with sulfanilamide, and total ammonia determined using phenylhypolchlorite methodology (Stainton et al. 1977). Total Kjeldahl nitrogen (TKN) will be determined as total ammonia following sulfuric acid block digestion (Crowther et al. 1980). Total nitrogen will be calculated as the sum of TKN and NO_3 + NO_2. Finally, reactive silicon will be estimated ascorbic acid reduction to molybdenum blue (Stainton et al. 1977).

Samples for phytoplankton analysis will be preserved in Lugol's acetate solution (Koenings et al. 1987) and analyzed by Eco-Logic Ltd., Vancouver, British Columbia. Algal standing crop will be estimated by the algal pigment chlorophyll *a* (chl *a*) with samples prepared by filtering 1 to 2 L of lake water through a Whatman 4.25-cm GFF glass-fiber filter, and 1-2 ml of saturated $MgCO_3$ solution added prior to completion of filtration. The filters will be stored frozen in individual plexislides for future analysis. Pigment will be extracted after homogenizing glass-fiber filters in 90% acetone using a tissue grinder and pestle. Concentrations of Chl *a* (corrected for inactive phaeophytin) will be determined using the fluorometric procedure of Strickland and Parsons (1972) with low-strength acid will be used to estimate phaeophytin (Riemann 1978).

Bottom-to-surface zooplankton hauls will be taken using a 0.2-m diameter, 153-m mesh, conical net. The net will be pulled manually at a constant ~0.5 m sec^{-1}, and rinsed prior to removing and preserving all specimens in neutralized 10% formalin (Koenings et al. 1987). Identification of *Daphnia* will follow Brooks (1957), *Bosmina* after Pennak (1978); and the copepods after Wilson (1959) and Yeatman (1959). Enumeration will consist of counting triplicate 1-ml subsamples taken with a Hansen-Stempel pipette in a 1-ml Sedgewick-Rafter cell. Zooplankton body sizes will be obtained by measuring the length to the nearest 0.01 mm of at least 10 individuals along a transect in each 1-ml subsample (Koenings et al. 1987) and, zooplankton biomass, weighted by organism density, will be estimated from specie-specific regressions of zooplankter body length and weight after Koenings et al. (1987).

10. Determine the Akalura Lake sockeye salmon run strength (escapement and harvest) and age structure (FY98-FY03; June-September).

    An adult enumeration weir has been operated historically to determine escapement into Akalura Lake (Edmundson et al 1994). The annual operation of this weir will support this project. Inclusive of the weir operation is the objective of sampling the adult sockeye escapement for age, whereby approximately 500-1000 scales will be collected annually. A scale will be taken from each fish, and ages determined from acetate impressions using a microfiche projector.

    The historical annual harvest of Akalura Lake sockeye salmon is largely unavailable because this stock was harvested in a mixed-stock fishery with no means to separate Upper Station late run fish from Akalura fish (Edmundson et al, 1994). Previous estimates of Akalura Lake late run sockeye salmon contribution to the commercial catch employed an Upper Station to Akalura late run escapement ratio estimator (Edmundson et al. 1994). This approach will be refined for this proposed project. Commercial catch data will be collected from both Cape Alitak and Moser-Olga Bay sections similar to what has been undertaken since 1985, at a rate of 600 scales by section.

11. Determine the supplemental production necessary, beyond natural juvenile recruitment, to increase overwinter survival and smolt production to optimum levels (equivalent to production from desired escapement of 60,000); collect the required number of sockeye eggs from Akalura Lake escapement and produce supplemental juveniles for subsequent release into the lake. (FY98-FY01; September).

    Each year, based on the limnological data and escapement levels, recommendations for supplemental production will be delineated. These recommendations will occur by August 1 and will determine the number of sockeye salmon eggs required by PCH for incubation and supplemental production of juvenile sockeye salmon. Aerial and foot surveys will be conducted to determine when sufficient sockeye are holding near the mouth of major spawning tributaries. Brood source fish will be seined and sorted by sex and held in net pens in Akalura Lake until females have ripened. Remote egg collection will follow procedures outlined by McDaniel et al (1994). After fertilization, disinfection and water hardening, eggs will be chilled in ice filled coolers to delay development in preparation for transport to the city of Kodiak. Disease screening will be conducted to determine titer levels of IHN virus in ovarian fluid. Eggs will be transported by float plane to the city of Kodiak and then transported to Pillar Creek Hatchery. Eggs will be acclimated to water temperature prior to seeding into Kitoi box incubators and fertility will be checked as a quality control measure to assure high green to eyed egg survival. Egg density in each incubator will be 250,000 with flows set at 10 gpm.

During the incubation period, temperature units (TU) will be monitored daily to track egg development. Eggs will be treated with formalin as required to control fungus. Other general maintenance will be conducted according to ADFG and KRAA fish culture operational standards. After reaching the eyed egg stage, eggs will be shocked and dead and live eggs will be enumerated to calculate green to eyed egg survival. Incubators will be maintained throughout the rest of the incubation period following operational standards as previously mentioned.

Sockeye fry will volitionally migrate from incubators to raceways. Akalura Lake fry will be segregated from other hatchery stocks in raceways according to ADFG compartmentalization policy (McDaniel et al 1994). Fry will be enumerated as they enter the raceways using an electronic counter. Fry will be fed, beginning with semi moist starter mash. After reaching 0.3 g in size, fry will be fed omp semi moist pelletized feed. Rearing fry will be sampled weekly to estimate feed conversion and growth.

After fry reach 0.25 g and/or when Akalura Lake surface water temperatures reach 6°C, (period of wild stock migration from shoal rearing area), a portion of the juveniles will be stocked into Akalura Lake. In mid summer when the zooplankton community is at peak production (monitored by limnological sampling), another portion of the juveniles (~1.5-2.0 g) will be stocked. The remainder of the juvenile sockeye salmon will be reared until late October (~8-10 g) and stocked into the lake just prior to freeze up.

Juveniles will be removed from raceways and transported in an oxygenated tank from PCH to a float plane staging area. There they will be transferred to a transport tank in a float plane where they will be monitored by a fish culturist while in transit to Akalura Lake. Fry will be released into Akalura Lake after being acclimated to the lake water temperature.

12. Determine the effect of supplemental production on the overwinter survival, age, and growth of juvenile sockeye presmolt and smolt emigrating from the lake (FY99-FY03; September-June).

Marking will be conducted at PCH prior to supplemental lake stocking (potentially) using ventral and adipose fin clips for differentiation of stocking lots in addition to identifying wild from supplemental smolt production. The number of marks will be determined by the ADFG biometric staff once stocking numbers, desired accuracy level, and available funds are defined. A fairly large number of fry will be necessary due to the estimated low survival rate of released fry, which violates the closed population assumption of most mark- recapture designs (Thompson 1992 and Cormack 1981).

Hydroacoustic/townet surveys and smolt mark recapture techniques will be employed to determine overwinter survival, age, and size characteristics of supplemental and wild juveniles. The methodology will be the same as described previously. Surveys will occur in September or October. In addition, all sockeye salmon juveniles captured by townet will be examined for marks. Smolt sampling will occur from early May to the end of June. Potentially, a random sample of each nights smolt catch will also be examined for marks to apportion survival of the stocking lots. Ratio estimators developed for dealing with coded wire tag data will likely be employed to determine the overall overwinter survival by lot and size. ADFG biometric staff will assist with determining sample sizes and the analysis of data.

13. Determine the effect of supplemental production on the smolt-adult survival and age of returns to Akalura Lake (FY02-FY07).

Samples of adult sockeye salmon will be collected and examined for marks during weir operation and from the harvest. This information will analyzed to determine smolt to adult survival of supplemental production. The number of adults necessary to examine for marks will be determined by ADFG biometrics staff.

The Trustee Council, in 1995, developed criteria and guidelines to assess supplementation projects. The emphasis of these criteria and guidelines is to assure that benefits outweigh risks for proposed supplementation projects.

The benefits of rehabilitating Akalura Lake sockeye salmon include the rebuilding of the population to levels which would provide for commercial, sport, subsistence harvest. The 1995 and 1996 runs were extremely depressed, and could decline even further without supplementation. Thus, restoring this system may prevent the potential for extinction of sub populations of Akalura Lake sockeye salmon.

Genetic risks are of concern for supplementation projects. This restoration project is not expected to result in any risk to natural stocks being targeted (Akalura Lake sockeye salmon) nor any non-targeted stocks. Supplemental production will utilize only native Akalura fish for hatchery culture to increase juvenile survival. Also, criteria will be developed to determine minimum escapement levels which will trigger supplemental production. This will assure that target stock brood fish will not be collected at escapement levels, which in the event of a hatchery failure, could result in risk to the native gene pool. Also, when escapement levels trigger supplemental production brood fish will be selected randomly from all sub populations of the native stock, to minimize the risk of extinction.

This project will not create mixed stock fishery concerns as the management plan for both the Cape Alitak and Moser-Olga Bay sections is clearly defined with regard to which species will be managed for during specific time periods. This management plan has been in effect since 1988 during which period the minimum sockeye salmon escapement goal (40,000 fish) for Akalura has been achieved in all years except those where decreased production could be attributed to the 1989 escapement of 116,000 fish.

If successful, this project will result in restoring natural production levels of the Akalura Lake system. Edmundson et al (1994) reported that at full production, the system is capable of producing 100,000 sockeye salmon, annually. This would provide a 40 - 60,000 fish harvestable surplus, worth approximately \$200,000-\$300,000 to resource users each year. Other unquantifiable values, such as preventing extinction of subpopulations of the resource, and restoring historical use will occur as result of this project.

The KRPT has expressed support for the restoration of Akalura sockeye salmon. In addition a Fish Transport Permit (FTP) is in preparation to provide thorough review of this project by the ADFG. The PCH management plan will also be amended and reviewed by ADFG and KRAA upon approval of this proposal. The appropriate federal permits will be obtained from the US Fish and Wildlife Service prior to conducting any work on Kodiak National Wildlife Refuge lands of which the Akalura Lake system is included. Lastly, the evaluation of environmental effects according to standards of the NEPA will be completed in FY98 as result of this project.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

ADFG, KRAA, and USFWS will cooperate on this project. In FY 98, ADFG will be responsible for determining juvenile and adult sockeye life history and rearing environment status, and the appropriate strategies to increase natural productivity of Akalura Lake. This will include defining the level of supplemental production required to increase overwinter survival and smolt production. ADFG will be responsible for permitting (FTP, amend PCHMP, special use permits) and NEPA reporting (EA). In FY 98, KRAA will be responsible for evaluating spawner location, distribution and disease incidence and assessment of fish culture parameters. In addition, KRAA will be responsible for determining the incubation and rearing capacity of PCH necessary to support supplemental production. This will include hatchery modifications, and all preparations for future supplemental production efforts. The USFWS will cooperate by assisting with historical data compilation and review to supplement development of the EA.

SCHEDULE

A. Measurable Project Tasks for FY 98

Oct 1-15:	Spawner surveys, disease screening, egg collection
Oct 1-10:	Abundance, survival and growth estimates -Hydroacoustic/townet surveys; gillnet sampling and gut analysis of Dolly Varden char
Nov 1-Dec 31:	Production evaluation, prepare NEPA compliance documents, permitting
Jan 1-Mar 30:	Modify PCH -order materials, equipment, etc. Recruit for personnel; gillnet sampling and gut analysis of Dolly Varden char
Apr 1-30:	Finish PCH modifications; order smolt, fry sampling, and hydro/tow supplies and complete personnel recruitment
April 1-25:	Prepare and submit DPD; gillnet sampling and gut analysis of Dolly Varden char
May 1-Sept 30:	Smolt, fry, stickleback, limnology, escapement data collection

Sept 1-30: Determine supplemental production level; prepare for remote eggtake and collect required eggs

B. Project Milestones and Endpoints

The project's milestones and endpoints are described in the Project Design, Objectives section. The Objectives for FY 98 focus on development of specific restoration strategies, which will provide guidance for further detailing of project milestones. Presently, data indicates that supplemental production may be an appropriate restoration technique for Akalura Lake sockeye salmon. If further data collection, as proposed for FY 98, supports current information, supplemental production will begin in FY 99. The evaluation of supplemental production will continue through the adult sockeye salmon return cycle which would be 5-6 years after the final year of stocking(~FY 07).

C. Completion Date

The majority of the restoration objectives are expected to be complete by FY 05, with evaluation of adult returns continuing until FY 07. Again, this schedule is dependent upon restoration development proposed for FY 98.

PUBLICATIONS AND REPORTS

A document will be written in FY 98 assessing the environmental effects of the project as required by the NEPA. The EA will be submitted to the appropriate federal agency by 01 February, 1998. An annual report will written upon completion of FY 98 activities.

PROFESSIONAL CONFERENCES

Principle Investigators (PI) will attend the annual 1998 Restoration Workshop sponsored by the Trustee Council. The PI's will also attend a project technical review session if deemed necessary. The dates and locations of these workshops are pending at this time. The attendance of these workshops is intended to provide PIs with current information on sockeye salmon restoration and evaluation techniques that will aid in the implementation of this project.

NORMAL AGENCY MANAGEMENT

Previous studies of Akalura Lake sockeye salmon (F/S 27; 97258) have provided evidence of damage to the resource as result of the 1989 EVOS. If the EVOS had not occurred, the resultant damage to Akalura Lake sockeye salmon productivity, presumably, would not have occurred. Thus, ADFG, KRAA, and the USFWS would not have been involved in damage assessment or restoration activities at Akalura Lake. Currently, the ADFG in cooperation with KRAA is conducting restoration projects at four Afognak Island sockeye salmon systems

(Afognak, Malina, Laura, and Portage Lakes). These entities have also worked on rehabilitation projects at Karluk and Frazer Lakes located on the southern portion of Kodiak Island.

This project is necessary to prevent further decline of Akalura Lake sockeye salmon production and to assure the sustainability of these runs in the future. In addition, this project will provide continued evaluation of resource damage that has been documented by (F/S 27; 97258). This project will also improve management of the resource by providing limnological and fishery data that will aid pre-season forecasting. The likelihood for alternative funding sources for collection of this data is remote, since the ADFG is expected to absorb further budget reductions in the near future. Also, KRAA is projecting near- term revenue declines as result of poor salmon prices and will be cutting operational costs.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will be integrated and coordinated with existing ADFG and KRAA projects. Personnel, equipment and expertise in rehabilitation procedures that are currently, or have been used will supplement this project. For example, in FY 98, personnel that routinely manage and conduct hydroacoustic surveys, smolt mark-recapture studies, limnology sampling, hatchery eggtakes, incubation and rearing will assist with this project. Hydroacoustic gear, rafts and outboard engines, smolt and limnology sampling equipment and hatchery gear will supplement the required equipment for this project. Logistics required will also be coordinated with other projects located in the vicinity of Akalura Lake (air and vessel charters, etc.). The ADFG weir operation at Akalura will assist with data collection for this project. It is anticipated that other "in kind" costs will be provided to this project including biologist 's salaries for preparing and reviewing reports, fish culturist's salaries for operation and maintenance of PCH, and other costs associated with PCH (utilities).

PROPOSED PRINCIPAL INVESTIGATOR(S)

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PERSONNEL QUALIFICATIONS

Principal Investigators

Steven G. Honnold
Alaska Department of Fish and Game, CFMD Division
211 Mission Road
Kodiak, Alaska 99615

July, 1995 to present. Area Resource Development Biologist. Responsibilities include development and management of salmon rehabilitation and enhancement programs on Kodiak Island and the Alaska Peninsula. This includes ongoing sockeye salmon enhancement projects at Spiridon, Hidden, Crescent, Waterfall, and Jennifer Lakes, rehabilitation projects at Afognak, Malina, Laura, and Portage Lakes, monitoring of post-project productivity status at Karluk, and Frazer Lakes and feasibility work on 23 lakes on the Alaska Peninsula. Responsible for evaluation of pink, coho, chum and sockeye salmon production at Kitoi Bay Hatchery, and sockeye salmon production from Pillar Creek Hatchery. Also, responsible for EVOS habitat restoration project at Little Waterfall Creek and lake assessment at Red and Akalura Lakes (F/S 27; 96258). Supervise limnology sampling on all Kodiak Island and Alaska Peninsula lakes, fishpass projects on Afognak Island, hydroacoustic sampling and various sockeye salmon smolt sampling projects on Kodiak Island and the Alaska Peninsula.

March 1989 to July 1994. Assistant Area Biologist, ADFG, FRED Division . Responsible for oversight of lake limnology sampling, fishpass projects, EVOS damage monitoring and restoration projects, and hydroacoustic sampling at up to 20 salmon systems. Assisted with the development of enhancement and rehabilitation projects throughout the Westward Region. Also assisted with development of Pillar Creek Hatchery and evaluation work at Kitoi Bay Hatchery.

May 1986-February 1989. Fish Culturist, ADFG, FRED Division. Worked at Big Lake, Kitoi Bay, Fort Richardson and Elmendorf Hatcheries culturing all species of pacific salmon. Also assisted with hatchery evaluation work at Big Lake, including weir and smolt projects.

Charles O. Swanton
Alaska Department of Fish and Game, CFMD Division
211 Mission Road
Kodiak, Alaska 99615
Regional Salmon Research Biologist

1995-Present. Regional Salmon Research Biologist. Responsible for supervision of all salmon research activities within the Westward Region. The projects include: sockeye salmon smolt outmigration studies (Kodiak and Chignik), run reconstruction and brood table development for eight sockeye stocks, and escapement goal evaluation and preseason run forecasting.

1991-1994. Kodiak Area Salmon Research Biologist. Supervised salmon research activities conducted on Kodiak salmon stocks. Projects include: salmon catch and escapement age, length, and sex data collection; inseason sockeye salmon test fishery and stock separation; population assessment of sockeye smolts and rearing fry; and Frazer Lake fry, smolt, and adult population assessment. Inseason, evaluate sockeye salmon run strength and postseason conduct run reconstruction and escapement goal formulation. Perform data analysis and provide technical support for all Westward region stock separation projects.

1989-1991. Principal Investigator EVOS F/S study 7b&8b. Responsible for all scientific and administrative facets of Exxon Valdez oil spill damage assessment studies conducted on Kodiak and Chignik pink salmon populations. Assessment included collection and analysis of stream residence time, fecundity, egg retention, available spawning habitat, preemergent fry, escapement and commercial catch data.

Assisting Personnel

Ivan Vining
Alaska Department of Fish and Game, CFMD Division
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July, 1995 to present. Biometrician II (this position requires a minimum of a Masters Degree in either statistics or biostatistics, my Masters degree is in biostatistics). My responsibilities center around developing, analyzing, and reporting fisheries studies associated with stock population parameters including population abundance, multi-stock and age separation, growth rates, survival rates, and maturity models. The species which these types of work were done are: king crab (blue and red), Tanner crab (opilio, bairdi and tanneri), Korean hair crab, spot shrimp, salmon (sockeye, coho, chinook, chum and pink), herring and several species of groundfish (specifically pollock, black rockfish, sablefish and Pacific cod). The data collected for these studies has been from weir samples, dip-net samples (both within a river system and hatchery), trawl surveys, pot surveys, and catch samples. The job also requires assisting biologists on simple and complicated presentations and reports which must be submitted to such agencies as the Alaska Board of Fisheries and the North Pacific Fisheries Management Council and reviewing written material for publication. The job has recently required setting up and using GIS packages. Lastly, this job requires supervising two other biometricians (Biometrician Is).

October, 1991-June, 1995. Biometrician I (same requirements as Biometrician I). The responsibilities for this position are the same as for the Biometrician I, except it did not require supervising anyone.

Dana Charles Schmidt
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Commercial Fisheries Management and Development Division
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October, 1991 to present. Limnologist III, Principal Limnologist, FRED Division, Alaska Department of Fish and Game, Soldotna, AK. Responsibilities include establishing research objectives for the Statewide limnological investigations of the Commercial Fisheries Management and Development Division. This section provides direction for other components of the Division for determination of stocking rates for sockeye salmon in lakes and in the application of fertilization. This section also provides input to the commercial fisheries division for determination of the escapement goals for sockeye salmon. Supervise the limnology laboratory which completes water quality and plankton analysis for water samples taken from several hundred lakes statewide.

April, 1985 to October, 1991. Fishery Biologist IV, Regional Research Biologist, Westward Region, Alaska Department of Fish and Game. Responsible for establishing research objectives and priorities for the Westward Region Commercial Fisheries Division. This Division has management authority over extensive salmon and herring stocks on the Alaska Peninsula and Kodiak Island, in addition to management of the major shellfish stocks in the Gulf of Alaska and the Bering Sea. Annual ex-vessel value of these fisheries is several hundred million dollars, Research highlights included studies of crab larvae settling rates in the Gulf of Alaska and investigations on the effects of oil spill overescapement on the sockeye salmon production of major lakes on Kodiak Island.

May, 1982 to September, 1985. Acting F.B. IV, Susitna River Aquatic Studies Coordinator, Alaska Department of Fish and Game. The entire program under supervision included approximately 25 permanent and 50 seasonal employees. During this interim period, responsible for reorganizing the studies into a more efficient structure to meet the long term monitoring needs for determination of the effects of the Susitna project on the aquatic resources of the Susitna River. Supervised development of operational plans for 18 technical study programs on the Susitna River, assignment of priorities of tasks, and review of the technical merit of the programs proposed. Prior to January 1985. F.B. III, Resident and Juvenile Anadromous Project Leader, Su-Hydro Aquatic Studies Program, Alaska Department of Fish and Game. Supervised research programs on resident and juvenile anadromous fish in the Susitna River that may be impacted by development of the Su-Hydro Project. Technical studies included development of models of sport fishery exploitation on arctic grayling populations, modeling instream flow responses of juvenile salmon habitat, development of baseline population parameters of resident fish and juvenile salmon and development of projections of supersaturated gas dissipation below the proposed dam sites.

January, 1981 to May, 1982: Fishery Biologist, Terrestrial Environmental Services, Anchorage, Alaska. Responsible for field and office review of the aquatic studies programs of the Alaska Power Authority for the Susitna Hydro-Electric Program. This responsibility included assisting the Alaska Department of Fish and Game in study plan development, providing preliminary assessment of impacts of the project on aquatic resources and presenting to the public progress of the aquatic studies programs.

May, 1980 to October, 1980: Fishery Biologist, U.S. Fish and Wildlife Service, Soldotna, Alaska. Assisted on a radio-telemetry project and juvenile salmon habitat survey on the Kenai River, 6-mile Creek and the Deshka River in the Cook Inlet area. Activities included tagging and radio tagging chinook and coho salmon, collection of juvenile salmon and measurements of associated habitat, and assisting in the analysis of scale patterns from Kenai River chinook salmon. Other activities included statistical analysis of data, report review and preparation of a publication on the Kenai River chinook for Alaska magazine.

Education:
Ph.D. in Fisheries 1973
Major Field - Fisheries- Minor Field Pharmacology,
Oregon State University, Corvallis, Oregon
M.S. in Biology, 1970 Major Field - Aquatic Biology Minor Field - Sanitary Biology,
University of Utah, Salt Lake City, Utah
B.S. in Wildlife Biology, 1968, University of Montana, Missoula, Montana

Gary Kyle
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Division of Commercial Fisheries Management and Development
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April, 1977 to April, 1988: Project Biologist and later Area Biologist for the Division of Fisheries Rehabilitation, Enhancement, and Development of the ADF&G in Soldotna Alaska. Conducted and evaluated various fisheries enhancement and evaluation projects in the Cook Inlet watershed including limnological investigations of sockeye salmon producing lakes, and evaluation of hatchery stocking programs. Also, during the period I served as a project limnologist for the Limnology Section which involved the collection, analysis, and interpretation of limnological data from sockeye nursery lakes for assessment of rearing capacity and for modeling purposes.

April, 1988 to present. Regional Limnologist for the Limnology Section for ADF&G in Soldotna, Alaska. Supervised by Dr. Dana Schmidt. As the Regional Limnologist for the Southcentral Region comprising of the Interior, PWS, Cook Inlet, and Alaska Peninsula; the primary purpose of this position is the supervision of staff in the coordination, assignment, prioritization, analysis, and review of subordinates work and interagency contract work related to lake fertilization and stocking projects, water quality monitoring projects, and fisheries and limnological research. In addition, the position is responsible for training subordinates, reporting and review of project results for publications and meetings, and administrating state and non-state (contract) budgets.

Education: 1975 Bachelor of Science, Life Science/Natural Resources, University of Wisconsin.

Publications: A total of 34 technical reports, 8 journal manuscripts, 24 formal presentations, and 6 magazine articles dealing with adult sockeye production, lake fertilization, lake stocking, and in-lake assessments of juvenile sockeye production.

Chris Clevenger
Alaska Department of Fish and Game, CFMD Division
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July, 1994 to present. Hatchery Manager. Responsible for development and operation of KRAA Pillar Creek Hatchery. Duties include remote sockeye salmon eggtakes, incubation, rearing and stocking of juveniles, and scientific/education projects.

July, 1990 to July, 1994. Hatchery Manager, ADFG, FRED Division. Responsible for development and operation of Pillar Creek Hatchery. Duties include remote sockeye salmon eggtakes, incubation, rearing and stocking of juveniles, and scientific/education projects.

October, 1985 to July, 1990. Assistant Hatchery Manager, ADFG, FRED Division. Assisted with oversight of all sockeye and coho salmon fish culture duties at Big Lake Hatchery.

Steven T. Schrof
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Kodiak, Alaska 99615

April, 1994 to present. Fishery Biologist. Responsible for field projects associated with enhancement and development programs on Kodiak Island. This includes hydroacoustic surveys, sockeye smolt condition sampling, lake limnology sampling, and fishery monitoring.

July, 1993 to April, 1994. Fishery Technician III. Responsible for limnology sampling, stream surveys, disease screening, and juvenile sockeye and coho sampling at 23 Alaska Peninsula Lakes.

May, 1988 to July, 1993. Fish Culturist. Assisted with fish culture duties for all species of pacific salmon at Pillar Creek, Snettisham, and Deer Mountain fish hatcheries.

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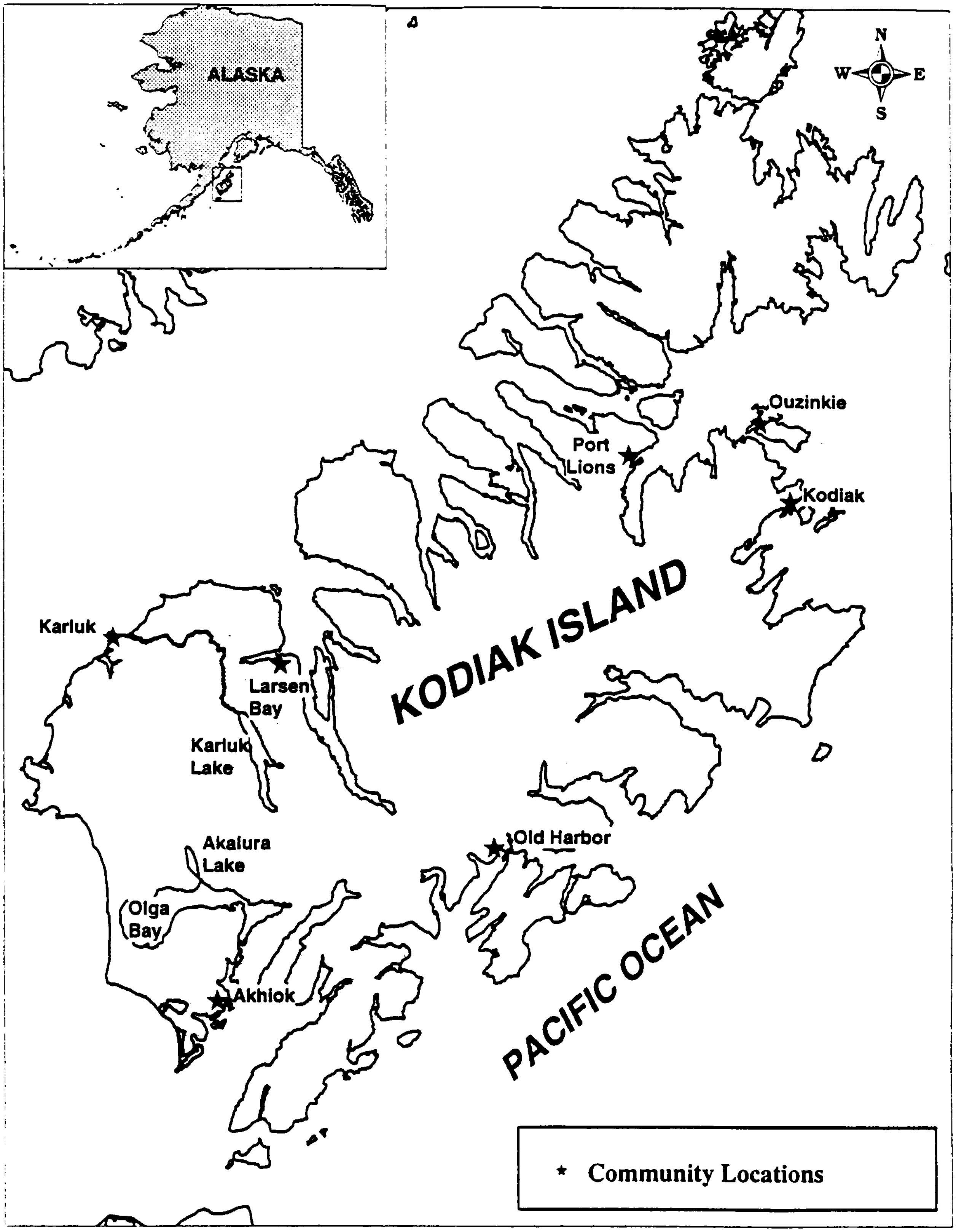

Figure 1. Akalura Lake located on the northside of Olga Bay, Kodiak Island.

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998						
Personnel		$113.3						
Travel		$3.2						
Contractual		$185.2						
Commodities		$13.8						
Equipment		$9.5	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$325.0	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003	
General Administration		$30.0						
Project Total	$0.0	$355.0	$360.0	$330.0	$300.0	$220.0	$170.0	
Full-time Equivalents (FTE)		1.5						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: This is the initial year of proposed Akalura Lake Sockeye Salmon Restoration which will be conducted jointly by ADFG and Kodiak Regional Aquaculture Association (KRAA). This represents ADFG's FY 98 budget request. FY 98 work will focus on field studies to provide data for development of restoration strategies and an environmental assessment (EA).

Note: Long range funding requirements include KRAA contractual costs.

1998

Project Number: [redacted] 98270
Project Title: Akalura Lake Sockeye Salmon Restoration
Agency: ADFG

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared: 3/25/97

4/11/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1998
S.Honnold PCN 7045	Fishery Biologist III	18C	2.0	6.0	0.0	12.0
C. Swanton PCN 1721	Fishery Biologist III	18E	2.0	6.2	0.0	12.4
Coggins PCN 1332	Fishery Biologist II	16E	1.0	5.3	0.0	5.3
I. Vining	Biometrician II	19D	0.7	6.5	0.0	4.6
2 positions	Fishery Biologist I - development	14D	4.0	4.5	10.0	28.0
2 positions	Fishery Biologist I - research	14D	2.0	4.5	10.0	19.0
2 positions	Fishery Biologist I - limno lab	14J	1.0	5.0	0.0	5.0
2 positions	FW tech III - development	11F	2.0	4.0	4.0	12.0
2 positions	FW tech III - research	11D	3.0	4.0	3.0	15.0
	Subtotal		17.7	46.0	27.0	
					Personnel Total	$113.3

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1998
Kod-Anchorage-Annual Sockeye Workshop - Honnold	0.4	1	3	0.15	0.9
Kod-Anchorage-Annual Sockeye Workshop - Swanton	0.4	1	3	0.15	0.9
Kod-Anchorage-Technical Program Review - Honnold	0.4	1	2	0.15	0.7
Kod-Anchorage-Technical Program Review - Swanton	0.4	1	2	0.15	0.7
					0.0
Note: per diem increased to cover rental car expense.					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.2

1998

Project Number: 98251
Project Title: Akalura Lake Sockeye Salmon Restoration
Agency: ADFG

FORM 3B
Personnel
& Travel
DETAIL

Prepared: 3/25/97

Contractual Costs:	Proposed
Description	FFY 1998
Conference registrations	0.5
Fuel boats (500 gallons X $1.33/gallon) & outboard equip & parts	1.0
Air charters for field work and camp support: hydro/townet surveys, smolt and fry sampling, limnology	
10 hrs of Goose charters @ $580/hr	5.8
12 hrs of Beaver charters @ $450/hr	5.4
12 hrs of C206 charters @$320/hr plus 30 hrs of stand by @ $160/hr for limnology sampling	8.6
Biosonics analysis of hydroacoustic data	1.5
Phytoplankton analysis - Ecologic Ltd.	1.8
Equipment repair: sonar gear, Ohaus scales, misc.	0.5
CONTRACTOR: KRAA FOR HATCHERY SUPPORT	160.1
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$185.2

Commodities Costs:	Proposed
Description	FFY 1998
Office supplies-Paper ($0.5), Xerox supplies and computer printer supplies ($0.5)	$1.0
Laboratory glassware ($0.4), chemical reagents ($0.5)	$0.9
Raingear, hip boots and gloves for 6 people @ $250	$1.5
Food (250 man days @ $15/day)	$3.8
Flotation coats for 2 people @ $250	$0.5
First-Aid/safety supplies	$0.4
Camp supplies: kerosene, lantern fuel, wire, duct tape, rope, flashlights and batteries	$1.0
Smolt and fry sampling supplies: dipnets, seines, slides, MS222, dish tubs, buckets, aerators, etc.	$2.0
Fin clipping equipment	$0.0
Lake sampling supplies: rope, anchors, buoys, bottles, zooplankton nets	$2.5
Film and photo processing	0.2
Commodities Total	$13.8

1998

Project Number: 98251
Project Title: Akalura Lake Sockeye Salmon Restoration
Agency: ADFG

FORM 3B
Contractual &
Commodities
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1998
30 hp outboard engine - replacement for previous Trustee purchase	1	3.5	3.5
Achilles 14' inflatable raft - replacement for previous Trustee purchase	1	4.0	4.0
Beach seine for seining shoals	1	2.0	2.0
			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 a		**New Equipment Total**	$9.5

Existing Equipment Usage: Description	Number of Units	Inventory Agency
boats, metal hull	1	ADFG
boats, rubber	1	ADFG
motor, outboard	1	ADFG
acoustic sounder	1	ADFG
oscilloscope	1	ADFG
freezer	1	ADFG
recorder, dat	1	ADFG
computer	1	ADFG
smolt trap	1	ADFG

1998

Project Number: 98251
Project Title: Akalura Lake Sockeye Salmon Restoration
Agency: ADFG

FORM 3B
Equipment
DETAIL

Prepared: 3/25/97

1998 EXXON VALDEZ TRUSTE UNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998						
Personnel		$11.0						
Travel		$0.0						
Contractual		$17.8						
Commodities		$13.8						
Equipment		$117.5	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$160.1	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FYY 2003	
Indirect								
Project Total	$0.0	$160.1	$240.0	$187.0	$164.0	$80.0	$47.0	
Full-time Equivalents (FTE)		3.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

Comments: FY 98 is the initial year of the proposed Akalura Lake Sockeye Salmon Restoration project. The project will be conducted jointly by ADFG and KRAA. This represents KRAA's FY98 budget request. FY 98 expenditures will be, primarily, for preparing Pillar Creek Hatchery for incubation, marking, and rearing of Akalura Lake sockeye in the event that supplemental production is determined to be the preferred restoration method.

Note: long range funding requirements for KRAA portion of budget are included in the total budget long range funding requirements.

1998

Project Number: 98251
Project Title: Akalura Lake Sockeye Salmon Restoration
Name: KRAA

FORM 4A
Non-Trustee
SUMMARY

Prepared:

4/11/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FFY 1998
C. Clevenger PCN 5051	Fish Culturist III	18J	0.0	6.5	0.0	0.0
1 position	Fish Culturist I-KRAA	14C	1.0	4.4	0.0	4.4
2 positions	FW tech II - KRAA	9B	2.0	3.3	0.0	6.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.0	14.2	0.0	
					Personnel Total	$11.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1998
					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

1998

Project Number: 98251
Project Title: Akalura Lake Sockeye Salmon Restoration
Name: KRAA

FORM 4B
Personnel
& Travel
DETAIL

Contractual Costs:	Proposed
Description	FFY 1998
Air taxi flights for disease screening, fish culture assessment	
5 hrs of Beaver @ 450/hr	2.2
2 hrs of C206 @ 320/hr	0.6
equipment rental - backhoe, etch, for preparing for raceway placement	5.0
Repairs to dam and pipeline	10.0
Contractual Total	$17.8

Commodities Costs:	Proposed
Description	FFY 1998
Raingear, hip boots and gloves for 6 people @ $250	1.5
Food (50 man days @ $15/day)	0.8
Flotation coats for 2 people @ $250	0.5
First-Aid/safety supplies	0.2
Camp supplies: kerosene, lantern fuel, wire, duct tape, rope, flashlights and batteries	0.3
Plumbing: 8"pvc pipe, incubator fittings, misc.	10.0
Fin clipping supplies	0.5
Commodities Total	$13.8

1998

Project Number: 98251
Project Title: Akalura Lake Sockeye Salmon Restoration
Name: KRAA

FORM 4B
Contractual &
Commodities
DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1998
Module separator	1	15.0	15.0
Raceways	5	6.0	30.0
Support structures for raceways	10	0.6	6.0
			0.0
Back up well	1	45.0	45.0
Electrical upgrades	1	10.0	10.0
Transport tank	1	3.5	3.5
Freight	80	0.1	8.0
			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**	$117.5

Existing Equipment Usage: Description	Number of Units	
incubators	16	
raceways	6	
hatchery building	1	
outboard engines	2	
rafts	2	
computer	1	
pressure washer	1	
oxygen contactors	10	
DO meter	1	
automatic feeders	10	
chemical building	1	
chemical pump	1	

1998

Project Number: 98251
Project Title: Akalura Lake Sockeye Salmon Restoration
Name: KRAA

FORM 4B
Equipment
DETAIL

98273

Project Title: Surf Scoter life history and ecology: Linking Satellite technology with traditional knowledge to conserve the resource.

Project Number:	98273
Restoration Category:	Subsistence, Research
Proposers:	Dan Rosenberg Alaska Dept. of Fish and Game 333 Raspberry Road Anchorage, Alaska 99503
Lead Trustee Agency:	ADFG
Cooperating Agencies:	DOI
Alaska SeaLife Center:	No
Project Duration:	1st year, 3-year project
Cost FY 98:	\$179,400.
Cost FY 99:	\$203,000.
Cost FY 00:	\$225,000.
Cost FY 01:	\$NA
Cost FY 02:	\$NA
Geographic Area:	Prince William Sound
Injured Resource/Service:	Subsistence; intertidal community.

RECEIVED
APR 15 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

This project will study the life history and ecology of surf scoters (*Melanitta perspicillata*) wintering in Prince William Sound (PWS) and lower Cook Inlet (LCI), and integrate this information with traditional ecological knowledge. Scoter populations in Alaska are declining for unknown reasons. Communities in PWS and LCI harvest scoters for subsistence purposes. Scoters are among the least studied of North American waterfowl and little is known of their life history, ecology, and distribution. Scoters will be marked with surgically implanted satellite transmitters to define the breeding areas, molting areas, and wintering areas. Local participation will be solicited and information will be conveyed to local residents through the Chugach School District and Youth Area Watch programs.

INTRODUCTION

This project will study the life history and ecology of surf scoters (*Melanitta perspicillata*) wintering in Prince William Sound (PWS) and lower Cook Inlet (LCI) and integrate this information with traditional ecological knowledge collected from community members within the study area. In the first year (FY98) we will initiate a pilot project to test the feasibility of catching scoters in PWS and marking them with a limited number of surgically implanted satellite transmitters. Satellite telemetry will allow us to define the breeding areas, molting areas, and wintering areas of this subsistence resource. Information will be conveyed to residents of Tatitlek through the Chugach School District and Youth Area Watch programs, and their participation in the capture and monitoring of scoters will be solicited. In future years, we propose additional satellites transmitters be implanted in scoters in the same areas and additional sites closer to Nanwalek, Port Graham, and Chenega, and also incorporate the participation of residents of these communities through the Chugach School District and Youth Area Watch programs. In future years, we also propose to collect ecological information on breeding and molting sites, as well as more information on wintering sites and migration routes.

Residents of the communities affected by the *Exxon Valdez* Oil Spill remain concerned about the abundance and safety of their traditional food resources (*Exxon Valdez* Oil Spill Trustee Council, 1996). In 1993, 55% of the households in Tatitlek reported using scoters harvested for subsistence purposes, as did 40% of the households in Nanwalek and almost 12% of Port Graham households (Scott et al. 1996). From 1957 through 1993, scoters in Alaska have been estimated to decline by as much as 30% (Hodges et al. 1996). However, regional trends have not been compared. The cause of this decline is unknown and can only be speculated. Quite likely, it may be the result of a combination of factors such as habitat loss, contaminants, or climate change. Several studies have shown scoters to bioaccumulate trace metals and organochlorines from their environment (Vermeer and Peakall 1979; Henny et al. 1991; Olendorf et al. 1991; Henny et al. 1995).

Scoters are among the least studied of North American waterfowl (Godfrey 1989, Savard and Lamothe 1991, Henny et al. 1995). Little is known of their life history, ecology, and breeding, wintering, and molting distributions (Bellrose 1976; Herter et al. 1989; Goudie et al. 1994). Surf scoters, black scoters (*M. nigra*), and white-winged scoters (*M. fusca*) all occur in PWS and lower Cook Inlet. Among these, the surf scoter is the most abundant (Isleib and Kessel 1973). It occurs as both a year-round resident and migrant. Surf scoters are most numerous in spring due to the influx of migrants probably in response to spawning Pacific herring (*Clupea pallasi*) (Isleib and Kessel, 1973; Bishop et al. 1995). Nonbreeders remain in PWS in summer.

Most scoters depart PWS in spring to unknown nesting areas, perhaps in interior Alaska and the Yukon (Gabrielson and Lincoln 1959). Male seaducks abandon incubating females in early summer and congregate at communal molting sites (Salomonsen 1968). Often these areas are distinct from nesting or wintering areas. As with other waterfowl, wing feathers are lost simultaneously, rendering birds flightless for about one month until new feathers emerge.

In winter, surf scoters feed in intertidal and subtidal zones, areas susceptible to contaminants (Vermeer and Peakall 1979). They feed primarily on bivalves, especially mussels, but in spring they may switch to a diet composed primarily of herring roe (Vermeer 1981; Goudie et al. 1994; Bishop et al. 1995). White-winged scoter die-offs occurred in the Cape Yakataga area in southeast Alaska during 1990-1992 (Henny et al. 1995). Although no definitive cause could be identified, elevated levels of cadmium were detected in the birds, but no source of contamination could be identified. The difficulty of detecting a source of contamination was confounded by lack of specific information on breeding, molting, or wintering areas of these birds.

Human activities, such as hydroelectric development (Savard and Lamothe 1991), estuarine pollution (Ohlendorf et al. 1991), or introductions of exotic species (Bordage and Savard 1995) on the breeding, wintering, or molting areas potentially have profound affects on abundance or distribution of a population. The lack of information on distribution and migration patterns can prevent the identification of potential harmful environmental exposures or alterations and make it extremely difficult to determine possible causes of population declines. Location of breeding grounds, migration routes, and timing of migration are important factors used to evaluate contaminant uptake or loss in a migratory species as well as changes to food resources and other environmental changes (Henny et al. 1991).

Scoters are an important subsistence resource to the people living in the communities of PWS and LCI (Scott et al. 1996). Populations appear to be declining and breeding area affiliations are unknown. The susceptibility of scoters to contaminants is a concern to resource managers and subsitence consumers. We propose a program that will integrate traditional knowledge, scientific methods, and modern technology to perpetuate the subsistence patterns of these communities by understanding more about scoter life history and ecology, sharing knowledge with local community members, involving the youth of the communities in the restoration process, and improving conservation strategies for this species.

Little is known about scoter ecology, breeding areas, molting areas, and migration routes. Basic reproductive ecology information is lacking for surf scoter populations wintering in PWS. Determination of breeding distribution is the first step in assessing breeding ecology. Potential breeding sites range throughout Alaska and the Yukon Territory. Once satellite telemetry has defined breeding areas, we propose to define habitat associations and measure productivity beginning in FY 99 and continuing in FY 00. If we can obtain adequate sample sizes and scoters exhibit philopatry to winter areas, mark and recapture data will be analyzed to estimate annual survival rates by age and sex (Lebreton et al. 1992).

Black scoters, white-winged scoters, and Barrow's goldeneyes (*Bucephala islandica*) are also an important subsistence resource to communities in PWS and LCI (Scott et al. 1996). In subsequent years, we will attempt to incorporate these species into our study if local residents express an interest or have preferences. However, due to the larger numbers of surf scoters present in PWS in winter, we have chosen to begin our study with this species. At present, wildlife satellite transmitter technology has yet to produce a transmitter small enough to be used safely in goldeneyes or harlequin ducks.

This project is integrated with project \052B Traditional Ecological Knowledge, project \210 Youth Area Watch, project \025 Nearshore Vertebrate Predator Project, (Predation on Herring Spawn), project \427 Harlequin Duck Recovery Monitoring, project \159 Prince William Sound Marine Bird Surveys, and proposed project 98426-Harlequin Duck Population Dynamics-Patterns and Processes.

NEED FOR THE PROJECT

A. Statement of Problem

Surf scoters have been used as a subsistence resource for centuries by the native inhabitants of PWS and along with black scoters and white-winged scoters are the most abundant avian species found at archeological sites (Linda Yarborough, USFS, pers. comm). In recent times, among the three species of scoters in PWS, surf scoters are the most abundant in winter (Dan Esler, USGS-BRD, pers. comm.). However, little is known about the distribution or movements of these birds within or outside of PWS. Although surf scoters are known to breed throughout much of Alaska and Canada (Gabrielson and Lincoln 1959; Godfrey 1986) nothing is known about specific populations and the link between winter, breeding, and molting areas. The few studies that have identified molting sites have not made the link between these and winter and breeding areas (Johnson and Richardson 1982; Dau 1987).

Since the USFWS initiated breeding pair surveys in 1957, breeding populations of scoters have declined in Alaska (Hodges et al. 1996). In marine environments, scoters feed on bivalves, especially blue mussels (*Mytilius edulis*), species known to concentrate contaminants. As mentioned, scoters are known to bioaccumulate contaminants and die-offs have occurred, including several among white-winged scoters at Cape Yakataga, in southeast Alaska (Henny et al. 1995). The cause of this die-off was undetermined. In addition, scoters are susceptible to environmental changes and habitat alterations over their entire range. As scoters have different winter, breeding, and molting areas they are susceptible to changes over a wide geographic area.

Because little is known about their ecology, breeding areas, molting areas, and migration routes, it is difficult to determine the cause or source of a declining population and which sub-populations may be affected. Without understanding the cause of a population decline it becomes extremely difficult to implement conservation and management strategies to reverse its course. Identifying the distribution of a population is the first step in this process.

B. Rationale/Link to Restoration

The location of breeding grounds, migration routes, winter areas, and the timing of migration are all critical factors used to evaluate contaminant uptake or loss in a migratory species as well as evaluating the consequences of other environmental disturbances or changes (Henny et al. 1991). Scoter populations are susceptible to natural and man-made disturbances over a wide and inaccessible geographic area.

To conserve this subsistence resource and restore the traditional activities associated with this species, we have proposed to identify the movements, distribution, and ecological relationships of surf scoters using satellite telemetry. This information is necessary to identify problems and develop and implement management strategies to promote the species long-term conservation. We hope this information and the activities associated with collecting this data will allow resource managers to reverse the decline in scoter populations; renew local confidence in the health of this food supply; help maintain traditional lifestyles; provide opportunities to the youth of local communities to promote their historical connection with this subsistence resource; merge traditional knowledge with modern science to develop a more complete understanding of scoter life history and ecology; and help students develop skills to promote the conservation of this species and others important to their economy and lifestyle.

Restoration requires assessment of population health and definition of impediments to recovery. This proposed work will begin the process of understanding the factors that affect population dynamics in surf scoters and develop management strategies to ensure the long-term health and welfare of the population. Without an understanding of the underlying events that influence population change, we can not prescribe specific activities to conserve or enhance the population.

C. Location

In FY 98 capture work will be conducted in Prince William Sound. Capture sites will occur in northern PWS between Valdez and Cordova and on northern Montague Island. Capture sites will be in the same areas used for harlequin ducks (\025 Nearshore Vertebrate Predator Project and \427 Harlequin Duck Recovery Monitoring). In future years capture sites will be added in PWS and LCI where feasible, closer to the communities of Chenega, Nanwalek and Port Graham. Work at breeding or molting sites will be dictated by information on breeding and molting distribution collected in FY98 and FY99.

In FY98, community involvement (Chugach School District, Youth Area Watch, traditional knowledge) will be focused on the village of Tatitlek. In future years we plan on expanding community involvement to include the communities of Chenega, Nanwalek and Port Graham.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

This program will incorporate residents of the communities of Prince William Sound and lower Cook Inlet in the collection and monitoring of data. Project personnel will adhere to the protocols for including indigenous knowledge in the restoration process presented in Appendix C of the Invitation to Submit Restoration Proposals for Federal FY 1998. The project will inform and coordinate our community involvement activities, including the collection of indigenous knowledge with Dr. Henry Huntington, TEK specialist EVOS Restoration Office; Martha Vlasoff, community coordinator; Roger Sampson and Rick DeLorenzo, Chugach School District; and the Subsistence Division of the Alaska Department of Fish and Game.

We will solicit advice from the above parties and gather information on Traditional Ecological

Knowledge (TEK) through local community facilitators and residents. We will attempt to involve local youth in bird capture and monitoring and TEK data collection through the Youth Area Watch program.

Efforts will be made throughout the restoration process to participate in and provide public involvement in the design and implementation of this project. Project staff will be available to present information to local communities or prepare articles or photographs for Trustee Council publications. Boat and air charter contracts, telemetry observers, other services will be contracted from local sources when possible.

PROJECT DESIGN

A. Objectives

FY 98:

1) Develop techniques to capture surf scoters in spring on saltwater;

2) Mark 6 adult males and 4 adult females with surgically implanted satellite telemetry transmitters;

3) Determine migration routes, breeding areas, and molting and wintering sites;

4) Document traditional ecological knowledge about scoters from residents of Tatitlek (and other communities if opportunities are available); and

5) Incorporate local community members through the Chugach School District and Youth Area Watch program in the collection and monitoring of data, including traditional knowledge.

B. Methods

ADF&G will capture, mark, and monitor scoters with professional staff, veterinarians, and local assistance. We will capture adult surf scoters in late March and early April during the herring spawn, when large flocks of sea ducks aggregate to feed on herring roe. The commercial herring gillnet fishery which precedes major spawning events by a few days ranges from April 9-28 for the period from 1972-1993 (Donaldson et al. 1995). Capture sites will be determined by monitoring known areas of herring spawn deposition (Morstad et al. 1996), scoter concentrations, ADF&G Commercial Fisheries Division aerial spawn and survey maps, and local knowledge. Scoters will be captured at a minimum of two sites, one located in northern PWS, as near Tatitlek as feasible, and the other on northern Montague Island. We will attempt to capture and implant satellite transmitters in 3 male and 2 female surf scoters at each site.

Surf scoters will be captured with either floating or land-anchored mist nets suspended among decoys or in passive drive traps consisting of two 100' wings which lead birds into a holding pen in shallow water. Sea kayaks will be used to slowly herd flocks towards a trap. Trap locations will be mapped using Global Positioning Systems and nautical charts (NOAA).

All captured scoters, in addition to those marked with telemetry, will be banded with USFWS aluminum leg bands and with individually coded plastic tarsus bands. Sex will be identified based on plumage characteristics and age will be determined by bursal probing. Adults do not have a bursa; if possible, second-year birds will be distinguished from third year subadults by bursa depth. Prior to release, birds will be weighed, measured (culmen, tarsus, and wing length) and blood and feather samples will be collected and archived for future contaminant, genetics, and radio isotope studies.

Once transported to the work vessel, a certified veterinarian, trained in avian implant surgeries, will place transmitters in the peritoneal cavity with the antenna exiting caudally, following procedures described by Petersen et al. (1995). Satellite transmitters will measure 10 mm deep, 55 mm long, 35 mm wide and weigh approximately 30 g (<3% body weight) (Telemetry 2000, Columbia, Maryland). Battery life can be expected to last from 6 - 12 months depending on advances in technology at time of purchase. Efforts will be made to maximize battery life. Each transmitter will be hermetically sealed with a teflon-coated multi-strand stainless-steel antenna. Transmitters will be programmed and calibrated to record and transmit body temperature to confirm that signals are being emitted from live birds. After surgery, scoters will be held in an appropriate container and provided water. Scoters will be released when the veterinarian determines they have recovered from the effects of surgery. In the case of immediate post-release mortality, conventional radio transmitters will be attached to each bird to facilitate retrieval of satellite transmitters. Attachment of conventional transmitters will be designed to ensure that radio packages fall off after 1-2 weeks. All ducks will be released at the point of capture.

Satellite transmitters will be programmed to transmit a signal at a time and frequency to be determined to ensure they will not interfere with existing telemetry studies. Signals will be analyzed using Argos (Landover, Maryland) Data Collection and Location System. Argos Standard and Animal-Tracking data processing services will provide information on the precision of each location. Movements will be monitored throughout the life of the transmitter. Locations will be mapped using a Geographic Information System (GIS). Movements and locations of scoters will be forwarded to the Chugach School District so students can monitor the progress and movements of birds between breeding, molting, and wintering areas.

The Chugach School District, through Youth Area Watch, will provide interested students and teachers to participate in capture and monitoring. The school district will provide classroom aides (computer and software, maps etc.) to be used in local schools for monitoring scoter movements throughout the year. ADF&G will relay satellite monitoring information to local communities. Students will assist in collecting information from local residents on TEK, current scoter distribution and abundance, and band returns from marked birds shot by local hunters.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Dan Esler, USGS-BRD, will cooperate to assist in radio telemetry implants. This project and proposed project 98426 Harlequin duck population dynamics - patterns and processes, will coordinate and attempt to share resources whenever feasible.

All data collection and analysis will be supervised by ADF&G. Private sector contracts for fuel purchase, equipment, vessel support and air charter will be solicited, usually from the local Prince William Sound or lower Cook Inlet region. Contracts for satellite transmitters and data downloading will be solicited from the private sector.

Cooperation for community involvement will be sought through the EVOS Restoration Office, Chugach School District, and the Alaska Department of Fish and Game Subsistence Division (see above).

SCHEDULE

A. Measurable Project Tasks for FY 98

November-February:	Coordinate and plan community involvement, Youth Area Watch and TEK. Attend Synthesis Workshops in local communities. Meet with local subsistence harvesters. Attend Restoration Workshop. Order satellite transmitters and field gear. Contract for vessel support, veterinary services. Organize field gear, test equipment.
March-April:	Reconnaissance surveys for scoter concentrations. Capture birds for radio implants. Maintain and store field equipment.
May-September:	Monitor satellite transmitters. Coordinate community involvement, Youth Area Watch and TEK.

B. Project Milestones and Endpoints

FY99

October-March:	Monitor radioed birds. Coordinate and plan community involvement.
March-April:	Capture birds for radio implants.
April:	Submit annual report.
May-September:	Monitor birds for defining migration routes, breeding areas, and molting areas.

	Coordinate with local communities.
July-August:	Breeding and molting site habitat assessment, productivity studies.

FY00

October-March:	Monitor radioed birds.
	Coordinate and plan community involvement, Youth Area Watch and TEK.
March-April:	Capture birds for radio implants.
April:	Submit annual report.
May-September:	Monitor birds for defining migration routes, breeding areas, and molting areas.
	Coordinate with local communities.
July-August:	Breeding and molting site habitat assessment, productivity studies.

C. Completion Date

All project objectives, except final reports and publications, will be met following FY00.

PUBLICATIONS AND REPORTS

An annual report of FY98 activities will be submitted to the Restoration Office before 15 April 1999. Because FY98 is the first year of this project, journal publications will not be generated until completion of all field work and community involvement.

PROFESSIONAL CONFERENCES

None in FY 98.

NORMAL AGENCY MANAGEMENT

The work proposed here is not part of normal agency management and is related specifically to research addressing oil spill restoration concerns. No similar work has been conducted, is currently being conducted, or is planned using agency funds.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

As described in the Introduction, this research relies on incorporation of methods and data from other EVOS Trustee sponsored research, including projects /427, /025, and proposed project 98426. Equipment purchased under those projects will be used to conduct the proposed research; and research sites, data collection and analysis will follow previously established standards. All efforts will be made to share vessel support, telemetry monitoring, study sites, and equipment with proposed project 98426. Proposed March demographic surveys for harlequin ducks (98426) will be used to help identify scoter concentrations.

This project is integrated with project \052B Traditional Ecological Knowledge, project \210 Youth Area Watch, project \025 Nearshore Vertebrate Predator Project, (Predation on Herring Spawn), project \427 Harlequin Duck Recovery Monitoring, project \159 Prince William Sound Marine Bird Surveys, and proposed project 98426-Harlequin Duck Population Dynamics-Patterns and Processes.

See Community Involvement and Traditional Ecological section above for more details on coordination of TEK and Youth Area Watch activities.

PROPOSED PRINCIPAL INVESTIGATORS

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PERSONNEL QUALIFICATIONS

Dan Rosenberg has been a waterfowl biologist for The Alaska Department of Fish and Game (ADF&G) since 1985. From 1980-1983 Mr. Rosenberg conducted field research in Alaska as a waterfowl biologist for the U.S. Fish and Wildlife Service and from 1983-1984 as a Habitat Biologist for ADF&G. Mr. Rosenberg received a Bachelor of Science degree in Wildlife Management from Humboldt State University, Arcata, CA in 1979.

Mr. Rosenberg has conducted harlequin duck population (age and sex structure) and production surveys in Prince William Sound since 1994 as the Principle Investigator of a Trustee sponsored restoration project. He has conducted extensive waterfowl population monitoring and habitat assessment surveys on the Copper River delta, Stikine River delta, Kenai wetlands, upper Cook Inlet, Aleutian Islands, and Kodiak Island. As project leader, Mr. Rosenberg has assessed impacts to waterfowl and wildlife populations from hydroelectric development, urban expansion, habitat alterations, chemical pollutants, timber harvest, and surface mining.

OTHER KEY PERSONNEL

Mike Petrula, Wildlife Biologist, ADFG. Field logistics, capture, data analysis, telemetry monitoring, report preparation.

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1998 EXXON VALDEZ TRUSTEE NCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel		$74.2						
Travel		$7.6						
Contractual		$42.3						
Commodities		$38.4						
Equipment		$2.8	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$165.3		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
General Administration		$14.1						
Project Total		$179.4		$232.0	$240.0	$0.0	$0.0	
Full-time Equivalents (FTE)		1.2						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: This is a new project. No money is allocated for NEPA compliance. Only salary money is allocated for attendance at Anchorage workshops. Travel to villages for TEK "Synthesis Workshops" is not included. Travel to Tatitlek for coordinating Youth Area Watch and Chugach School District Programs is included in this budget.

1998

Prepared: April 97

Project Number: 98273
Project Title: Surf Scoter life history and ecology: Linking Satellite technology with traditional knowledge to conserve the resource.
Agency: ADFG

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs: Name	Position Description	GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FY 1998
D. Rosenberg	WBIII, Principle Investigator	18F	4.5	6.2		27.9
Mike Petrula	WBI, Data analysis, report prep., graphics	14C	4.5	4.1	1.0	19.5
2 F&G Tech.	F&G Tech. III, Field Technicians	11F	3.0	3.7	1.0	12.1
E. Becker	Biometrician II	19L	1.0	6.9		6.9
C. Barnhill	Cartographer II	16L	1.5	5.2		7.8
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		14.5	26.1	2.0	
					Personnel Total	$74.2

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1998
Portage-Whittier Alaska Railroad vehicle,boat, and 1 psng.	0.4	4			1.6
Portage-Whittier Alaska Railroad vehicle and psng.	0.2	4			0.8
Portage-Whittier Alaska Railroad Psg. fare	0.1	1			0.1
Anchorage-Tatitlek by air	0.5	3	3	0.1	1.8
Anchorage -Valdez by air	0.3	2	4	0.1	1.0
Airport parking, taxi fare, excess baggage					0.3
Per diem, Cordova, Valdez, Whittier			20	0.1	2.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$7.6

1998

Prepared: April 97

Project Number: 98273
Project Title: Surf Scoter life history and ecology: Linking Satellite technology with traditional knowledge to conserve the resource.
Agency: ADFG

FORM 3B
Personnel
& Travel
DETAIL

4/15/97

1998 EXXON VALDEZ TRUSTEE ıCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Contractual Costs:		Proposed
Description		FY 1998
Warehouse for equipment storage and maintenance - 7 months @ $775/mo		5.5
Air charter for field support 4 hrs @ $250/hr		3.0
Boat and outboard motor repair		3.0
Trailer and boat moorage Valdez/Cordova		0.1
Photo processing		0.2
Vessel support for winter surveys 10 days @1500/day		15.0
Satellite telemetry data downloading		10.0
Air freight - equipment shipment		0.5
Veterinarian	Surgical Implants	3.0
Anesthetist	Administer anesthetics	2.0
When a non-trustee organization is used, the form 4A is required.	Contractual Total	$42.3

Commodities Costs:	Proposed
Description	FY 1998
Boat fuel 175 galllons @ $1.50/gal	0.3
Boat supplies- replacement parts, props, fuel lines, fuel filters, water filters, battery, absorbent rags, oil, emergency provisions	1.0
Field survey supplies- rite-in-rain notebooks/paper, nautical charts, batteries,	0.3
Computer software for analysis, graphing, mapping	0.8
Camp materials and supplies	0.8
Surf scoter leg bands 200@ $1/band	0.2
Mist nets and trapping equipment	1.5
Satellite radio transmitters - 10 @ $3,000 each	30.0
Veterinarian surgical supplies	0.8
2 - Inflatable Sea Kayaks and 6 sets paddles	1.0
2 - Pet carriers @ $60.00 each	0.2
10 - External radio transmitters w/2-3 week duration @$145 each	1.5
Commodities Total	$38.4

1998

Prepared:April 97

Project Number: 98273
Project Title: Surf Scoter life history and ecology: Linking Satellite technology with traditional knowledge to conserve the resource.
Agency: ADFG

FORM 3B
Contractual &
Commodities
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
Innnova Inflatable Kayaks- telephone bid REI	4	0.7	2.8
(these kayaks serve different functions than those ordered under commodities			0.0
and will often all be in use simulaneously with the others)			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	$2.8

Existing Equipment Usage: Description	Number of Units	Inventory Agency
20 ft. Caribe rigid hull inflatable	1	ADFG
17 ft. Boston Whaler	1	ADFG
10x40 binoculars	4	ADFG
Spotting Scopes	2	ADFG
Achilles 8 ft inflatable dinghy	2	ADFG
Remington Shotguns	2	ADFG
Honda generators	3	ADFG
Survival Suits	2	ADFG
Outboard Motors/various hp	6	ADFG
Magellan GPS	3	ADFG
Marine VHF radios	4	ADFG

1998

Project Number: 98273
Project Title: Surf Scoter life history and ecology: Linking Satellite technology with traditional knowledge to conserve the resource.
Agency: ADFG

FORM 3B
Equipment
DETAIL

98274

DOCUMENTARY FILM ON SUBSISTENCE USE OF HERRING, HERRING SPAWN, AND RESOURCES IN THE NEARSHORE ECOSYSTEM IN PRINCE WILLIAM SOUND

Project Number:	98274
Restoration Category:	Subsistence Restoration
Proposer:	Tatitlek Village Council
Lead Trustee Agency:	Alaska Department of Fish and Game
Alaska SeaLife Center:	
Duration:	1st year, 1 year project
Cost FY 98:	$116,100
Cost FY 99:	0.0
Cost FY 01:	0.0
Cost FY 02:	0.0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Herring; the nearshore ecosystem and subsistence

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EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT
This project is would produce a 50 minute film on the subsistence use of herring, herring spawn, and nearshore ecosystem resources in Prince William Sound. Historically, the nearshore ecosystem produced critical resources for subsistence users including: herring spawn, octopus, clams, mussels, sea otters, harlequin ducks, and chitons. In the harbor seal documentary (project 96214) Tatitlek residents discussed their view of the relationship between the *Exxon Valdez* oil spill, Pacific herring populations, harbor seals populations and their ability to pursue subsistence. This film will expand on this discussion by documenting all facets of herring and nearshore ecosystem resource use including the ecological and biological knowledge people use to harvest those resources.

INTRODUCTION

Subsistence uses of natural resources are essential to the economies and cultures of the communities in the oil spill region. In FY 96, the Trustee Council provided funding (96214) to produce a documentary on subsistence harbor seal hunting in Prince William Sound. The project was proposed by the village of Tatitlek, which depends heavily on subsistence harvests of harbor seal, Pacific herring and other marine resources. When first proposed, it was the intention of the village council and the Department of Fish and Game, Division of Subsistence to produce a series of films that would cover each species effected by the oil spill. This proposal is for a film on the subsistence uses of herring, herring spawn, and nearshore ecosystem resources in Prince William Sound.

NEED FOR THE PROJECT

A. Statement of Problem

The injured service this project addresses is subsistence. The injured resources are Pacific herring and those resources found in the nearshore ecosystem including herring spawn, clams, cockles, mussels, octopus, chitons, and harlequin ducks. In Prince William Sound, chitons and octopus provide fresh, easily accessible sea food during the winter months. For example, in 1988, households in Tatitlek harvested a total of 1,600 pounds of octopus and 173 pounds of chitons (Stratton 1990). In the spring, spawning activity around Tatitlek draws the community out on to the beaches to pick herring spawn for home use and children fish for herring with rod and reel. In 1988 Tatitlek residents harvested 3,100 pounds of roe on kelp and 1,500 pounds of herring (Ibid.). Throughout the summer, people harvest clams, cockles, and mussels.

Much of the oil from the *Exxon Valdez* was deposited in the nearshore zone severely disrupting harvest activities and creating concerns about the safety of those resources contaminated by the oil spill. The 1993 population crash of herring in Prince William Sound brought a further halt to important subsistence and commercial activities and increased residents unease regarding the long term effects of the oil spill. This project will provide local people an opportunity to be a part of the effort to help in the recovery of herring and nearshore resources, and in so doing, put them in contact with researchers and information about these critical resources. It is the hope of the community that their knowledge of these resources, and their view about the importance of the subsistence be communicated through the film to the Trustee Council, scientists, and the general public.

B. Rational/Link to Restoration

The restoration objective for subsistence states that recovery will have occurred when " the cultural values provided by gathering, preparing, and sharing foods are integrated into community life" (p.82). One strategy to meet this objective is to "facilitate the participation of and communication with subsistence users in the restoration process" (p.86). The decline in herring roe on kelp and nearshore resources such as octopus has greatly affected subsistence harvesting, resulting in lost opportunities to teach subsistence skills and traditional knowledge associated with these resources. One means of preserving these skills and knowledge are transmitted to the next generation and integrated into on going restoration efforts is to document them on film.

The intent of this project is to contribute to the restoration of herring and nearshore ecosystem resources and subsistence uses by providing a medium for harvesters to transmit their knowledge and observations, gained from years of experience, to the scientific community. Currently no medium exists that presents harvesters' knowledge within its own contextual framework. Producing this video will help fill this void and enhance the restoration of Pacific herring and nearshore resources by providing a harvester's perspective on herring and nearshore ecology. As such, this project will contribute to various restoration strategies including: Sound Ecosystem Assessment; the Enhancement of Subsistence Resources; Increase Involvement of Subsistence Users in the Restoration Process; and project 97248 Documentation of Herring and Other Forage Fish Natural History Through Local and Traditional Ecological Knowledge.

C. Location

Filming will take place in Tatitlek and other locations in Prince William Sound.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

This project was initially proposed by the Tatitlek village council. A subcontract will ensure community involvement in the production of the film. The council and chief Gary Kompkoff, will be involved in selecting a contractor for the film and in decisions concerning content of the film.

PROJECT DESIGN

A. Objectives

The overall objective of this project is to promote the recovery of injured Pacific herring populations and nearshore resources and the subsistence use of herring, herring spawn and nearshore resources through the production of a documentary on the subsistence uses of these resources in Prince William Sound. This includes harvesting techniques, methods of processing, the distribution of resources and the traditional knowledge employed in the harvest of herring, roe on kelp and nearshore resources.

B. Methods

A fifty (50) minute documentary film will be produced through a professional services contract. The film will document subsistence nearshore and herring harvests in Prince William Sound, primarily focusing on the village of Tatitlek. A film crew will visit the village for one week in January to film the distribution of subsistence resources during the celebration of Russian Christmas, and for ten days in April and May of 1998 to document the harvest and distribution of herring and herring roe on kelp, octopus, clams and other nearshore resources. Interviews will be conducted with a wide spectrum of the community to gather traditional knowledge and views about the importance of these resources and subsistence to the community. In collecting this information the film project will also tie in with project 97248 Documentation of Herring and other Forage Fish Natural History through Local and Traditional Ecological Knowledge. A subcontract within the contract supports community involvement. In FY 99, the documentary will be completed, presented in a public screening in Tatitlek and Anchorage, and distributed to oil spill affected communities, libraries, tribal authorities, agencies, and non-governmental organizations.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The production and post production work on the film will be contracted out to an experienced film maker who has the expertise to make a quality film. In contracting out for this production the proposers want to hire someone who will actually create and produce the product rather than contracting out for creative talent. By hiring a video production company the proposers will maintain control over all aspects of the process. In consultation with the community and ADF&G staff the video production company will create a story line before shooting the film. All footage will be shot on location and include interviews with members of the community and footage of harvesters. Once the film is completed the production company will edit the footage using digital state of the art editing equipment.

SCHEDULE

A. Measurable Project Tasks for FY 98 (October 1, 1997-September 30, 1998)

October 1, 1997:	Project Approval

October - November 1997:	Develop contract guidelines, evaluate bids, award contract.
December 1997 - January 1998:	In consultation with harvesters and ADF&G staff, contractor will develop story line for film.
January 1998:	Travel to Tatitlek and film necessary footage.
April 1998 - May 1998:	Travel to Tatitlek and Prince William Sound to film harvesting footage.
June 1998 - November 1998:	Edit film.
December 1998:	Contractor will provide completed film and deliver 100 copies.

A. Project Milestones and Endpoints

October 1997:	Project Approval.
November 1997:	Contract Awarded.
January 1998:	Storyline completed, filming begins.
May 1998:	Filming ends.
June 1998:	Editing begins.
November 1998:	Editing completed.
December 1998:	Completed film delivered.

A. Completion Date

December 1998

PUBLICATION AND REPORTS

The film will be widely distributed to federal and state agencies, non-governmental agencies, and interested parties. Showings will take place in Tatitlek, Anchorage, and Cordova.

PROFESSIONAL CONFERENCES

The film may be shown at professional conferences.

NORMAL AGENCY MANAGEMENT

This project does not fall under existing statute or regulation governing the activities of the Alaska Department of Fish and Game, Division of Subsistence.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will contribute to various restoration strategies including: Sound Ecosystem Assessment; the Enhancement of Subsistence Resources; Increase Involvement of Subsistence Users in the Restoration Process; and especially project 97248, Documentation of Herring and Other Forage Fish Natural History Through Local and Traditional Ecological Knowledge. The proposer has been in contact with the principal investigator of project 97248 and we have discussed coordinating efforts regarding documentation of local knowledge of Pacific herring. For example, we plan to film sessions when local people discuss their knowledge of herring.

PROPOSED PRINCIPAL INVESTIGATOR

Gary Kompkoff
Chief, Tatitlek Village Council
Tatitlek, Alaska
(907) 325-2311

William E. Simeone
Subsistence Resource Specialist II
Alaska Department of Fish and Game
Division of Subsistence
(907) 267-2309

PRINCIPAL INVESTIGATOR

Gary Kompkoff
Mr. Kompkoff is a life long resident of Tatitlek and life long harvester of subsistence foods. He has president and chief of the Tatitlek village council for over ten years.

William E. Simeone
Dr. Simeone has worked in oil spill and subsistence related projects in Prince William Sound for the last seven years. Two of those years have been with the Alaska Department of Fish and Game, Division of Subsistence. Dr. Simeone also administered, coordinated, and consulted on the harbor seal documentary.

OTHER KEY PERSONAL

Dr. James Fall. Dr. Fall has been regional supervisor for the Alaska Department of Fish and Game, Division of Subsistence in the South-central region for over ten years. He has considerable experience documenting the effects of the oil spill on subsistence.

Ed Gregorieff. Mr. Gregorieff has been a long time resident of Tatitlek and life long hunter and fishermen.

Dr. Craig Mishler. Dr. Mishler has worked extensively on subsistence and oil spill issues on Kodiak Island for the Division of Subsistence.

Rita Miraglia. Ms. Miraglia is oil spill coordinator for the Division of Subsistence and has worked closely with oil spill communities in Prince William Sound and Lower Cook Inlet.

Illene Totemoff. Ms. Totemoff has been long time resident of Tatitlek and a life long harvester and processor of subsistence foods.

Jessie Tiedemen. Ms. Tiedemen is a long time resident of Tatitlek and a life long harvester and processor of subsistence foods.

LITERATURE CITED

Stratton, Lee. 1990. *Resource Harvest and Use in Tatitlek, Alaska.* Alaska Department of Fish and Game, Division of Subsistence Technical Paper No. 181. Anchorage, Alaska.

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel		$11.2						
Travel		$1.6						
Contractual		$95.0						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$107.8		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
General Administration		$8.3						
Project Total	$0.0	$116.1		$0.0	$0.0	$0.0	$0.0	
Full-time Equivalents (FTE)		0.2						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

1998

Prepared: 1 of 4

Project Number: 98274
Project Title: Subsistence Herring and Nearshore Ecosystem Documentary
Agency: Alaska Department of Fish and Game, Division of Subsistence

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/10/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs: Name	Position Description	GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FY 1998
W. Simeone	Coordinator/Consultant/Administrator	SRS II	2.5	4.46		11.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.5	4.5	0.0	
					Personnel Total	$11.2

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1998
Three round trips to Tatitlek and Prince William Sound	0.4	2	10	0.08	1.6
					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	$1.6

1998

Project Number: 98274
Project Title: Subsistence Herring and Nearshore Ecosystem Documentary
Agency: Alaska Department of Fish and Game, Division of Subsistence

FORM 3B
Personnel
& Travel
DETAIL

Prepared: [illegible]0/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
The Alaska Department of Fish and Game, Division of Subsistence will develop a request for proposal for a documentary film maker. Of this total, $10k will go to the local community.	95.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$95.0

Commodities Costs:	Proposed
Description	FY 1998
Commodities Total	$0.0

1998

Prepared: 3 of 4

Project Number: 98274
Project Title: Subsistence Herring and Nearshore Ecosystem Documentary
Agency: Alaska Department of Fish and Game, Division of Subsistence

FORM 3B
Contractual &
Commodities
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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 a		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1998

Prepared: 4 of 4

Project Number: 98274
Project Title: Subsistence Herring and Nearshore Ecosystem Documentary
Agency: Alaska Department of Fish and Game, Division of Subsistence

FORM 3B
Equipment
DETAIL

4/10/97

98278

PROJECT TITLE: Development of an Ecological Characterization and Long-Term Environmental Monitoring Program for Kachemak Bay

Project Number:	98278
Restoration Category:	Monitoring, General Restoration
Proposer:	ADFG
Lead Trustee Cooperating Agencies	ADFG ADEC, NOAA
Duration:	1st year, 2-year project
Cost FY 98:	$144.9
Cost FY 99 and Outyears:	To Be Determined
Geographic Area:	Kachemak Bay and Southern Kenai Peninsula
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 ecological characterization; the monitoring program will be tied to specific injured species and services to be determined in the development of that plan

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EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

Using EVOS and other scientific information, local knowledge, and traditional ecological knowledge, this project will develop, synthesize, and document the available ecological knowledge and status of Kachemak Bay. Based on this information and other sources, ADFG will develop a highly integrated ecological characterization including information on human, physical, and biological elements of the ecosystem which will be published on a compact computer disk (CD). This information will be used to identify restoration opportunities, gaps in our knowledge of the ecosystem, and provide background information for the monitoring program. A long-term environmental monitoring program will be identified for Kachemak Bay to assist in the monitoring and restoration of species and resources injured by the EVOS. Implementation of the monitoring program will begin in FY99.

INTRODUCTION

Kachemak Bay and the adjacent Fox River Flats are designated by the State as critical habitat areas (CHAs). CHAs were established to protect and preserve habitat areas crucial to the perpetuation of fish and wildlife. This highly productive estuarine system is critical to sustaining fish and wildlife, including most species injured by the oil spill.

Kachemak Bay is also a valuable estuary to the economy and lifestyles of many Alaskans. Kachemak Bay supports a wide variety of human activities including: commercial, recreational, and personal use fishing, sport and subsistence hunting, trapping, cattle grazing, shellfish and plant gathering, aquatic farming (shellfish), harbors, docks, and other marine transportation needs, pipelines and utility lines, recreation, tourism, and passive uses such as education and wildlife watching. Several of these activities are classified as "services" reduced by the oil spill.

Although the value of Kachemak Bay has not been quantified in economic terms, the inherent value of the bay to the people of the State of Alaska is very high. This value is reflected in the use of the bay, as well as in the steps the state has taken to ensure that the ecological integrity of the bay is maintained for the long-term. This commitment includes the CHA designations as well as the 1993 land acquisition by the state of surface title to in holdings in Kachemak Bay State Park with the assistance of the EVOS Trustee Council. This commitment also includes the recent nomination of the bay, the Fox River Flats, and portions of Kachemak Bay State Park (including the 1993 acquisition) to the National Oceanic and Atmospheric Administration (NOAA) for designation as a National Estuarine Research Reserve (reserve or NERR).

In 1994, Governor Walter Hickel requested funding to explore the establishment of a reserve in Southcentral Alaska; Governor Tony Knowles reaffirmed that request in early 1995. At the request of NOAA, the federal Trustees of the EVOS criminal settlement authorized the expenditure of settlement funds to study the feasibility of establishing a research reserve to aid restoration efforts. These funds were expended in a large part to help in the EVOS restoration effort. NOAA provided that funding in 1995 to the Alaska Department of Fish and Game (ADFG) to select a site and develop an environmental impact statement and reserve operational plan. The search area for a potential site approximated the EVOS spill affected area. A multi-agency site selection committee (SSC) reviewed Kachemak Bay against previously established criteria and recommended that Governor Knowles nominate the site for designation as a reserve. The site selection process was completed with Governor Knowles' nomination of the site to NOAA on April 2, 1997 (see Attachment 1 for a map of the boundaries).

Reserves are discrete areas containing key habitat within an estuarine system that are protected by state laws from significant ecological change. Reserves are established to promote long-term education, research, and monitoring. The proposed Kachemak Bay NERR will improve protection for many resources through increased knowledge and education, and allow for continued human use. More importantly, however, reserve designation insures a long-term commitment by the state and the federal government to conduct research in this highly productive estuary.

ADFG is identified as the likely lead agency for operation of the reserve. Both NOAA and ADFG want to establish an appropriate role for the reserve in furthering long-term EVOS restoration efforts, particularly through the reserve's and monitoring research program. Most of the resources and services injured by the spill are found in the Kachemak Bay watershed, and several restoration program research projects, including the Alaska Predator Ecosystem Experiment (APEX, \163), have included Kachemak Bay in their study areas.

Kachemak Bay was in the area affected by the EVOS. Most restoration related research and monitoring, however, has concentrated in areas where greater direct impact from oiling occurred. Research and monitoring in Prince William Sound (PWS), particularly the ecosystem-based projects, provided new insight into species life-cycles and survival rates, ocean circulation patterns, and other information vital to resource managers. The proposers of this project feel that additional information and data synthesis in areas other than PWS is necessary to further improve understanding of the larger ecosystem. The proposed Kachemak Bay NERR was chosen to represent a large biogeographic region extending from the Copper River Delta through the mid-Aleutian Island chain (Kupreanof Point).

This proposal capitalizes on several other projects by combining resources to maximize cost-efficiency, ensure the best quality product, and demonstrate the commitment of ADFG and NOAA to address these issues. The proposers established an overall work plan (see below) for projects geared toward developing a comprehensive understanding of the Kachemak Bay ecosystem, its relationship to human communities, and addresses some of the needs of the EVOS restoration effort. The work plan is designed to further the restoration effort, improve the ability of resource agencies to effectively address management issues, and provide accurate and comprehensive information to the public and managers in a format that is easy to understand. This includes overall effort, includes tasks funded by **both EVOS civil (proposed) and other funds**.

Draft Work Plan for FY 98 through FY 00 In anticipation of reserve designation and the development of a research and monitoring program, ADFG and NOAA are cooperating on several projects that will provide a framework and the information necessary for ecosystem analysis. These projects are:

1. *Development of an Ecological Characterization of Kachemak Bay*: The goal is to develop, produce, and distribute an ecological characterization of Kachemak Bay that addresses the needs of resource managers and users. An ecological characterization is "a structured approach to the synthesis of human, physical, and ecological information for management purposes" (South Carolina Department of Natural Resources 1996). This ecological characterization will be produced in electronic format and published on a compact computer disk or CD. This will include the development of a centralized Geographic Information System (GIS) for the Kachemak Bay. The GIS will be made accessible to state, federal, and local government agencies and tribal governments, the public, private organizations, and corporations. This effort will necessarily involve the definition of user needs, and coordination with all related EVOS, other agencies, local governments, and non-profit organizations.

2. *Long-Term Standardized Ecological Monitoring Program*: The goal is to develop and implement a long-term standardized ecological monitoring program for Kachemak Bay. Ecological monitoring will include biotic and abiotic parameters. Efforts will be coordinated with other Kachemak Bay and other appropriate monitoring and modeling efforts to maximize efficiency and maximize benefits to all projects.

3. *Ecological Model of Kachemak Bay*: The ultimate goal is to eventually develop an ecological model of Kachemak Bay. No specific proposal is advanced for this task in FY98 or FY99. We would like to monitor the modeling project (\300) to consider how those efforts, as appropriate, could include Kachemak Bay.

Each of these projects is integral to a comprehensive understanding of the ecology of Kachemak Bay and human influences on the environment. The project is designed to develop information related to spill-affected resources and services through an ecosystem approach to research, but is limited geographically to Kachemak Bay and its watershed. The Trustee Council has deliberately moved toward the ecosystem approach over the past several years, as have ADFG and NOAA. ADFG and NOAA expect the reserve to serve as a coordinating mechanism for ecosystem-based research in Kachemak Bay following designation.

This proposal is divided into two components: (1) the ecological characterization and (2) long-term monitoring program. ADFG and partners are not requesting funds for the development of an ecological model at this time. We intend to coordinate with and, as appropriate, provide information to other EVOS modeling efforts in the hopes that these efforts will ultimately assist in the development of a model for Kachemak Bay. The department will separately identify other efforts of the ecological characterization effort which would not be funded by EVOS, but would help provide a more complete understanding of the ecosystem. An overview of the tasks that would be funded with **EVOS criminal funds** for this proposed project is provided below.

A. Ecological Characterization : Evaluate and synthesize ecological information on the Kachemak Bay watershed. An approach will be developed to identify information gaps in ecosystem understanding, restoration opportunities for injured species and services, and provide an information base for future monitoring efforts. Information will be collected from the following sources: (1) *scientific information*, based on information from scientific studies, including past studies in Kachemak Bay, local biologists, and EVOS studies; (2) *local knowledge*, including local information on resources from the non-native knowledgeable people of the Kachemak Bay area; and (3) *traditional ecological knowledge* (TEK), or the ecological knowledge from the native community (this project will follow established protocols adopted by the Trustees Council). FY98 will focus on identification of the user needs, and the collection and development of initial information (with periodic interaction among the three groups). The first six months of FY99 will focus on integrating the information and developing consensus on the how the information can be used and disseminated in the CD or other means.

B. Monitoring Program : The department has developed a collaborative effort in FY97 to design a long-term ecological monitoring program for Kachemak Bay. This effort will be undertaken in cooperation with NOAA and the Alaska Department of Environmental Conservation (ADEC), as well as coordinate with the efforts of the Cook Inlet Regional Citizens Advisory Committee (CIRCAC), Cook Inlet Keeper (CIK), U.S. Geological Survey (USGS), Mineral Management Service (MMS), EVOS Trustees staff, and other monitoring efforts in or affecting the area. The monitoring plan will be tied directly to information needs related to injured resources and lost or reduced services in the bay. The monitoring plan will be implemented in FY99 pending receipt of funding. It is the intention of the proposers that the monitoring begun under this proposal will be carried on in subsequent years. EVOS oriented efforts will be coordinated with and complement monitoring efforts as part of NOAAs national monitoring program. Currently, NOAA provides individual reserves with up to $15,000 per year to establish monitoring programs relevant to specific issues at each site. The proposed project would focus on the monitoring for restoration and monitoring the restoration of injured species and services.

NEED FOR THE PROJECT

A. Statement of Problem

The primary problems that this project and cooperating efforts will attempt to address are described below:

- *Need for Ecological Information for Restoration and Monitoring:* The best current source of ecological information on the Kachemak Bay area may be the Kachemak Bay/Fox River Flats CHA plan (ADFG, 1993). Resource information from this study was based primarily on studies in Kachemak Bay from the 1970's and interviews by local biologists (Debra Clausen and Rick Sinnott, personal communication). Much of this information is outdated (e.g. distribution, abundance, and use of several crustacean species has changed significantly since the 1970s). The ecological knowledge of the many injured species and ecosystems in the northern Gulf of Alaska has been significantly advanced through EVOS restoration studies which have not been fully reflected in this plan or other documents. This information needs to be developed, synthesized, and presented in useable, easily accessible form, and analyzed to identify gaps in our understanding of the ecosystem for future study and possible restoration opportunities for injured species and resources. There is a need for the development of a centralized GIS for Kachemak Bay by resource managers and to aid in future restoration efforts. Moreover comprehensive resource baseline information needs to be developed in concert with the monitoring program to allow comparisons of changes over time.

- *Need for Community Involvement in Restoration Effort:* The EVOS Trustees Council has recognized the value and need for community involvement in the restoration effort. Participation of the local community, both native and non-native, is necessary to 1) promote public understanding of the restoration effort, 2) complement scientific information on the area, and 3) help increase public involvement in resource management decisions. It is also important that this information be integrated to recognize the sensitivity of some information.

- *Need for Long-Term Monitoring Program:* There is a great deal of public interest and support for the establishment of a long-term ecosystem monitoring program (ADFG 1997). Such a program can assist in the restoration effort through increased understanding of the ecosystem and in monitoring the restoration of injured species and resources. Governor Knowles, in response to a recent letter to "stakeholders representatives" on the recent State Oil and Gas Lease Sale 85A (March 18, 1997), directed the state resource agencies "to develop a specific coordinated water quality data gathering and permitting program and establish a budget for this effort." EVOS Trustees Council was identified as a possible source of funding for such an effort. A long-term monitoring program in Kachemak Bay will help meet these needs.

- *Need to Meet Needs of Managers and Other Users:* It is important to synthesize, develop, and publish the information in a form that will be used by the public. To ensure this occurs, development and synthesis of information must reach the users of the data to ensure that their needs are met and the product will be used.

- *Consider Other Alternatives to Modeling:* The Trustees have invited modeling proposals as a follow-up project to EVOS ecosystems project \300. While successful modeling can help managers, other, more straight-forward approaches to analyze and present information for use by resource managers and the public.

- *More Attention to Kachemak Bay and Identify Restoration Needs:* Compared to research efforts in Prince William Sound, Kachemak Bay to date has played a minor role in restoration effort. Kachemak Bay and lower Cook Inlet should be more fully integrated into the EVOS restoration effort. This includes the identification of potential restoration opportunities in Kachemak Bay. It will also help bring a different perspective to the restoration effort.

B. Rationale/Link to Restoration

The project will help implement many of the policies of the EVOS Trustees Council to reflect a comprehensive, balanced approach to restoration (EVOS Trustees 1994). This includes Trustees Council policies related to applying an ecosystem approach to 1) "contribute to a healthy, productive and biologically diverse ecosystem within the spill area that supports the services necessary for the people who live in the area" and 2) "to better understand what factors control the populations of injured resources." This project will also address the policies related to "injuries addressed by restoration, and will emphasize resources and services injured by the spill and other important aspects of the ecosystem. The injured resources and services are also of great economic, cultural, and subsistence value to people living in the oil spill area.

The Kachemak Bay NERR, which will be established for long-term research, monitoring, and education, could significantly contribute to the EVOS restoration effort. The goals of the NERR System and initial goals and objectives of the Kachemak Bay NERR are included in Attachment 2. The Kachemak Bay NERR goals (based on an initial survey of research and education needs) are as follows:

1. Evaluate the effects of uses on the health and stability of the reserve's ecosystem;

2. Establish a comprehensive database of baseline data that allows rapid access to historical and acquired research and educational information gathered within the reserve;
3. Coordinate research and educational efforts to streamline efforts and avoid unnecessary duplication;
4. Enhance scientific understanding of estuarine ecosystem processes and functions;
5. Gather and make available information needed by coastal managers for improved understanding and management of the estuarine ecosystems;
6. Monitor the impacts of human stresses on the estuarine environment and the effectiveness of water pollution control strategies;
7. Promote ecosystem management;
8. Provide a site under long-term protection for comparative studies that assist the State of Alaska in better responding to oil spill impacts and providing relevant information to federal, state, local and tribal governments, oil companies, and other interested organizations; and
9. Work with managing agencies to develop the information necessary to maintain the long-term ecological integrity of Kachemak Bay.

These are compatible with the goals and policies of the EVOS Trustees Council. ADFG and NOAA are committed to linking the goals and objectives of the research reserve to the overall restoration effort. These efforts are in addition to normal activities that will be conducted by the reserve.

The development of an ecological characterization will provide a comprehensive compilation of information on the Kachemak Bay ecosystem, and will be a mechanism for consolidating and synthesizing information for use by management agencies and the public. This will involve the development of a comprehensive GIS, which will allow comparisons of changes over time. This represents a type of conceptual model or ecological characterization of Kachemak Bay that supports other restoration efforts, including the development of mathematical models supported by the Trustee Council; identifying future restoration needs in Kachemak Bay; and identifying areas for the deployment of long-term monitoring stations and establishment of sampling sites. The project includes the participation of native associations in the Kachemak Bay area as well as local (non-native) citizens. The incorporation of traditional ecological and local knowledge is essential to the success of the project.

The project will further contribute to recovery objectives by identifying information gaps for injured resources and services in Kachemak Bay. These information gaps will be addressed through research conducted in the future by the proposed reserve. In addition, the project will further contribute to the recovery effort by assisting the Trustee Council in synthesizing information for EVOS research and developing a system that will be used by agencies in making management decisions. This project will use a more simplistic, proven technique of providing information to the public and management agencies. This differs from Trustees Project \300 which seems to be directed to developing predictive mathematical models. This project will result in the development of a centralized GIS for Kachemak Bay, part of which will be included in the ecological characterization published in compact disc format to the public, federal, state, and local agencies, and other interested parties. The information included in the characterization will be relevant to the overall restoration objectives of the participating agencies and the Trustee Council itself. This project supports many of the same objectives as Project \300, including developing new information for the management of natural resources in Southcentral Alaska, developing additional insight into the ecology of the coastal ecosystems of the spill area, and developing predictive models of ecosystem change.

The ecological characterization aspect of this project is also designed to assist in identification of specific locations in Kachemak Bay for long-term monitoring to assist resource agencies in efforts to restore injured resources and services. In the first year of the project, a comprehensive long-term monitoring plan will be developed for Kachemak Bay. The development of this monitoring plan should be coordinated with Project \300 so that, as appropriate, it can obtain data that can be used to assist the development and use of mathematical models developed under that project. The monitoring plan is likely to include the development of continuous data on abiotic parameters such as temperature, salinity, dissolved oxygen, turbidity, petroleum hydrocarbons, and sea-level and can help distinguish whether trends are natural or are related to anthropogenic factors.

This information is essential to making the most appropriate decisions on how to benefit the restoration of injured species and services. The monitoring information developed over the long-term will help corroborate the descriptive and predictive capabilities of Trustee Council supported modeling efforts. Long-term monitoring data will also support improved accuracy of ecosystem models in the future. The data will also be used by both ADFG and NOAA to support effective management of marine and estuarine resources.

C. Location

The project is for the Kachemak Bay area and surrounding uplands on the southern Kenai Peninsula. The project will benefit Kachemak Bay, surrounding communities, and the entire spill-affected area. Affected communities include Homer, Anchor Point, Kachemak City, Kachemak Silo, Halibut Cove, Seldovia, Port Graham, Nanwalek, and adjacent areas.

Substantial benefits from this project will be realized by the EVOS restoration effort, other management agencies, native organizations, and other organizations in the Kachemak Bay area. The proposed EVOS-funded aspect of the ecological characterization will focus on a coordinated effort to collect and synthesize ecological information (included information collected to help the restoration effort) from three sources: 1) scientific, 2) local, and 3) traditional ecological knowledge. The methods to define user needs and collect, synthesize, and integrate the information could serve as a model for EVOS restoration and other agency management and planning efforts. The need to collect and use this information has been identified as a concern by management agencies. For example, the need to effectively collect and use local knowledge in management decisions has been the focus of efforts under the Alaska Coastal Management Program (Behnke 1997).

The overall effort, much of which is funded by non-EVOS funds, will result in the development of one or more versions of a CD to address the needs of users. This will provide an effective means to compile and disseminate ecological information on the restoration effort and other sources on the Kachemak Bay ecosystem. This type of characterization is a relatively straightforward approach using tested, state-of-the-art technologies, and is not dependent on the development of predictive mathematical models (see Attachment 2). The CD(s) will be prepared by the close of FY99. Although the effort will focus on Kachemak Bay, this approach will provide a model for application in other areas of the EVOS restoration effort and management and planning agencies. This type of characterization has not been applied anywhere in Alaska. The U.S. Fish and Wildlife Service has prepared an interactive GIS CD for Prince William Sound, however, this CD represents a compilation of existing data layers and does not include a narrative description of other aspects of the physical, biological, and human elements of the Prince William Sound ecosystem. GIS information is also provided at a gross scale, and has little utility for site-specific, small-scale land use management and planning decisions. The Kachemak Bay ecological characterization will be produced at a scale necessary for these types of management decisions.

The development of a comprehensive water quality monitoring program (FY98) and initial implementation (FY99) in Kachemak Bay will provide a model for water quality monitoring efforts in the EVOS restoration effort. This effort will be designed to both assist in monitoring the recovery of injured species and resources, and to help agencies in management efforts.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

A major focus of this project is on community involvement and the inclusion of traditional ecological knowledge in the proposed characterization of the Kachemak Bay ecosystem. This project has a specific local knowledge compontent to obtain information from long-time local residents. With respect to TEK, the project seeks to form partnerships with Seldovia, Nanwalek, and Port Graham to review ecological knowledge available through existing records, to document TEK that is not already available and that communities are willing to share, to incorporate other relevant information related to Kachemak Bay, and to determine how this information can be coordinated and used with the scientific and local knowledge that are also to be compiled under this project.

This work will be carried out in cooperation with Project \052, in particular the TEK work done under \052B. Since \052B has already reviewed existing sources of TEK data (such as ADFG's Whiskers database), this project can make use of that effort. This project also intends to make use of the expertise of the TEK Specialist(s) hired under \052B. All work on this component of the project will follow the Protocols for Including Indigenous Knowledge in the *Exxon Valdez* Oil Spill Restoration Process.

PROJECT DESIGN

This project has two related components: 1) the development of an *ecological characterization* and 2) the development of a *long-term monitoring program*. The first component, the ecological characterization, represents a cost share effort in both the first and second year of the project. ADFG has been notified by NOAA of its decision to approve a two-year "Coastal Management

Fellowship."[1] The fellow, under the guidance of the mentor (also the Principal Investigator), will be responsible for the preparation and coordination of the effort with project partners, production of a coordinated Kachemak Bay GIS, and the production of one or more CDs to represent the ecological characterization. NOAA will fund the equivalent of approximately 21 months of this two year fellowship. As a contribution to the proposed EVOS effort, we will ask the Trustees to fund approximately three months of the fellowship. It was envisioned that other funds and assistance would be needed beyond the fellow to produce a comprehensive and high quality product. For clarity, this section will distinguish between the effort funded through EVOS and other tasks funded by other sources. The second component involves the development of a long-term monitoring program to assist in the restoration effort and initial implementation, is proposed to be largely funded by EVOS civil settlement funds.

A. Objectives

The overall project objectives, including other sources of funding, are as follows:

1. Develop, synthesize, and integrate existing information on Kachemak Bay, including scientific, local, and traditional ecological knowledge.

2. Document the information in a simple, easy to use format that will meet the needs of the general public and management agencies.

3. Develop a long-term environmental monitoring program for Kachemak Bay to assist in and monitor injured species and services.

4. Implement an environmental monitoring program for Kachemak Bay.

5. Identify restoration opportunities for injured species and services in Kachemak Bay and information gaps in our understanding of the Kachemak Bay ecosystem.

B. Methods

Ecological Characterization Component

EVOS Funded Task - Collection, Synthesis of Scientific, Local Knowledge, and TEK

Efforts to collect information in the first year will be coordinated by the Fellow. The overall approach is outlined below:

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[1] NOAA implements a nationally competitive process through the NOAA Sea Grant Process to seek fellows for selected projects. This process ensures that the fellow has the qualifications to meet the needs of the project. Fellows are post Masters or Ph.D. students with both an education and experience in the areas needed to complete the project.

FY98:

- Determine Information Needs and Uses: The effort to define user needs will be coordinated by the Fellow with oversight from the principal investigator. This will be completed during the first quarter. This effort will involve at least one or two meetings with the TEK specialist(s) under \52B and at least one individual from each of the three components: (1) scientific information-- ADFG/Habitat and Restoration Division; (2) local knowledge-- Pratt Museum/Homer; and (3) TEK-- ADFG/Subsistence Division. The purpose of the initial meetings is to discuss the project approach and the process for identifying user needs, develop initial survey questions or guidelines related to injured species and services and other aspects of the ecosystem, encourage the participation of other agency staff and information contacts, identify key user groups, and lay the ground work for a workshop in Homer in late November or early December. Participants in this workshop will include the principal investigator, task leaders, \52B representatives from one or more representatives from the management agencies, Cook Inlet Keeper, University of Alaska/Kachemak Bay Campus, primary and secondary education, local residents, and at least one community representative (the community facilitator?) from Seldovia, Nanwalek, and Port Graham, and other groups as appropriate. The primary purpose of the workshop will be to identify and prioritize information needs related to project objectives to guide the information collection efforts.

- Information Collection: Task leaders in each of three components will collect information as described below. The methodology will vary based on the type of information. The primary time period for collection will be January to the end of May. Two mid-term workshops (three days, two nights) will be held during this period (tentatively March and May). Workshop participants will include \52B project TEK expert, the Fellow, the task leaders, and at least one additional participant from each of three tasks (one from each of the three participating villages). The principal investigator and the \52B TEK expert will jointly faciliate these meetings. One meeting will be held in Seldovia and the other in Port Graham or Nanwalek. The purpose of these meetings is to stimulate discussion, share information, and promote trust and understanding among each of the three groups. Generally accepted information will be provided to

- Compilation of Information: The task leaders will compile both narrative and spatial data collected in FY98 by September 30, 1998. Information will be exchanged as agreed among the task leaders and community facilitators.

FY99:

- FY99 efforts will focus on the synthesis and integration of available special and narrative data. With respect to TEK, this project will follow the protocols adopted by the EVOS Trustees Council. This task should be completed by March 1999.

Methodology for the individual components is provided below.

1. Scientific Information/ADFG-Habitat and Restoration Division: Scientific knowledge will be gleaned from EVOS reports and other scientific studies on the species and services in Kachemak Bay. Species accounts for key species in Kachemak Bay will be collected or developed, including both generic life history information and specific information, where available, on their use of Kachemak Bay. Where available, this information will be based on species accounts developed for the EVOS Trustees Council. Sensitivity of the species to oil spills and other disturbances will be identified. Narrative and data collection will focus on needs and format of presentation based on guidance from need assessment. Spatial data on distribution of key species and harvest areas for the key species will be developed with the cooperation of scientists which reside in or have knowledge of the Kachemak Bay community. Maps previously developed from the Kachemak Bay/Fox River Flats CHA plan or other sources will be verified and updated as appropriate. If applicable, changes in species distribution, abundance, and use of the area will be identified. This information will be used, in part, to make comparisons over time and identify restoration opportunities for injured species and resources. The lead biologist will also assist in identifying future monitoring activities. This effort, including participation in the need identification and meetings, is expected to require four months time of a habitat biologist.

2. Local Knowledge/Pratt Museum: Local knowledge will be collected from residents of Homer and adjacent communities, Seldovia, and other knowledgeable residents in the Kachemak Bay area. The focus and questions of information collected will be decided during the first quarter in cooperation with other project leaders. This will include, but not be limited to, information on species distribution and historical and present human use of these resources. Information will be collected through formal interviews of long-time residents and other knowledgeable residents of the community. At least 25 individuals will be formally interviewed. Interviews will be conducted by trained interviewers and transcribed. Each interview is expected to take three hours. Information will be recorded and transcripts prepared and made available to other task leaders and the general public. After all the interviews are completed, the project leader will be asked to summarize and synthesize the results based on the information priorities established by the group. The task leader and one interviewee will also participate in each of the workshops during the first three quarters.

   Due to its extensive experience in this area, established protocols, contacts, qualified staff, and commitment to make the information public, we expect to contract with the Pratt Museum to complete this task. However, solicitation would be necessary pursuant to Alaska's procurement code, AS 36.30, to ensure that the appropriate state procurement requirements are met.

3. TEK: TEK about the Kachemak Bay ecosystem will require a number of related tasks, employing various methods. First, working with Project \052B, we will review existing sources of TEK, such as the Whiskers database. This will allow us to avoid duplicating previous work, and will also allow us to develop familiarity with the type and extent of information available to this component. The method for this task will be an extended literature and database search.

Second, working with the communities of Seldovia, Nanwalek, and Port Graham, we will determine the scope and terms of their involvement and the TEK that will be included in the ecosystem characterization. We intend to incorporate facets of Kachemak Bay that area residents feel are significant, including historical and cultural aspects of the area as well as ecological understanding. In this way, we hope to come closer to including the Native perspective on the significance of Kachemak Bay, rather than merely including those items that fall within the scope of scientific interest. This task is a cooperative negotiation.

Third, working with community members and participants in the scientific and local knowledge components of the project, we will hold a series of synthesis workshops to discuss our findings and their significance. These workshops will be small, held in a setting conducive to good and open discussions, and run by a facilitator. Each workshop will produce a small summary, with recommendations for subsequent work in each project component.

Fourth, again working with the area's communities, we will record those aspects of their understanding of the ecosystem that community residents are willing to share and to have recorded for inclusion in the ecosystem characterization. The scope of this effort will have been negotiated in the second task above. This task may include a variety of methods, depending on what type of information is being recorded and depending on the outcome of the scoping negotiations. Possible methods include questionnaires, semi-directive interviews, mapping sessions, group discussions, audio-taped or video-taped interviews, and participant observation. This task will produce narrative and spatial information to be reviewed in each community and included as appropriate in the combined ecosystem characterization.

This effort will be closely coordinated with the local knowledge project to avoid duplication and coordinate techniques. Like, the local knowledge, at least 25 interviews will be conducted.

Non-EVOS Funded Related Tasks

As part of the NOAA funded Coastal Management Fellowship, we will coordinate the preparation of a an ecological characterization of the Kachemak Bay watershed. As a starting point, this will be based on a prototype prepared by the South Carolina Department of Natural Resources in cooperation with the NOAA/Coastal Services Center entitled *Ecological Characterization of Otter Island, South Carolina* (South Carolina Department of Natural Resources 1996). To provide an overview of what the project might look like we included the introduction and outline for this product in Appendix 3. Please note that this is a prototype, and that participating parties have learned a great deal from this prototype and several changes/improvements are being made to this effort to provide guidance and background for future efforts. The results of this effort will provide some clear guidelines on the process for creating this type of ecological characterization. It should also be noted that, while the technology and basic approach will be the same, we will customize this approach to meet the needs of the users, EVOS restoration needs, and other project needs as established in the first quarter.

This project will result in the establishment of several partnerships with local, state, and federal agencies, non-profit organizations, educational institutions, and local communities. Cooperation with local entities will maximize the success and accomplishments of this product to benefit all contributors. One such benefit is the development of a coordinated, comprehensive GIS for Kachemak Bay. This effort, funded by non-EVOS funds, will be used both in ecological characterization and provide an important management and educational tool for agencies, non-profits, the University of Alaska/Kachemak Bay Campus, and native tribal or profit entities. ADFG has undertaken a fairly extensive review of existing GIS data available for the Kachemak Bay area. While a significant amount of valuable digitized data is available for this project, much of the data is too general for use in site specific management decisions. Other data, such as the site specific spatial data included in the Kachemak Bay/Fox River Flats CHA plans, has not been and should be digitized (note: some of this data will be modified in the EVOS project). ADFG and NOAA are committed to seeking other funds for GIS and other aspects of the ecological characterization which are not addressed in this proposal.

Long Term Ecological Monitoring Component

Development of Monitoring Plan - FY98

The second component of this project involves the development and initial implementation of an environmental monitoring program. The first year, FY98, will focus on the design of a monitoring program to benefit injured species and services and other monitoring efforts. In the second year, FY99, the department will start to implement the monitoring program. The effort to develop a monitoring plan will be undertaken by ADFG, NOAA, and ADEC. Due to the high level of public interest, this project will require coordination with several groups either undertaking monitoring efforts and/or interested in an environmental monitoring program. Initial environmental monitoring needs for Kachemak Bay will be identified this summer during the development of a management plan for the Kachemak Bay NERR (this effort is currently funded through federal EVOS criminal settlement funds). The first step in the process to develop a monitoring plan will be to develop a detailed work plan with project participants. The general process for developing the comprehensive monitoring program is envisioned to proceed as follows:

1. Establish Advisory Group or Panel: One of the first steps in the process will be to establish an advisory group or panel. The group should include: (1) technical experts in water quality and environmental monitoring; (2) community representatives; (3) industry representatives; and (4) a representative from the Trustees Council staff to help ensure benefit restoration and coordinated with other the EVOS restoration effort.

2. Review Available Literature and Identify Existing and Proposed Restoration Monitoring Efforts: The effort should include a review of the literature on environmental monitoring techniques. Historical, present, and proposed monitoring efforts in Kachemak Bay should be identified. This is necessary to avoid duplication and to provide for coordination and efficiency.

3. Injured Species and Services: Identify injured species and services that could most benefit from an environmental monitoring program. Identify other restoration studies which could benefit from a monitoring program. This project should coordinate with project(s) approved under the ecosystem modeling project \300 to identify inputs and data that might be required for that model.

4. Develop the Monitoring Plan: An environmental monitoring plan should be developed to benefit and monitor the recovery of injured species and services. This should include recommendations for implementing the plan, including a budget. The plan will acknowledge and show the relationship of other monitoring efforts (US Geological Survey's Watershed Monitoring Program and Cook Inlet Keeper's Citizens Monitoring Program). The development of the plan will require several meetings with the advisory group. A draft and final monitoring plan will be developed. This should be coordinated with the NERR System-wide monitoring program, and utilize established protocols (and example of who this might be accomplished is included in Attachment 3.

C. Cooperating Agencies, Contracts, and other Agency Assistance

Trustee Agencies:

ADFG is identified as the principal Trustee Agency. Two other Trustee Agencies, ADEC and NOAA, have requested funding for this project. General responsibilities include:

- ADFG: lead Trustee Agency, provide project oversight and management, overall responsibility for ecological characterization component, share the responsibility to develop a monitoring plan
- NOAA: request funds to assist in the development of the monitoring plan, bring NOAA expertise in the effort, and help integrate the monitoring effort with the system-wide monitoring program
- ADEC: request funds to work with ADFG in effort to develop a monitoring plan; ADEC will be a major player in the effort, providing technical assistance, support in the development of a monitoring plan, coordination of ADEC's participation

Contractors:

ADFG will issue contracts to following parties:

- Pratt Museum: Complete the "local knowledge" task under the ecological characterization component
- Village Participants in TEK: (complete when we receive information from Rita Miragli/Subsistence Division)

SCHEDULE

A. Measurable Project Tasks for FY98

Ecological Characterization Component

Oct.	Task leaders meet individually with task participants to identify needs
Nov.	Task leaders meet collectively
early Dec.	1st workshop in Homer with task leaders, task participants, and users to determine need
Jan.-Mar.	Task participants undertake research, interviews, collect information
late Mar.	2nd workshop, held in Seldovia
Apr.-May	Continue research, interviews, collect information
late May	3rd workshop, held in Port Graham or Nanwalek
Jun.-Sept.	Complete narratives and maps for each task, including initial identification of information gaps, restoration opportunities

Long Term Monitoring Component

Oct.	Establish advisory group or panel
early Nov.	First advisory group/panel meeting, review and final work plan
Nov.-Dec.	Review literature and complete inventory of past, present, and proposed monitoring efforts
Dec.	Identify injured species or services that will likely be included in the environmental monitoring program
Jan.-Mar.	Develop monitoring objectives and testable hypothesis, draft monitoring plan to address hypothesis (including one or two advisory group meetings)
Apr.-May	agency/advisory group review of work plan
Jun.-Jul..	Develop final monitoring plan

B. Project Milestones and Endpoints

Ecological Characterization Component

Dec. 97	List of information needs for injured species and services, list of research and survey questions, information needs of managers and other users
Mar. 98	Status report on project including results of 2nd workshop
May	Status report including results of 3rd workshop
Sept.	Complete draft narratives and maps, and identification of information gaps and restoration opportunities
Oct-Nov.	Two to three workshops to integrate narrative and spatial data, and decide what will be included in ecological characterization

Jan.-Mar. 99 Complete narratives and maps

Long-term Environmental Monitoring Component

Dec. 97	Complete literature search and description of past, current. and proposed monitoring efforts, and identification of injured species and services which the program will monitor
Mar. 98	Complete draft monitoring plan
July 98	Complete final monitoring plan
Sept 99	Complete initial implementation of monitoring plan

C. Completion Date

Ecological Characterization Component

The ecological characterization CD will be completed by Fellow by September 1999.

Long-Term Monitoring Program

The long-term monitoring plan is expected to be completed by July 1998. It is our intent to develop a program for long-term environmental monitoring, so there is no finite completion date.

PUBLICATIONS AND REPORTS

The ecological characterization will be published on a CD. The monitoring plan will be completed and published in the form of a final report. It is likely that both of these products could lead to additional publications and reports, although there is no specific plans at this time to produce these. This will be addressed further in subsequent years.

PROFESSIONAL CONFERENCES

Pending funding for travel and per diem, the principal investigator and task leaders will attend and participate in the conferences. NOAA provides funding for the Fellow to participate in at least one conference per year.

NORMAL AGENCY MANAGEMENT

This proposal supports activities related directly to restoration needs. The proposers are seeking to establish a role for the proposed Kachemak Bay NERR to provide long-term assistance to the overall restoration effort. The projects identified in this proposal are partially funded through other sources. Funding from the Trustee Council ensures restoration related needs are included in project design, local and traditional ecological knowledge are incorporated into all projects, and the information is made available to the overall restoration effort. These activities would not have been conducted if the spill had not occurred, and are not part of normal agency activities.

The overall effort to designate a reserve in Alaska is not mandated by federal nor state legislation. Participation in the National Estuarine Research Reserve System is a voluntary partnership between coastal states and the federal government. The desire by the state government to establish a reserve in Southcentral Alaska is directly related to restoration efforts. The federal government provided funding for this effort from the criminal restitution funds resultant from spill settlements.

COORDINATION AND INTEGRATION WITH THE RESTORATION EFFORT

The information below highlights overall work plan funding arrangements described in the introduction. Projects are listed as (A) currently funded; and (B) likely to be funded. Specific activities under both that have been identified for support under this proposal are listed as "Request EVOS Trustee Council Support."

A. Currently Funded

<u>NOAA Coastal Services Center (CSC) Coastal Management Fellowship</u>

The CSC is providing funds to ADFG 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 coordinating the effort and the design and production of the CD(s). The overall objectives of the Fellowship project (supplemented with other funds) will be to:

1. Prioritize information management needs related to coastal management, education, EVOS restoration, and the proposed Kachemak Bay NERR.
2. Design a digital ecological characterization methodology for Kachemak Bay.
3. Establish partnerships to assist in completing the ecological characterization.
4. Provide GIS technical assistance to project partners.
5. Design and implement the digital ecological characterization of Kachemak Bay.
6. Develop a plan to maintain and update the ecological characterization.
7. Evaluate the project and prepare recommendations for future updates, other coastal districts, and other states.

NOAA Contribution	$64,000
Requested EVOS Trustees Contribution	$12,000
Total Funding	$76,000

<u>NOAA Sanctuaries and Reserves Division (SRD) Pre-Designation Funding</u>

The SRD has provided funds to ADFG to develop an EIS and reserve operation plan. By September 1997, ADFG is expected to have completed the a draft of the Kachemak Bay NERR operation plan. This plan will be developed under a public process, and help provide guidance to the restoration effort. This project will be coordinated with the EVOS effort. These funds were provided pursuant to agreement of the federal trustees overseeing the EVOS federal restitution funds. Funds support ADFG staff and travel, DNR staff, and Division of Governmental Coordination (DGC) and other overhead as follows:

NOAA Contribution	$160.5

Requested EVOS Trustee Contribution	$0.0
Total Funding	$160.5

NOAA SRD In-Kind Services

The SRD is providing in-kind services to ADFG to support development of the EIS and reserve operation plan. These funds were provided pursuant to agreement of the federal trustees overseeing the EVOS federal restitution funds. Funds support an advisory and assistance services contract to SRD, travel, and printing of the draft EIS and operation plan. The SRD provides advice and guidance to ADFG in developing these documents and in overall efforts to designate the proposed Kachemak Bay NERR. The SRD also worked with ADFG to develop the tentative work plan identified above, develop funding requests, and coordinate planning efforts to develop a long-term monitoring plan for Kachemak Bay.

Non-Trustee Council	$50.0
Requested EVOS Trustee Contribution	$0.0
Total Funding	$50.0

B. Likely to be Funded

NOAA SRD Supplemental Predesignation Funding

SRD is requesting additional funding to support completion of the final reserve operation plan. Funds under this award will support ADFG staff, travel, DGC staff, and other overhead costs.

Non-Trustee Council	$75.0
Requested EVOS Trustee Contribution	$0.0
Total Funding	$75.0

NOAA Support for the Development of a Long-Term Monitoring Program for Kachemak Bay

SRD is requesting additional funding to support the development of a comprehensive long-term plan for ecological monitoring of abiotic and biological parameters in Kachemak Bay. The monitoring plan will be tied directly to information needs related to injured resources in the bay. Funds will support NOAA's Coastal Monitoring and Bioeffects Assessment Division and the Sanctuaries and Reserves Division in working with ADFG, ADEC, and DNR staff to develop a monitoring program that reflects identified restoration needs. This activity would not be conducted by the agency under normal agency operations. The development of this monitoring program is required to establish an appropriate role for the proposed Kachemak Bay NERR in long-term EVOS restoration efforts.

Non-Trustee Council (not including in-kind support noted above)	$5.0
Requested EVOS Trustee Contribution	$10.0
Total Funding	$15.0

Other Funding

ADFG will solicit additional funding to assist in development of the GIS and other aspects of the ecological characterization. There is a potential to create additional partnerships with NOAA and solicit funding from other sources to assist in this effort which are not addressed by the proposed EVOS project.

PROPOSED PRINCIPAL INVESTIGATOR

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Qualifications:

Glenn has functioned as ADFG's Alaska Coastal Management Program (ACMP) coordinator for 17 years. In that capacity, he was responsible for overseeing the development and implementation of the ACMP. He has gained a extensive understanding of the Alaska Coastal Management Program and has 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 most notable Section 309 projects were: the *Kenai River Cumulative Impact Study*, which undertook an extensive assessment of cumulative impacts and developed a comprehensive GIS for the Kenai River (Liepitz 1994, Seaman 1995) ; and (2) the *Aquatic Habitat Restoration and Enhancement Study (*see Betsy Parry below). Glenn is also the ADFG's NERR System coordinator. Glenn has overall responsibility for the state's effort to establish a NERR in Alaska. He is also the mentor for the NOAA/CSC Fellow. He has proven his coordination abilities and the ability to produce high quality products on time.

OTHER KEY PERSONNEL

ADFG

- Fellow/Coastal Management Fellowship: The Fellow will be selected in late May following a Fellowship matching workshop at the CSC in Charleston, South Carolina. ADFG will chose among 14 finalist selected by CSC for seven projects. Finalist are selected by the CSC based on a extensive national advertising process, through the Internet, and through the NOAA Sea

Grant offices. The center's process ensures that finalist include several highly qualified finalists that have the qualifications to complete the project.

- Betsy Parry/Habitat and Restoration Division: Betsy Parry was the lead biologist on several projects for ADFG on the Section 309 *Aquatic Habitat Restoration Project* and the production of two technical reports (Parry, Rozen, and Seaman 1993; Parry and Seaman 1997). This project represented a statewide survey of aquatic habitat restoration projects, and prepared case study reports, policy guidance, and overall recommendations for improving aquatic habitat restoration projects in Alaska. More recently, she has been responsible for the development of wetland regulations in Alaska.

- Ron Stanek/Division of Subsistence: Ron Stanek has been a Subsistence Resource Specialist with the Division of Subsistence since 1980, with extensive fieldwork experience in lower Cook Inlet, including the communities of Port Graham, Nanwalek and Seldovia.8

ADEC

- Jeff Hock/Environmental Specialist: Jeff has worked on environmental monitoring programs for ADEC for over 15 years, where he currently supervises the Waterbody Recovery, Assessment, and Protection Unit within the ADEC's Water Quality Section. From 1987 to 1995, he functioned as the supervisor and team leader of the Monitoring Unit, with 4 staff Ecologists and a technician, based in Juneau. His staff grew to 5 Environmental Specialists after response to the Exxon Valdez Oil Spill in 1989. He continued providing sampling and quality assurance support to regions with increased emphasis upon specialized Federal grant projects. Jeff explored and implemented promising technologies with direct application to the identification or resolution of environmental problems, including: EPA developed outfall modeling software, groundwater well-purging technologies, rapid bio-assessment protocols, vessel tracking satellite telemetry, global positioning technology, geographic information systems, automated water quality data acquisition, and telemetry systems. From 1995 to present, Jeff served as the team leader to 7 staff in the Waterbody Recovery, Assessment, and Protection Unit within the Water Quality Protection Section of ADEC's Watershed Management Program in Juneau. He also 1) supervised Watershed staff in Juneau, Anchorage, and Fairbanks; 2) developed and maintained the state's biannual reporting of impaired water bodies; 3) developed and implemented ADEC's watershed framework by working with local stakeholders; 4) reviewed water quality standards and developed issue papers; developed resource targeting priorities; and 5) participated on various statewide water quality planning committees.

NOAA

- Dr. Andrew Robertson Senior Executive Service - ES04 (1301) Chief, Coastal Monitoring and Bioeffects Assessment Division, ORCA/NOS Dr. Andrew Robertson is Chief of the Coastal Monitoring and Bioeffects Assessment Division (CMBAD), Office of Ocean Resources Conservation and Assessment, National Ocean Service, NOAA in Silver Spring, Maryland. He manages the National Status and Trends Program which is only nation-wide program of marine pollution monitoring and assessment for U.S. coastal waters, including the Great Lakes. The program determines the levels and biological effects of contaminants and develops assessment reports. It is closely coordinated with other federal agencies. such as U.S. Environmental Protection Agency, and coastal states.

Dr. Robertson has served as a scientific expert at national and international workshops on topics related to marine environmental quality (coastal pollution, ocean dumping, and non-point sources of pollution), ecosystem health, and petroleum pollution in the Arctic. In addition, he is a member of several working groups and committees to develop a more effective and integrated environmental monitoring program in the United States.

Dr. M. Jawed Hameedi GS 15-07 (1301)
Chief, Bioeffects Assessment Branch, CMBAD/ORCA, NOS Dr. Jawed Hameedi is Chief of the Bioeffects Assessment Branch of CMBAD, Office of Coastal Resources Conservation and Assessment, National Ocean Service, NOAA in Silver Spring Maryland. He manages a program of environmental monitoring and assessment focused on sediment toxicity assessment, application of biomarkers, development of sediment quality guidelines, and evaluation of in situ changes in the benthic biological communities. Since 1989, he has also participated in the development of the scientific content of the international Arctic Monitoring and Assessment Program (AMAP) and is currently a co-author of an Arctic-wide assessment of petroleum pollution. Prior to assuming his current position, he served as deputy director and director of the Outer Continental Shelf Environmental Assessment Program during the period 1981-92. This multi-year (1974-92) and inter-disciplinary program was the largest marine environmental research program in Alaska. The program produced over 4,000 reports, including inter-disciplinary synthesis reports, covering all aspects of coastal and marine sciences. In particular, the program focused on the movement and fate of spilled oil, determination of the biological effects of petroleum pollution, ecological characterization of coastal areas and seas of Alaska, development of monitoring strategies, and analysis of environmental consequences of petroleum development. During his tenure in Alaska, he also served as agency representative to the Regional Response Team, and managed the operations of NOAA's Kasitsna Bay Laboratory.

PRATT MUSEUM

- Betsy Webb/Curator of Collectons: She has 26 years professional experience as curator with several museum organizations. She is an experienced exhibit interpretive specialist and has written over 100 exhibit scripts in here career. She has been actively involved in the statewide Communities of Memory Project, collecting local oral histories of fishermen, homesteaders, artists, ranchers, and other local groups. She has held several appointed committee positions for the Society for the Preservation of Natural History Collections, and has presented papers annually at the Museums Alaska Conference.

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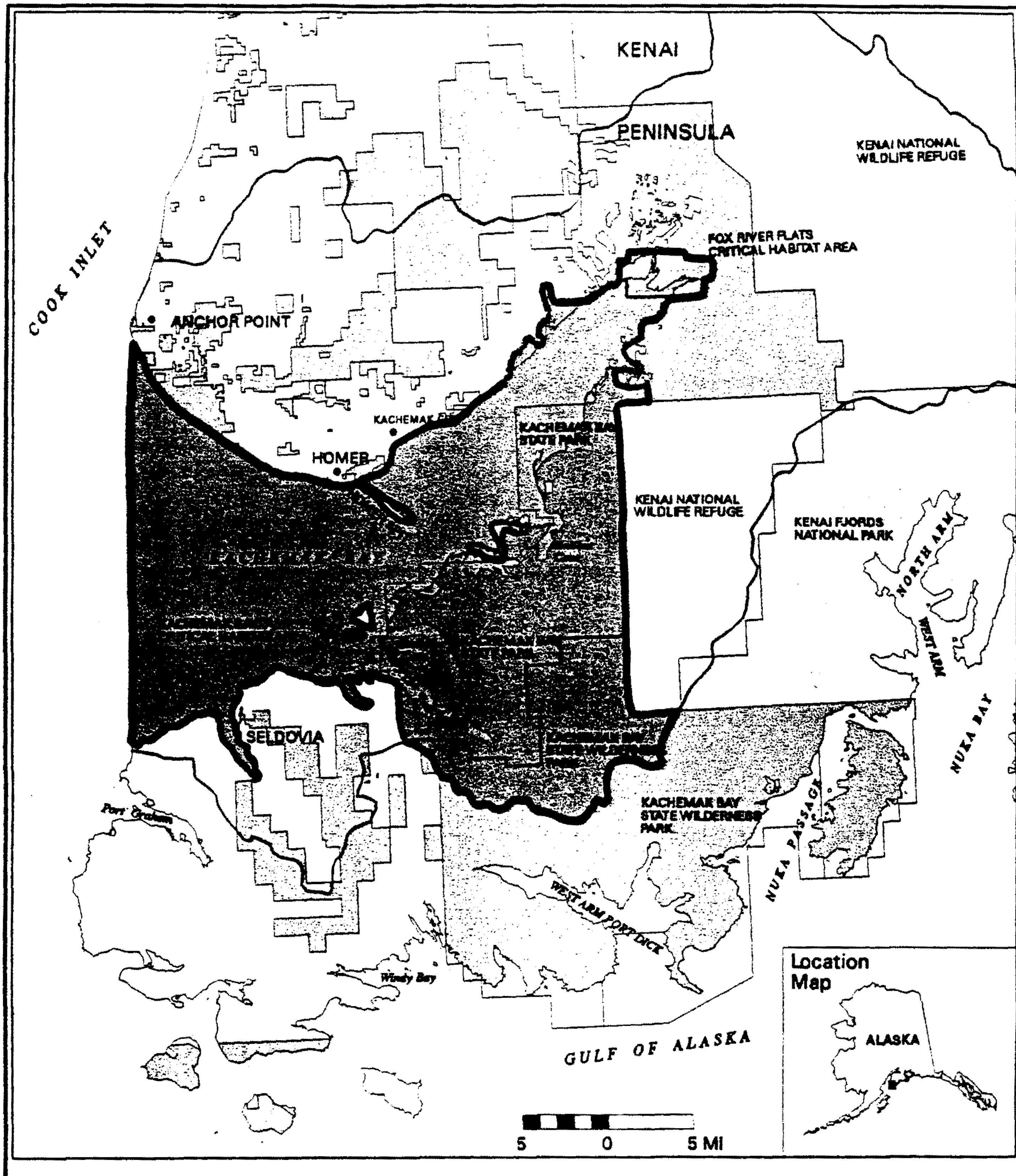


Figure 2.

Boundaries For Proposed Kachemak Bay NERR

Proposed NERR Boundary (State Lands & Waters)

- NERRS Core Area
- NERRS Buffer Area
- Approximate Kachemak Bay Watershed

Adjacent Land Status

- Federal
- State
- Private/Other

Otter Island Project

OTTER ISLAND ECOLOGICAL CHARACTERIZATION PROJECT - INTRODUCTION

Purpose

This ecological characterization for Otter Island, South Carolina is a prototype digital publication. *Its principal purpose is to demonstrate the means and utility of publishing information synthesis "documents" in digital form, and to provide a basis for evaluation of this approach.* The intended benefits of this effort are to: stimulate improvement, simplify updating, broaden distribution, and foster wider use of data and information appropriate to better understand and manage coastal ecosystems. A useful result of this project is that it provides characterization information applicable to management of Otter Island.

This CD-ROM prototype was created and published by the NOAA Coastal Services Center (CSC), and its Analysis and Characterization cooperators at the South Carolina Department of Natural Resources, and the NOAA National Geophysical Data Center. This *evaluation copy* of the Otter Island ecological characterization is being distributed to coastal resource mangers and other interested persons for their review and comment. If reviewers find such characterizations to be useful management "tools" and the implementation demonstrated here is judged a successful beginning, then this capability will be incorporated into future services provided by the NOAA Coastal Services Center.

Return

Background

Ecological characterizations of coastal systems have been conducted, as intensive descriptions of ecosystems, since the 1970's and their results have been published for limited distribution in paper form only. They have most often been undertaken to assemble before-the-fact information about ecosystems prior to mining, drilling, or other resource extraction activities and to plan mitigation strategies for associated shore zone impacts. Typically these studies were structured to include thorough descriptions

of physical and biological systems and to include some information about the economic implications of such development in coastal areas.

This prototype for Otter Island advances that earlier conception of ecological characterization, broadening it to include digital publication of text, images, bibliographic information, tabular and geographic data, management protocols and scenarios, and other relevant information. Furthermore, by inter-linking the information contained, and by making it accessible with new computer capabilities, this prototype begins to demonstrate a truly *integrated* and *interactive* data and information capability. The immediate objective in demonstrating these capabilities, is to *improve retrieval and application of information useful for management, scientific, and educational uses.*

This characterization for Otter Island was influenced by two workshops, convened by the NOAA Coastal Services Center (CSC) to obtain guidance concerning methods, techniques, and benefits of conducting ecological characterizations. The first meeting convened a group of experts to evaluate ecological characterization as a means of knowledge-gathering and problem-solving--in modern terms and from a scientific perspective. The second workshop brought together experienced managers and decision makers from many US coastal regions to examine practical and institutional aspects of establishing ecological characterization capabilities at the NOAA Coastal Services Center, initially through this prototype effort.

This and other Analysis and Characterization program activities support the Center's data and information philosophy which seeks to provide:

1. ready access to information resources through its data clearinghouse and library functions,

2. improved coverage of basic coastal data of long-term interest and broad application through its data integration and development functions, and

3. an ecosystems perspective provided by suitably integrated case-studies and published as ecological characterizations, such as this example for Otter Island.

Return

Needs

For ecological characterizations to be most useful to coastal managers, and for them to become sufficiently holistic and adaptive, they must better examine human dimensions with other interacting components of ecosystems. Such comprehensive efforts and the resulting information syntheses might better be re-labeled *socio-ecological characterizations*; to reflect the combined influences of human use and management activity with (often) more narrowly-defined ecological dynamics and physical processes.

The long range goal of *ecosystem-based management* is to improve resource sustainability by basing decisions and practices upon sound ecological and socio-economic knowledge, and to do so in ways that explicitly consider present and future generations. This means balancing natural factors and human values in a stable manner -- a challenging task which is largely beyond the scope of this initial prototype (see Ecological Characterization).

Ecological characterization must then become both a process through which all of the above factors can be usefully merged (information synthesis), and a "pathway" by which the resulting knowledge can be better communicated and perhaps, reinterpreted to consider changing needs and opportunities. As a practical consideration, this limited *prototype for Otter Island seeks principally to demonstrate an improved, more contemporary approach to ecological characterization as an information delivery mechanism.*

Return

Site selection -- why Otter Island?

The decision to focus this prototype effort on Otter Island was a practical one which recognized that the first need was for a trial or "proof-of-concept" exercise for digital publication of characterization information. It also recognized that *any site presents limitations* and that such capabilities should continue to be refined and expanded through work at other scales, in other ecosystems, and in response to evolving management needs.

The targeted ecological system, Otter Island, is a 2088-acre (845 ha) barrier and marsh island facing St. Helena Sound on the lower South Carolina coast. This island is located in the combined Ashepoo, Combahee, Edisto drainage basin (ACE Basin), and was purchased by the state of South Carolina for inclusion in the ACE Basin National Estuarine Research Reserve. The goals of the National Estuarine Research Reserve System (NERRS) and the state Heritage Trust program influence the management of Otter Island which will benefit from the information contained in this product.

Since an expected benefit of ecological characterization is a greater ability to make comparisons between sites with similar characteristics and management problems, there is good potential for benefit from selecting a site which is part of a larger network of sites. The NERR system, of which Otter Island (and the ACE Basin) is a part, provides such a network of sites with similar management objectives and immediate need for comprehensive ecological/management assessments.

The decision to select Otter Island as the focus of this prototype effort was further influenced by its position -- at the outlet of the ACE Basin and bridging two systems previously treated in important prior ecological characterization efforts -- the Edisto River Basin Ecological Characterization (Marshall, 1993) and the Sea Islands

Ecological Characterization (Mathews et al. 1980, McKenzie and Barclay 1980, Miglarese et al. 1980, Sandifer et al. 1980). Information and knowledge acquired in these two studies provide the foundation for this ecological characterization of Otter Island.

Finally, though no less important, Otter Island presents the advantage of a relatively simple case study because it is an uninhabited island now owned wholly by the State of South Carolina. Thus, effort for this prototype could be allocated better to the task of demonstrating digital publication of synthesis information for an ecosystem with relatively well-understood management concerns.

Disadvantages of a site such as Otter Island were also considered. Its small size, seemingly very manageable problems, good ecological "health", and its minimal human use complications (it has no resident human population) all posed recognized limitations on the breadth and depth of a trial effort. But the advantages offered by: supportive local needs and interests; known and tractable management issues and objectives; readily available, existing ecological data and information (from many sources including previous characterizations); potential generalizability of experience to similar management units; and the limited investment of demonstration resources required by virtue of the island's finite size and problems; all were thought to greatly outweigh its disadvantages.

Return

Organization

The information, data, and tools in this ecological characterization are organized in four parts, the Otter Island Project, Ecosystem Description, Resource Management, and Data and Information. Each of these can be accessed while viewing any of the others.

The Otter Island Project portion provides an orientation to this CD-ROM and to ecological characterization generally. It contains: a description of project activities that culminated in this prototype, plus a discussion of ecological characterization ideas; an overview of Otter Island itself; brief descriptions of the methods used to synthesize the information it contains, and the technologies that make it work; and the evaluation form.

The Ecosystem Description portion contains narrative text with icons and word links which can be "clicked on" to see: photographs, figures and tables, drawings, maps, and other supporting data and information. Together, these interactive information resources describe and explain the physical processes that shape Otter Island and its surroundings, the characteristics of its ecosystems, and some of the human dimensions that influence and are influenced by these systems.

The Resource Management portion, also in narrative text with "clickable" links,

contains the Otter Island Management Plan, other policy documents that influence the fate and condition of the island, a discussion of management issues and challenges that confront it, and a brief introduction to interactive management scenarios (see scenarios in data and information below).

The Data and Information portion contains: both interactive and non-interactive "atlases" with maps showing features and processes on and around the island; a photo gallery of associated species with descriptions of each; searchable bibliographies that facilitate access to relevant books, articles, and other publications; metadata and other documentation describing the source and derivation of resources contained here; and interactive management scenarios. These management scenarios guide the user through examples of decision processes simulated using the data and information resources contained on this CD. All data and information sources are accessible both directly, through the Data and Information menu, or indirectly, via "clickable" links embedded at appropriate points in the narrative portions of the characterization.

Return

Send Your Comments and Evaluations!

Keeping in mind the objectives of this prototype CD-ROM, please take time to view the product evaluation section before you begin to examine the rest of the Otter Island ecological characterization. Your comments are important to the Coastal Services Center's efforts to improve delivery of information for coastal management.

Otter Island EC - Introduction (top of page)
NEXT SECTION: APPROACH TO ECOLOGICAL CHARACTERIZATION
RETURN TO OTTER ISLAND PROJECT
RETURN TO MAIN MENU

Main Menu

ECOSYSTEM DESCRIPTION

(top of page)

RETURN TO MAIN MENU

Ecosystem Description

PHYSICAL PROCESSES

LOCATION

GEOLOGIC HISTORY

- Regional Geologic Structure
- Stratigraphy
- Holocene Sea Level Changes

PHYSIOGRAPHY

- South Carolina Coastal Region
- Lower ACE Basin
- Otter Island
- Neighboring Islands

SOILS

- Structure and Formation of Soils
- Soil Classification
- Nutrient Dynamics
- South Carolina Coastal Region
- Otter Island

CLIMATE

WATER QUALITY

- Estuarine Water Quality
- Edisto Watershed
- ACE Basin
- ACE Basin NERR

REFERENCES

Physical Processes (top of page)

RETURN TO ECOSYSTEM DESCRIPTION

RETURN TO MAIN MENU

Ecosystem Description

ECOLOGICAL SYSTEMS

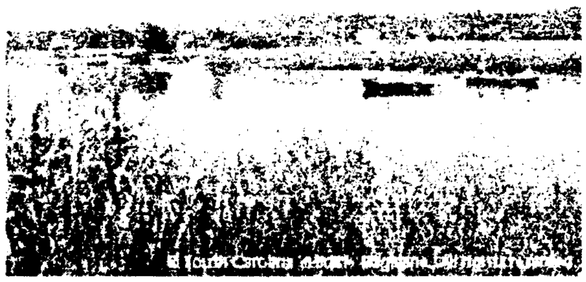
Ecological Systems (top of page)

RETURN TO ECOSYSTEM DESCRIPTION

RETURN TO MAIN MENU

Ecosystem Description

HUMAN DIMENSIONS



Human Dimensions (top of page)

RETURN TO ECOSYSTEM DESCRIPTION

RETURN TO MAIN MENU

ATTACHMENT 3

Possible Monitoring Program Utilizing the
NERR System Protocols

A minimum of three YSI Model 6000 data loggers could be deployed. One data logger would be designated as a long-term control in a "pristine" location within Kachemak Bay. Additional data loggers would be deployed at various sites to test specific questions on injured species. At every site, water temperature, conductivity (salinity), pressure (depth), pH, dissolved oxygen, and turbidity data will be collected continuously at 30 minute intervals. If deemed necessary, nutrients (nitrogen, phosphorous) and other ancillary data will also be collected. Weather data (wind speed and direction, air temperature, relative humidity, rainfall, barometric pressure, photosynthetically active radiation) would be collected for Kachemak Bay allowing local weather events to be related to runoff observations. The procedure to be used for data collection has been separated into four phases: pre-deployment, deployment, retrieval, and post-deployment.

Pre-deployment-- Prior to deployment, calibration and maintenance steps must be performed on the instruments. Equipment required includes: a calibration kit, a communication cable, and a personal computer with PC6000 software installed. A standardized calibration log including the date, initials of the technician, date of dissolved oxygen (DO) membrane replacement, battery charge, cell constant, ISE (mV), DO charge, turbidity status, and pressure offset will be kept as part of a field log. The instrument would be visually inspected for any abnormalities such as a cracked pH probe. O-rings would be cleaned and greased, and sensors be tightened as needed. The DO membranes would be replaced and allowed to sit at least 24 hours prior to deployment. When the oxygen probe has settled for 24 hours, calibrations be performed following the manufacturer's instructions for 100% air saturation calibrations. The depth sensor would be calibrated to sea level. Calibration of pH will be performed using buffer solutions of pH 7 and 10 (used in salt/brackish waters) purchased pre-made from a scientific supply house. Specific conductivity (mS/cm) with pre-made standards can be used in the salinity calibration. Turbidity calibration solutions could be purchased at 200 NTU concentrations and diluted to the desired level using distilled water. During calibration, the following settings would be checked in the Diagnostics section of the instrument's software:

conductivity cell constants = 4.9-5.1
turbidity = 46-47
DO charge = 25-75, ideally 40-60
ISE1 (pH) = 180 to -180 depending on pH standard used
Aux adc (turbidity) = -100 to +100

Following calibration and maintenance, the instrument would be programmed for unattended sampling. If a telemetry system is to be used, a communication cable from a personal computer could be attached to the data logger which will then be accessible through the YSI PC6000 software.

Deployment- Equipment required for deployment includes: YSI 6000 Data loggers. keys to the lock, and devices to secure the data logger. The data logger is then be secured using a stainless steel cage attached to a steel pipe by means of galvanized chain, which is welded to the pipe and locked to the cage. After a data logger is secured and lowered the instrument number, file name, site, date/time, weather conditions, and any other observations will be recorded in the deployment section of the same field log used during pre-deployment. To roughly check for instrument accuracy, field readings for dissolved oxygen, temperature, salinity, specific conductance, pH, and secchi disk depth will be taken with hand held instruments.

Retrieval- Equipment required for retrieval includes : a transportation cup, key to cage lock, marine lithium grease, scrubber or brass brush, and a hand cloth. The data logger is then retrieved from the water and the probe immediately placed in the water filled transportation cup. The data logger will be cleaned of debris and fouling organisms. The amount and nature of the debris is be noted in the retrieval section of the field log. The data logger would be placed in a secure container to prevent severe vibrations to the unit during transportation. The cage and lock is be cleaned with the scrubber or brass brush and the lock lubricated with lithium grease. The cage and chain will be inspected for decay. The date/time, weather conditions, and any observations are also be recorded in the retrieval section of the field log. To roughly check for calibration drift, field reading are taken with hand held instruments as done on deployment and recorded in the field log.

Post-deployment- A calibration check are performed at the laboratory before major cleaning and breakdown. The calibration check would involve comparing readings of the data logger against calibration standards and recording these in the post-deployment section of the field log.

Once the calibration check is completed the data logger body and probes are completely cleaned of debris. Equipment required for cleaning includes: a cloth scrubber, a small test tube brush, isopropyl alcohol, and a hex screwdriver.

Following cleaning, the data are uploaded to a personal computer. This is done by attaching a communication cable from the data logger to a personal computer and accessing the data logger using PC6000 software. Next, the file will be exported in text format to the Excel directory. Raw data will be processed using a rigorous quality assurance/quality control procedure. The processed data is then be transmitted to a centralized data management office (CDMO) at the Belle W. Baruch Institute of Marine Biology and Coastal Science, South Carolina. The CDMO summarizes the processed data into standard graphical products which will be made available to researchers, coastal zone managers, and the general public via a World Wide Web homepage. A time series statistical analysis procedure similar to that in Lorda and Saila (1986) is used in detecting significant differences between sites and within sites.

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998	PROPOSED FY 1998 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NOAA
			$23.6	$110.2				$11.1
Personnel	$0.0	$92.7						
Travel	$0.0	$18.5						
Contractual	$0.0	$18.5						
Commodities	$0.0	$0.0						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$129.7		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
General Administration	$0.0	$15.2						
Project Total	$0.0	$144.9		TBD	TBD	TBD	TBD	
Full-time Equivalents (FTE)	0.0	1.5						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$0.0	$0.0		$0.0	$0.0	$0.0	$0.0	

Comments:This project is proposed two components: (1) development of ecological characterization and (2) development of a long-term monitoring program. The break down in cost for each is provided below. Long range funding requirements (i.e., FY1999 and beyond) do not include an estimate for the monitoring element, which will be developed in the monitoring plan.

1. Ecological Characterization : Contributing to the overall effort, EVOS funds will be used to collect, update, and synthesize ecological information related to injured species and services. Personal services costs for each of the three tasks are listed below.

a. Scientific knowledge Task -- $9.6K total, includes 3 months of HB II to be task leader
b. Local Knowledge -- 10 K total
c. TEK --

2. Long-Term Environmental Monitoring Plan:
a. ADFG --
b. ADEC --

3. Principal Investigator:
ADF&G --

1998

Prepared: 1 of 13

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: ADFG

FORM 2A
MULTI-TRUSTEE
AGENCY
SUMMARY

4/15/97

1998 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$67.8
Travel		$13.5
Contractual		$17.5
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$98.8
General Administration		$11.4
Project Total	$0.0	$110.2
Full-time Equivalents (FTE)		1.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
	$50.0	TBD	TBD	TBD	

Dollar amounts are shown in thousands of dollars.

Comments:

1998

Prepared: 2 of 13

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: ADFG

FORM 3A
TRUSTEE
AGENCY
SUMMARY

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs: Name	Position Description	GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FY 1998
Glenn Seaman	Habitat Biologist III	18L	1.5	6.4		9.6
Betsy Parry	Habitat Biologist II	16C	6.0	4.7		28.2
(to be determined)	Fellow (post Masters/Ph.D.)		3.8	3.2		12.2
Celia Rozen	Librarian	17F	1.0	5.4		5.4
Ron Stanek	Subsistence Resource Specialist III	18K	2.0	6.2		12.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		14.3	25.9	0.0	
					Personnel Total	$67.8

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1998
7 trips Anch to Homer,for HB III,	0.20	7	14	0.1	2.8
3 trips Anch to Seldovia for HB, SRS III	0.25	3	9	0.1	1.7
3 trips Anch to Port Graham/Nanwalek for HB II, III & SRS III	0.29	3	9	0.1	1.8
				0.1	0.0
Monitoring Plan -- 4 trips to Homer for HB II over the course	0.20	4	4	0.1	1.2
of a year				0.1	0.0
				0.1	0.0
TEK -- 2 trips to Homer task leader mtg. and 1st workshop	0.20	2	5	0.1	0.9
TEK -- 1 trip to Seldovia, Port Graham, and Nanwalek for "permission"	0.29	1	4	0.1	0.7
TEK -- 1 trip to Seldovia interview sessions	0.25	1	5	0.1	0.8
TEK -- 1 trip to each Port Graham and Nan or interview session	0.29	2	10	0.1	1.6
TEK - 1 trip for village reps to participate in workshops	0.08	6	15	0.1	2.0
				Travel Total	$13.5

1998

Prepared:

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: ADFG

FORM 3B
Personnel
& Travel
DETAIL

4/15/97

Contractual Costs:	Proposed
Description	FY 1998
Telephone Calls and Teleconferences	2.0
Photocopying	1.0
Printing Draft Monitoring Plan	1.5
Printing Final Monitoring Plan	2.0
Contract for Completing Local Knowledge Component of Information Collection Effort	10.0
TEK -- interview fee of $40 x 25 persons for village interviews	1.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$17.5

Commodities Costs:	Proposed
Description	FY 1998
Commodities Total	$0.0

1998

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: ADFG

FORM 3B
Contractual &
Commodities
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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 a	**New Equipment Total**		$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Ecological Characterization Component:		
Camera equipment	2	ADFG
Sun Workstation	1	ADFG
Personal Computers	3	ADFG
Color Printers/Plotters	2	ADFG

1998

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: ADFG

FORM 3B
Equipment
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel		$7.4						
Travel		$2.6						
Contractual		$0.0						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$10.0		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
General Administration		$1.1						
Project Total	$0.0	$11.1		$0.0	$0.0	$0.0	$0.0	
Full-time Equivalents (FTE)		0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: See comments on ADF&G budget sheet.

1998

Prepared: 6 of 13

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
Robertson	Senior Executive Service	ES04	0.5	7.4		3.7
						0.0
Hameedi		GS15	0.6	6.1		3.7
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.1	13.5	0.0	
					Personnel Total	$7.4

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Two trips to Homer, Alaska from Washington D.C. for for participation in meetings and workshops	0.9	2	8	0.1	2.6
					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	$2.6

1998

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

Prepared:

4/15/97

Contractual Costs:	Proposed
Description	FY 1998
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed
Description	FY 1998
Commodities Total	$0.0

1998

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: NOAA

FORM 3B
Contractual &
Commodities
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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 a		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1998

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: NOAA

FORM 3B Equipment DETAIL

Prepared:

4/15/97

1998 EXXON VALDEZ TRUS' COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel		$17.5						
Travel		$2.4						
Contractual		$1.0						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$20.9		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
General Administration		$2.7						
Project Total	$0.0	$23.6						
Full-time Equivalents (FTE)		0.2						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: See ADFG budget comments.

1998

Prepared: 10 of 13

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: ADEC

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
Jeffry Hock	Environmental Specialist IV	20K	2.5	7.0		17.5
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.5	7.0	0.0	
					Personnel Total	$17.5

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Monitoring Program, estimated three trips to Homer from Juneau	0.5	3	9	0.1	2.4
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$2.4

1998

Prepared:

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: ADEC

FORM 3B
Personnel
& Travel
DETAIL

4/15/97

Contractual Costs:	Proposed
Description	FY 1998
Telephone Costs	1.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$1.0

Commodities Costs:	Proposed
Description	FY 1998
Commodities Total	$0.0

1998

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: ADEC

FORM 3B
Contractual &
Commodities
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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 a		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1998

Project Number: 98278
Project Title: Development of an Ecological Characterization and Long-Term Monitoring Program for Kachemak Bay
Agency: ADEC

FORM 3B
Equipment
DETAIL

Prepared:

4/15/97

98286

98286

NATIVE VILLAGE OF EYAK

P.O. BOX 1388, CORDOVA, ALASKA 99574
TEL 907-424-7738/FAX 907-424-7739

April 14, 1997

Steven Pennoyer
Chairman
Exxon Valdez Oil Spill Trustee's Council
345 G Street, Suite 401
Anchorage, Alaska 99501-3451

Chairman Pennoyer

This is a letter requesting technical assistance for the following proposals:

1. The *second year of #97286, Youth/Elders Conference on Subsistence.* The first year of this was funded, however more then six months into the fiscal year, we have yet to see any money. It is kind of hard to do anything when it takes this long to receive funding. The injured resource on this is subsistence. The work or activity would be to stage a conference. Our Tribe would do the work. The funds requested for the second year are $108,000. 98286

2. Copper River Inter-Tribal Fisheries Commission Development. The injured resource is subsistence, as in salmon, both subsistence and commercial. The work or activity would be to organize the Tribes on the Copper River, to protect and enhance the salmon runs on the one of the major remaining, sources of subsistence, the Copper River. It would also entail monoriting the tributaries of the upper Copper River, to see that the individual runs are not over fished. The Tribes of the Copper River would do the work. As the salmon are four year fish, this would be a four year project, with $150,000, for the first year and $100,000 for each of the remaining three years. 98331

3. Eyak Subsistence Recovery Camp Project. The injured resource is subsistence. The work or activity would be to set up meeting to come up with a plan for a Subsistence Recovery Camp. The Native Village of Eyak 98332

would do the work. This is a one year project and would run about $50,000.

4. Sea Otter Population Monoriting. The injured resource is subsistence, mainly sea otters. The work would be to monoritor the sea otters in Prince William Sound. The Tribes in PWS would do the work. This is a 5 year project, with the first year costing $269,611, and a total cost of $817,979. 98333

5. Restoration of Prince William Sound Pink Salmon through Test Fishery Project. The injured resource is pink,chum, silver and red salmon. The work or activity would be to test fish, to clear the way for remote releases of hatchery salmon, to move the fishing effort away from oil spill damaged runs. The Native Village of Eyak would do the work, with technical assistance. This would be a three year project, costing $500,000 per year. 98334

6. Artifact Repositories. We intend to submit a proposal for a Artifact Repository. The cost would be between $500,000-1,000,000. I understand this proposal is not due by April 15. Dr. Lora Johnson will be helping us with this proposal. We would like help from EVOS also.

As we are a Tribe and a Non-Profit, we have no money or staff to develop these projects. I as well as the rest of our Council have to make a living and we do these things when we have time. We request assistance to develop these projects.

Sincerely yours

Robert J. Henrichs

Robert J. Henrichs
President, Traditional Council

cc: Molly McCammon
Executive Director
EVOS

98287-BAA

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

RECEIVED
APR 14 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	98287
Restoration Category:	Research
Proposer:	ABR, Inc.
Lead Trustee Agency:	
Cooperating Agencies:	
Duration:	1st year, 3-year project
Cost FY98:	\$133,710
Cost FY99:	\$141,119
Cost FY00:	\$247,072 (including publication of results)
Geographic Area:	Northern Gulf of Alaska (Resurrection Bay to Montague Island)
Injured Resource:	Several species of seabirds; secondarily, marine mammals

ABSTRACT

We propose to conduct a 3-year study of seabirds in the Northern Gulf of Alaska (Resurrection Bay to Montague Island) by using a ship-of-opportunity sampling platform of 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 and geographic variation in the distribution and abundance of seabirds, including species that were injured by the *Exxon Valdez* oil spill. It also will provide valuable information to the restoration program by providing data on the year-round status of seabird populations and the processes that influence their variation.

INTRODUCTION

This study will use an available platform of opportunity 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 that the *Exxon Valdez* Oil Spill Trustee Council concluded were injured by the spill (*Exxon Valdez* Oil Spill Trustee Council 1996); (2) these data can 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; and (3) it will describe the natural variation of the system, particularly with respect to seabirds. Injured resources that would be studied would include Common Loon, cormorants, Common Murre, Marbled Murrelet, and possibly Pigeon Guillemot and Kittlitz's Murrelet. In addition, a large suite of other seabird species also would occur (and, hence, would be sampled) in this area. 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 1996).

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 proposed project (years 1998-2000) that 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 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 geographic and temporal 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 two important reasons for conducting this study. For example, 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 Pprince William Sound (PWS; Piatt et al. 1990, Ford et al. 1996, Piatt and Ford 1996). In addition, breeding seabird colonies are both larger and more numerous in the Northern GOA than in PWS (USFWS Seabird Colony Catalog), as generally are seabird at-sea densities (Day, unpubl. data). In spite of these important facts, however, the amount of money spent on subsequent post-spill research in the GOA was just a fraction of that spent in PWS.

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; 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 (Day, pers. obs.).

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 the 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 is will be used to develop an understanding of the processes that cause variation in the at-sea distribution and abundance of seabirds, 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 of seabirds. It also will describe natural variation in at-sea populations of seabirds, so that realistically measurable recovery criteria can be developed. Finally, it will examine the seasonal and interannual importance to seabirds of oceanographic frontal structures, which not only tend to concentrate seabirds, but also tend to concentrate 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 1996). Injured resources that would be studied include Common Loon, cormorants (any or all of three species), Common Murre, Marbled Murrelet, and possibly Pigeon Guillemot 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 the effects of ecological processes 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 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 1996).

C. Location

The study will be conducted in the open waters of the continental shelf of the northern GOA, from off of Resurrection Bay to off of the western end of Montague Island. 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. 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 assessment of recovery.

B. Methods

This study proposes using a ship of opportunity to investigate the at-sea distribution and abundance of seabirds on the shelf of the Northern GOA during 6 cruises/year for 3 consecutive years. The GLOBEC cruises will be conducted during six periods of biological interest in the region: February/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 November/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 not delineated at this time, but instead will be laid out somewhere between the Seward Line (which lies off the mouth of Resurrection Bay) and the western end of Montague Island. Hence, 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 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 (e.g., shearwaters, storm–petrels), than do other methods (van Franeker 1994). (Tubenosed birds probably will be common in the sampling area at certain times of the year.) 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 length in the field will be 1 km, with 10–15 of these "raw" transect samples taken between each pair of fixed oceanographic stations. 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. 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 two-way ANOVA on ranked (if necessary) data, with habitat (i.e., water mass) and season as the treatments; in subsequent years, we would use a multi-factor ANOVA, with habitat, season, and year as the treatments. If pseudoreplication appears to be a problem with the data sets, we might test for differences with paired-sample tests (e.g., ANOVAs 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 (Hurlbert 1984, 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 guilds. In terms of the latter, we will assign each species to ecological guilds 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 ≤20 km offshore), the mid-shelf region (which is poorly understood at this time), and the oceanic region (from around the shelf break to over the continental slope). It also is possible that the outer edge of the Seward Line will intersect the inner edge of the Alaska Stream; if it does, this may be designated as another habitat. 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 (Napp et al. 1996; Incze and Ainaire 1994, cited in Napp et al. 1996), seabird densities 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 ANOVA on ranked (if necessary) seabird data. As described in the temporal tests (above), habitat would be one of the factors included in the ANOVA. We also will use the guild data in a similar multi-factor ANOVA.

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 each year and, 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).

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.)

SCHEDULE

A. Measurable Project Tasks for FY98 (October 1, 1997-September 30, 1998)

Feb/Mar 1998:	First cruise (emphasis: upward migration of oceanic zooplankton)
Apr 1998:	Second cruise (emphasis: spring phytoplankton bloom)
May 1998:	Third cruise (emphasis: maximal biomass of oceanic copepods)
July 1998:	Fourth cruise (emphasis: juvenile salmon first at sea)
Oct 1998:	Fifth cruise (emphasis: juvenile salmon prepare to leave the shelf)
Nov/Dec 1998:	Sixth cruise (emphasis: minimal biological activity)
Mar-Dec 1998:	Keypunch data and QA/QC (after each cruise)
Dec 1998/Jan 1999:	Data analysis
Jan-Apr 1999:	Preparation of Annual Report
15 April 1999:	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 (FY98–00). Interannual differences will be tested during the final two years 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 (FY98–00).

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 (FY98–00).

4. "To relate the observed natural variability in seabird populations to previous assessments of impact and recovery." Analysis of variability and power calculations will be done each year separately and in the third year of the study with data collected in all three years (i.e., FY98–00).

C. Completion Date

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

PUBLICATIONS AND REPORTS

We will submit Annual Reports during each of the first two years 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 third and 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 four 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 no scientific conferences in FY98. Hence, no travel funds are requested for FY98. We will, however, attend scientific conferences in FY99 and FY00.

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 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).

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

This is the first year of a proposed 3-year project. Hence, there are no proposed changes in this first year. However, tentative budgets for FY99 and FY00 include annual increases of 5%/year, to cover inflationary increases. In addition, the FY00 budget includes additional costs associated with the production of a Final Report and with the production of 4 manuscripts (1.5 months of time/manuscript). Finally, these costs do not include money for management of this project by an outside agency.

PRINCIPAL INVESTIGATOR

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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 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 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 will be assisted in these studies by another qualified ABR biologist who will be named later. His assistant in FY96 research on Kittlitz's Murrelets is Debora Nigro, who has nearly 10 years of experience in seabird research in Alaska. We hope that she also will be able to assist Dr. Day in this research.

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

PROJECT DESCRIPTION

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^{-1} (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 Samborotto 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., *Centropages 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 uCi ^{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; Omori 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 (Omori, 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.

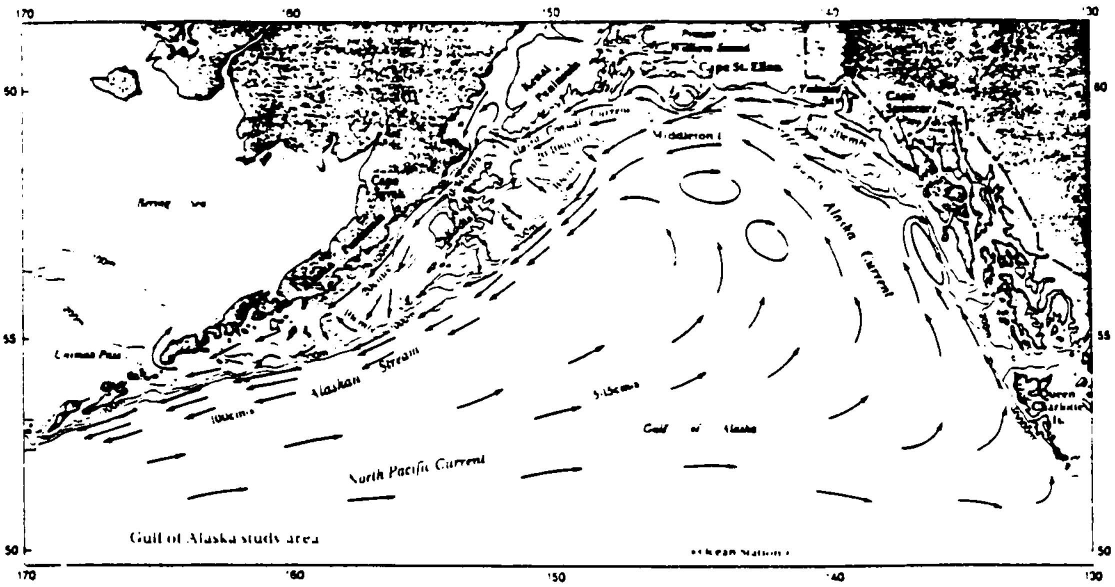


Figure 1. Schematic circulation of the Gulf of Alaska. (from Reed and Schumacher, 1986)

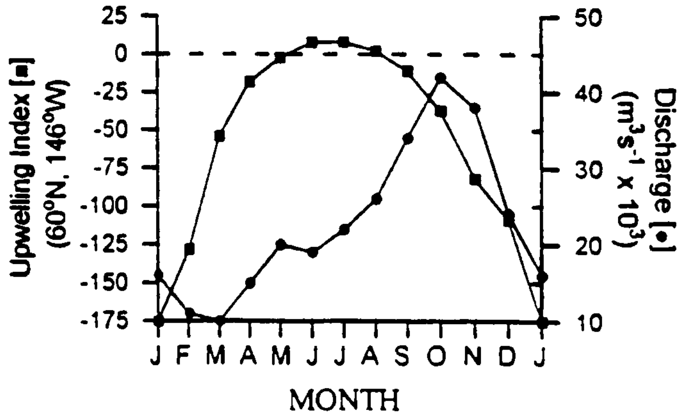


Figure 2. Mean monthly values of the upwelling index (from 1965–1992) and the estimated freshwater discharge (from 1930–1992) into the GOA using the hydrology model of Royer (1982).

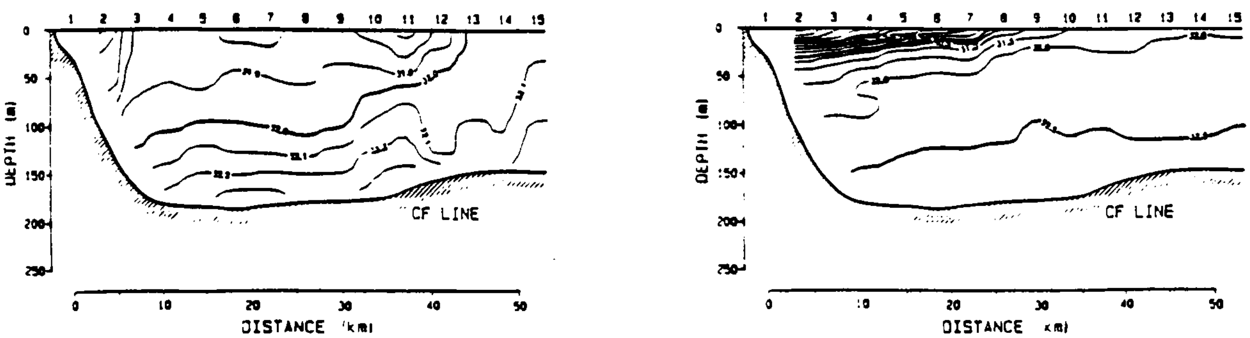


Figure 3. Cross-shelf salinity distribution in 1983; April (left) and September (right). (from Johnson et al., 1988)

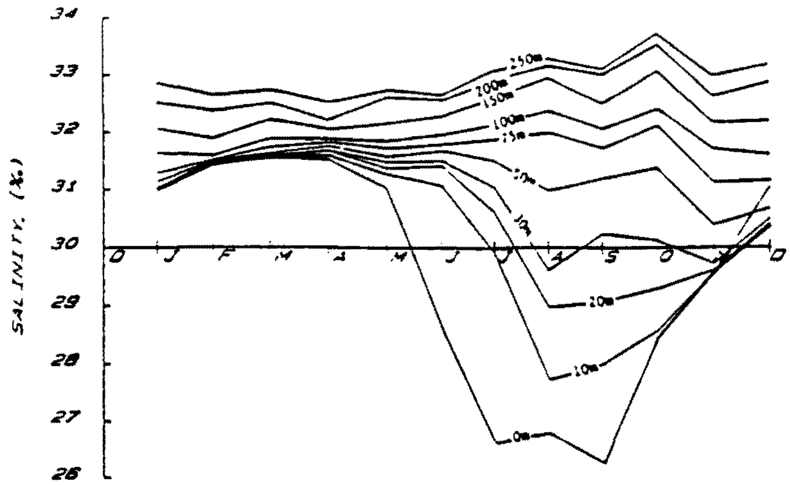


Figure 4. Mean monthly salinity at selected depths at GAK1 from 1970–1983. (from Xiong and Royer, 1984)

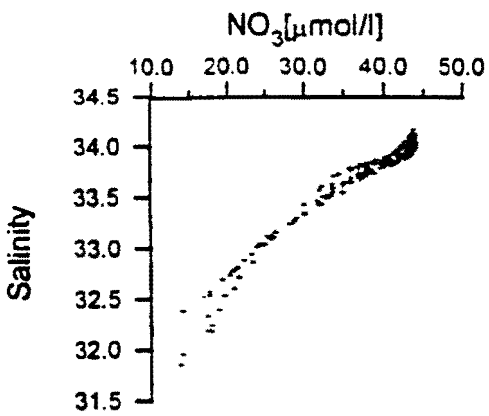
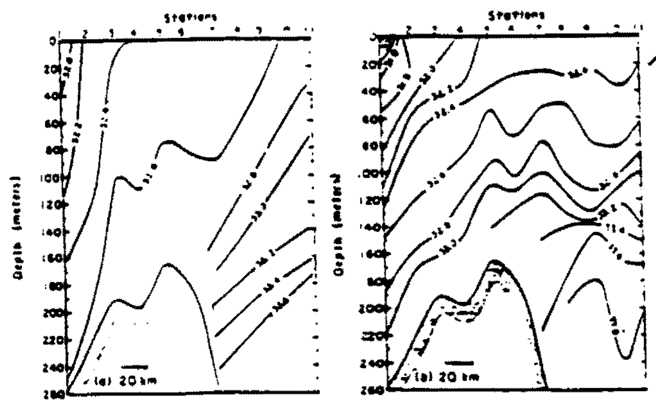


Figure 5. Vertical section of salinity along the Seward Line for winter (left and summer (right) showing inshore intrusion of saline water in summer. (from Royer, 1975)



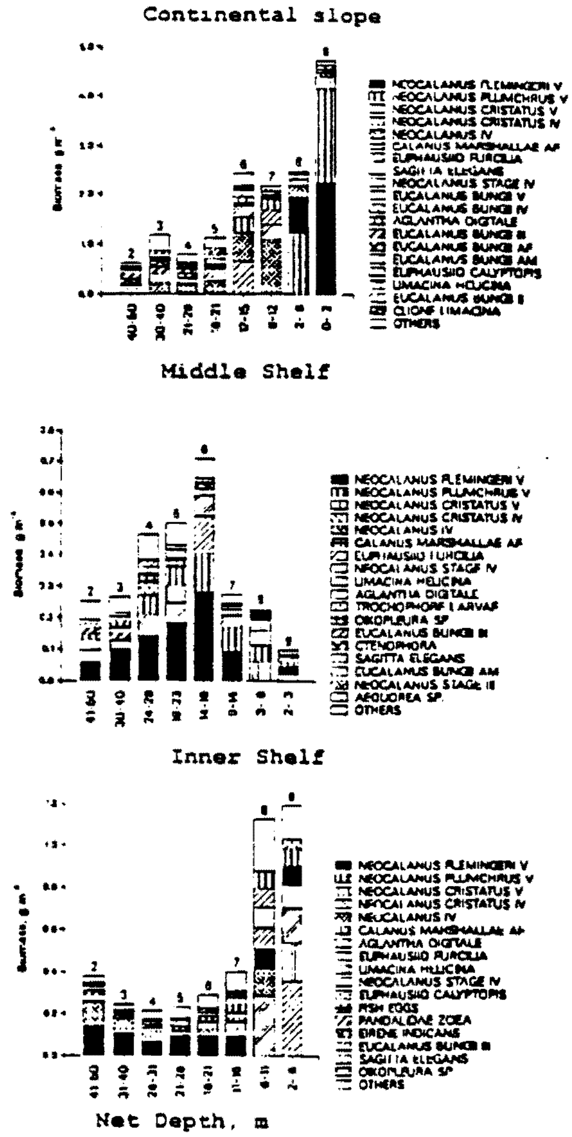


Figure 6. Salinity-NO_3 relationship from Alaska Stream and western GOA shelf stations occupied during WOCE P17N. Only data between 125 and 450 m are plotted.

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

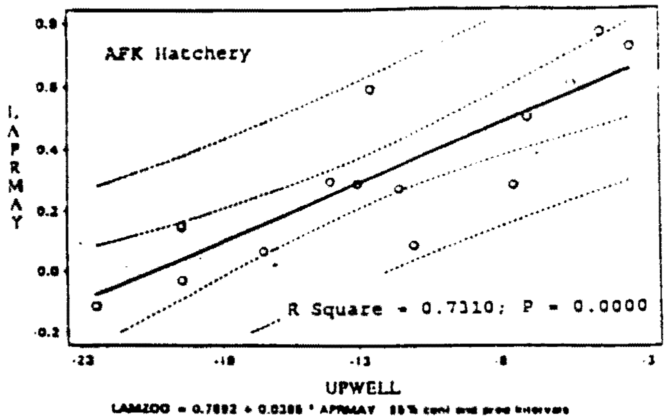


Figure 8. Regression plot of the logarithm of the April–May averaged phytoplankton settled volume against the April–May average upwelling index. (T. Cooney, pers. comm.)

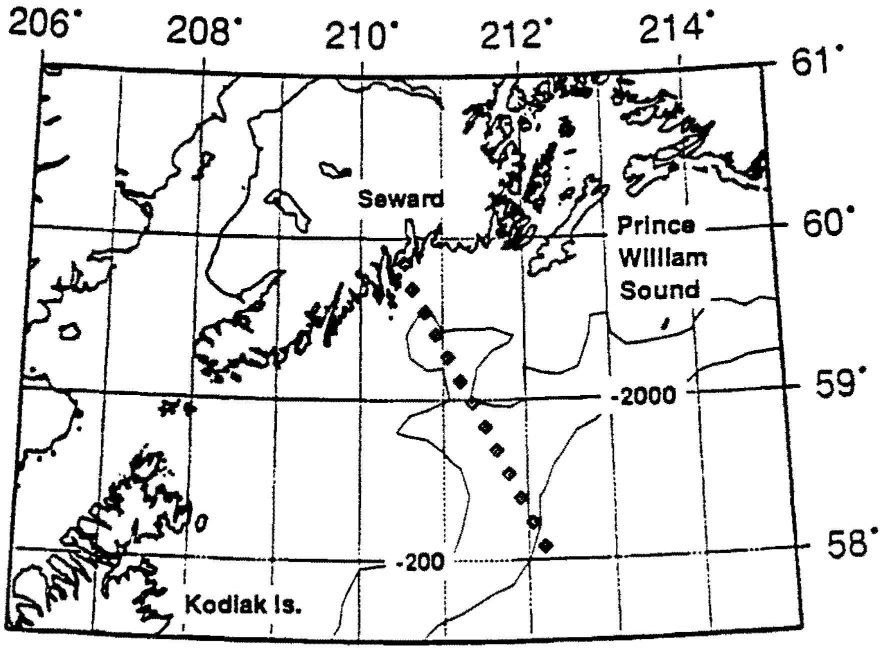


Figure 9. Location of the Seward Line with nominal locations of the proposed CTD and water sampling stations included (depths are in meters).

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1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
May 1, 1997 - April 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998						
Personnel	N/A	$121.0						
Travel	N/A	$10.0						
Contractual	N/A	$1.7						
Commodities	N/A	$1.1						
Equipment	N/A	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	N/A	$133.8	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY2001	Estimated FFY 2002	Estimated FFY 2003	Estimated FFY 2004
Indirect	N/A	$0.0						
Project Total	N/A	$133.8	$141.1	$247.1	N/A	N/A	N/A	N/A
Total Personnel Hours *	N/A	2,032						
	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	$51,260 (includes data analysis)
Publications	$0
Professional Conferences	$0
Workshop Attendance	$10,220
NEPA Compliance	$0
Community Involvement	$0

1998

Project Number:
Project Title: **Seabird-oceanographic relationships in the northern Gulf of Alaska : integration with NSF study "GLOBEC"**
Name: **ABR, Inc.**

FORM 4A
Non-Trustee
DETAIL

Prepared: 4/10/1997

1998 EXXON VALDEZ TRUS'__ _OUNCIL PROJECT BUDGET
May 1, 1997 - April 30, 1998

Personnel Costs:				* Hours	* Hourly		Proposed
Name		Position Description		Budgeted	Costs	Overtime	FFY 1998
Ritchie	R	Principal		4.0	$96.00	$0	0.4
Murphy	S	Research Coordinator		16.0	$89.00	$0	1.4
Day	R	Senior Scientist		928.0	$71.00	$0	65.9
DeLong	T	Office/Contracts Manager		16.0	$66.00	$0	1.1
Smith	M	GIS Specialist		88.0	$55.00	$0	4.8
Staff		Research Biologist II		868.0	$49.00	$0	42.5
Zusi-Cobb	A	Graphics Technician/GIS		80.0	$48.00	$0	3.8
Barkley	C	Word Processor/Administrative Assistant		24.0	$37.00	$0	0.9
Staff		Technician I		8.0	$27.00	$0	0.2
		Subtotal		2032.0	N/A	0	
						Personnel Total	$121.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1998
EVOS Meetings in Anchorage	350	1	3	150	0.8
Technical Review Meeting in Anchorage	350	1	2	150	0.7
Air Travel to/from Cruises (Fairbanks to Anchorage)	350	12			4.2
Bus (Anchorage to Seward)	70	12	24	125	3.8
Fee (5%) on Travel Costs					0.5
				Travel Total	$10.0

1998

Prepared: 4/10/1997

Project Number:
Project Title: **Seabird-oceanographic relationships in the northern Gulf of Alaska : integration with NSF study "GLOBEC"**
Name: **ABR, Inc.**

FORM 4B
Personnel
& Travel
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
May 1, 1997 - April 30, 1998

Contractual Costs:	Proposed
Description	FFY 1998
1 ABR Field Laptop Computer for 1.5 months @ $350 per month	0.5
2 Phone/Fax/Modem	0.4
3 Printing/Off-Site Photocopying/Slide Preparation	0.7
4 Fee (5%) on Contractual Costs (excluding ABR Equipment Lease)	0.1
Contractual Total	$1.7

Commodities Costs:	Proposed
Description	FFY 1997
1 Misc. Gear and Supplies	1.0
2 Fee (5%) on Commodity Costs	0.1
Commodities Total	$1.1

1998

Prepared: 4/10/1997

Project Number:
Project Title: **Seabird-oceanographic relationships in the northern Gulf of Alaska : integration with NSF study "GLOBEC"**
Name: **ABR, Inc.**

FORM 4B
Contractual &
Commodities
DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1996
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	

1998

Prepared: 4/10/1997

Project Number:
Project Title: **Seabird-oceanographic relationships in the northern Gulf of Alaska : integration with NSF study "GLOBEC"**
Name: **ABR, Inc**

FORM 4B
Equipment
DETAIL

98288-BAA

Monitoring Population Status of Sea Otters from the Sex-age Structure of Winter-killed Carcasses
Submitted Under the BAA

Project Number:	98288
Restoration Category:	Research
Proposer:	ABR, Inc.
Lead Trustee Agency:	
Cooperating Agencies:	
Duration:	1st year, 2-year project
Cost FY 98:	$123,062
Cost FY 99:	$120,379
Geographic Area:	Prince William Sound
Injured Resource/Service:	Sea Otters

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APR 1 4 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

We propose to assess the feasibility of monitoring the population status of sea otters from the sex-age structure of winter-killed carcasses collected on beaches. Monitoring of winter-killed carcasses currently is done at one site in western PWS, and from those results it appeared that otters had recovered from the oil spill by 1992; however, these results conflict with those from other studies of otters. We will attempt to reconcile these conflicts by investigating geographic and habitat-related variation in the sex-age structure of carcasses, factors that have not been accounted for in the current monitoring program. We will identify sources of variation, estimate the proportion of carcasses found, and recommend improvements of the monitoring effort.

INTRODUCTION

Sea otters are the most vulnerable species of mammal to marine oil spills. A sizable number died in the *Exxon Valdez* spill, and they are still considered as having not recovered. Three indicators of population status have been used to assess recovery of sea otters: (1) the abundance of live otters, compared to prespill numbers and trends since the spill, (2) the mortality rates of otters with radio transmitters, and (3) the age structure of otters found dead. Monson and Ballachey (1994) found that the age structure of otter carcasses was skewed toward prime-age animals for 2 years after the spill, but it then returned to normal, suggesting a recovery. Carcasses continue to be collected by DOI-BRD in an effort to monitor.population status postspill. We believe, however, that data collected since the spill may have yielded a biased measure of injury and subsequent recovery, and moreover that the current carcass collection effort is likely inadequate for monitoring trends in population status. We propose a two-year study that will enable a more defensible assessment of the carcass data and will develop a more effective sampling protocol for the long-term monitoring of sea otter population status. In the first year (FY 98), we will collect carcasses during spring and conduct boat counts of live otters to measure age structure during summer (when age-classes are easily distinguishable). The carcass data will be analyzed to identify geographic and habitat variability in sex-age structure and the boat counts will be used in analyses planned for the second year (FY 99). During the second year, we will collect carcasses to relate the sex-age structure of the dead otters with the sex-age structure of the live population from the previous pupping season and also to increase the sample size of carcass data for identification of sources of variation.

NEED FOR THE PROJECT

A. Statement of Problem

Natural mortality for sea otters tends to be highest during late winter (Kenyon 1969, Johnson 1987). To assess year-to-year trends in the magnitude and sex-age composition of winter mortality, Johnson (1987) conducted systematic early spring surveys for carcasses on the beaches of Green Island, Prince William Sound, during 1976-84. He estimated the age of each dead otter from annuli in their teeth. This survey has been repeated each year since the spill to assess differences and trends in the number and age structure of carcasses (Monson and Ballachey 1994). Similar surveys have been conducted at Amchitka Island (Estes and Smith 1973) and along the California coast (Bodkin and Jameson 1991), and at both locations temporal, geographic, and habitat-related variation in carcass deposition were identified.

In Prince William Sound, Monson and Ballachey (1994) categorized carcasses into three age classes (0-1 years old = juvenile, 2-8 years old = prime age, >8 years old = old), and reported a shift in the representation of these classes from before to after the spill. During 1976-84, juveniles composed 44%, prime age otters 17%, and old otters 39% of the carcasses (Johnson 1987). No carcasses were collected in the late 1980's, but of those found immediately after the spill and judged (based on the state of decomposition) to have died before the spill, the representation of these three age categories was exactly the same as in the 1976-84 sample. However, a higher percentage of prime age otters (47%) was observed among carcasses that were judged to have died just after the spill (i.e., summer of 1989). The percentage in this prime-age category remained high in the 1990 and 1991 samples, and then declined in 1992 and 1993 to the prespill level. Monson and Ballachey's (1994) interpretation was that the spill caused higher than normal mortality among prime age animals, and that this effect persisted for 2 years afterwards.

There are two difficulties with this interpretation, however. (1) Telemetry studies after the spill showed no increase in mortality of prime-age sea otters, but if anything, a possible increase in juvenile mortality (Rotterman and Monnett 1991, Monnett and Rotterman 1992). Thus, the interpretation that the carcass data showed increased prime-age mortality relative to juveniles directly conflicts with the telemetry data. (2) The 1990 and 1991 carcasses were collected not only from Green Island, the site of the prespill collections, but also from other parts of the western sound; all later collections were made only at Green Island. When the Green Island data are partitioned out, they do not show any shift towards more prime-age animals (14% prime age in 1990 versus 17% prespill). Thus, the perceived shift was due entirely to carcasses collected from other areas of western Prince William Sound, where no baseline exist. An alternate interpretation of these data is that the age structure of sea otter carcasses differs geographically. If this is true, then the Green Island data are not an appropriate baseline for all parts of the western sound.

This alternate explanation seems plausible. Boat surveys of sea otters in various parts of western Prince William Sound show great heterogeneity in density and pup production in the living population (Johnson and Garshelis 1995). Thus, the proportion of juveniles varies a great deal among sites (and also varies a great deal by year: 14-100% in the prespill carcass data set). Similarly, the proportion of old-age otters may vary by site. The ratio of old:juvenile carcasses varies significantly by year, and yields a far different interpretation of injury and recovery than gleaned from the proportion of prime-age animals:

Time period	Old:Juv
1976-84	0.89
prespill 89	0.89
postspill 89	0.77
1990-91	0.72
1992-94	1.24

Viewed in this way, it would seem difficult to argue that the only perturbation was in the prime-age category, and that by 1992-94 the age distribution had returned to normal. The equivocal nature of these results limits their value in interpreting postspill recovery and in monitoring postspill population status.

B. Rationale/Link to Restoration

We propose a study that will (1) provide a stronger basis for interpreting the results of postspill carcass collections, and (2) provide recommendations for employing carcass collections as a monitoring technique. Both of these overall goals are important in assessing sea otter recovery in the western sound. Other population assessment studies on sea otters are being conducted at northern Knight Island, where preliminary results suggest a lack of recovery (J. Bodkin, pers. comm.). These results seem to conflict with the carcass data from nearby Green Island (Monson and Ballachey 1994), as well as boat survey data from various portions of the western sound (Garshelis and Johnson, in review).

We will attempt to reconcile these apparent conflicts (1) by providing a more definitive interpretation of previously-collected carcass data and (2) by expanding the carcass recovery effort to a larger, more representative portion of the western sound, including sites on Knight Island. In expanding the carcass collection effort we will be able to investigate whether significant geographical differences occur in age structures of winter-killed sea otters at sites across the western sound. If such differences exist, they could explain the perceived shift towards more prime-age animals among carcasses collected the first two years after the spill (when the data included carcasses for sites other than Green Island). We will then relate these differences to variation in density and composition in the nearby living population of sea otters, as well as possibly lingering effects of the spill. From these analyses, we would propose and provide guidelines for a modified carcass collection program to monitor recovery. Conversely, if our results show no significant geographical differences, the original interpretation of the postspill data would be strengthened, as would be the justification for continuation of the current monitoring effort at Green Island.

C. Location

This project will be conducted at various sites in western Prince William Sound, in addition to Green Island. It will specifically include sites where a sizable number of sea otter carcasses were collected in 1990 (the carcasses that had a high proportion in the prime-age category). We will use locations that provide a range of otter densities, demographic structure, oil exposure, and habitat features under which we can test our hypotheses.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

We will attempt to use traditional ecological knowledge where available. We have contacted the Spill Area-wide Coordinator (Martha Vlasoff) to identify information sources and potential uses of traditional knowledge, such as information on common sea otter haul-out sites and locations where numerous sea otter carcasses tend to accumulate. We have included in our budget airfare and time to visit Cordova and Chenega to talk with Community Involvement Facilitators and local residents. We plan to use the information gathered in these communities to identify study sites and perhaps modify hypotheses about factors affecting sea otter mortality. We will hire local technicians from the Prince William Sound-Gulf of Alaska area, provided qualified personnel are available. We will rely on local contractors and sources of personnel wherever possible. We will use a boat contracted from Prince William Sound or the Kenai Peninsula for our berthing and transport. We will also rely on local flight services for our air transport.

PROJECT DESIGN

A. Objectives

1. Determine whether the age structure of dead sea otters varies among sites in western Prince William Sound.

2. Ascertain whether the age structure of dead sea otters found on beaches is related to the composition of the nearby living population, physical attributes of the beaches on which they were found, and degree of oiling of these beaches following the spill.

3. Determine whether the age structure of sea otters found dead on beaches is related to age-related differences in observability of the carcasses (different positions on the beach, different rates of decomposition).

4. Estimate the proportion of observable carcasses found in a normal beach search, and use this result to refine previous estimates of spill-related mortality derived from carcass recovery experiments (DeGange et al. 1994, Garshelis 1997).

5. Produce guidelines for monitoring sea otter populations from recovery of carcasses on beaches.

B. Methods

We propose the following null hypotheses and associated tests:

1. Age and sex structures of sea otters found on beaches do not vary throughout western Prince William Sound.

We will examine previously-collected data on counts of live otters and data on the location of carcasses collected after the spill (or observed by residents of Prince William Sound) to generate a potential list of areas in western Prince William Sound that could produce sufficient numbers of sea otter carcasses for analysis of age-sex composition. During mid-April to early May, before the regrowth of spring vegetation, we will walk beaches, in two teams of two, at various sites to search for carcasses. One observer in each team will search the upper third of the intertidal zone and the other will search along the storm-tide line. We will take a photograph of carcass and record its location, its sex, and state of decomposition. We will collect the skull and, for males, the baculum. Later we will extract a premolar, which will be sectioned, stained, and examined microscopically to estimate the age at death from the number of dark-staining annuli (Garshelis 1984). We will search beaches until we find a sufficient number of carcasses in different areas ($n = 15 - 20$ per site) to compare age and sex compositions. We foresee searching at least 50 km of shoreline at each of 6 or more study sites. We will use goodness-of-fit tests to compare proportions (2 sexes, 3 age classes) among study sites.

2. The age and sex composition of sea otter carcasses does not reflect the composition of the nearby living population.

We anticipate that the first hypothesis will be rejected, and we will thus seek an explanation for differing age-sex compositions of carcasses. In the summer following our carcass collections we will conduct boat surveys (e.g., Johnson and Garshelis 1995; Garshelis and Johnson, in review) along stretches of shoreline near the beaches from where we collected carcasses. We will differentiate pups, based on their size and behavior, and classify independent otters into 3 age categories based on pelage coloration (Garshelis 1984). We will then use these data in log-linear models with carcass data collected in 1999 to determine whether any association exists between proportion of juveniles, proportion of old animals, and otter density in the living population versus the respective composition and density of carcasses found along nearby beaches. We will also investigate (also with log-linear models) potential associations between composition and density of carcasses and various physical attributes of the beaches on which they were found (e.g., substrate, slope, direction facing with respect to prevailing currents, enclosure/exposure, etc.), as well as the degree of oiling of the beach following the spill.

3. The age composition of carcasses found on beaches reflects the age composition of otters that died.

Even if the first hypothesis is not rejected, an important question is whether the age structure of collected carcasses accurately reflects the ages of dying otters. Some age classes of otters may be more prone than others to haul-out before death, some may haul-out in areas where they are more likely to be found by observers, and some may be scavenged more readily. We cannot test the propensity of otters to haul-out, but we can investigate relationships between age, location (type of beach, position on beach), and state of decomposition. Also, some beaches will be searched twice, by different sets of observers, to assess relative rates of decomposition and disappearance of different age classes of carcasses.

4. Observers find 70-90% of observable carcasses.

Only one estimate exists for the recovery rate of sea otter carcasses during a normal beach search. In the spring of 1990, two independent groups of observers searched for carcasses on the beaches around Green Island. The first group (which was us) did not collect the carcasses, but recorded a description and location of each. By matching locations and descriptions, it was possible to determine the number seen by both groups, and the number seen by only one of the two groups, and thereby generate a mark-resight estimate for the total number available to be seen (this estimate excludes those too buried in debris or too decomposed to be seen by observers). Each of the two groups in this test saw 70-90% of observable carcasses. These data were used to help refine an estimate of total otter mortality following the spill (Garshelis 1997). We propose to replicate this methodology (i.e., search several beaches twice with two sets of independent observers) in order to assess our carcass recovery rates. We plan to use Green Island as the primary double-counting site: as in the previous work described above, we will count but not collect carcasses, and then compare our locations and descriptions of carcasses with those retrieved by the DOI-BRD in their survey. By coordinating with them, we save the cost of searching a large number of beaches twice, and also provide data specific to the site where the current monitoring is being done. These data will not only help refine past estimates of spill-related mortality, but will yield important insights into the value of carcass collections for monitoring population status and recovery from catastrophic events like oil spills.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

All components of this project will be conducted by the private sector, except the second part of the double-count at Green Island, where we will utilize the data already being collected by the DOI-BRD in their ongoing monitoring effort. We have not made arrangements for this cooperation as yet, but will pursue cooperative agreements and share logistic and other support where possible.

SCHEDULE

A. Measurable Project Tasks for FY98 (October 1, 1997 - September 30, 1998)

Oct 1 - Dec 31:	Determine locations of carcasses found in 1990 and 1991; Arrange cooperative agreements
Jan 1 - Apr 10, 1998:	Arrange logistics and prepare for field

Apr 10 - May 15, 1998:	Conduct beach searches for sea otter carcasses
May 15 - Jun 15,.1998	Keypunch data, QA/QC, send tooth specimens to lab
Jul 1 - Jul 15, 1998:	Conduct boat counts of live otters
Jul 15 - Sep, 1998:	Keypunch data and QA/QC
Sep - Dec, 1998:	Data analysis
Jan - Apr, 1999	Data analysis and report preparation
Apr 15, 1999:	Submit Final Report on FY96-98 research

B. Project Milestones and Endpoints

1. "Determine whether the age structure of dead sea otters varies among sites in western Prince William Sound." FY 98 field work will begin in spring 1998; data analysis and report preparation will be completed by April 15, 1999. FY 99 field work (carcass counts only) begins in spring 1999; data analysis and report preparation will be completed by April 15, 2000.

2. "Ascertain whether the age structure of dead sea otters found on beaches is related to the composition of the nearby living population, physical attributes of the beaches on which they were found, and degree of oiling of these beaches following the spill." FY 98 field work will begin in spring 1998; data analysis and report preparation will be completed by April 15, 1999. FY 99 field work (carcass counts only) will begin in spring 1998; data analysis and report preparation will be completed by April 15, 2000.

3. "Determine whether the age structure of sea otters found dead on beaches is related to age-related differences in observability of the carcass (different positions on the beach, different rates of decomposition)." FY 98 field work will begin in spring 1998; data analysis and report preparation will be completed by April 15, 1999. FY 99 field work (carcass counts only) begins in spring 1999; data analysis and report preparation will be completed by April 15, 2000.

4. "Estimate the proportion of observable carcasses found in a normal beach search, and use this result to refine previous estimates of spill-related mortality derived from carcass recovery experiments." FY 98 field work will begin in spring 1998; data analysis and report preparation will be completed by April 15, 1999. FY 99 field work (carcass counts only) begins in spring 1999; data analysis and report preparation will be completed by April 15, 2000.

5. "Produce guidelines for monitoring sea otter populations from recovery of carcasses on beaches." Report conclusions in FY 99 by April 15, 2000.

6. Manuscript submission. We will plan to submit at least one manuscript to the *Journal of Wildlife Management* by December 2000 as part of FY 99 budget.

C. Completion Date

We propose two years of field work, analysis, and reporting. Sampling for carcasses will be conducted during spring of 1998 and 1999. Boat counts of live otters will be conducted only during summer of 1998. Final data analysis and report writing will be completed by April 15, 2000.

PUBLICATIONS AND REPORTS

We propose to submit a manuscript during FY 99. The tentative subject will be factors affecting beach-cast carcass recovery and implications for monitoring population status and the target journal will be the *Journal of Wildlife Management.*

PROFESSIONAL CONFERENCES

Because FY 98 is the first year of this study, we will not have any results to present until FY 99.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

We do not have any formal cooperation agreements with other restoration studies at this time. We plan to coordinate carcass counts at Green Island with the DOI-BRD as part of our estimation of the proportion of carcasses observed (objective 4). Cooperating on these carcass counts will save considerable effort and cost to this study, and provide DOI-BRD with a more accurate estimate of the number of observable carcasses. Other cost savings might be achieved by coordinating counts of live otters with DOI-BRD. Because the Nearshore Vertebrate Predator Program (NVPP) is operating in the same area as our proposed study, and because it has complementary objectives (e.g., monitoring recovery of sea otters), we anticipate that there will be multiple opportunities for cooperative efforts, including data sharing.

This research will be valuable to the NVPP because it will help reconcile their results, based on aerial surveys of northern Knight Island and Naked Island, indicating lack of recovery (J. Bodkin, pers. comm.) with the results of the previous carcass age structure monitoring, which seemed to indicate injury followed by recovery (Monson and Ballachey 1994). We also expect that our study will provide useful insights into age-specific mortality in the area of the NVPP studies.

We do not have any co-funding sources and do not anticipate any co-funding opportunities.

PROPOSED CO-PRINCIPAL INVESTIGATORS

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PRINCIPAL INVESTIGATORS

David Garshelis, co-principal investigator, studied sea otters in Prince William Sound from 1979-82 for his Ph.D. (University of Minnesota, 1983). The study involved pioneering efforts in age estimation and in radiotemeletry, including activity monitoring from remote stations and the first surgical implantation of transmitters in this species. The study also involved collection of data on social organization, long range movements, seasonal and yearly fluctuations in abundance, mortality, foraging ecology, and conflicts with fisheries. Employment since 1983 has been with the Minnesota Department of Natural Resources as a Wildlife Research Biologist, developing particular expertise in population monitoring. Resumed sea otter studies after the *Exxon Valdez* oil spill (1990-96), investigating changes in abundance (based on counts from boats), foraging, and time budgets. Has published 12 peer-reviewed technical papers on sea otters and 23 other peer-reviewed papers, including several dealing with aspects of population ecology and monitoring.

Charles B. Johnson, co-principal investigator, is a Senior Research Biologist at ABR, Inc. He has studied sea otter abundance, distribution, productivity, food habits, and behavior in Prince William Sound since 1990. He completed his M. S. thesis on the ecology of mink in southeast Alaska in 1985 and has worked on a variety of wildlife issues in Alaska since 1980. His research focus has been on studies of habitat and food preferences and studies of wildlife responses to development, disturbance, and other perturbations.

Garshelis and Johnson will be assisted in this study by other trained personnel that will be chosen at a later date.

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1998 EXXON VALDEZ TRUS OUNCIL PROJECT BUDGET

May 1, 1997 - April 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998	LONG RANGE FUNDING REQUIREMENTS					
			Estimated FFY 1999	Estimated FFY 2000	Estimated FFY2001	Estimated FFY 2002	Estimated FFY 2003	Estimated FFY 2004
Personnel	N/A	$81.7						
Travel	N/A	$12.0						
Contractual	N/A	$29.1						
Commodities	N/A	$0.3						
Equipment	N/A	$0.0						
Subtotal	N/A	$123.1						
Indirect	N/A	$0.0						
Project Total	N/A	$123.1	$120.4	N/A	N/A	N/A	N/A	N/A
Total Personnel Hours *	N/A	1,562						
	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	$24,984 (includes data analysis)
Publications	$0
Professional Conferences	$0
Workshop Attendance	$10,362
NEPA Compliance	$0
Community Involvement	$3,160 (not including potential local hires and contracts)

1998

Project Number: 98288
Project Title: **Monitoring Population Status of Sea Otters from the Sex-age Structure of Winter-killed Carcasses**
Name: **ABR, Inc.**

FORM 4A
Non-Trustee
DETAIL

Prepared: 4/10/1997

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

May 1, 1997 - April 30, 1998

Personnel Costs:				* Hours	* Hourly		Proposed
Name		Position Description		Budgeted	Costs	Overtime	FFY 1998
Murphy	S	Research Coordinator		8.0	$89.00	$0	0.7
Garshelis	D	Senior Research Biologist		276.0	$62.00	$0	17.1
Johnson	C	Senior Research Biologist		504.0	$62.00	$0	31.2
DeLong	T	Office/Contracts Manager		16.0	$66.00	$0	1.1
Zusi-Cobb	A	Graphic Technician/GIS		40.0	$48.00	$0	1.9
Staff		Research Biologist II		86.0	$49.00	$0	4.2
Staff		Technician III		402.0	$43.00	$0	17.3
Staff		Technician II		156.0	$38.00	$0	5.9
Barkley	C	Word Processor/Administrative Assistant		26.0	$37.00	$0	1.0
Staff		Technician I		48.0	$27.00	$0	1.3
			Subtotal	1562.0	N/A	0	
						Personnel Total	$81.7

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1998
TEK visit--Fbks to Cordova and Chenega	1120	1	3	150	1.6
Field Mobilization--Fbks to Vdz	460	6	0	150	2.8
Field Mobilization--MN to Vdz	960	2	0	150	1.9
Crew Change--Vdz to PWS	450	2	0	150	0.9
EVOS Meetings in Anchorage--Fbks to Anc	350	2	6	150	1.6
EVOS Meetings in Anchorage--MN to Anc	850	2	6	150	2.6
Fee (5%) on Travel Costs					0.6
				Travel Total	$12.0

1998

Prepared: 4/10/1997

Project Number:
Project Title: **Monitoring Population Status of Sea Otters from the Sex-age Structure of Winter-killed Carcasses**
Name: **ABR, Inc.**

FORM 4B
Personnel
& Travel
DETAIL

Contractual Costs:	Proposed
Description	FFY 1998
1 Boat Charter for 21 days @ $1,300/day (includes food, water, and skiff)	27.3
2 Phone/Fax/Modem	0.1
3 Printing/Off-Site Photocopying/Slide Preparation	0.2
4 Film and processing 5@$20/roll	0.1
4 Fee (5%) on Contractual Costs	1.4
Contractual Total	$29.1

Commodities Costs:	Proposed
Description	FFY 1997
1 Misc. Gear and Supplies	0.2
2 Maps and Aerial Photos	0.1
3 Fee (5%) on Commodity Costs	0.0
Commodities Total	$0.3

1998

Prepared: 4/10/1997

Project Number:
Project Title: **Monitoring Population Status of Sea Otters from the Sex-age Structure of Winter-killed Carcasses**
Name: **ABR, Inc.**

FORM 4B
Contractual &
Commodities
DETAIL

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1996
			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	
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	

1998

Project Number:
Project Title: **Monitoring Population Status of Sea Otters from the Sex-age Structure of Winter-killed Carcasses**
Name: **ABR, Inc**

FORM 4B
Equipment
DETAIL

Prepared: 4/10/1997

98289-BAA

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

Submitted Under the BAA

RECEIVED
APR 14 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	98289
Restoration Category:	Research
Proposer:	ABR, Inc.
Lead Trustee Agency:	
Cooperating Agencies:	
Duration:	1st year, 2-year project
Cost FY 98:	$125,800
Cost FY 99:	$216,650 (including publication costs)
Geographic Area:	Prince William Sound
Injured Resource:	Black Oystercatcher

ABSTRACT

Black Oystercatchers currently are considered to be "injured with recovery unknown." Because most of the unresolved issues for this species pertain to impacts to the breeding population in Prince William Sound, this study is designed to assess phenology and productivity of the same population of breeding oystercatchers that was studied during 1989–1993. Phase I (Year 1) will entail an examination of the reproductive parameters that were identified by previous researchers as having been negatively impacted by the oil spill and an evaluation of whether these birds have recovered from the previously identified impacts. Data analyses will focus on comparisons of previously oiled sites with unoiled sites and among-year analyses.

INTRODUCTION

Black Oystercatchers are conspicuous denizens of intertidal and supratidal habitats throughout southcentral Alaska (Isleib and Kessel 1973), which was affected by the *Exxon Valdez* oil spill (EVOS). Because much of the long-term damage from EVOS was manifested in the intertidal zone (Stekoll et al. 1996), 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 the 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; 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; Murphy et al. 1997) and assessments of the performance of the breeding population (Sharp et al. 1996, Andres 1994a, 1994b). Overall, there perhaps was greater consensus among the various studies on the nature of impacts to this species than for any other bird species identified as negatively impacted by EVOS.

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 1996). 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 oiled habitats has been demonstrated by several studies (Andres 1994a; 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 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. 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. 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, 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).

C. Location

We propose to conduct this study in western PWS, with field work planned for Knight (Bay of Isles/Marsha Bay), Green, Little Green, Channel, and Montague (Port Chalmers) islands. These sites are the same as those studies 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 were identified.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

In FY98, we will charter a boat and crew from a local PWS community to provide berthing and logistical support. 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 (approximately 40% of the proposed budget);
2. Principal Investigators will be available to present highlights of the research program to PWS communities; and
3. Principal Investigators 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 assess 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. We propose to accomplish these goals in two phases, with Phase I (Year 1) representing a modest effort intended to evaluate efficiently but thoroughly the status of Black Oystercatchers with respect to the claims of injury made to date. If continued injury (i.e., lack of recovery) is detected, a more focused and intensive investigation will be pursued in Phase II (Year 2). If recovery can be demonstrated based on Phase I data, Phase II simply will entail publishing the results of Phase I in a peer-reviewed journal.

In Phase I, 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 Phase I 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 mortality of Black Oystercatchers chicks.

6. To measure rates of development for Black Oystercatcher chicks.

B. Methods

This study proposes to evaluate the status of Black Oystercatchers with respect to impacts and recovery during the breeding season in western PWS. We propose to conduct a 35-day cruise from late May to early July that would overlap with most of the nesting and brood-rearing periods for this species. Project personnel will live aboard a 35–50 ft. research vessel that will provide transportation between study sites and berthing; survey work primarily will be conducted from a 12–15 ft inflatable skiff. Two biologists will conduct the field work, which will entail five distinct periods of activity, each of which will take approximately one week to complete.

1. *Initial Nesting Survey*—Nearshore boat surveys will be conducted in late May and early 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), and habitat characteristics.

2. ***Follow-up Nesting Survey***—A second nesting survey will be begun immediately after finishing the initial survey to find new nests or second nests of pairs that failed in their initial attempt, to check on the status of known nests, and to collect any data at nest sites not recorded during the first visit. We anticipate that the earliest nesters will have hatched young and begun brood-rearing during this survey.

3. ***Hatching Success Survey***—During the hatching period, we will opportunistically monitor hatching success at as many nest sites as possible. Because we anticipate that hatching will occur over a period of up to two weeks, we will move among the nests in a sequence based on estimated hatching dates. Numbers of chicks hatched at each site will be noted and nest contents will be inspected.

4. ***Initial Brood Survey***—The initial brood survey will commence as soon as chicks are known to be at least 7 days old. During this survey, we will capture, band, and measure growth parameters for individual chicks. Chicks also will be photographed. Feather development will be assessed to help with aging the brood. 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.

5. ***Follow-up Brood Survey***—After we have completed our initial round of banding and growth measurements, we will revisit the brood-rearing areas where the chicks were banded and recapture as many chicks as possible. Optimally, recaptures of individuals will occur 7–10 days after the initial measurements were taken. Growth measurements and photographs 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. Field activities will cease after this survey is completed.

Nearshore 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 if any already are banded. All oystercatchers seen will be classified as "single," "pair," or "pair with nest." 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 the habitat type, both at the nest sites and within the breeding territories. 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) where appropriate. For example, measurements of eggs and chicks will closely follow the protocols outlined by these researchers to ensure comparability of data among years. Formulas used to calculate egg volumes and instantaneous change in bill length and body weight also will be calculated using 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, 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. Any known hatching dates will be used 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 and to determine habitat type within the breeding territories. 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. (Bob 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, and reproductive performance of Black Oystercatchers between previously oiled and unoiled territories and areas and with data collected in previous years. Our 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.

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 1998 does not differ from that recorded during previous years, including prior to the spill.

Analyses of differences between sites (oiled vs. unoiled) generally 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. 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 using paired differences (e.g., 1989 egg volumes minus 1998 egg volumes) in two-sample tests (t-tests or Mann-Whitney tests) where appropriate. Differences in distribution (among sites) will be tested with multi-factor analysis of variance.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

With respect to shared logistics, tremendous cost savings could be realized if we could share a vessel with another project(s). Because we have minimal demands on use of the vessel for data collection, virtually any vessel that was located in the vicinity of Green Island (e.g., Bay of Isles) and with room to berth our two-person crew could be used by this project. Although we have not specifically figured out a way to share resources with studies, we may not be aware of all of the possibilities. We certainly are amenable to pursuing cost-saving alternatives to our proposed study plan, and we would welcome the participation of other scientists on our research vessel, if practical.

At this time, we have no cofunding source for this project.

We will contract a research vessel and crew from PWS to provide berthing, logistic support, and a platform from which to conduct surveys. 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. (These management costs will be funded directly from the lead Trustee agency to the managing agency, which is how ABR's 1996 Kittlitz's Murrelet contract was set up. Hence, that management money is not listed on the enclosed budget.)

SCHEDULE

A. Measurable Project Tasks for FY98 (October 1, 1997–September 30, 1998)

April–May 1998:	Arrange logistics (boats, equipment, etc.)
May 28–July 2 1998:	Conduct field sampling
July–August 1998:	Keypunch data and QA/QC
September–October 1998:	Data analysis
November 1998–January 1999:	Preparation of Annual Report

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 1998 (and, if impacts are found in 1998, again in 1999). Analyses and reporting will commence in late summer; thus, all work associated with this objective will be completed in FY98 (and, if impacts are found in FY98, again in FY99).

2. "To document the phenology of breeding events." This objective will be addressed during field work in summer 1998 (and, if impacts are found in 1998, again in 1999). Analyses and reporting will commence in late summer; thus, all work associated with this objective will be completed in FY98 (and, if impacts are found in FY98, again 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 1998 (and, if impacts are found in 1998, again in 1999). Analyses and reporting will commence in late summer; thus, all work associated with this objective will be completed in FY98 (and, if impacts are found in FY98, again in FY99).

4 "To assess the hatching success of Black Oystercatchers." This objective will be addressed during field work in summer 1998 (and, if impacts are found in 1998, again in 1999). Analyses and reporting will commence in late summer; thus, all work associated with this objective will be completed in FY98 (and, if impacts are found in FY98, again in FY99).

5. "To estimate mortality of Black Oystercatchers chicks." This objective will be addressed during field work in summer 1998 (and, if impacts are found in 1998, again in 1999). Analyses and reporting will commence in late summer; thus, all work associated with this objective will be completed in FY98 (and, if impacts are found in FY98, again in FY99).

6. "To measure rates of development for Black Oystercatcher chicks." This objective will be addressed during field work in summer 1998 (and, if impacts are found in 1998, again in 1999). Analyses and reporting will commence in late summer; thus, all work associated with this objective will be completed in FY98 (and, if impacts are found in FY98, again in FY99).

C. Completion Date

Sampling for the project will be completed in FY98. Data analysis and preparation of the Annual Report will be completed by 15 April 1999. By January 1999, we anticipate knowing what our recommended strategy for Phase II will be. If there is evidence of continued injury (i.e., lack of recovery) to Black Oystercatchers from Phase I, we will recommend that we use Phase II funding to conduct a more-in-depth study that examines the proximate causes for the impacts and impediments to recovery. The proposed budget for Phase II 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 Phase II budget represents an estimate for an expanded study, and the results of Phase I may not warrant that expansion. If we detect no evidence of continued injury during Phase I, we will propose that Phase II simply entail producing a Final Report and preparing a manuscript for publication in a peer-reviewed journal.

PUBLICATIONS AND REPORTS

We will submit an Annual Report after the first year of the study. This report will be submitted to the Chief Scientist no later than 15 April 1999 and will cover all Phase I (Year 1) activities.

PROFESSIONAL CONFERENCES

Because FY98 will be the first year of data collection, we will not attend any conferences this year. We will consider attending scientific meeting in FY99, after the Phase-1 data have been analyzed.

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 16 years of experience designing research programs for assessing the effects of human activities on wildlife. He has studied 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. Most 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 five publications on the effects of the EVOS on birds (Day et al. 1995, 1997, in press; Wiens et al. 1996; Murphy et al. 1997).

Mr. Murphy has been employed by ABR, Inc. (formerly Alaska Biological Research, Inc.), for 16 years and serves as 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, 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

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, 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 to monitor 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.

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1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

May 1, 1997 - April 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998						
Personnel	N/A	$72.8						
Travel	N/A	$3.7						
Contractual	N/A	$48.7						
Commodities	N/A	$0.9						
Equipment	N/A	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	N/A	$126.1	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY2001	Estimated FFY 2002	Estimated FFY 2003	Estimated FFY 2004
Indirect	N/A	$0.0						
Project Total	N/A	$126.1	$216.7	N/A	N/A	N/A	N/A	N/A
Total Personnel Hours *	N/A	1,236						
	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	$18915
Publications	$0
Professional Conferences	$0
Workshop Attendance	$7245
NEPA Compliance	$0
Community Involvement	$0

1998

Prepared: 4/10/1997

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

FORM 4A
Non-Trustee
DETAIL

1998 EXXON VALDEZ TRUSTE UNCIL PROJECT BUDGET

May 1, 1997 - April 30, 1998

Personnel Costs:			* Hours	* Hourly		Proposed
Name		Position Description	Budgeted	Costs	Overtime	FFY 1998
Ritchie	R	Principal	4.0	$96.00	$0	0.4
Murphy	S	Research Coordinator	348.0	$89.00	$0	31.0
DeLong	T	Office/Contracts Manager	16.0	$66.00	$0	1.1
Mabee	T	Research Biologist II	530.0	$49.00	$0	26.0
Zusi-Cobb	A	Graphics Technician/GIS	24.0	$48.00	$0	1.2
Staff		Technician III	274.0	$43.00	$0	11.8
Barkley	C	Word Processor/Administrative Assistant	24.0	$37.00	$0	0.9
Staff		Expediter / Field Specialist	16.0	$27.00	$0	0.4
		Subtotal	1236.0	N/A	0	
					Personnel Total	$72.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1998
EVOS Meetings in Anchorage	350	1	3	150	0.8
Technical Review Meeting in Anchorage	350	1	2	150	0.7
Travel to/from Cruises (Fairbanks to Valdez)	460	3	0	150	1.4
Charter Flight (Valdez to Prince William Sound)	600	1			0.6
Fee (5%) on Travel Costs					0.2
				Travel Total	$3.7

1998

Prepared: 4/10/1997

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

FORM 4B
Personnel
& Travel
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

May 1, 1997 - April 30, 1998

Contractual Costs:	Proposed
Description	FFY 1998
1 Boat Charter (35 days @ $1300 per day)	45.5
2 ABR Spotting Scopes (2.33 scope-months @ $175 per month)	0.4
3 Phone/Fax/Modem	0.2
4 Printing/Off-Site Photocopying	0.3
5 Fee (5%) on Contractual Costs (excluding ABR Equipment Lease)	2.3
Contractual Total	$48.7

Commodities Costs:	Proposed
Description	FFY 1997
1 Misc. Gear and Supplies	0.9
2 Fee (5%) on Commodity Costs	0.0
Commodities Total	$0.9

1998

Prepared: 4/10/1997

Project Number:
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 1996
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	

1998

Prepared: 4/10/1997

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

FORM 4B
Equipment
DETAIL

98290

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

RECEIVED
APR 15 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	98290
Restoration Category:	
Proposer:	Jeffrey W. Short and Bonita D. Nelson NMFS, Auke Bay Laboratory ABL Program Manager: Dr. Stan Rice NOAA Program Manager: Bruce Wright
Lead Trustee Agency:	NOAA
Cooperating Agencies:	
Alaska SeaLife Center:	
Duration:	Service Ongoing
Cost FY 98:	75.7
Cost FY 99:	75.0
Cost FY 00:	75.0
Cost FY 01:	75.0
Cost FY 02:	75.0
Cost FY 03:	75.0
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.

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 46,000 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. 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.

This 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) . This year we will produce a new product which will include environmental data analyzed since 1995 as well as data collected and analyzed from Trustee funded laboratory studies, analytical quality control data as well as Subsistence data.

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. This is a continuation of project 96290 and previously funded under TS#1, 93053, 94290 and 95290.

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.

B. Rationale/Link to Restoration

Archiving of the Trustee hydrocarbon sample data will insure 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.

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 as needed.

3. Provide a new software product for the publicly accessible database which includes hydrocarbon samples analyzed through 1997, Trustee funded laboratory studies, analytical quality control data and Subsistence data.

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. The new 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 laboratory studies, Subsistence sampling and analytical quality control procedures as well as environmental samples analyzed since 1995.

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.

C. Contracts and Other Agency Assistance

No contracts are anticipated

SCHEDULE

A. Measurable Project Tasks for FY98

Samples will be stored and data analyzed throught 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 to include laboratory data .

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 FY97 will be available 15 April, 1998 in the form of the annual report.

PROFESSIONAL CONFERENCES

One meeting, an annual Quality Assurance Control meeting which ABL's Senior Chemist attends, is the results of an international calibration exercise for the integrity and credibility of chemical analyses. This meeting occurs in the Washington D.C. area.

NORMAL AGENCY MANAGEMENT

NOAA and NMFS has statutory stewardship for all 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 int he proposed budget) to the operation of this project making it truly :ooperative.

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 FY97, it is a continuation of the same service.

PROPOSED PRINCIPAL INVESTIGATOR

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Juneau, Alaska 99801
907-789-6065
907-789-6094
jshort@abl.afsc.noaa.gov

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.

Bonita D. Nelson
Education:
BS 1979, University of Illinois, Urbana (Ecology, Ethology , Evolution)
MS 1986, University of Alaska-Juneau (Fisheries)
Other Experience:
Database manager of the Trustee hydrocarbon data for 3 years. Responsibilities include: supervision of data entry of sample and analytical data; processing and dissemination of data for principal investigator; database management. Nelson has designed and managed databases as well as analyzed data for the radio telemetry program at the Auke Bay Laboratory for 10 years.

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998						
Personnel	$55.2	$56.4						
Travel	$4.1	$4.1						
Contractual	$3.0	$3.0						
Commodities	$5.5	$3.5						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$67.8	$67.0	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003	
General Administration	$8.5	$8.7						
Project Total	$76.3	$75.7	$75.0	$75.0	$75.0	$75.0	$75.0	
		0.0						
Full-time Equivalents (FTE)	1.0	1.8						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$38.2	$33.6	$35.0	$25.0	$25.0	$20.0	$20.0	

Comments:

This project is ongoing to support the maintenence of all environmental samples collected for petroleum hydrocarbon analyses; storing and archiving of same samples; interpretation of chemical data; and, release of data to principal investigators and the public.

NOAA Contribution:

Habitat Program Manager, S. Rice, 1 mo @ $ 9.6K: Principal Investigator, J. Short, 2 mo @ $ 13.6K = $ 17.2K:
Senior Chemist, M Larsen, 2 mo = $ 10.4K for a total of $ 33.6K

Total NOAA contribution: $33.6K

1998

Project Number: 98290
Project Title: Hydrocarbon Database & Interpretation
Agency: National Oceanic and Atmospheric Administration

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared: 4/11/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1998
B Nelson	Database Manager/Fish Biologist	9/6	6.0	5.0		30.0
M Larsen	Senior Research Chemist	11/6	2.5	6.0		15.0
J Maselko	Fishery Research Biologist	7/3	2.5	3.2		8.0
J Short	Senior Research Chemist	13/0	0.5	6.8		3.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		11.5	21.0	0.0	
					Personnel Total	$56.4

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1998
Anchorage, Workshop, 1	0.4	1	4	0.2	1.2
Miscellaneous (Car rental, telephone chgs, POV mileage, etc.)					0.3
					0.0
Quality Assurance/Quality Control Annual Meeting,1 Senior Chemist	1.6	1	4	0.2	2.4
Miscellaneous (Car rental, telephone chgs, POV mileage, etc.)					0.2
National Institute for Standards & Technology					0.0
Washington, D. C.: Annual meeting for analytical					0.0
performance review					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$4.1

1998

Project Number: 98290
Project Title: Hydrocarbon Database & Interpretation
Agency: National Oceanic and Atmospheric Administration

FORM 3B
Personnel
& Travel
DETAIL

Prepared: /11/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FFY 1998
Disposal of Archived Samples (classified as hazardous materials)	3.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$3.0

Commodities Costs:	Proposed
Description	FFY 1998
New interfaces and computer software upgrades	3.0
Production of updated public information discs of chemical data	0.5
Freezer maintenance and repairs	
Commodities Total	$3.5

1998

Project Number: 97290
Project Title: Hydrocarbon Database and Interpretation
Agency: National Oceanic and Atmospheric Administration

FORM 3B
Contractual &
Commodities
DETAIL

Prepared:
4/11/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1997
			0.0
			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
Freezers	2	NOAA
Computer, Compaq	2	NOAA
Power Supply	1	NOAA

1998

Project Number: 98290
Project Title: Hydrocarbon Database and Interpretation
Agency: National Oceanic and Atmospheric Administration

FORM 3B
Equipment
DETAIL

Prepared: /11/97

98291

Hydrocarbon Monitoring Before and After Chenega Area Beach Cleanup

RECEIVED
APR 1 5 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	98291; hydrocarbon monitoring portion
Restoration Category:	Monitoring
Proposer:	Christine Brodersen NMFS, Auke Bay Laboratory ABL Program Manager: Dr. Stan Rice NOAA Program Manager: Bruce Wright National Marine Fisheries Service, Auke Bay Laboratory
Lead Trustee Agency:	NOAA; hydrocarbon monitoring portion only
Cooperating Agencies:	USDA Forest Service & ADEC
Alaska Sea Life Center:	----
Duration:	May 1997 through fall of 1999 (if cleanup begins in June 1997)
Cost FY 97:	100.6K
Cost FY 98:	57.7K
Cost FY 99:	7.4K
Geographic Area:	Eight beach segments on Latouche, Elrington & Evans Islands, in the vicinity of Chenega Bay.
Injured Resource/Service:	use of the subject beaches by Chenega residents

ABSTRACT

Beaches on eight Chenega Area beach segments that are still visibly oil contaminated are scheduled to be cleaned in June and July of 1997, using PES-51. We plan to monitor the success of the process at removing hydrocarbons from the sediment by sampling sediments before, just after, and one year after cleaning. We will also test biological availability of hydrocarbons released by the cleaning process by sampling mussels and chitons at the same time, and more completely at one beach by sampling caged mussels anchored in the vicinity . Mussels will be tested because they are filter huge quantities of water and are a useful water-sampling device, and chitons will be tested because they are harvested from these beaches by local residents.

INTRODUCTION

Beaches on eight Chenega area beach segments are scheduled for cleaning in the summer of 1997. The beaches are all within a few miles of Chenega Bay and widely used by local residents, who have specifically requested that this cleanup effort take place. The Alaska Department of Environmental Conservation and the U.S. Forest Service are the lead agencies for the project. The cleaning will be done using the surfactant PES-51, which is very biodegradable and non-toxic, and which floats on water. The PES and associated oil will we washed down slope with cold seawater, and collected in floating booms.

As of mid-April, 1997, the Environmental Assessment for the project and the need for an Environmental Impact Statement are being reviewed. If the proposed cleaning is cleared for 1997, as much of the cleaning as possible will be done between mid-June and mid-July, and all beaches not cleaned in that time will be done the following September to avoid conflicts with salmon spawning.

The effectiveness of cleaning oiled beaches nine years after the spill is not known, and there are concerns that oil may be remobilized, released into the water, and made biologically available to food chains. Monitoring of hydrocarbon (HC) levels in sediments and biota needs to be done, and that portion of the project, the HC monitoring, is covered by this NMFS DPD. The proposed hydrocarbon monitoring at the specific sites will determine the chemical effectiveness of the cleaning and provide a measure of potential harm from remobilization of the oil. This monitoring will provide a key part of the basis for evaluating whether this procedure should be used again elsewhere.

NEED FOR THE PROJECT

A. Statement of Problem

There are two concerns to be addressed by this HC monitc ·ng work: 1) whether the cleaning will ultimately be successful, and 2) whether the work will release significant quantities of oil into the water column

B. Rationale/ Link to Restoration

This monitoring is of the effects and effectiveness of a specific restoration project, the cleaning of eight beach segments near Chenega Bay.

C. Location

The beach segments involved are ER020-B on the north end of Elrington Island, EV037-A and EV039-A on the north-eastern tip of Evans Island, and LA015-C, LA019-A, LA020-B, LA020-C, and LA021-A on the north end of Latouche Island.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Residents of Chenega Bay have requested this cleaning, have determined the specific beaches to be cleaned, will be members of the party that is to determine when each beach is adequately cleaned, and will be hired as workers for the project and to provide transportation to and from the beaches in question.

PROJECT DESIGN

A. Objectives

1. Determine how much HC levels on the beaches are reduced by cleaning.

2. Determine whether significant levels of oil HCs are remobilized by the cleaning process and become biologically available.

B. Methods

Our working hypotheses are 1) that HCs in biota and in sediments will be considerably lower one year after cleaning than before cleaning, and 2) that cleaning activities may temporarily remobilize HCs, releasing them into the water and consequently in beach biota.

The key steps of our methods are to sample for hydrocarbons just before the cleaning (to determine baseline levels), immediately after the cleaning (to test for remobilized oil), and one year after the cleaning (to determine the success of the cleaning process). Sediment sampling will b in two parts. Selected spots in the area to be cleaned will we sampled to determine whether HC levels fall over time, and samples will be taken down slope from the cleaning areas (which are mostly high in the intertidal) to learn whether HCs are moved rather than removed. Tissue samples will be taken from two species. Mussels will be sampled because they filter large quantities of water and collect HCs from it, making them a valuable water-sampling device, and chitons will be sampled because they are collected by local residents from most of the target beaches.

Sampling proceedures:
All the beaches designated for cleaning will be sampled for oil HC levels twice, before cleaning and one year after the initial sampling, to determine reductions in oil concentrations. Some of the beaches, those cleaned earliest in the season, will be sampled an additional time shortly after being cleaned to observe any elevated HC levels in surface sediments and organisms. One beach will be monitored more thoroughly for release of hydrocarbons into the waters surrounding the cleaning operations, by the use of caged mussels .

Each beach sampling will have components: 1) collection of sediments for HC analysis at selected points on the beach, 2) collection of sediments for HC analysis along a transect from the area to be cleaned down slope into the low intertidal, 3) collection of mussels for HC analysis and 4) collection of chitons for HC analysis. The sampling techniques to be used are based on those used throughout the EVOS damage assessment and restoration (R103-1, R93036, R94090, R95090); see Babcock et al 1994.

Specific techniques will be as follows. Note that this 1998 DPD is for the final sampling only; the initial two samplings will have already taken place in spring and summer of 1997.

Sediment samples will be taken for before-and-after comparisons at each individual sample location, *not* for between-location or between-beach comparisons. As such, the locations will be specifically selected to include any especially oily areas, to be distributed roughly over the entire area to be cleaned, and to be spots that are practical for sampling. Practicality includes two factors: presence of sediments fine enough to sample (grains size no larger than about 4 mm), and patches of samplable sediment large enough to support nine sampling pits (at least 1000 cm^2 available, after any cobbles or small boulders having been lifted off of the sediment surface). Throughout this protocol, a "sample location" will mean one of these selected ≥ 1000 cm^2 patches of samplable sediment.

An average of eight sediment sample locations will be selected for each beach. The sample taken from each location will consist of three sub-samples (approximately 30 cm^3 each) composited in one HC-free glass jar, along with three similar sub-samples taken from 10 cm below the three surface sub-samples. Holes dug for removal of the deeper sub-samples will be refilled for a minimum of disruption to the sample location, and any cobbles or small boulders removed will be replaced. The three holes dug at each subsequent sampling time will be from the same sample location but will not necessarily coincide with the initial three holes. Enough information on each sample location must be recorded (field notes, GPS readings & photographs) that each location can be readily found again for the later sampling times.

Most sediment sample analyses will be by ultra-violet fluorescence spectrophotometry (UVF), a quick screening method (see Analysis section below). The samples with the highest HC concentrations will be analysed by GC/MS as well, to determine oil composition and degree of weathering. Comparisons will be between the samples taken from a single location at the three sample times.

Transect samples will be taken to determine whether oil is simply moved down the beach instead of being cleared from the beach altogether. A single transect for each beach will be placed in a convenient and practical location extending from the area to be cleaned down slope into the low intertidal area.

Approximately eight sample points (fewer for a particularly steep beach, more for a very level beach) will be selected along the transect. They will be approximately equidistant from each other, but most will almost certainly have to be adjusted up or down slope from the prescribed point to find a practical sample location. Sample location requirements are much like those for the regular sediment samples above, but smaller patches of sampleable sediment will be adequate because only surface sediment is needed in this case. Each sample will consist of three sub-samples of surface sediment composited in one HC-free glass jar.

Analysis of sediment samples will be by ultra-violet fluorescence spectrophotometry (UVF). Comparisons will be between the distributions of HCs along a single transect at the three sample times.

Biological samples of mussels (*Mytilus trossulus*) and chitons (*Katharina tunicata*) will serve several purposes, if enough of them can be found to sample. HCs in either species will indicate that HCs are biologically available to predators. Mussels filter huge quantities of water and concentrate and retain HCs from the water, magnifying the concentrations and integrating them somewhat over time.

Chitons are collected by Chenega Bay residents from most of the eight subject beaches. HCs will be monitored in the chitons to determine whether they temporarily carry increased HC loads in the weeks after the cleaning process, and whether they are essentially HC-free by the spring following cleaning.

A up to three HC-free glass jars of mussels and of chitons will be collected on each beach if possible. Each sample will be composited of animals from all parts of the beach where they can be found.

Analysis of mussel and chiton samples will be by gas chromatography/mass spectrophotometry (see Analysis section below). Comparisons will be between the samples taken from a single beach at the different sample times.

Caged mussels will have been used at one beach during the summer of 1997 to check more thoroughly for release of hydrocarbons into the waters surrounding the cleaning operations. Mussels will be collected from an uncontaminated nearby area. Five groups of at least 100 mussels each will be deployed in cages anchored near shore but such that they do not go dry at low tide. Two will be well beyond the cleaning area, one on each side. The other three will be just outside the area to be boomed during cleaning. These will be deployed on the initial 1997 sampling trip, and a subset of mussels taken from the cages and frozen just before cleaning of that beach begins, during the cleaning, just after the cleaning, and again in August or September when the cleaning crews go out to finish the beaches that were missed in June and July. The caged mussel portion of the monitoring will have been completed in 1997.

Chemical analysis of samples will be done at the Auke Bay Fisheries Laboratory. Two different methods will be used, an ultraviolet-florescence (UVF) quick screening technique and complete analysis by gas chromatography / mass spectrophotometry (GC/MS).

All sediment sample HCs will be measured by UVF, in terms of µg total petroleum hydrocarbons (TPH) per g of wet sample weight. This method is sufficiently accurate to compare HC concentrations on these beaches when calibrated with a GC/MS analysis of one sample per beach. This method gives results more quickly and far less expensively than GC/MS.

All biological tissue sample HCs will be measured by full GC/MS analysis, as will approximately one sediment sample per beach per sampling time. This is a thorough technique that gives concentrations of individual oil compounds, which are presented in terms of µg total polynuclear aromatic hydrocarbons (TPAH) per g of dry sample weight, which is the sum of the concentrations of all measured aromatics (excluding perylene which is biogenic). GC/MS analysis allows for "fingerprinting" the source of oil, and determining the degree of weathering it has undergone. There is no quick screening method available at this time for tissue samples.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The Chenega Cleanup project is being overseen by ADEC and the Forest Service, with much of the work contracted out to private agencies. Only the HC monitoring described herein is being carried out by NOAA. NOAA's Auke Bay Laboratory was specifically asked to do this monitoring because of experience and expertise in HC sampling and analysis.

SCHEDULE

A. Measurable Project Tasks for FY 98 (October 1, 1997 - September 30, 1998)

Oct - Dec	Data analysis & Progress Rept for 1997 samples
Jan 15 - 24 (3 days)	Attend Annual Restoration Workshop
March - May (2 weeks)	Arrange logistics for sampling trip
Late May, approx 10 days	Re-sample Chenega area beaches
June - Sept	Sample analysis
June - October	Hydrocarbon analyses

B. Project Milestones and Endpoints

Beach cleanup is scheduled for mid-June through mid-July of 1997. The three HC monitoring sampling trips are scheduled for late May, 1997, late July, 1997, and May or June of 1998. The question of whether the work releases significant quantities of oil into the water column will be answered by the samples taken on the second trip. The question of whether the cleaning successfully removed beach HCs will be answered by the samples from the third trip.

C. Completion Date

A final report presented in April of 1999 will mark the completion of the HC monitoring portion of this project. A paper or poster will be presented at the 1999 EVOS Symposium as well.

PUBLICATIONS AND REPORTS

A progress report will be presented in April of 1998.

PROFESSIONAL CONFERENCES

A poster covering results from the first two sampling trips will be presented at the Annual Restoration Workshop in 1998.

NORMAL AGENCY MANAGEMENT

Although NOAA NMFS has statutory stewardship for all living marine resources, NOAA is conducting this project only because the oil spill occurred and marine resources were injured. NOAA NMFS will, however, make a significant contribution (as stated in the proposed budget) to the operation of this project.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Timing of monitoring operations, and precise locations to be monitored are being coordinated principally with Dianne Munson of ADEC.

PRINCIPAL INVESTIGATOR

Christine Brodersen
NMFS Auke Bay Fisheries Laboratory
11305 Glacier Highway
Juneau AK 99801
phone: 907-789-6098
fax: 907-789-6094
chris.brodersen@noaa.gov

Education: University of Washington; B.S. Zoology 1971, & Graduate work at U of A Southeast

Relevant Experience:
1974 - present: Fisheries Research Biologist at Auke Bay Fisheries Laboratory, including:
1974 - mid-1980s: Conducted laboratory research on the toxicity of Alaskan crude oils to Alaskan marine species, especially larval stages.
1989 - 1991: Conducted training classes in the handling of hydrocarbon-analysis samples for personnel in agencies doing EVOS field work; coordinated legal chain-of-custody procedures for Auke Bay Laboratory EVOS work.
1989 - present: Participated in proposals, data analysis and reporting for mussel bed monitoring and restoration work (R103 - 96090) and conducted associated laboratory experiments on measures of potentially oil-related stress in mussels.
1994 - 1996: Conducted laboratory experiments on trophic transfer of pristane that helped establish the theories behind the PWS pristane project (96195).
1996: Participated in extensive mussel population surveys in PWS with Nearshore Vertebrate Predator study.

Relevant publications & presentations:
More than a dozen papers, reports and presentations on the effects of Alaskan oil, tanker ballast water, and the EVOS.

LITERATURE CITED

Babcock, M.M., P.M. Rounds, C.C. Brodersen and S.D. Rice. 1994. 1991 and 1992 Recovery monitoring and restoration of intertidal oiled mussel (*Mytilus trossulus*) beds in Prince William Sound impacted by the *Exxon Valdez* oil spill. Alaska Fisheries Science Center Processed Report 94-02. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Auke Bay Lab., 11305 Glacier Hwy., Juneau, AK 99801-8626.

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel		$23.9						
Travel		$11.7						
Contractual		$11.4						
Commodities		$5.3						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$52.3		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
General Administration		$4.4						
Project Total	$0.0	$56.7		$13.3	$0.0	$0.0	$0.0	
Full-time Equivalents (FTE)		0.4						
	Dollar amounts are shown in thousands of dollars.							
Other Resources		$25.5						

Comments:

NOAA Contribution:

Habitat Program Manager, S. Rice, 1 mo @ 9.6K: Principal Investigator Chris Brodersen, 3 mo @ 15.9K

Total Contribution: $25.5K

1998

Project Number: 98291, Hydrocarbon monitoring portion only
Project Title: Chenega Area Cleanup
Agency: NMFS, Auke Bay Fisheries Laboratory

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared:

4/11/97

1998 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET
October 1, 1997 --ptember 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
Brodersen	Fisheries Res. Biologist	GS11 / 7	1.5	5.3	0.0	8.0
TBA, beach work assistance			0.5	5.3		2.7
						0.0
For sample analysis, chem lab personnel:						0.0
Holland	Chemist	GS11 / 6	0.5	5.3		2.7
Larsen	Chemist	GS11 / 6	0.8	5.3		4.2
Lunasin	Chemist	GS9 / 5	1.5	4.2		6.3
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		4.8	25.4	0.0	
					Personnel Total	$23.9

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Brodersen, Juneau -> Cordova -> Juneau	0.4	1	1	0.2	0.6
TBA, Juneau -> Cordova -> Juneau	0.4	1	1	0.2	0.6
Brodersen, Cordova -> Chenega -> Cordova (charter each way)	0.7	1	8	0.2	2.3
TBA, Cordova -> Chenega -> Cordova (share charter)			8	0.2	1.6
Boat out of Cordova for sampling, estimated daily charge	0.7	8			5.6
Brodersen, Juneau -> Anchorage -> Juneau for EVOS Workshop	0.4	1	3	0.2	1.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$11.7

1998

Prepared:

Project Number: 98291, Hydrocarbon monitoring portion only
Project Title: Chenega Area Cleanup
Agency: NMFS, Auke Bay Fisheries Laboratory

FORM 3B
Personnel
& Travel
DETAIL

4/11/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
Chem lab contract labor for analyses:	
TAG employee(s), 9 weeks	11.4
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$11.4

Commodities Costs:	Proposed
Description	FY 1998
I-Chem HC sample jars, inc shipping	0.7
Film & photo developing,	0.2
Misc. sampling supplies (solvents, ice chests, aluminum foil, sample shipping, other equipment)	1.0
For sample analysis, chem lab solvents & supplies:	3.4
Commodities Total	$5.3

1998

Project Number: 98291, Hydrocarbon monitoring portion only
Project Title: Chenega Area Cleanup
Agency: NMFS, Auke Bay Fisheries Laboratory

FORM 3B
Contractual &
Commodities
DETAIL

Prepared:

4/11/97

1998 EXXON VALDEZ TRUS COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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
Computer equipmint		NMFS
HPLC		NMFS
GC/MS		NMFS
GPS		NMFS
UVF radios		NMFS

1998

Prepared:

Project Number: 98291, Hydrocarbon monitoring portion only
Project Title: Chenega Area Cleanup
Agency: NMFS, Auke Bay Fisheries Laboratory

FORM 3B
Equipment
DETAIL

4/11/97

98292-BAA

Sea-Land Link: salmon carcasses and forest productivity submitted under the BAA

Project Number:	98-242 -BAA
Restoration Category:	Research
Proposer:	Prince William Sound Science Center
Lead Trustee Agency:	NOAA
Cooperating Agencies:	
Alaska SeaLife Center:	
Duration:	1st year, 4-year project
Cost FY 98:	$157.3
Cost FY 99:	$155.8
Cost FY 00:	$159.1
Cost FY 01:	$97.4 close-out
Cost FY 02:	
Geographic Area:	Prince William Sound
Injured Resource/Service:	Pink salmon, Sockeye salmon, Commercial fishing, Sports fishing, Subsistence

RECEIVED
APR 11 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

Both pink and sockeye salmon and the services they provide were injured by EVOS. Because these salmon are anadromous, they may supply an important marine-terrestrial link between production in both systems. While it has been shown that carcasses of salmon contribute significant nutrients to streams (Kline et al. 1990), it is not known to what extent these nutrients may also be important to terrestrial plants adjacent to these streams. Funding is requested to determine whether this link is important to the productivity and composition of adjacent forest in the EVOS-impacted area. Should a link be established, new management and EVOS settlement decisions might have to be made for forest plant species.

INTRODUCTION

Anadromous fishes, such as pink (Oncorhynchus gorbuscha) and sockeye (Oncorhynchus nerka) salmon, start life in freshwater streams but most spend one to four years of their life cycle in the ocean before returning to those streams to spawn before dying (Meehan and Byornn 1991). A number of studies have looked at the effects of logging on the rearing and spawning of anadromous fishes in nearby streams (Murphy and Milner 1997), but there is scant information on what ocean runs of anadromous fish may return to the watershed in terms of nutrients and production. A few studies, however, have shown that salmon carcasses contribute significant nutrients to anadromous streams and stream trophic systems (Kline et al. 1990, Bilby et al. 1996) and that variation in escapement is reflected in changes in marine-derived nitrogen in these systems (Kline et al. 1997). Foliage from plants next to these streams have also been shown to contain salmon-derived nitrogen (Bilby et al. 1996), indicating that nearby plants can acquire important plant nutrients, such as nitrogen, from anadromous fish carcasses. Because pink and sockeye salmon were injured by EVOS, should a significant link be established between salmon-nutrient input and the productivity of economically important forest species (e.g. spruce and hemlock), new management and EVOS settlement decisions might have to be made regarding the recovery of production in these plant species. Thus, funding is requested to determine the importance of nutrient input from salmon carcasses on the production and composition of nearby plant communities.

The forests of the Pacific northwest are made distinct by high plant productivity (Pojar and MacKinnon 1994). The extent to which salmon-derived nutrients play into this distinctiveness is unknown. However, there is good evidence from fertilization experiments to suggest that productivity in temperate and boreal forests is nitrogen-limited (Vitousek and Howarth 1991, refs. therein). Nitrogen is an important plant nutrient; and an important variable in the study of plant communities. It is central to both productivity (Chapin 1980, Field and Mooney 1986) and resource competition (Tilman 1986, Tilman and Wedin 1991, Wilson and Tilman 1991). These, in turn, influence the composition of plant communities, shifting the dominance of particular species (Tilman 1987, Inouye and Tilman 1988, Tilman and Pacala 1993). Thus, changes in the availability of nitrogen can have a dramatic impact on the production and types of plants within a community. If salmon carcasses are an important supply of this limiting nutrient, the productivity and composition of adjacent forest communities may be affected by changes in salmon escapement and run strength.

This project will be conducted over funding years FY98-FY01. Site selection, a fertilization experiment, and sampling and analysis of vegetation for the presence of salmon-derived nitrogen will be conducted the first year. Once the presence of salmon-derived nitrogen is established, a second and third year will be required for two reasons: (1) to confirm nitrogen limitation, the fertilization experiment must be followed over several seasons as many nitrogen-limited species do not respond in the first year (Fagerstrom and Lohm 1977, Vitousek and Howarth 1991), (2) to assess the importance of variability in salmon runs to plant productivity and to determine the extent of salmon-influence away from stream banks. There will be only close-out in the fourth year. Because this study contains strong links to other restoration projects (e.g. Sound Ecosystem Assessment, SEA), it will both benefit from data made available by these projects and will contribute to the overall understanding of pink and sockeye salmon ecosystem dynamics.

NEED FOR THE PROJECT

A. Statement of Problem

Both pink and sockeye salmon and the services they provide to commercial, subsistence, and sport fishing, were injured by EVOS. Because these salmon are anadromous, typically spawn at high densities, and contribute significant amounts of nutrients to freshwater systems (Kline et al. 1990, 1993, 1997), and because foliage from plants next to salmon streams has been shown to contain salmon-derived nitrogen (Bilby et al. 1996), pink and sockeye salmon may supply an important marine-terrestrial link between production in both systems.

We are unaware of any study to determine the significance of the link between presence and quantity of salmon-derived nitrogen and terrestrial plant production. However, salmon-derived nitrogen may be of great importance to forest communities in Prince William Sound (PWS). PWS is part of the Chugach National Forest. This forest, along with the Tongass Forest in Southeast Alaska, contains 92 % of the commercial forests of coastal Alaska (Viereck and Little1972). The forest community in PWS is classified as <u>Picea sitchensis-Tsuga heterophylla</u> (sitka spruce-western hemlock), characterizing a narrow band adjacent to the Pacific Ocean, typically extending only a few kilometers inland from sea level to timberline (Viereck and Little 1972). Forest productivity in boreal regions, like PWS, is typically nitrogen-limited (Vitousek and Howarth 1991), and economically valuable trees such as spruce and hemlock can benefit from the presence of nitrogen-fixing species, more tolerant of nutrient limitation. For example, sitka alder (<u>Alnus sinuata</u>) pioneers landslides, clearings, and glacial retreats, adding nitrogen and organic matter to soils too sterile for sitka spruce and western hemlock (Viereck and Little 1972). In addition, nitrogen availability has been shown to have a significant, positive effect on annual net primary productivity of conifers such as spruce and hemlock (Reich et al. 1997). Given nutrient limitation in PWS forests, and the proximity of salmon streams to much of the area, questions concerning production of economically valuable plants and the dynamics of salmon returns need to be addressed.

This project seeks to determine whether salmon-derived nitrogen is present in the foliage of plant species adjacent to salmon streams, whether salmon-derived nitrogen increases primary production in terrestrial plants adjacent to salmon streams and the extent of this influence, and whether salmon-enhanced production can shift the composition of forest communities away from nitrogen-fixing pioneer species to more economically important conifers.

B. Rationale/Link to Restoration

The damages to pink and sockeye salmon stocks by EVOS may have resulted in a decline in available nitrogen to forests along anadromous streams. Should a link between marine and terrestrial production via salmon carcasses be confirmed, the status of forest production following EVOS must be considered and new management and EVOS settlement decisions might have to be made for forest plant species and their services, such as logging and subsistence. Results from this study would also stimulate consideration of positive feedbacks between terrestrial plant production and salmon production and benefit efforts to understand the importance terrestrial organic input or stream habitat to salmon growth and recruitment (e.g. Bilby and Bisson 1992, Hicks et al. 1991). Thus, this project would contribute to an ecosystem understanding of the importance of injured salmon and address the issue of secondary injury to forest plants and their services by EVOS via a salmon carcass link.

C. Location

Coastal forest plants adjacent to freshwater streams will be studied within Prince William Sound. At least 10 sites will encompass eastern, central, and western portions of the sound. Results from this project will directly benefit communities within Prince William Sound that depend on both fishing and forests and forest products for economic and subsistence needs, including Cordova, Chenega Bay, Tatitlek, and Valdez.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The importance of sitka spruce to traditional subsistence cannot be overemphasized. It serves as food, medicine, glue, structural material, line, and fuel, and is known simply as real tree (naparpiaq) in the Alutiiq language (Russell 1991). Berry-laden forest shrubs are also a very important part of traditional subsistence (Russell 1991). Given the importance of coastal forests to communities in Prince William Sound to traditional subsistence as well as ownership of coastal forests by native corporations (e.g. Chugach Alaska Corporation) for logging, this project cannot ignore the impact it might have.

Communities in Prince William Sound will be involved as follows: 1) landowners will be contacted for permits and permission to gather plant and soil samples; 2) experimental manipulation will be done on forest service land only and only with appropriate permits; 3) transportation to field sites will be done with local hire; 4) a non-technical written report of project results will be provided after the second year and upon completion of the project.

PROJECT DESIGN

A. Objectives

1. Establish a link between salmon and terrestrial plants by determining whether salmon-derived nitrogen is present in plants adjacent to salmon streams.

2. Determine whether salmon-derived nitrogen increases primary production in terrestrial plants adjacent to salmon streams, and the extent of influence away from streambanks.

3. Determine if there are differences between plant composition in communities with salmon-enhanced production and those without.

B. Methods

1. salmon-plant link - Stable isotope methods will be required to test whether nitrogen present in tissues of terrestrial plants was originally derived from salmon. Spawning salmon contain higher proportions of the heavier isotopic form of N than from other sources and thus can be used to trace N from spawning salmon through the trophic system (Kline et al. 1990, 1993).

This project will measure the presence and proportion of salmon-derived nitrogen in the foliage of 5 common plant species: Picea sitchensis (spruce), Tsuga heterophylla (hemlock), Alnus sinuata (sitka alder), Rubus spectabilis (salmonberry), Vaccinium ovalifolium (early blueberry). Spruce and hemlock production is important to logging and subsistence (including fuel wood) interests (Russell 1991, Viereck and Little 1972). The fruits from salmonberry and blueberry shrubs are also important subsistence resources and the plants themselves provide a comparison between faster-growing shrubs and slower-growing conifers in terms of the importance of salmon-derived nitrogen to productivity. Plants with faster growth rate are expected to respond more quickly to increased nitrogen availability (Field and Mooney 1986, Chapin 1980). Because sitka alder has symbiotic nitrogen-fixing bacteria (Viereck and Little 1972), this species is predicted to contain less salmon-derived nitrogen (Lajtha and Marshall 1994) and have less of a response to salmon-derived nitrogen in terms of primary production.

In the first year of this project, an analysis of 10 foliage samples from each species (=50 samples) will be collected near 5 streams with salmon (esp. pink and/or sockeye) and 5 streams without. Sampling will occur in early June, just after the spring flush of new growth and when differences between isotopic ratios of anadromous versus non-anadromous sites are still elevated (Bilby et al. 1996). A second sampling effort will be conducted in late July-early August when fruits become nitrogen sinks in shrub species (Salisbury and Ross 1992) and after sockeye and pink salmon begin returning to streams (=1000 total samples).

New foliage will be picked from plants within 5 m of stream edges. Isotope ratio analyses will be conducted according to methods set out in Kline et al. (1990). Dried samples will be ground to a powder and sent to the Stable Isotope Facility at the University of Alaska, Fairbanks where samples will be loaded into combustion boats for mass spectrometric analysis by a Europa Scientific model 20/20 stable isotope analyzer. Analytical results will include $^{13}C/^{12}C$ and $^{15}N/^{14}N$ ratios and %C and %N. If plants adjacent to salmon streams contain a significantly greater ratio of $^{15}N/^{14}N$ than plants adjacent to non-salmon streams, this will indicate a link between salmon-derived nitrogen and terrestrial plants in Prince William Sound.

2. salmon nitrogen - terrestrial plant production relationship - To establish that nitrogen is limiting to plants in Prince William Sound (Vitousek and Howarth, 1991), ammonium-nitrate fertilizer will be applied the first year in May within a 10 m^2 radius of 10 individuals of each species mentioned above. Ten more individuals of each species without fertilization will be used as controls. Fertilization experiments will most likely result in increased growth in the leaves of conifers during the first season (Fagerstrom and Lohm 1977) but may not affect deciduous species until later in the season or in following years (Chapin 1980). Thus, fertilization treatments will continue in the second and third years of this project (enrichment rate = 50 kg $ha^{-1}yr^{-1}$; Nadelhoffer and Fry 1994). Productivity differences between fertilized and unfertilized plots, measured each year, will indicate that nitrogen is limiting and thus an important variable in the productivity of these plant species. Primary productivity will be estimated from measurements made in June and July-August and are described below. Nitrogen fertilizer will be labeled with ^{15}N and vegetation will be sampled in the third year for isotopic analysis (see methods above; 50 samples x 2 treatments = 100 samples) in order to establish that nitrogen fertilization resulted in subsequent productivity (Nadelhoffer and Fry 1994).

An analysis of variance of estimated productivity of plants growing near (within 5 m of) salmon streams and those growing near streams without salmon will indicate whether salmon nitrogen positively influences the productivity of the plant species of interest. In the first year of this project, productivity estimates will be collected from 5 plants of each species (=25 samples) at 5 streams with salmon and 5 streams without salmon (=625 samples total). Sampling for productivity estimates will be conducted in early June and late July-early August in order to get estimates of early productivity as well as biomass after peak growth. Productivity will be estimated from standardized samples of foliage and fruit that are dried and then weighed. Standardized samples will be comparable between sites but not across species. Estimates of conifer above-ground productivity will be made by collecting 10 samples from each individual of new season growth from the tips of branches (easily distinguished by a lighter green color). A single wood core will be taken from each individual and annual growth rings compared as well, giving a longer time scale perspective, comparable to ocean productivity data collected by other Council projects. Estimates of above-ground productivity for shrub species will be determined using total fruit and foliage dried biomass contained on one stem with a nodal diameter of 2 cm.

The second and third year of this project will be devoted to finding the extent of salmon-influence away from stream banks and the effect of variability in run strength. The conifer and shrub species found to have the greatest proportion of salmon-derived nitrogen in year one of this project will be sampled for isotope and productivity analyses in the following design. Ten foliage samples will be collected from each species at 5-, 10-, 20-, and 50-meters away from the banks of 5 streams with salmon and 5 streams without (=800 total samples). Productivity samples will also be collected, as above, for the two species at 5-, 10-, 20-, and 50- meters away from the stream bank. Analyses of years 1-3 productivity and ^{15}N for 5 m samples will be compared to salmon-run data collected by other Council projects.

3. differences in plant composition - Plant composition is expected to differ between plant communities adjacent to salmon streams and those adjacent to streams without salmon. Frequency of species less likely to benefit from salmon-nitrogen (i.e. alder) would be expected to decrease near salmon streams or be statistically indistinguishable between the two types of sites, while the frequency of other species (e.g. spruce) would be expected to increase. In year one of this project, two 50 meter linear transects will be conducted on both sides of 5 salmon streams and 5 streams without salmon. Frequency of mature individuals of the six species of interest will be recorded as they are encountered along the transect within 5 m of the stream bank. Analysis of variance will be conducted on frequency to determine differences between communities near salmon streams and those near streams without salmon.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Funds are allocated for floatplane and/or small boat charter to research sites for sampling of vegetation. Services from UAF mass spectrometry will be required for stable isotope analyses.

SCHEDULE

A. Measurable Project Tasks for FY98 (October 1, 1997 - September 30, 1998)

Oct. 1 - Dec. 31:	[First quarter] Hire Staff; site selection; obtain permits
January 1998:	Attend EVOS workshop in Anchorage
Jan 1 - Mar 31:	[Second quarter] Arrange logistics; purchase equipment; preliminary site selection completed
Apr 1 - Jun 30:	[Third quarter] Initiate fertilizer treatments, initial field sampling, process vegetation samples, data entry.
Jul 1 - Sep 30:	[Fourth quarter] Second field sampling, process vegetation samples, data entry, preliminary analysis.

B. Project Milestones and Endpoints

FY98 Set up fertilizer experiment, Isotope and productivity analyses of 5 plant species, Analysis of plant community composition.
FY99 Continue fertilizer experiment, Isotope and productivity analyses of 2 plant species at various distances from stream bank.
FY00 End fertilizer experiment with isotope analysis, Continue isotope and productivity analyses of 2 plant species at various distances from stream bank.
FY01 Final analyses, report and closeout.

C. Completion Date

End of FY01 (30 September 2001)

PUBLICATIONS AND REPORTS

An annual report will be prepared to meet the Council's requirements for work done in 1998. No peer-reviewed articles are anticipated from the first year's work. However, in the second year we will prepare manuscripts presenting results of the first two years of work for publication in professional journals.

PROFESSIONAL CONFERENCES

None in FY98

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will make use of preceding Council research through the designation of field sites, and use of ocean productivity data for comparison to conifer growth rings.

PRINCIPAL INVESTIGATORS

Tania Vincent, Plant Community Ecologist
Thomas Kline, Oceanographer, Fish Ecologist
Prince William Sound Science Center
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tel: (907) 424-5800
fax: (907) 424-5820
e-mail: tania@cdr.lter.umn.edu

PRINCIPAL INVESTIGATOR QUALIFICATIONS

Dr. Vincent will be responsible for project administration, vegetation sampling, fertilization experiment and report writing. Over the past eight years, she has conducted long-term experimental ecological research on the effects of soil nitrogen enrichment, soil disturbance, and soil resource heterogeneity on the productivity, richness, and composition of plant communities; she has been actively involved in teaching the biology of local plants at the Prince William Sound Community College; and she was principal investigator of a rare plant survey for the proposed Shepard Point Road out of Cordova. Dr. Vincent has assisted Dr. Scheel on Council project \009 for the past two years and is familiar with the logistics of working in Princè William Sound. Her work has been published in several peer-reviewed scientific journals.

Dr. Kline will be responsible for stable isotope analysis and report writing. He has been actively involved in stable isotope research since 1985. His use of stable isotopes has been in fish ecology with emphasis on salmonid fishes in northern, western, south central and southeast Alaska. His innovative use of the techniques has allowed him to quantify the effect of salmon carcass nutrient input to juvenile sockeye salmon production. This research has been the first to provide direct evidence for the importance of salmon carcasses for juvenile salmon production. He has generated stable isotope models that enable the quantification of different sources of production important in salmon ecosystems. His on-going efforts include collaborations with ADF&G, the North Slope Borough, and BPX. The results of these projects have been presented in numerous scientific papers as well as in public forums (speaking to local groups and classes). T. Kline initiated project 320I which has been the first comprehensive project using natural stable isotopes in Prince William Sound. Through this project he has developed new models and application of natural stable isotope abundance methods. He was the first to provide direct evidence of the importance of carbon from the Gulf of Alaska in Prince William Sound.

Please address all correspondence related to this proposal to Tania Vincent.

KEY PERSONNEL

Project biologist/Field manager (TBN):	Will be responsible for field scheduling and logistics, equipment and data management, assists with vegetation sampling, analysis, and report writing.
Lab assistant (TBN):	Assists with all aspects of analysis and report writing for stable isotope work.

LITERATURE CITED

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Kline, T. C., Jr., J. J. Goering, and R. J. Piorkowski. 1997. The effect of salmon carcasses on Alaskan Freshwaters pp.179-204 in A. M. Milner and M. W. Oswood, eds., Freshwaters of Alaska: Ecological Syntheses, Ecological Studies 119. Springer, New York.

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Kline, T. C., Jr., J. J. Goering, O. A. Mathisen, P. H. Poe, P. L. Parker, and R. S. Scalan. 1990. Recycling of elements transported upstream by runs of Pacific salmon: I. delta15N and delta13C evidence in Sashin Creek, southeastern Alaska. Can. J. Fish. Aquat. Sci. 47:136-144.

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1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel		$86.2						
Travel		$1.6						
Contractual		$38.3						
Commodities		$3.0						
Equipment		$2.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$131.1		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
Indirect		$26.2						
Project Total	$0.0	$157.3		$155.8	$159.1	$97.4		
Full-time Equivalents (FTE)		17.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

Amounts shown rellect Science Center costs only. General administration costs for the Lead Agency are not included in Progect Totals or Long Range Funding Requirements shown on this page.

Indirect costs are calculated at the negotiated rate of 20% of total direct costs.

1998

Prepared:

Project Number:
Project Title: Sea-Land Link: salmon carcasses and forest productivity submitted under the BAA.
Name: Tania Vincent, Prince William Sound Science Center

FORM 4A
Non-Trustee
SUMMARY

4/9/97

1998 EXXON VALDEZ TRUSTEI UNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 1998
T.L.S. Vincent	Principal Investigator		4.0	5.0		20.0
T. Kline	Principal Investigator		3.0	6.4		19.2
vacant	Project Biologist		6.0	4.7		28.2
vacant	Lab technician		4.0	4.7		18.8
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		17.0	20.8	0.0	
					Personnel Total	$86.2

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Cordova-Anchorage (EVOS workshop)	0.2	2	6	0.2	1.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.6

1998

Project Number:
Project Title: Sea-Land Link: salmon carcasses and forest productivity submitted under the BAA.
Name: Tania Vincent, Prince William Sound Science Center

FORM 4B
Personnel
& Travel
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:			Proposed
Description			FY 1998
float plane charter	15 days at $600		9.0
LD telephone, fax, photocopies			0.8
UAF stable isotope analytical	$25/sample	1000 samples	25.0
PWSCC lab fee for isotope prep	$3/sample	1000 samples	3.0
statistical analysis software			0.5
		Contractual Total	$38.3

Commodities Costs:	Proposed
Description	FY 1998
vegetation sampling supplies (tree trimmer, increment borer, brush cutter, caliper)	0.5
field supplies	0.8
foul weather and safety gear	0.4
office and computer supplies	0.4
ammonium-nitrate fertilizer	0.2
heavy N isotope tracer	0.2
stable-isotope sampling and prep.supplies	0.5
Commodities Total	$3.0

1998

Project Number:
Project Title: Sea-Land Link: salmon carcasses and forest productivity submitted under the BAA.
Name: Tania Vincent, Prince William Sound Science Center

FORM 4B
Contractual &
Commodities
DETAIL

Prepared:

1998 EXXON VALDEZ TRUSTE OUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases:		Number	Unit	Proposed
Description		of Units	Price	FY 1998
drying oven		1	0.5	0.5
balance	0.1g accuracy	1	1.5	1.5
				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	$2.0

Existing Equipment Usage:	Number	
Description	of Units	

1998	Project Number: Project Title: Sea-Land Link: salmon carcasses and forest productivity submitted under the BAA. Name: Tania Vincent, Prince William Sound Science Center	FORM 4B Equipment DETAIL

Tania L. S. Vincent
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Cordova, AK 99574
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Education

1996 **Ph.D. Ecology**. *Testing Patterns of Species Richness: A Study of Experimental and Natural Prairie Plant Communities.* Dept. Ecology, Evolution, and Behavior; University of Minnesota; St. Paul, MN. Thesis advisor D. Tilman.

1987 **B.S. summa cum laude, Ecology and Evolutionary Biology,** honors program, minor in mathematics. University of Arizona; Tucson, AZ.

Teaching Experience

1994-present **Part-time University of Alaska Faculty at Prince William Sound Community College (Cordova, AK).** BIOL 201 Environmental Biology (4 cr with lab), AWS (Alaska Wilderness Studies) 194L Plant Community Ecology of Prince William Sound (1 cr).

Research and Other Professional Experience

present **Prince William Sound Science Center**. Part-time Plant Ecologist, Volunteer Ecologist, octopus project.

1989-1996 **University of Minnesota.** Doctoral Research: prairie plant diversity at Cedar Creek Natural History Area, Nature Conservancy prairie reserves, MN.

1994-1995 **Chugach National Forest Service.** Assistant Biologist: geese and shorebird surveys in Prince William Sound, AK.

1987 **Senior Project**: *Patterns in desert plant communities in relation to soil type.* Tucson, AZ. Advisor: J.R. McAuliffe, University of Arizona.

Academic Honors

1993 Carolyn M. Crosby Fellowship, University of Minnesota
1993 Dissertation Award, Cedar Creek Natural History Area
1991 James W. Wilkie Natural History Fellowship, Bell Museum of Natural History
1987 summa cum laude graduate, University of Arizona
1987 faculty of science outstanding senior award, University of Arizona

Publications

Vincent, T.L.S., D.L. Scheel, J.S. Brown, and T.L. Vincent. 1996. *Tradeoffs and coexistence in consumer-resource models: it all depends on what you eat.* American Naturalist. 148(6): 1038-1058.

Vincent, T.L.S. and T.L. Vincent. 1996. *Using the ESS maximum principle to explore root-shoot allocation, competition and coexistence.* Journal of Theoretical Biology 180: 111-120.

Scheel, D., T.L.S. Vincent, and G.N. Cameron. 1996. *Global warming and the diversity of bats in Texas.* Conservation Biology. 10(2): 452-464

in review:

Vincent, T.L.S. and D. Tilman. *Productivity and plant species richness: the effects of fire, drought, and nutrient availability.* Ecology.

Curriculum Vitae

THOMAS CLAYTON KLINE, JR.

March, 1997

Prince William Sound Science Center

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Personal

Born: 24 April 1954, Fairfax County, Virginia

Social Security #: 227-64-8284

Education

1991	Ph.D. in Oceanography, University of Alaska, Fairbanks
1983	M.S. in Fisheries, University of Washington, Seattle
1979	B.S. in Fisheries, University of Washington, Seattle
1976	B.S. in Oceanography, University of Washington, Seattle
1972-74	Coursework at Sophia University, Tokyo

Research Interests

- Ecosystem analysis
- Anadromous and amphidromous fishes
- Biogeochemical Ecology
- Natural abundance of stable isotopes

- Aquatic ecology with emphasis in ecosystem productivity as it affects megafauna
- Nutrient cycling
- Underwater science and technology
- Underwater photographic imaging technology

Professional Experience

1994-97	Research Scientist, Prince William Sound Science Center
1995-97	Director, Prince William Sound Science Center Scientific Diving Program
1995-97	Diving Safety Officer, Prince William Sound Science Center Scientific Diving Program
1992-93	Instructor, University of Alaska Fairbanks
1991-94	Postdoctoral Fellow, University of Alaska Fairbanks
1991	Technician, University of Alaska Fairbanks
1985-91	Research Assistant, University of Alaska Fairbanks
1984-85	Teaching Assistant, University of Washington
1977-83	Research Assistant, University of Washington

Teaching Experience

1993	Upward Bound Math/Science, Marine Science
1992	Fisheries 400, Fisheries Science
1991	Marine Science and Limnology 460, Marine Studies for Science Teachers with Drs. R. Highsmith, R. T. Cooney, and J. J. Kelley
1991	Marine Science and Limnology 611, Field Problems in Marine Biology with Dr. R. Highsmith
1984-85	Fisheries 405, Economically Important Mollusca with Dr. K. K. Chew
1984	Fisheries 454, Aquatic Food Chains with Dr. F. B. Taub

Professional Societies

American Academy of Underwater Sciences

American Fisheries Society

American Society of Limnology and Oceanography

Sigma Xi

The Explorers Club

Scientific Presentations

1997 (planned submission) American Academy of Underwater Sciences Seventeenth Annual Scientific Diving Symposium "Diving for Science...1997", November 13 - 16, Northeastern University, Boston, MA.

1997 (abstract submitted) 15th Lowell Wakefield Fisheries Symposium: Fishery Stock Assessment Models for the 21st Century - Combining Multiple Data Sources October 8 -11, 1997, Anchorage, Alaska, USA "Mass-balance ecosystem model validation using $^{15}N/^{14}N$ data" (with D. Pauly).

1997 (planned submission) 48th Arctic Science Conference, September 1997, Valdez, Alaska. "Spatial patterns of Gulf of Alaska carbon in Prince William Sound pelagic food webs determined by $^{13}C/^{12}C$."

1997 (invited speaker) American Fisheries Society Annual Meeting "Interfaces" Special Symposium: Spatial Patterns and Processes in Aquatic Environments, 25-29 August, 1997, Monterey, CA, "Spatial patterns of Gulf of Alaska carbon in Prince William Sound pelagic food webs determined by $^{13}C/^{12}C$."

1997 Coastal Marine Institute Annual Symposium, 25 February 1997, Fairbanks, Alaska "North slope amphidromy assessment" (with J.J. Goering).

1997 *Exxon Valdez* Oil Spill Trustee Council Workshop, Anchorage, Alaska. "SEA: Confirming food web dependencies in the Prince William Sound ecosystem using stable isotope tracers - food webs of fishes."

1996 American Academy of Underwater Sciences Sixteenth Annual Scientific Diving Symposium "Diving for Science...1996", Smithsonian Institution, Washington, D.C. "Octopus research in Prince William Sound Alaska: the birthing of a scientific diving program and the role of the AAUS."

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Activities

Field Fisheries, oceanographic and limnological sampling in Alaskan remote sites (also: small vessel operations: in- and outboards, scuba diving sampling, under- and above-water photography, aerial photography). Foreign fisheries observer (solo fisheries data acquisition on independent stern trawler). Marine archaeology (with Queensland Museum).

Lab Sample preparation for natural stable isotope chemistry, gas chromatography. Invertebrate and fish identification for stomach content analysis and epibenthic analysis, phyto- and zooplankton identification and enumeration, chlorophyll analysis, molluscan growth and population studies, microcosm experiments.

Other Member, North Slope Borough, Science Advisory Committee. Advisor to environmental consulting firm on shoreline management manual.

Other Qualifications

NAUI Master Scuba Diver A52506, EMP Basic Medic First Aid (CPR inclusive), AHA CPR, DAN oxygen first aid for scuba diving accidents, University of Alaska Scientific Diver 5, PSI high-pressure cylinder Visual Inspector 3205, NAUI Advanced Scuba Diver, PADI Equipment Specialty Diver, NAUI Open Water II Scuba Diver, PADI Basic Scuba Diver

Recent Collaborators

Goering, J., Kelley, J., Cooney, R., Eslinger, D., McRoy, C., Paul, A., Norcross, B., Stokesbury, K. (Univ. Alaska Fairbanks), Bozanic, J. Salmon, D., Scheel, D., Vaughan, S., Patrick, V., Thomas, G. (PWS Science Center), Willette, M., Schmidt, D (Alaska Dept. Fish and Game), Falkenberg, C., Kulkarni, R., Nochetto, R. (Univ. Maryland), Jin, E. (Univ. Toronto), Mooers, C., Wang, J. (Univ. Miami), Mason, D. (Univ. Wisconsin), Bishop, M. (U.S. Forest Service)

Graduate and Post-Graduate Advisors

Chew, K. (M.S., Univ. Washington), Goering, J. (Ph. D., Univ. Alaska Fairbanks), Kelley, J. (Post-doctoral, Univ. Alaska Fairbanks)

98293-BAA

Bidarki and gumboot chitons: Recruitment and habitat selection. Submitted under the BAA

Project Number: 98293-BAA

Restoration category: Research

Proposer: Prince William Sound Science Center

Lead Trustee Agency: NOAA
Cooperating Agencies:

Alaska SeaLife Center:

Duration: 1st year of 4

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EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Cost FY98: $183.9K
Cost FY99: $157.7K
Cost FY00: $156.0K
Cost FY01: $90.8K close-out
Cost FY02: $0

Geographic Area: Prince William Sound, Cook Inlet

Injured Resource/Service: Subsistence services, chitons, intertidal & subtidal communities, predators of chitons (black oystercatchers, harlequin ducks, sea otters)

ABSTRACT

Bidarki (Katharina tunicata) and gumboot (Cryptochiton stelleri) chitons are important intertidal subsistence resources in spill-area villages; and the complaint that chitons are harder to find following the oil spill has been repeatedly voiced by village residents over at least the past five years. No EVOS study has examined bidarki and gumboot populations with the goal of identifying whether densities are depressed on oiled/treated beaches or with the intent to design enhancement methods. We propose to examine recruitment and retention of these chitons in intertidal and nearshore subtidal habitats, experimentally test factors affecting chiton use of intertidal habitats, and design methods to enhance densities of these chitons in the intertidal.

INTRODUCTION

We propose to examine recruitment, growth, and habitat selection in two species of chitons: Katharina tunicata (Class Polyplacophora, Order Neoloricata, Family Mopaliidae) and Cryptochiton stelleri (Class Polyplacophora, Order Neoloricata, Family Acanthochitonidae), locally known as bidarkis and gumboots, respectively. These chitons are valued subsistence resources as both are large (bidarkis to 8-10 cm, gumboots often surpassing 20 cm, Kozloff 1987) and both occur in the intertidal. Several residents of Port Graham, Alaska, contacted for traditional ecological knowledge of octopuses (project /009-D), mentioned that these chitons are harder to find than they used to be, and requested that we find out more about them.

Chitons are best known from the intertidal habitats they use, since these are most accessible. During work on the project Survey of Octopuses in Intertidal Habitats (/009-D), we surveyed both intertidal and shallow subtidal habitats. Because subsistence users had previously expressed concern about chitons, we noted the occurrence of chitons on these surveys. However, the surveys were designed to assess octopus habitats and densities and not to assess chitons quantitatively. We detected both bidarkis and gumboots to depths of 15 m below MLLW (mean lower low water). These two species of chitons were relatively uncommon at sites surveyed for octopuses (recorded at 7 of 31 sites visited in 1995. Scheel et al. 1996), although bidarkis could be numerous when encountered. For example, over all intertidal sites surveyed, the average density of bidarkis and gumboots were 0.19 and 0.13/1000 m^2 respectively, while the densities only on sites that had at least one individual of the species were 19 and 4.6/1000 m^2 respectively. As these numbers show, bidarkis were more common in the intertidal than gumboots; however gumboots were more common on subtidal surveys than bidarkis (0.07/1000 m^2 for bidarkis versus 0.2/1000 m^2 for gumboots. Scheel et al. 1997). Finally, these chitons (especially bidarkis) were not common at locations selected for octopus surveys (/009-D). For example, bidarkis were only abundant at one site, an exposed oceanic shoreline where no octopuses were found (Scheel et al. 1996). None of the sites chosen as likely octopus habitat had an abundance of bidarkis (Scheel et al. 1997). This made it impractical to simultaneously study octopuses and chitons, and Survey of Octopuses in Intertidal Habitats was therefore not successful at providing information about bidarkis and gumboots, their habitat associations, or recruitment rates.

Unlike sessile intertidal invertebrates, chitons actively select the habitats they occupy. As such, habitat degradation resulting from oil spill and cleanup effects (e.g. Stekoll et al. 1996, van Tamelen & Stekoll 1996, Highsmith et al. 1996, Duncan & Hooten 1996, Hooten & Highsmith 1996) may result in abandonment of areas that were occupied prior to the oil spill. Chitons are grazers that feed on algae, and algae communities in oiled areas have undergone dramatic changes in the years following the spill (Highsmith et al. 1996, Duncan & Hooten 1996). Even if settlement rates in damaged habitats are unchanged, oiled habitats may not retain juvenile chitons. If, due to the greater impact of oil at higher tidal elevations, chiton distributions have shifted downward or survival rates are lower following settlement, then chitons may be less available to subsistence harvesters. We propose to examine recruitment rates to the post-metamorphose stage, to test what factors affect retention of these juveniles in oiled and non-oiled habitats, and to design methods for enhancing intertidal populations.

Since any effect of habitat changes on chitons have not been established yet, work on enhancement methods will be deferred until the third and final field year of this proposal.

NEED FOR THE PROJECT

A. Statement of the problem

Subsistence use of chitons has resulted in the perception that these animals have declined in abundance in traditional intertidal use areas. Declines in intertidal chitons may have resulted from habitat degradation following the oil spill, particularly from changes in the algal communities on oiled shoreline. It should be possible to design restoration activities that promote the recolonization of intertidal areas with chitons and other intertidal grazers. Restoration of intertidal chitons would help restore lost subsistence resources and services and may also benefit nearshore foragers that were injured by the oil spill and that consume chitons (such as octopuses, black oystercatchers, harlequin ducks, sea otters, and river otters).

The initial injury to subsistence services was due to uncertainties about the safety of eating intertidal organisms. In some cases, post-spill subsistence harvests were less than 25% of pre-spill harvests (Fall & Field 1996). Subsequent studies indicated that unless subsistence seafoods were visibly contaminated, they were likely safe to eat (Bolger et al. 1996, Brown et al. 1996). Subsistence harvest levels increased in the second and third years following the spill as results of these studies became known and also as people became more concerned about the loss of cultural aspects of a subsistence lifestyle. Currently, however, residents of many villages indicate that they have to travel further and work harder than before the spill to maintain their subsistence lifestyles, that they feel populations of some resources are unusually low, and that they remain concerned about the safety of many marine foods (Fall & Field 1996). In discussing intertidal resources with village residents, the complaint that chitons were, and still are, harder to find following the spill has been voiced repeatedly (e.g., respondents to 1992 surveys from Tatitlek and Chenega Bay [Fall & Utermohle 1995]; as discussed in a 1994 meeting on Community Knowledge Transfer [13 May 1994 memo from M. McCammon]; pers. comm. Simeon Kvashnikof Jr. [1996] and Walter Meganack Jr. [1997] of Port Graham, both to D. Scheel).

In some cases, reduced populations of subsistence resources have been documented in the natural resource damage assessment process. Although intensive work was done in the intertidal, very little data was collected on chitons. For example, chitons are not mentioned in Exxon Valdez Oil Spill: Fate and effects in Alaskan Waters (Wells et al. 1995). In Proceedings of the *Exxon Valdez* Oil Spill Symposium (American Fisheries Society Symposium 18, 1996), perhaps the definitive summary volume of EVOS natural resource damage assessment, data on chitons are presented in only one paper (Brown et al. 1996), and chitons are mentioned in only a few others. In Brown et al. (1996), unspecified chitons were one of four types of molluscs tested for hydrocarbon contamination because they are used as subsistence food. Brown et al. (1996) found that a few chitons from some sites were contaminated, but that the frequency of contamination was lower for chitons than for the filter-feeding molluscs included in the study (clams and mussels). Chitons are mentioned in Highsmith et al. (1996) in a list of food items of Harlequin Ducks and Black Oystercatchers; and in Fall & Field (1996) when discussing seafood contamination. Aside from these studies and our own data from the octopus surveys, we are aware of no other EVOS projects that examined chitons.

Bidarkis and gumboots, however, may be responding to oil spill damages in a way that reduces their availability to native subsistence harvesters who collect chitons for home use and also eat them raw as a convenient meal when away from home hunting or fishing. Traditionally, more pounds of chitons have been harvested than any other marine invertebrate except octopuses (Fall & Utermohle 1995). Bidarkis are a resource especially missed now that subsistence involves greater effort and travel. Because bidarkis are collected in the intertidal, can be picked of rocks easily with any flat blade, and can be eaten without any preparation, they provide a quick and easy field meal when available. In their absence more effort or planning may be necessary to eat during day-long outings.

Most chitons are grazers similar to limpets (Chelazzi et al. 1994). They feed on microflora such as coralline algae and gametophyte stages of macroalgae (Littler et al. 1995). Both populations and recruitment of grazing limpets declined dramatically in oiled habitats or in oiled but not in non-oiled treatments (Highsmith et al. 1996, Duncan & Hooten 1996) and had not completely recovered by 1993 (Hooten & Highsmith 1996). These results are consistent with work following other oil spills (see discussions in Highsmith et al. 1996, Duncan & Hooten 1996). Chitons, although not included in these analyses, likely suffered a similar fate. Changes in algal communities may inhibit the recovery of grazers. Conversely, a healthy population of chitons can dramatically effect marine algal communities through selective grazing (Littler et al. 1995); and the absence of chitons may therefore limit the rate of recovery of intertidal algae populations. If damages to algal communities limit recovery of chitons, relatively inexpensive activities may promote more rapid localized restoration. For example, cages placed in intertidal plots to exclude predators had the unanticipated effect of increasing algal and grazer recruitment, apparently by altering physical disturbances (Duncan & Hooten 1996).

B. Rationale/Link to Restoration

We propose to examine recruitment and habitat selection in bidarki and gumboot chitons with the goal of designing a method to enhance intertidal chiton populations for subsistence use. Successful enhancement of these chitons in the intertidal would promote the recovery of subsistence services and may also assist recovery of intertidal foragers that feed on chitons, such as octopuses, black oystercatchers, harlequin ducks, sea otters, and river otters.

Our ultimate goal is to increase bidarki and gumboot populations in intertidal habitats. Three approaches are conceptually possible: increase recruitment, increase retention, or decrease mortality. Cages placed in intertidal plots to exclude predators had the unanticipated effect of increasing algal and grazer recruitment (Duncan & Hooten 1996). However, since the cages were not effective in excluding predators, it is likely the increase in grazers resulted either from increased recruitment or increased retention. We therefore choose to begin with a focus on these two mechanisms.

Thus, to design successful restoration activities, we must first answer two questions: Are juvenile chitons available in these habitats? Once juveniles appear in an area, how and why do they choose to remain in the habitat? The first two years of the proposed work are designed to answer these questions. The third year will apply the results of the first two to the development and testing of possible enhancement methods.

C. Location

Research will be conducted in Prince William Sound and Cook Inlet. Communities that may benefit include Tatitlek, Chenega Bay, Port Graham, and Nanwalek. All subsistence communities in the oil spill area could benefit if a successful restoration technique is developed.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Traditional and local knowledge, in part, has led to the development of this proposal. Such knowledge may provide further insight during the course of this work. Due to the importance of this resource to native communities, we feel it is appropriate as well as beneficial to the project to recruit some of our research assistants from the native communities. The project work force and budget are designed with this intent.

The following procedures have worked well for the octopus surveys (/009-D) and will be followed for this project: 1) consult with community facilitators in local communities during the conception and design of the project to seek input; 2) advertise all boat hires and employment opportunities in communities near where the work is to be performed; 3) visit local communities during the course of the field work and, where appropriate, base field work out of the villages using local lodging and/or boats; 4) provide a written report in non-technical language on project results after the second year and upon completion of the project; 5) acknowledge all local contributions appropriately, and 6) apply the results of the research in ways designed to benefit local communities, people, and cultural practices.

PROJECT DESIGN

A. Objectives

1. Examine effects of oiling/treatment history and algal community composition on rates of recruitment to post-metamorphose stages of bidarkis and gumboots;

2. Examine effects of oiling/treatment history and algal community composition on retention rates of post-metamorphose stages of bidarkis and gumboots;

3. Design manipulations to intertidal habitats that enhance recruitment or retention and growth of post-metamorphose stages of bidarkis and gumboots, resulting in enhancement of intertidal bidarki populations in manipulated areas. [Year 3 only]

B. Methods

1. Recruitment - Bidarkis are numerically more common than gumboots and relatively more abundant in the intertidal than the subtidal in Prince William Sound (Scheel et al. 1997). Due to the difficulties of examining subtidal substrates, the recruitment work will be primarily focused on bidarkis. However, some sampling of gumboots should also be possible with these techniques, as some gumboots are exposed during minus tides.

We propose to follow the general methods of the Coastal Habitat Injury Assessment projects (CHIA. Sundberg et al. 1996, Stekoll et al. 1996, Highsmith et al. 1996, Dean et al. 1996), although our methods will necessarily be more limited in scope (e.g. we do not propose to work in all three major regions of the spill-impacted area). We will select study sites stratified by habitat type (sheltered rocky, coarse textured, exposed rocky; but not estuarine as this is not typical habitat for bidarkis). A similar reference site (non-oiled to lightly oiled) will be matched to each oiled site (moderate to heavy oiling). Where ever possible, we will choose site pairs that were included in the CHIA projects, although some additional site pairs will be designated based on the distribution of chitons (i.e., since no chitons were reported in the CHIA study we cannot be sure that many of those sites are suitable for this study), and observations made during octopus surveys. Using randomly located quadrats and repeating sampling procedures at three intertidal heights (one, two and three meters vertical drop below mean higher high water), we will sample all epi-flora and epi-fauna. Since bidarki chitons are not burrowers, we will not have to remove sediments to sample in-fauna. Length of all chitons will be measured. These data will provide a characterization of the biological habitat, particularly algal communities, and will include the occurrence of the smallest size class of bidarkis, which we will take to be indicative of recruitment to post-metamorphose life stages. Whenever compatible with the identification of plants and animals, the organisms will be left in place to minimize impacts.

Because we are concerned with movement of chitons between intertidal and subtidal habitats, it is necessary to measure recruitment rates in subtidal areas. Both intertidal and subtidal recruitment will be measured by placement of clean artificial substrates (e.g. tiles or other suitable surfaces) during the breeding season (reported as May-June in California [Ricketts & Calvin 1968] and May in Puget Sound [Morris 1966]) at fixed stations across several depths from the intertidal to 10 m subtidal. Detailed habitat data will be recorded at each station. For subtidal stations, habitat data will be collected by SCUBA diving, underwater photography, and by bringing sample substrate to the surface for detailed or microscopic examination. Tiles will be brought to the surface and attached organisms measured at suitable intervals.

In the first year, collection of these data will identify habitat factors correlated with chiton densities and recruitment. Analyses of these data will be used to generate hypotheses about what limits intertidal populations. Consideration of the response of grazers to oiling and treatment history suggests that recruitment of the smallest size-class can be affected by substrate roughness, dominant algal cover, and algal recruitment rates. If similar results are obtained for chitons, this suggests that experimental manipulation of these factors will alter recruitment rates. Following the first year of work, experiments will be designed in the second year to test our understanding of the influence of habitat and algal communities on recruitment.

2. Retention - Site selection and sampling design will follow that of Objective 1. However, this objective is concerned with the fate of individuals following recruitment. We will therefore tag individuals using two procedures that have been successful on other shelled molluscs: Floy fingerling ID tags glued to the shell with Marine epoxy (Ebert & Lees 1996) and microlamp tags used during time-lapse photography (Chelazzi et al. 1994). ID tags allow the history of individuals that are sighted more than once to be followed. Microlamp tags allow individual movements to be traced by automated photography over short distances.

Every individual bidarki or gumboot encountered during the sampling described above that is large enough to be tagged will be marked. In addition, each site selected for sampling will be searched for chiton aggregations. Gumboots do not commonly aggregate in the Sound, although, where abundant, several may be found in a short stretch. However, bidarkis can occur at densities on the order of one hundred per square meter in dense aggregations. All individuals present at these aggregations will also be marked with ID tags. Following the initial tagging of individuals, subsequent searches will turn up both marked and unmarked individuals, providing data on turnover rates, movement rates, and habitat selection.

We will investigate subtidally using SCUBA diving to increase sample sizes for gumboots (which are more abundant subtidally), to find the lower limits of patches of bidarkis encountered in the intertidal, and to relocate tagged individuals adjacent to sites in the intertidal where they were marked. Although bidarki densities appear to be lower subtidally than intertidally (Scheel et al. 1997), this result is based on minimal sample sizes and some further investment is warranted to test it in areas where bidarkis are abundant. Subtidal sampling is also necessary to record movements of individuals out of the intertidal if it occurs. Two methods will be used: complete inspection of randomly located plots and removal of selected substrate for surface inspection; and localized searching near intertidal sites to locate dense aggregations if they exist. In each case, individuals will be removed to the surface, tagged and released again as near as possible to their capture site. Sites will be permanently marked with subsurface and/or surface buoys to aid in relocation. Once tagged individuals have been released, sites will be revisited to record occurrence of new and tagged individuals. Habitat data will be recorded as described in Objective 1.

Analyses of the first year of data will be used to identify factors that are correlated with a high retention of tagged bidarkis. We expect that retention will be primarily influenced by the availability of desirable algal forage and possibly by predation refuges. The second year will be devoted to experimental manipulation of these factors to test our understanding of how these habitat features regulate retention of chitons. We anticipate that relocating tagged chitons into a variety of habitats may be a powerful experimental technique to test our hypotheses, but detailed design of those experiments will be done following examination of the first year's data.

3. Enhancement

The third year of the proposed work will be devoted to applying the understanding gained in Years 1 and 2, with the goal of enhancing chiton numbers in intertidal habitats. If our results indicate that recruitment rates vary between habitats and may limit the use of intertidal habitats, restoration will focus on manipulation of recruitment rates. Techniques that promote restoration of macroalgae or alter the flow of water over the intertidal (e.g. create artificial tidepools) may alter recruitment, or local recruitment might be enhanced with a hatchery rearing program. Alternatively, if recruitment is random among habitats as chitons settle from the plankton, but retention varies between habitats we will seek to manipulate habitat quality to maximize retention in intertidal habitats. This may involve fertilization or placement of artificial substrate to enhance microalgal growth, enhancing refuges, or selective removal of predators. We expect other possibilities will emerge in the course of the project; and detailed design of experimental enhancement will be done following the second year of research.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Funds are allocated for charter of a vessel to support survey dives, beach access and provide a mobile field platform. This vessel will likely be a privately-owned fishing or research vessel from a community in the EVOS-impacted area. Vessel and survey contracts will be awarded to the most suitable bidders responding to advertisement. Equipment rental and services may also be needed to support short term use of small equipment or expert services (e.g. for computer services, or to have specimen identification confirmed by a specialist). We also allocated funds to consult with a statistical specialist to ensure proper statistical design.

SCHEDULE

A. Measurable Project Tasks for FY 98 (October 1, 1997 - September 30, 1998)

Oct. 1 - Dec. 31: [First quarter] Hire staff; examination of GIS databases for preliminary site selection; obtain NEPA categorical exclusion; statistical sampling design;

January 1998: Attend EVOS workshop in Anchorage

Jan 1 - Mar 31: [Second quarter] Arrange logistics (boats, equipment, contracts, etc.); purchase equipment; preliminary site selection completed.

Apr 1 - Jun 30: [Third quarter] Community visits, preliminary site visits (April); intensive field work to establish sites (May) and begin sampling (May-

Jun). Field work will be concentrated during minus-tide series in these months.

Jul 1 - Sep 30: [Fourth quarter] Continued sampling (July); data entry and preliminary analyses

B. Project Milestones and Endpoints

FY98 Identify and establish study sites; characterize habitat factors affecting recruitment and retention of bidarki and gumboot chitons.

FY99 Experimentally test mechanisms regulating recruitment, retention and habitat selection of bidarkis and gumboots.

FY00 Design and test experimental enhancement methods.

FY01 Final analyses and closeout including recommendations for enhancement program.

C. Completion Date

End of FY01 (30 September 2001).

PUBLICATIONS AND REPORTS

An annual report will be prepared to meet the Council's requirements for work done in 1998. No peer-reviewed articles are anticipated from the first year's work, although they will be prepared if results warrant. However, in the second year we will prepare manuscripts presenting results of the first two years of work for publication in professional journals.

PROFESSIONAL CONFERENCES

None in FY98.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will make use of preceding Council research through the designation of common field sites and sampling design (see methods). This project will also make use of data on chitons collected in Survey of Octopuses in Intertidal Habitats (/009-D) as well as seek the input of researchers involved in the Coastal Habitat Injury Assessment projects.

PRINCIPAL INVESTIGATORS

David Scheel, Behavioral Ecologist
Tania Vincent, Plant Community Ecologist
Prince William Sound Science Center
P.O. Box 705
Cordova, AK 99574
tel: (907) 424-5800
fax: (907) 424-5820
e-mail: dls@grizzly.pwssc.gen.ak.us

Responsibilities: Dr. Scheel will be responsible for project administration, SCUBA sampling and all tagging and movement (retention) studies, identification of intertidal and subtidal fauna, and chiton relocation experiments. He has been working on intertidal and subtidal octopus habitat studies for the past three years in the spill-impacted area.

Dr. Vincent will be responsible for characterization of intertidal and subtidal flora, recruitment sampling and all other experimental designs and analyses. She has been assisting Dr. Scheel with the octopus habitat studies for the past three years and is familiar with intertidal plant communities in the spill-impacted area.

C.V.s for both investigators are attached. Please address all correspondence related to this proposal to David Scheel.

KEY PERSONNEL

Project biologist/field manager (vacant):	Primary responsibility for field scheduling and logistics, equipment and data management, assists with analyses and report writing.
Field assistants (vacant):	Assists with all aspects of field work and sampling.

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Scheel, D, R. Dodge, T.L.S. Vincent. 1997. Survey of octopus in the intertidal in Prince William Sound, Alaska. *Exxon Valdez* Oil Spill Restoration Project final report (Restoration Project 96009-D). Prince William Sound Science Center, Cordova, AK.
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CURRICULUM VITAE

David Scheel
P.O. Box 2113
Cordova, Alaska 99574
(907) 424-7437 (home), -5800 (office)

Education

B.S. 1984 *cum laude*, Biology, Renesselaer Polytechnic Institute, Troy, N.Y.
M.S. 1986, Ecology, University of Minnesota, Minneapolis, M.N.
Ph.D. 1992, Ecology, University of Minnesota, Minneapolis, M.N.

Professional Experience

1993 to present - Prince William Sound Science Center
(Associate Scientist)

1995 to present - University of Alaska Fairbanks
(Affiliate Assistant Professor)

Fall 1995 - Prince William Sound Community College
(Instructor, Geographic Information Systems)

1984 to 1994 - University of Minnesota
(Graduate Student, Teaching Assistant, Post-doctoral Associate, Teaching Specialist, Consultant)

1992-1993 - University of Houston
(Post-doctoral Associate)

1985 to 1992 - Serengeti Wildlife Research Institute
(Visiting Scientist, Research Scientist)

Grants and Academic Honors

1995-1997 *Exxon Valdez* oil spill restoration research on octopus, seabirds, and killer whales ($482,000); NEPA assessment for Shepard Point Road ($508,000).
1994-1995 Co-author, Editor, Co-PI for Sound Ecosystem Assessment, *Exxon Valdez* oil spill restoration (program annual budget, ~$4,500,000).
1984, 1985, 1989 - Graduate School Fellowship, University of Minnesota.
1985, 1986 - Dayton Natural History Fellowship, Bell Museum of Natural History

Professional Memberships

Wildlife Conservation Society of Tanzania
Society for Conservation Biology
Animal Behavior Society
International Society for Behavioral Ecology

Tania L. S. Vincent
P.O. Box 2113
Cordova, AK 99574
907-424-7437
tania@cdr.lter.umn.edu

Education

1996 **Ph.D. Ecology.** *Testing Patterns of Species Richness: A Study of Experimental and Natural Prairie Plant Communities.* Dept. Ecology, Evolution, and Behavior; University of Minnesota; St. Paul, MN. Thesis advisor D. Tilman.

1987 **B.S. summa cum laude, Ecology and Evolutionary Biology,** honors program, minor in mathematics. University of Arizona; Tucson, AZ.

Teaching Experience

1994-present **Part-time University of Alaska Faculty at Prince William Sound Community College (Cordova, AK).** BIOL 201 Environmental Biology (4 cr with lab), AWS (Alaska Wilderness Studies) 194L Plant Community Ecology of Prince William Sound (1 cr).

1989-1993 **Teaching Assistant, University of Minnesota.** Courses: ecology, plant-animal interactions, general biology, introductory animal behavior, zoology, plant community ecology. Labs I have designed: deforestation, genetic drift and founder effects, fire ecology, and tree diversity. I also enrolled in a **Teaching Biology course** to strengthen my teaching skills.

1993 **Elementary Education.** Instructor and Coordinator for the Prince William Sound Science Center's after-school Science Club (Cordova, AK).

Research and Other Professional Experience

present **Prince William Sound Science Center**. Part-time Plant Ecologist, Volunteer Ecologist, octopus project.

1989-1996 **University of Minnesota.** Doctoral Research: prairie plant diversity at Cedar Creek Natural History Area, Nature Conservancy prairie reserves, MN.

1994-1995 **Chugach National Forest Service.** Assistant Biologist: geese and shorebird surveys in Prince William Sound, AK.

1984-1988 **Field Assistant**: plant succession in MN, D. Tilman, U of MN; natural history of fruit bats in American Samoa, P.A. Cox, Brigham Young; bumblebee competition in CO, M.L. Rosenzweig, U of AZ.

1986, 1991 **Field Courses:** Marine Ecology in Baja California (U of AZ), Tropical Ecology in Costa Rica (Organization for Tropical Studies).

1987 **Senior Project**: *Patterns in desert plant communities in relation to soil type.* Tucson, AZ. "Advisor: J.R. McAuliffe, University of Arizona.

Academic Honors

1993 Carolyn M. Crosby Fellowship, University of Minnesota
1993 Dissertation Award, Cedar Creek Natural History Area
1991 James W. Wilkie Natural History Fellowship, Bell Museum of Natural History
1987 summa cum laude graduate, University of Arizona
1987 faculty of science outstanding senior award, University of Arizona

Publications

Vincent, T.L.S., D. Scheel, J.S. Brown, and T.L. Vincent. 1996. *Tradeoffs and coexistence in consumer-resource models: it all depends on what you eat.* American Naturalist. 148(6): 1038-1058.

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Scheel, D., T.L.S. Vincent, and G.N. Cameron. 1996. *Global warming and the diversity of bats in Texas.* Conservation Biology. 10(2): 452-464

in review:
Vincent, T.L.S. and D. Tilman. *Productivity and plant species richness: the effects of fire, drought, and nutrient availability.* Ecology.

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel		$83.6						
Travel		$5.0						
Contractual		$34.8						
Commodities		$3.3						
Equipment		$26.6	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$153.2		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
Indirect		$30.6						
Project Total	$0.0	$183.9		$157.6	$156.0	$90.8	$0.0	
Full-time Equivalents (FTE)		16.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

Amounts shown reflect Science Center costs only. General administration costs for the Lead Agency are not included in Project Totals or Long Range Funding Requirements shown on this page.

Science Center indirect costs are calculated at the negotiated rate of 20% of total direct costs.

1998

Prepared: D. Scheel

Project Number:
Project Title: Bidarki and gumboot chitons: Recruitment and habitat selection.
Name: David Scheel, Prince William Sound Science Center

FORM 4A
Non-Trustee
SUMMARY

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 1998
D. Scheel	Principal Investigator		4.0	6.9		27.7
T.L.S. Vincent	Principal Investigator		4.0	5.5		21.8
vacant	Project Biologist		6.0	4.2		25.5
vacant	Field technician		2.0	4.3		8.6
						0.0
The field technician position will be advertised in local communities						0.0
with the intent of filling the position from a community where						0.0
subsistence use of chiton is common.						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	16.0	20.9	0.0	
					Personnel Total	$83.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Cordova-Anchorage (EVOS workshop)	0.2	2	6	0.2	1.5
Cordova-Port Graham	0.4	3	6	0.1	1.8
Cordova-Tatitlek	0.3	1	2	0.1	0.5
Cordova-Chenega Bay	0.4	2	4	0.1	1.2
					0.0
Funds to travel to Port Graham, Tatitlek and Chenega Bay					0.0
are for community involvement.					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$5.0

1998

Prepared: D. Scheel

Project Number:
Project Title: Bidarki and gumboot chitons: Recruitment and habitat selection.
Name: David Scheel, Prince William Sound Science Center

FORM 4B
Personnel
& Travel
DETAIL

4/7/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:				Proposed
Description				FY 1998
vessel charter	27 days at	$	1,000	27.0
consultant, statistical design				5.0
computer support				1.5
LD telephone, fax, photocopies				0.7
shipping or freight				0.6
			Contractual Total	$34.8

Commodities Costs:		Proposed
Description		FY 1998
fingerling tags	2000 @ $370/1000	0.7
micro-lamp tags, glue, misc. tagging supplies		1.0
field supplies		0.8
office & computer supplies		0.4
foul weather & safety gear		0.4
	Commodities Total	$3.3

1998

Prepared: D. Scheel

Project Number:
Project Title: Bidarki and gumboot chitons: Recruitment and habitat selection.
Name: David Scheel, Prince William Sound Science Center

FORM 4B
Contractual & Commodities
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
SCUBA gear (2 each dry suits, regulators, BCDs, dive computers, weights, gloves, hoods; 6 tanks	2	4.3	8.6
For Survey of Octopuses (/009-D), we rented gear for two divers and spent $5,390 in 1997 for a field effort similar in			0.0
size to the one proposed here. Therefore, over a 3-yr project, it will be less expensive to buy dive gear than to lease it.			0.0
			0.0
SCUBA-quality portable air compressor & filters	1	10.0	10.0
In 1997, we could not find a reliable portable compressors available for short-term rent anywhere in Alaska or the			0.0
Pacific northwest. It will be necessary to purchase one.			0.0
Camera & underwater housing for time-lapse photography	1	5.0	5.0
microscope for examining algae	1	3.0	3.0
			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**	$26.6

Existing Equipment Usage: Description	Number of Units	

Prepared: D. Scheel

1998

Project Number:
Project Title: Bidarki and gumboot chitons: Recruitment and habitat selection.
Name: David Scheel, Prince William Sound Science Center

FORM 4B
Equipment
DETAIL

RECEIVED
APR 1 4 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Pinniped Response to Diet: Submitted Under BAA

Project Number:	98294
Restoration Category:	Research
Proposer:	David Cameron Duffy, Project Leader, University of Alaska Anchorage
Cooperating Agencies:	NOAA, Cornell University, University of Berne, Seward SeaLife Center
Alaska SeaLife Center:	yes
Duration:	two years
Cost FY 98:	$ K TBD
Cost FY 99:	$ K TBD
Geographic Area:	Gulf of Alaska
Injured Resource/Service:	Harbor seal

ABSTRACT

Food limitation during the first year of life has been suggested as a cause of reduced survival and declining populations of several Alaskan pinnipeds, such as Steller sea lion (*Eumetopias jubatus*), Northern Fur Seal (*Callorhinus ursinus*) and Harbor Seal (*Phoca vitulina*). One of these, the harbor seal, is a resource injured by the *Exxon Valdez* oil spill. The other two are important subsistence resources and are intimately tied to the management of Alaska's commercial fisheries, through the threatened status of the sea lion, under the Endangered Species Act. This project tests a hypothesis, derived from sled dog nutritional studies, that high-lipid diets lead to greater mitochondrial functioning in muscle. Additional work will use fatty acids to assess diet and whether the metabolisms of juvenile pinnipeds handle lipids differently than do adults, or whether well-fed animals do so differently than do starving animals.

Since all three species have greatly reduced populations, insufficient opportunities exist to test these aspects using a single species. By taking advantage of existing harvests and captive populations, this study will incur no additional mortality.

Initial field work will involve samples from existing projects in the Pribilofs and in Prince William Sound, on fur seals and harbor seals. Fewer organized opportunities exist to obtain samples for sea lions, but we will attempt to do so from southeast and western Gulf of Alaska populations.

Analysis of these samples will test for differences in mitochondrial activity, diet and lipid pathways. If these are found within species, reflecting age or body condition, then the second year of the study will use non-lethal sampling and controlled diets to measure the response of captive harbor seals and sea lions at the Alaska SeaLife Center in Seward.

INTRODUCTION

Major population decreases of three pinnipeds, Steller sea lion (*Eumetopias jubatus*), Northern Fur Seal (*Callorhinus ursinus*) and Harbor Seal (*Phoca vitulina*) represent major conservation challenges in Alaska, both because of concern for the future of the species, but also because these decreases may be symptomatic of serious problems in Alaska's marine ecosystems. Steller sea lion counts in the Aleutian Islands and Gulf of Alaska declined as much as 80% between 1975 and 1992 (Sease et al. 1993). Range-wide, the population was less than half what it was 30 years before (Loughlin et al. 1992), leading to listing of this species as threatened under the Endangered Species Act. This raises the prospect of limiting commercial fisheries activity under the Act, to prevent further declines in the population.

The Northern Fur Seal population in the Pribilofs, 70% of the world population, has declined 50%, leading to its being listed as 'depleted' under the Marine Mammal Protection Act (NMFS 1993a). This, along with other observations, raises considerable concern among the Aleut inhabitants of the Pribilofs concerning the state of the Bering Sea.

Harbor Seals in the Gulf of Alaska at Tugidak Island declined 92% between 1976 and 1992 (Frost et al 1994). In Prince William Sound, decreases were 60 - 90% (Frost et al 1994). The species is listed as "Not Recovering" by the *Exxon Valdez* Oil Spill Restoration Trustee Council and there is considerable concern by PWS subsistence users about the present condition of harbor seals as a resource.

The reasons for all three declines are not clear, although it appears that in each case several factors may be operating (National Research Council 1996). The *Exxon Valdez* oil spill affected harbor seal populations (Frost et al 1994), but there was less evidence of similar effects on Steller's sea lions (Calkins et al 1994). Take by fisheries may also be a problem (Alverson 1992; Sease 1992; NMFS 1993a) and there is limited subsistence take of all three species (e.g. Stratton 1990; National Research Council 1996).

While all these may contribute, the emerging consensus for all three species is that changes in their food supply have been primarily responsible for the decreases (e.g. Alaska Sea Grant College 1993; Merrick 1995; National Research Council 1996). There are several possibilities: that over-fishing on pollock is directly reducing food for pinnipeds, even for Prince William Sound harbor seals which are spatially removed from the Bering Sea fishery. Pollock may also be out competing other species for limited productivity. Pollock may be consuming other, more suitable prey (Anderson et al. EVOSTC 97163 L, APEX annual report).

None of these provides a mechanism that ties pollock to pinniped population dynamics. In the

Pribilofs, fur seals are not recruiting (Loughlin pers. observ.), suggesting mortality at the juvenile stage. Similarly, mortality seems focused at the juvenile level for sea lions (York 1994). Juveniles were less efficient than their mothers at foraging, with shorter and less frequent dives (Merrick 1995).

Yet another hypothesis is that it is not food availability but food quality that has become limiting. Pollock became more important in sea lion diets in the 1980's (Calkins and Goodwin 1988) and more important in the diet of young sea lions (Merrick and Calkins in press). Pollock have less lipid than do forage fish such as capelin, eulachon and herring (Roby, EVOSTC 96163G, APEX annual report). If a physiological mechanism could be found that reflected deleterious consequences of a low-lipid diet, this would provide support for this last hypothesis.

NEED FOR THE PROJECT

A. Statement of Problem

Populations of all three pinnipeds have declined, in two cases globally, but not uniformly. Food has been implicated as the cause, but the mechanism is unknown. This project would test one mechanism, based on food quality: animals, especially juveniles, on low-lipid diets have decreased foraging competence because they have reduced muscle capability which is a result of reduced mitochondrial growth. This in turn reduces aerobic capacity and rate of fat oxidation.

B. Rationale/Link to Restoration

The harbor seal is listed by the Trustee Council as not having recovered from the *Exxon Valdez* oil spill. Food is believed to hinder recovery, but the mechanism for this is unclear. This project will test a mechanism that may explain such non-recovery. While sea lions were not regarded as injured to any significant extent (Calkins et al. 1994), their current status as 'threatened' under the Endangered Species Act is a factor that may affect management of fisheries resources injured in the spill, if subsistence or commercial fisheries are curtailed to aid recovery. Further understanding of the mechanism for the decline would allow management efforts that maximize benefits to the pinnipeds while minimizing economic dislocation.

C. Location

The laboratory work will be conducted at Auke Bay, Alaska, Ithaca, New York and Berne, Switzerland. The captive rearing exercise will occur at the Alaska SeaLife Center in Seward, Alaska. Samples will be collected from Prince William Sound, the Pribilofs, and the Gulf of Alaska.

COMMUNITY INVOLVEMENT

While there is no special attempt at community involvement, it is an integral part of the project.

The Prince William Sound Harbor Seal Commission, through its integrated sampling supported by Native subsistence hunters, would be asked to provide samples of lipids and muscle. The Aleut people of the Pribilof islands of St. George and St. Paul would provide samples of fur seal and sea lion, from their subsistence harvests. The captive rearing effort at the Alaska SeaLife Center would expose tens of thousands of Alaskans and others to this project.

Finally, based on past experience, this project will receive extensive media coverage both within Alaska and nationally, as its results will bear on issues of concern for the Bering Sea, Prince William Sound and Gulf of Alaska, as well as the country's largest commercial fishery.

PROJECT DESIGN

A. Objectives

This project has three separate objectives

1. to determine if differences in mitochondrial function in wild pinnipeds reflect either age, origin, diet or body condition.

2. to determine if repeated sampling of captive harbor seals and sea lions fed single-species diets is possible.

3. to measure mitochondrial response in captive harbor seals and sea lions fed single-species diets.

B. Methods

Objective 1

Using samples from harvested furseals from the Pribilofs, of harbor seals from PWS, and sealions taken for other reasons, we will correlate mitochondrial activity with fatty acid profiles and lipid class composition. Samples will be flown to Auke Bay and Halifax, Canada for lipid analysis and to Ithaca, N.Y., and Berne, Switzerland for mitochondrial analysis. Simultaneous examination of fatty acid profiles of harbor seal blubber provides analytical quality control.

The entire blubber layer of each animal will be sampled for fatty acids and lipid class composition. Plugs (2.5cm x 2.5cm) will be dissected from the dorsal blubber layer so that the entire thickness of the layer is represented, and the resulting plug will be frozen in labeled airtight containers. Samples will be frozen at -20 C as soon as possible after collection. Frozen samples will be shipped to Auke Bay within 200 days of collection. In Auke Bay, samples taken from harbor seals will be divided into halves and the lipids extracted, one of the extracts will be shipped to Halifax for analysis of fatty acid profiles by S. Iversen at Dalhousie University, the other half will be retained and processed for both fatty acids and lipid class composition. All other samples will be processed in Auke Bay to determine fatty acid concentrations and lipid class composition. Details of the analysis are included in the FY98 proposal entitled "Fatty acid profile and lipid class analysis for estimating diet composition and quality in sealions and their prey".

Nutritional condition and mitochondrial function will be correlated in samples taken from wild pinnepeds to examine the hypothesis that poor quality diets are reflected in mitochondrial function. Dietary differences will be identified by comparing the fatty acid profiles in the each animal's blubber since differences in the fatty acid profile of harbor seals have been shown to reflect dietary differences (Iversen et al. In press). Detailed evaluation of this assumption in sealions forms the basis of a NMFS project proposed to coincide with the second year of this project (see proposal entitled "Fatty acid profile and lipid class analysis for estimating diet composition and quality in sealions and their prey"). While fatty acid profiles of the blubber alone cannot identify the sources of dietary diffferences, the consequences of the differences in terms of nutritional value can be measured by examining the lipid class composition. The proportion of total lipid comprised of triglyceride (TAG) represents the relative amount of surplus energy available to an animal, and therefore indicates nutritional condition. Presumably, animals with higher amounts of TAG will have greater mitochondrial function. Given sufficient samples, the influence of intraspecific demography and geographic distribution on diet and energy acquisition can be examined and related to mitochondrial function.

Objective 2

As the harbor seals and sea lions settle into the Alaska SeaLife Center, we will conduct an initial biopsy, then sequential biopsies to determine if such sampling can be supported without stress to the animals. The biopsy will be with an 11-gauge biopsy needle with suction, rather than by open biopsy. This method has been used successfully and repeatedly on Alaskan huskies which were biopsied eight times over 14 weeks, with exercise immediately after sampling (Reynolds et al. 1995).

The initial effort will also involve attempting to feed the captive harbor seals and sea lions a single species of fish for brief, then increasing periods of time, to assess whether the pinnipeds can maintain body weight and condition. This will involve working closely with the SeaLife Center staff.

Objective 3

If SeaLife Center staff believe they can manage both feeding and biopsy and if the initial field work is promising, then we will attempt a year-long experiment, on available sea lions and harbor seals, feeding them either low-lipid foods such as pollock or high-lipid species such as herring or eulachon. Diet would be adlibitum, with no attempt to maintain iso-caloric ingestion.

Three diet periods of 15 weeks would be undertaken, with sampling of lipids and muscle, at three to five week intervals, depending on the initial trials.

C. Cooperating Agencies, Contract, and other Agency Assistance

This is a joint project involving the Alaska SeaLife Center, NOAA, UAA, Cornell University. NOAA, Auke Bay Lab. will handle the fatty acid analysis the first year. The second year, there will be an independent, broader DPD that will service the fatty acid analysis needs of this project.

SCHEDULE

A. Measurable Project Tasks for FY 98

Summer 97	Collect furseal samples
Fall 97	Collect harbor seal samples
Spring 98	Analysis of lipids and mitochondria
Summer 98	Pilot sampling of captive sea lions and harbor seals at SeaLife Center
Fall 98	Begin year of feeding experiments

B. Project Milestones and Endpoints

Fall 98	Decision on whether to continue to second year
Fall 99	End of year of feeding experiments on captive sea lions and harbor seals
Spring 00	Completion of final report and manuscripts for publication

C. Completion Date

April 15, 00

PUBLICATIONS AND REPORTS

Papers on the initial field sampling will be produced, no matter what the results. If the results of both field sampling and captive rearing support the hypothesis, then a second series of publications will be produced. In addition, the project will produce 2 annual and one final report.

PROFESSIONAL CONFERENCES

This will again depend on the results.

NORMAL AGENCY MANAGEMENT

While two groups of the National Marine Fisheries Service are involved, they would not be active in this area had not the *Exxon Valdez* oil spill occurred.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project was developed from interactions between the EVOSTC Harbor Seal project and the

APEX ecosystem project.

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1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel		$8,547.5						
Travel		$1,794.0						
Contractual		$149,436.0						
Commodities		$1,200.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$160,977.5		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
General Administration		$4,283.3						
Project Total	$0.0	$165,260.8		$160,000.0	$160,000.0			
Full-time Equivalents (FTE)		0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

NOTE: THREE CONTRACT AMOUNTS (see 4B form below) ARE YET TO BE DETERMINED. ONCE DETERMINED, THESE AMOUNTS WILL INCREASE THE PROJECT TOTAL.

1998

Prepared:

Project Number: 98294
Project Title: Pinniped Response to Diet
Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/10/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
R. Heintz	fisheries research biologist	GS 12/1	0.5	6343.0		3,171.5
M. Larsen	reseach chemist	GS 11/6	0.5	5945.0		2,972.5
J. . Lunasin	research chemist	GS 9	0.5	4807.0		2,403.5
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.5	17095.0	0.0	
					Personnel Total	$8,547.5

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Juneau to Anchorage (Restoration Workshop)	444.0	1	6	225.0	1,794.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1,794.0

1998

Prepared:

Project Number:
Project Title: Pinniped Response to Diet
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

4/10/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
sample preparation contract	1,100.0
4A Linkage	148,336.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$149,436.0

Commodities Costs:	Proposed
Description	FY 1998
reagents for 40 samples @ $30/sample	1,200.0
Commodities Total	$1,200.0

1998

Project Number:
Project Title: Pinniped Response to Diet
Agency: NOAA

FORM 3B
Contractual &
Commodities
DETAIL

4/10/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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

1998

Prepared: 4 of 8

Project Number:
Project Title: Pinniped Response to Diet
Agency: NOAA

FORM 3B
Equipment
DETAIL

4/10/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel	$0.0	$87,358.0						
Travel	$0.0	$14,257.0						
Contractual	$0.0	$0.0						
Commodities	$0.0	$10,000.0						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$111,615.0		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
Indirect (32.9%)	$0.0	$36,721.0						
Project Total	$0.0	$148,336.0		$140,000.0	$140,000.0			
Full-time Equivalents (FTE)	0.0	13.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

NOTE: THE THREE CONTRACT AMOUNTS (see 4B form below) ARE YET TO BE DETERMINED. ONCE DETERMINED, THESE AMOUNTS WILL INCREASE THE PROJECT TOTAL.

1998

Project Number:
Project Title: Pinniped Response to Diet
Name: UAA

FORM 4A
Non-Trustee
SUMMARY

ared:
4/10/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:						
Name	Position Description		Months Budgeted	Monthly Costs	Overtime	Proposed FY 1998
D. Duffy	PI		1.0	8158.0		8,158.0
	post doc.		12.0	6600.0		79,200.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		13.0	14758.0	0.0	
					Personnel Total	$87,358.0

Travel Costs:					
Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1998
Juneau to Anchorage	444.0	3	5	225.0	2,457.0
Anchorage to Seward	200.0	12	24	225.0	7,800.0
moving expenses for post doc					3,000.0
conference					1,000.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$14,257.0

1998

Prepared:

Project Number:
Project Title: Pinniped Response to Diet
Name: UAA

FORM 4B
Personnel
& Travel
DETAIL

4/10/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
University of Berne	TBD
Cornell University	TBD
SeaLife Center	TBD
Contractual Total	$0.0

Commodities Costs:	Proposed
Description	FY 1998
computer software	3,000.0
liquid nitrogen	3,000.0
shipping and containers	2,000.0
graphics, printing, and poster printing	2,000.0
Commodities Total	$10,000.0

1998

Project Number:
Project Title: Pinniped Response to Diet
Name: UAA

FORM 4B
Contractual &
Commodities
DETAIL

4/10/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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	

1998	Project Number: Project Title: Pinniped Response to Diet Name: UAA	FORM 4B Equipment DETAIL

Prepared:

4/10/97

98296

RECEIVED
APR 1 4 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	98 296
Restoration Category:	General Restoration
Proposer:	DOI/NPS
Lead Trustee Agency:	DOI/NPS
Cooperating Agencies:	None
Alaska SeaLife Center:	No
Duration:	1st yr., 2 yr. project
Cost FY 98:	$107,000
Cost FY 99:	$0
Geographic Area:	No field work. Catalogue will include artifacts from the entire spill area.
Injured Resource/Service:	Archaeological Resources

ABSTRACT

This project consists of publication of an exhibit-quality catalogue that contains photographs of representative spill-related archaeological artifacts and an interpretation of their significance. Such a publication would give village residents, agencies, scholars and the general public a sense of the entire spill-related artifact collection and what can be learned from the collection and also acknowledge villagers' heritage resources and ties to place.

INTRODUCTION

In its comments on the final report for Project 96154, *Comprehensive Community Plan for the Restoration of Archaeological Resources in Prince William Sound and Lower Cook Inlet,* the National Park Service suggested the development of an exhibit-quality catalogue of spill-related artifacts as a way to share with a broad audience information about spill-related artifacts. Public Advisory Group members suggested that the catalogue address all spill-related artifacts, not just those recovered from Prince William Sound and lower Cook Inlet.

The final report for Project 96154 recommends curation of spill-related artifacts recovered from Prince William Sound and lower Cook Inlet in local repositories in the seven Native villages of the Chugach region and possibly an eighth facility in Seldovia. The Trustee Council has not yet decided whether to provide funding for local repositories in this part of the spill area and has initiated a process for determining which communities intend to establish a local repository and a consensus on the structure and function of a "regional repository organization."

Village leaders from some of these communities have placed the highest priority on construction of a local repository in their community and expressed a willingness to support development of a catalogue provided it does not delay progress on repositories. Development of the catalogue will not delay progress on repositories because the catalogue draws largely on existing reports and does not require that the artifacts reside in any particular location.

NEED FOR THE PROJECT

A. Statement of Problem

The final report for Project 96154 revealed that about 1,500 artifacts and scientific samples have been recovered from spill-injured archaeological sites in Prince William Sound and lower Cook Inlet. All but a few of these items pertain to early Native occupants of the spill-area. These items are stored in six different museums and offices in Juneau, Anchorage, Fairbanks and Valdez. Additional artifacts have been recovered from the Kodiak archipelago, but this area was not addressed in Project 96154.

Little information about these items is accessible to the public. Except for the six items on loan to the Valdez Museum, none of the spill-related artifacts is on public display. Furthermore, even if more of these items were on display, the cultural information conveyed would reach only the relatively small number of people able to visit the exhibits. Although a great deal of scholarly information about these artifacts is available in various reports (e.g., The Exxon Cultural Resources Program reports, the SUNY-Binghampton damage assessment report, and final reports for ARC1 and \007A & B) in libraries throughout Alaska and elsewhere, few members of the public have the interest to seek out these documents or the ability to understand them.

The primary objective of the proposed project is to make information about spill-related archaeological artifacts understandable and therefore accessible to a broad segment of the public. The proposed catalogue would contain photographs of representative artifacts as well as an interpretation of their cultural significance. For example, the catalogue could contain several photographs of "faunal remains" and explain what these artifacts tell us about the early residents of the spill area and the ecosystem that prevailed hundreds of years ago.

B. Rationale/Link to Restoration

The proposed project is an inexpensive way of affording a broad range of people the opportunity to view and learn about the cultural heritage of people in the spill area and thereby increase awareness and protection of injured archaeological resources. The proposed catalogue would be accessible to village residents, school children throughout Alaska and elsewhere, scholars in many parts of the world and others who may have an interest.

C. Location

The catalogue will address archaeological artifacts collected throughout the spill area (Prince William Sound, lower Cook Inlet and Kodiak archipelago). These artifacts are presently stored in Fairbanks, Anchorage and Juneau.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The Public Advisory Group and Community Involvement Facilitators have discussed the concept of an exhibit-quality catalogue at various workshops, meetings and teleconferences held in early 1997. Public Advisory Group members suggested that the catalogue address all spill-related artifacts, not just those recovered from Prince William Sound and lower Cook Inlet. Members of both groups expressed the opinion that development of the catalogue should not delay progress on repositories.

Traditional ecological knowledge could be valuable in the interpretation of artifacts. The Request for Proposals (RFP) for professional services to develop the catalogue will stress the importance of traditional ecological knowledge and ask bidders to describe how they would obtain this information.

PROJECT DESIGN

A. Objectives

1. An interesting and understandable description of representative artifacts and scientific samples and interpretation of their significance. The target audience for this information is the general public.

2. Wide dissemination of information about spill-related artifacts and scientific samples.

B. Methods

1. Inventory of artifacts and scientific samples. The final report for Project 96154 contains an inventory of artifacts and scientific samples recovered from Prince William Sound and lower Cook Inlet. Additional items have been recovered from the Kodiak archipelago. expanding the inventory to include artifacts and scientific samples from the Kodiak area should be a relatively small proportion of the total effort in this project.

2. Research. In order to describe and interpret artifacts and scientific samples, the principal investigator must conduct some research, primarily a review of pertinent literature and consultation with village elders and others who may possess traditional knowledge useful in interpreting these items.

3. Photographs. It is neither necessary not desirable for the catalogue to include photographs of all spill-related artifacts and scientific samples. Many of these items are duplicates or fragments and may not be illustrative of the type of artifacts being discussed. The catalogue will therefore include photographs of representative samples of artifacts. In some cases, photographs may be readily available. In other cases, it may be necessary to take new photographs.

4. Manuscript preparation. Drawing upon reports and indigenous knowledge, the principal investigator will describe spill-related artifacts and scientific samples and interpret their significance. The length and language of the text should be designed to attract the interest of the general public.

5. Review. The draft manuscript will be submitted to cultural resource managers at DOI/NPS, USFS and ADNR/SHPO, and the Trustee Council's Executive Director and Chief Scientist for review.

6. Publication. Upon approval by the Chief Scientist and Executive Director, the contractor will reproduce at least 1000 copies of the catalogue. Although the primary format for the catalogue will be hard copy, the lead agency will explore the possibility of using alternative vehicles, such as a CD-ROM, within the constraints of the funds available for this project.

7. Distribution. The Restoration Office will distribute the catalogue to key organizations, such as village councils and schools within the spill area, museums, the University of Alaska and other interested parties.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

The catalogue will be produced by a contractor selected through a competitive procurement process. The lead agency will be seeking an individual or group experienced in interpretation of archaeological artifacts as well as the production of exhibit-quality publications. Cultural resource personnel in USFS, DOI/FWS and ADNR/SHPO will be invited to participate in selection of the contractor and review of draft documents.

SCHEDULE

A. Measurable Project Tasks for FY 98 (October 1, 1997 - September 30, 1999)

Oct. 1, 1997–Jan. 31, 1998:	Issue an RFP, select a contractor and execute a professional services contract for development of an exhibit-quality catalogue of spill-related artifacts.
Feb. 1– Apr. 30, 1998:	The contractor completes an inventory of spill-related artifacts
May 1– Oct. 31, 1998:	The contractor completes a review of relevant final and draft reports and other literature, locating or taking photographs of representative artifacts and collecting traditional ecological knowledge pertinent to the interpretation of artifacts.
Nov. 1, 1998–Apr. 30, 1999:	The contractor completes a draft of the catalogue and sends it to agency cultural resource personnel and the Trustee Council's Executive Director and Chief Scientist for review.
May 1–Aug. 31, 1999:	The contractor completes necessary revisions, upon approval of the revised manuscript by the Trustee Council's Chief Scientist and Executive Director, and reproduces 1000 copies of the catalogue.
Sept. 1–Sept. 30, 1999:	The Restoration Office distributes the catalogue.

B. Project Milestones and Endpoints

The endpoint of this project, the publication and distribution of an exhibit-quality catalogue of spill-related artifacts and scientific samples, will be accomplished by September 30, 1999.

Project milestones include:

August 31, 1999:	Objective 1. An interesting and understandable description of representative artifacts and scientific samples and interpretation of their significance. The target audience for this information is the general public.
September 30, 1999:	Objective 2. Wide dissemination of information about spill-related artifacts and scientific samples.

C. Completion Date

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

PUBLICATIONS AND REPORTS

The project will produce at least 1000 copies of an exhibit-quality catalogue of spill-related artifacts. In addition, a final report will be prepared according to the specifications of *Procedures for the Preparation & Distribution of Reports*, that is, 36 copies (32 bound and 4 camera-ready) of the catalogue plus a title page, study history, abstract, key words, project data and citation and sent to the Oil Spill Public Information Office for distribution to a network of libraries and reproduction centers.

PROFESSIONAL CONFERENCES

Not applicable.

NORMAL AGENCY MANAGEMENT

None of the agencies responsible for managing archaeological resources in the spill area (DOI, USFS and ADNR) is required to produce catalogues of archaeological artifacts. Exhibit-quality catalogues are usually published by museums in conjunction with major exhibits.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The contractor will draw heavily on final and draft reports for past restoration projects, such as ARC1, \007A and \007B, as well as consultation with the principal investigators for these projects. The principal investigator will also coordinate with Project \052 in making village contacts.

PROPOSED PRINCIPAL INVESTIGATOR

The catalogue will be produced by a contractor selected through a competitive procurement process. The principal investigator will be specified in the professional services contract. The project manager for the National Park Service is:

Betty Knight
National Park Service
2525 Gambell Street, Room 107
Anchorage, Alaska 99503
Phone: (907) 257-2656
Fax: (907) 257-2695

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel	$0.0	$0.0
Travel	$0.0	$0.0
Contractual	$0.0	$100.0
Commodities	$0.0	$0.0
Equipment	$0.0	$0.0
Subtotal	$0.0	$100.0
General Administration	$0.0	$7.0
Project Total	$0.0	$107.0
Full-time Equivalents (FTE)	0.0	0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
	$0.0	$0.0	$0.0	$0.0	

Dollar amounts are shown in thousands of dollars.

Comments: This project consists of the production and distribution of an exhibit-quality catalogue of spill-related archaeological artifacts and scientific samples. The catalogue will be produced by a contractor selected through a competitive procurement process. The estimated maximum cost to produce the catalogue is $100,000. The Restoration Office will distribute the catalogue to villages, museums and schools throughout the spill area and elsewhere in the state. The estimated cost of mailing the catalogue is $500 and will be absorbed by the budget for Project 99100 (distribution will occur in FY 99). The cost of agency personnel required to oversee this project will be reflected in Project 98250, Project Management.

1998

Project Number: 98_______
Project Title: Exhibit-quality Catalogue of Archaeological Artifacts
Agency: DOI/NPS

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/14/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		0.0	0.0	0.0	
					Personnel Total	$0.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
					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

1998

Project Number: 98______
Project Title: Exhibit-quality Catalogue of Archaeological Artifacts
Agency: DOI-NPS

FORM 3B
Personnel
& Travel
DETAIL

4/14/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
Contract for production of an exhibit-quality catalogue of archaeological artifacts.	100.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$100.0

Commodities Costs:	Proposed
Description	FY 1998
Commodities Total	$0.0

1998

Project Number: 98______
Project Title: Exhibit-quality Cataloge of Archaeological Artifacts
Agency: DOI-NPS

FORM 3B
Contractual &
Commodities
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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

1998

4 of 4

Project Number: 98_____
Project Title: Exhibit-quality Catalogue of Archaeological Artifacts
Agency: DOI-NPS

FORM 3B
Equipment
DETAIL

4/14/97

98297-BAA

Oceanography of PWS Bays and Fjords. Submitted Under the Broad Agency Announcement.

Project Number: 98297-BAA

Restoration Category: Research

Proposer: Prince William Sound Science Center

Sponsoring Agency: NOAA

Duration: One year

Cost FY 98: $88.0 K

Cost FY 99: $0 K

Cost FY 00: $0 K

Cost FY 01: $0 K

Cost FY 02: $0 K

Geographic Area: Prince William Sound

Injured Resource/Service: Pacific Herring

RECEIVED
APR 14 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

Eaglek Bay, Whale Bay, Simpson Bay, and Zaikof Bay are the focus of the Sound Ecosystem Assessment (SEA) Herring group (320-T) because of historial observations of large numbers of juvenile Pacific herring. Hydrographic surveys and current velocity measurements from October 1995 to November 1996 show significant differences in water mass properties and circulation patterns between these 4 bays in Prince William Sound (PWS). The FY96 physical data will be combined with data from FY97, and correlated with biological measurements. SEA Physical Oceanography (320-M) has provided support for SEA Herring in the past, but support in FY98 will not be possible because of scheduled funding cuts. Without continued funding, physical data will only be available for 2 winter periods, October 1995 - March 1996, and October 1996 - March 1997. This proposal is for additional funding to provide physical support for the SEA Herring project, and document physical conditions in its third and final winter sampling period, October 1997 - March 1998. The goal of this research is to identify physical factors that control the production of Pacific herring in PWS.

INTRODUCTION

The goal of the SEA Herring project (320-T) work was to determine habitat overwintering quality for juvenile herring, and identify retention mechanisms in the nearshore regions.The physical oceanographic support for the herring project in FY94 - FY97 came from the SEA Physical Oceanographic project (320-M). Because SEA project 320-M is scheduled for closeout in FY99, emphasis in FY98 SEA Oceanography wil be on modelling, data synthesis, monitoring program development, and collaborative manuscript submission. No field work was proposed for FY98 under 320-M. Since the SEA herring project field work started approximately one year after the other SEA projects, SEA herring has remaining field work in FY98. Two cruises are planned in October 1997 and March 1998. Because of scheduled reductions in funding, SEA Physical Oceanography will be unable to provide oceanographic field suppoort for SEA herring in FY98. This proposal is for addition funding, separate from SEA 320-M, to provide the oceanographic support for the two FY98 SEA herring cruises, data analysis, and to address reviewers' comments regarding circulation model validation in relation to dispersal of herring larvae.

Starting in October 1995, measurements of temperature, salinity, oxygen, current velocity, fluorescence, and zooplankton data were collected in several bays and fjords around PWS by SEA Physical Oceanography (320-M). In 1996, the number of bays was reduced to 4: Whale, Eaglek, Simpson, and Zaikof Bays. Vertical sections of temperature, salinity, density, and current velocity were created for each cruise. Horizontal contours of temperature, salinity, and density, and horizontal velocity vector plots were also created. These hydrographic data show that unlike most of PWS, Eaglek Bay and Whale Bay (fjords) retain their upper layer stratification throughout the year. The fresh, cold suface layer is never entirely mixed. In contrast, Simpson Bay and Zaikof Bay resemble the neutrally stratified majority of PWS in March. This may mean that Eaglek Bay and Whale Bay are less connected to the Sound than Simpson Bay and Zaikof Bay. Large differences in temperature and salinity exist between bays at the same time of year. A temperature and salinity (and density) front is present at the mouth of Zaikof Bay in March 1996, but not at other bays. No anoxic deep layers were found in any of the bays.

Vertical sections of horizontal velocity show the currents in these bays to be extremely complex and seasonally variable. Differences exist between the head and the mouth of the bay in nearly all cases. Except for Eaglek Bay, the currents at 10 meters are generally weaker at the head than at the mouth of the bays. A strong current shear exists at the mouth of Zaikof Bay on both flood and ebb tide. The density fronts and horizontal velocity shears could be responsible for the retention of zooplankton and juvenile fish in the bay. An anticlyclonic eddy was observed at the mouth of Zaikof Bay in October 1996, which could also act as a retention mechanism.

In FY97, the herring nearshore hydrographic and current velocity data will continue to be analyzed. Several nearshore cruises are planned as part of the SEA herring project (320-T). Hydrographic, current velocity, and zooplankton measurements will be made by SEA oceanography (320-M) as in previous years. Comparisons will be made with the fish catch data. Physical retention mechanisms will be identified.

This proposal is for support to continue measurement in FY98 of water mass properties (temperature, salinity, and potential density), and current velocities, using a hull mounted acoustic Doppler current profiler (ADCP). Continued measurement of zooplankton densities, using an optical plankton counter (OPC), will be compared to small scale temperature, salinity, and fluorescence data measured by the Aquapack (towed with the OPC). To document the variability of the temperature in each bay as a function of time, deployment of temperature logger moorings (3 per bay) is proposed. Finally, to verify the predictions of the larval herring drift model being developed under SEA project 320-J, deployment of 9 satellite tracked drifting buoys is proposed.

NEED FOR THE PROJECT

A. Statement of the Problem

Pacific herring resources continue to be listed as injured and non-recovering. SEA is an interdisciplinary ecosystem approach to understand which biological and physical factors in the environment might be constraining the recovery of this species (320-T). Coupled biological and physical data (temperature salinity, and current velocity) are not available for the Sound. The dominant physical processes that influence Pacific herring production in PWS mostly unknown. The proposed project will continue the observations previously funded under SEA Oceanography (320-M), and perform the analysis necessary to understand critical processes. This coupling of physical data with juvenile herring research has been strongly supported by the peer reviewers. Following the SEA herring review in Anchorage in February, the reviewers strongly urged increasing physical-herring links, and in particular recomended using drifters to test the simulation model for drift of larval herring away from the spawning grounds.

B. Rationale/Link to Restoration

Without understanding how environmental and ecological factors might be influencing the recovery of injured species, there is no clear means for interpreting the past and present production status of Pacific herring in Prince William Sound. Further, restoration activities undertaken in the absence of knowledge about ecosystem function could conceivably cause more damage than they are intended to remedy. In the short term, development of improved stock assessment techniques and their application to building and evaluating numerical models of the herring ecosystem will improve the tools available for harvest management. Over the long term, as the SEA Herring program obtains a better understanding of ecosystem form and function in Prince William Sound, the risks associated with proactive restoration activities will become much less uncertain. The numerical models developed by SEA will allow a variety of "what if" restoration options to be evaluated prior to their implementation as a measure for protecting all resources in the region.

C. Location

This project has been designed for Prince William Sound. All communities that utilized the marine resources of Prince William Sound will benefit from this research.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Local fishing vessels and ships will be chartered for oceanographic cruises in FY98. This project will contribute information to local news letters and newspaper articles. Scientific results will be posted on the SEA web page, and will be accessible to the public.

PROJECT DESIGN

A. Objectives

The main objective of this research is to extend the work done by SEA Observational Oceanography (320-M) in support of SEA herring (320-T) into FY98. The overall goal of both SEA 320-M and this project is to identify the dominant physical processes (tides, storms, water temperature, salinity, etc.) that influence Pacific herring production in PWS. Specific goals for FY98 are:

1. Document the seasonal and interannual changes in water mass properties (temperature, salinity, and density), current velocity patterns in Eaglek Bay, Whale Bay, Simpson Bay, and Zaikof Bay, during the final year of the SEA Herring project (FY98).

2. Correlate fluorescence and zooplankton distributions with water mass properties, and current velocity.

3. Identify physical retension mechanisms (fronts, eddies, etc.) within the bays.

4. Obtain time series of temperature changes throughout winter (Oct. 97 - March 98) in each bay for use in the herring bioenergetics model.

5. Verify predictions of a larval drift simulation by the numerical circulation model developed under SEA project 320-J.

B. Methods

1. Temperature, salinity, and current velocity data will be collected with a CTD and a hull mounted ADCP on cruises in October 1997 and March 1998. In FY98, SEA Herring (320-T) has proposed using

only one vessel for field work. The fish acoustics sonar (SEA project 320-N) will be operated from this vessel. The ADCP and the fish sonar can not be operated simultaneously because of acoustic interference. To obtain both current velocities and fish abundances, funding for a separate vessel to operate the ADCP (and the CTD and OPC) is requested.

2. In addition to the CTD and ADCP, the Aquashuttle will be flown from the oceanography vessel. The Aquashuttle consists of an OPC to measure zooplankton, and an Aquapack to simultaneously measure temperature, salinity, oxygen, and fluorescence. Zooplankton densities and fluorescence will be correlated with water mass properties, and current velocities.

3. Potential physical retension mechanisms have been identified in FY96 field data. Density fronts were documented by the CTD and Aquapack surveys. Regions of strong velocity shears and eddies were documented by the ADCP. These features do not appear at all bays in all times of year. Continued CTD and ADCP measurements will allow more confident predictions of when and where these retention mechanisms occur.

4. Moored temperature loggers at 5, 25, and 50 meter depths, will be deployed at the head, middle, and mouth of each of the 4 bays to provide a continuous time series of temperature from October 1997 to March 1998. Previous results have indicated substantial differences in current velocities and water mass properties between the head and the mouth of some bays. Three moorings positioned along the bay axis will provide a coarse estimation of the spatial variations in temperature. Temperature loggers were deployed in FY96 under the SEA Herring project (320-T), however the majority of those were lost or malfunctioned, so that winter-time temperature data are inadequate for use in overwintering models.

5. ARGOS satellite tracked drifting buoys will be deployed just outside of Valdez Arm at the prime herring spawning site in May 1998. This corresponds to the beginning of the herring larval drift period. The release location could be modified depending on spawn location data in April (from ADF&G). As suggested by Chief Scientist Bob Spies and numerous reviewers, the larvel drift model requires field validation. Drifters will be deployed at 3 locations along the spawning site (about 50 km alongshore) at intervals of 2 to 3 days, and allowed to drift for roughly 2 months. Vessels or aircraft of opportunity will be used for the deployment. It is necessary to have several drifting buoys (9) to provide the necessary statistics to verify possible paths in the model predictions, and to show if retention is present or not.

C. Cooperating Agencies, Contracts and Other Agency Assistance

Vessel charters will contracted to the private sector through competitive bid.

SCHEDULE

A. Measurable Project Tasks for FY 98

October 1997:	SEA herring October cruise
October 1997:	Deploy temperature loggers
Oct. - Jan. 1998:	Analyze field data
January 1998:	EVOS Workshop - Anchorage
March 1998:	SEA herring March cruise
March 1998:	Retrieve temperature loggers
March - Sept.:	Analyze field data, prepare manuscripts
May 1998:	Deploy drifting buoys
September 1998:	Manuscripts submitted for pubilication

B. Project Milestones and Endpoints

All objectives listed under Project Design will be completed by the end of FY98. Depending on the status of injured Pacific herring resources at that time, additional research/monitoring may be needed. This contingency will be evaluated near the end of FY98 in cooperation with the EVOS Chief Scientist and the Trustee Council.

D. Completion Date

The completion data of this project is September 30, 1998.

PUBLICATIONS AND REPORTS

Manuscripts will be submitted on the following topics by the end of FY98:

1. Circulation and water mass properties in the bays and fjords of PWS. In Continental Shelf Research, or Journal of Geophysical Research.

2. Retention mechanisms for juvenile Pacific herring (joint with SEA herring). In Transactions of the American Fisheries Society.

PROFESSIONAL CONFERENCES

Travel is requested to present results at the EVOS Workshop in January 1998 in Anchorage.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This research will be coordinated with all components of the SEA program. Research cruises and much of the data collected will shared with other SEA investigators. This project will also cooperate with APEX and other EVOS-sponsored programs to provide the most efficient means for investigating biological and environmental factors common to all projects.

PROPOSED PRINCIPAL INVESTIGATOR

Shari L. Vaughan, Ph.D.
Prince William Sound Science Center
P. O. Box 705
Cordova, Alaska 99574
(907) 424-5800 Office
(907) 424-5820 Fax
vaughan@grizzly.pwssc.gen.ak.us

PRINCIPAL INVESTIGATOR

Shari L. Vaughan, Ph.D.
Physical Oceanographer, Prince William Sound Science Center
(P.I. of SEA Physical Oceanography project 320-M)

Education:

B.S., University of Miami, May 1981, Physics (major)/Mathmatics (minor)
M.S., University of Miami, May 1986, Physics

Ph.D., University of Miami, Rosenstiel School of Marine and Atmospheric Science (RSMAS), May 1993, Meteorology and Physical Oceanography (MPO), Kevin D. Leaman, advisor

Professional Experience (since 1986):

1986 - 1993: Research Assistant, University of Miami, RSMAS, MPO, Miami, Florida

1993 - 1995: Postdoctoral Associate, University of Miami, Cooperative Institute for Marine and Atmospheric Studies, a cooperative institute between RSMAS and NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, Robert L. Molinari, supervisor

Sept. 1995 - present: Physical Oceanographer, Prince William Sound Science Center, Cordova, Alaska

Recent Refereed Journals:

Vaughan, S. L. and K. D. Leaman, 1995: The Role of Small-Scale Cells in the Mediterranean Convection Process. J. Phys. Oceanogr., 25 (10), 2423-2436.

Vaughan, S. L. and R. L. Molinari, 1997: Temperature and Salinity Variability in the Deep Western Boundary Current. J. Phys. Oceanogr., (accepted, May issue).

OTHER KEY PERSONNEL

Shelton M. Gay: cruise staging, instrument calibration and maintenance, data acquisition and analysis, contribute to journal publications.

Loren Tuttle: collect and analyze mainly OPC and Aquapack data, maintenance of OPC, contribute to journal publications.

1998 EXXON VALDEZ TRUS.__ COUNCIL PROJECT BUDGET
February 1, 1998 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998R						
Personnel		$26,652.0						
Travel		$580.0						
Contractual		$29,800.0						
Commodities		$900.0						
Equipment		$15,396.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$73,328.0		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
Indirect (20%)		$14,665.6						
Project Total	$0.0	$87,993.6						
Full-time Equivalents (FTE)		0.4						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

1998

Project Number: 98297-BAA
Project Title: Oceanography of PWS Bays and Fjords
Name: Prince William Sound Science Center

FORM 4A
Non-Trustee
SUMMARY

Prepared: 1 of 4

4/11/97

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

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 1998
Shari Vaughan	Physical Oceanographer (PI)		1.0	7000.0		7,000.0
Kenric Osgood	Physical Oceanographer		0.0	4900.0		0.0
Shelton Gay	Physical Oceanographer		2.0	5176.0		10,352.0
Loren Tuttle	Biological Oceanographer		2.0	4650.0		9,300.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		5.0	21726.0	0.0	
					Personnel Total	$26,652.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
EVOS Workshop - Anch. - Jan.98 (1r/t @$160, 3 days @$140)	160.0	1	3	140.0	580.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$580.0

1998

Project Number:
Project Title: Oceanography of PWS Bays and Fjords
Name: Prince William Sound Science Center

FORM 4B
Personnel
& Travel
DETAIL

Prepared:

4/11/97

1998 EXXON VALDEZ TRUS.__ COUNCIL PROJECT BUDGET
February 1, 1998 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
Phone, fax, copying	200.0
Publication Costs	0.0
Mail, freight, shipping	200.0
Vessel Charter (2 cruises, 10 days ea. $1200/day)	24,000.0
ARGOS fee (9 drifters, 60 days ea. @ $10/day)	5,400.0
Contractual Total	$29,800.0

Commodities Costs:	Proposed
Description	FY 1998
Office supplies	200.0
Computer supplies	200.0
Marine supplies	500.0
Commodities Total	$900.0

1998

Project Number:
Project Title: Oceanography of PWS Bays and Fjords
Name: Prince William Sound Science Center

FORM 4B
Contractual &
Commodities
DETAIL

Prepared:

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

February 1, 1998 - September 30, 1998

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 1998
ARGOS satellite tracked drifting buoys	9	1500.0	13,500.0
Temperature loggers (4 bays, 3/bay)	12	158.0	1,896.0
			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**	$15,396.0

Existing Equipment Usage:	Number	
Description	of Units	

1998	Project Number: Project Title: Oceanography of PWS Bays and Fjords Name: Prince William Sound Science Center	FORM 4B Equipment DETAIL

Prepared:

4/11/97

BUDGET JUSTIFICATION: FY98 (Oct. 1, 1997 - Sept. 30, 1998)

Project Number:

Title: Oceanography of PWS Bays and Fjords

Proposer: Prince William Sound Science Center

Total Cost FY98: $88.0 K

Salary: Two months salary is requested is requested for 2 research associates to collect and analyze CTD and ADCP data (S. Gay), and OPC and Aquapack data (L. Tuttle). One month salary is requested for PI to analyze data and prepare manuscripts.

Travel: Travel is requested for one researcher to present results at EVOS Workshop in Anchorage in January 1998.

Services: Vessel charter for 2 cruises in FY98, Oct. 1997 and March 1998, 10 days each @ $1200 per day, to collect ADCP, CTD, and OPC/Aquapack data.

ARGOS, a French company that operates the satellites that track the drifting buoys, charges a fee of roughly $10 per day per drifter for this service.

Funding is requested to cover minimal phone, fax, and copying charges, and mail, freight, and shipping charges.

Supplies: Funding is requested to cover minimal office, computer, and marine supplies.

Equipment: 9 ARGOS satellite tracked drifting buoys will be deployed in a herring spawning area in May 1998 to verify the predictions of a numerical larval drift model.

Temperature logger moorings will be deployed in 4 bays in PWS (Eaglek, Whale, Simpson, and Zaikof Bays), at the head, middle, and mouth of each bay (12 total), to document winter conditions.

98298-BAA

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

Project Number: 98298-BAA

Restoration Category: General Restoration

Proposer: Michael R. Yarborough

Lead Trustee Agency:

Cooperating Agencies:

Alaska SeaLife Center:

Duration: 1 year

Cost FY 98: $6,200

Geographic Area: Seward

Injured Resource/Service: Archaeological Resources

RECEIVED
APR 15 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

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.

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 98 (October 1, 1997 - September 30, 1998)

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, 1998: Objective 1. Development of a publication that presents archaeological information gained from research at the Alaska SeaLife Center to the general public.

September 30, 1998: 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, 1998.

C. Completion Date

The brochure will be completed and distributed by September 30, 1998.

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.

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998
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 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
Other Resources					

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.

1998

Project Number: 98__
Project Title: Public Brochure on Archeology at the Alaska SeaLife Center
Name: Cultural Resource Consultants

FORM 4A
Non-Trustee
SUMMARY

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:				Months	Monthly		Proposed
	Name	Position Description		Budgeted	Costs	Overtime	FY 1998
	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 1998
						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

1998

Prepared: 4/14/97

Project Number: 98__
Project Title: Public Brochure on Archeology at the Alaska SeaLife Center
Name: Cultural Resource Consultants

FORM 4B
Personnel
& Travel
DETAIL

4/14/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
Brochure Printing	3.0
Contractual Total	$3.0

Commodities Costs:	Proposed
Description	FY 1998
Commodities Total	$0.0

1998

Prepared: 4/14/97

3 of 4

Project Number: 98__
Project Title: Public Brochure on Archeology at the Alaska SeaLife Center
Name: Cultural Resource Consultants

FORM 4B
Contractual &
Commodities
DETAIL

4/14/97

1998 EXXON VALDEZ TRUS. __ COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description		Number of Units	Unit Price	Proposed FY 1998
				0.0
				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	

1998	Project Number: 98__ Project Title: Public Brochure on Archeology at the Alaska SeaLife Center Name: Cultural Resource Consultants	FORM 4B Equipment DETAIL

98302-CLO

Prince William Sound Cutthroat Trout, Dolly Varden Char Inventory

Project Number:	98302 - CLO
Restoration Category:	Monitoring
Proposer:	USFS, Cordova Ranger District
Lead Trustee Agency:	USFS
Alaska SeaLife Center:	
Duration:	Second year, 2-year project
Cost FY 97:	$12,800
Cost FY 98:	$ 4,100
Geographic Area:	Prince William Sound
Injured Resource:	Dolly Varden char, cutthroat trout

RECEIVED
APR 15 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

ABSTRACT

This is the closeout of monitoring project 97302. This proposal is for the funding of the writing of the final report.

The status of cutthroat trout and Dolly Varden char following the *Exxon Valdez* oil spill is unknown, and little baseline information exists. One specific problem is the lack of information concerning the existence of these species in various watersheds. So far in FY 1997, the main researcher has interviewed local residents and other knowledgeable persons and conducted literature searches to document the locations of cutthroat trout and Dolly Varden char populations. A number of previously undocumented populations have been discovered. Additional work and some field sampling will occur during the rest of FY 1997 to verify unsubstantiated reports.

INTRODUCTION

There is little information available on the presence of Dolly Varden char (*Salvelinus malma*) and cutthroat trout *(Oncorhynchus clarki)* in various watersheds in Prince William Sound. Other studies have stated that there are only 14 lacustrine systems in Prince William Sound that have anadromous Dolly Varden char and only 10 with anadromous cutthroat trout (Hepler et al. 1993). Recent consultations with local residents indicate, however, that there may be many other lacustrine systems with these species. There are also a number of lacustrine and non-lacustrine systems with these species which have not been recorded in the Alaska Department of Fish and Game Anadromous Waters Catalog (1994 revision).

By conducting a more complete inventory of the lake and stream systems in Prince William Sound, we should get a better understanding of the distribution of these species, their abundance, and the magnitude of the effects of the oil spill on these species. If there are substantially more systems with large populations than had been previously reported, the spill may not have had a substantial impact on the overall health of the species and enhancement work may be unnecessary. On the other hand, if the number of systems are limited and populations are small, additional measures may be needed to protect these species and their habitat.

In FY 1997, researchers have conducted interviews with local residents and other knowledgeable persons and have reviewed the literature, agency reports, and other sources of information. So far a number of undocumented populations of both species have been discovered. Additional interviews and literature searches, as well as some field sampling, will be conducted during the remainder of FY 1997. The final report will be written in FY 1998.

NEED FOR THE PROJECT

A. Statement of Problem

The status of anadromous Dolly Varden char and cutthroat trout in Prince William Sound is currently unknown. One of the problems is that basic information, such as the stream systems which have these species, now appears to be incomplete. Without knowing how many stocks are present in the Sound or knowing whether large populations exist in remote streams or lakes, it is difficult to say whether further enhancement work is necessary to boost the populations or whether the species have recovered.

B. Rationale/Link to Restoration

This project will identify those systems with Dolly Varden char and cutthroat trout populations and provide an idea as to the relative numbers. If there are substantially more stocks than previously believed, or with greater numbers, we may be able to conclude that these species have recovered sufficiently, or that there is no need for further enhancement. If there are still some uncertainties, more intensive population studies could be carried out, presumably by the Alaska Department of Fish and Game Sportfish Division, which is responsible for population management of these species.

The information from this project can also be combined with the results of *EVOS* project 96145 to help determine the relative status of these species. If project 96145 determines that the populations throughout the Sound are genetically similar, and this project finds numerous streams with these species, there may be less need for concern. If, however, the populations are few, isolated, and genetically distinct, there may be a greater need for habitat protection or enhancement.

C. Location

A number of potential sites have been identified in the Valdez Arm area, Hinchinbrook Island, northern Montague Island, and Knight Island. A better understanding of these species would benefit all users of the Sound, but particularly the residents of Valdez, Tatitlek, Cordova, and Chenega.

COMMUNITY INVOLVEMENT

The idea for this project originated out of information we received from local residents regarding stocks of Dolly Varden char and cutthroat trout. We learned that there are a number of stream systems with these species which are not listed in the Anadromous Waters Catalog and were apparently not known to other researchers. Thus, one of the primary methods for conducting this project will be to contact local residents in the communities of the Sound and ask for information on stream systems with these species. Questionnaires, telephone calls, or other methods would be used to contact various tribal groups, sportfishing clubs, or persons who might have knowledge of the local streams.

PROJECT DESIGN

A. Objectives

1. Determine the presence or absence of cutthroat trout and Dolly Varden char populations in stream systems in Prince William Sound, using interviews, literature searches and other written information, and field sampling.

2. Compile the information on population locations from this project and other studies for inclusion in the Alaska Department of Fish and Game Anadromous Catalog.

B. Methods

The basic hypothesis is that there are a number of undocumented anadromous cutthroat trout and Dolly Varden char populations in Prince William Sound, some of which could have large numbers of fish. This project will require a thorough investigation of past studies by other agencies, and equally as important, a gathering of information from local residents and organizations. Field sampling may be needed to verify some reports or to determine the presence of these species in systems which appear suitable but have no information available.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

We would ask the Alaska Department of Fish and Game to provide information from past studies, but otherwise no other agency assistance is anticipated. The need for contracts with the private sector is not foreseen.

SCHEDULE

A. Measurable Project Tasks for FY 98

Writing and completion of final report: October, November 1997.

B. Project Milestones and Endpoints

Objective 1. Determine presence or absence of species: August 31, 1997.

Objective 2. Provide information to ADF&G for inclusion in the Anadromous Waters Catalog: November 30, 1997.

C. Completion Date

The field work should be finished by October 15, 1997, and the final report by November 30, 1997 (FY 98).

PUBLICATIONS AND REPORTS

There are no plans to submit the results of this study or the final report for publication.

PROFESSIONAL CONFERENCES

There are no plans to present this study at professional conferences. This information could be shared informally at USFS biologists meetings or other local meetings, such as the Cordova Flyfishers, but no additional travel or preparation funding would be required.

NORMAL AGENCY MANAGEMENT

The U.S. Forest Service has conducted similar surveys in the past, but only in conjunction with major projects, such as the road that was constructed around the south end of Montague Island. The other surveys did not attempt to estimate numbers of fish, only the presence or absence. Generally, the Forest Service only manages habitat, not populations. The Forest Service is not mandated by statute or regulation to conduct projects such as this. This project might also include studies on streams that are not on Forest Service land.

Without this project there would be no further injury to the affected species, but the project should provide a better basis for determining the status of the populations and their recovery. With this information we should also get a better understanding of habitat requirements for these species, which will improve the long-term management of the watersheds where they exist. This could help guide future land acquisitions if key habitats are threatened by timber harvest or other activities.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The need for this project became apparent while we were working with the investigators for *EVOS* project 96145. There was little information available on the location or size of cutthroat trout and Dolly Varden char stocks in Prince William Sound. We would hope to be able to coordinate some boat trips with them and, if needed, provide information to them on possible sampling sites for their project. We have not tried to obtain matching funding from other sources, but the U.S. Forest Service would provide the use of a boat and other services.

PROPOSED PRINCIPAL INVESTIGATOR

Merlyn Schelske
U.S. Forest Service
P.O. Box 280 Cordova, AK. 99574
907-424-7661
907-424-7214 (fax)

LITERATURE CITED

Hepler, K., P.A. Hansen, and D.R. Bernard. 1993. Impact of oil spilled from the *Exxon Valdez* on survival and growth of Dolly Varden and cutthroat trout in Prince William Sound, Alaska. Alaska Department of Fish and Game, Sportfish Division. 39 pp.

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel	$9.4	$3.6						
Travel	$0.9	$0.0						
Contractual	$0.0	$0.0						
Commodities	$1.1	$0.0						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$11.4	$3.6		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
General Administration	$1.4	$0.5						
Project Total	$12.8	$4.1						
Full-time Equivalents (FTE)		0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: Continuation of project 97302

1998

Project Number: 98302
Project Title: PWS Cutthroat Trout, Dolly Varden Char Inventory
Agency: US Forest Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
K.Hodges	Fish Biologist	GS-9	0.3	3.9		1.2
M.Schelske	Bio Tech	GS-7	0.7	3.4		2.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.0	7.3	0.0	
					Personnel Total	$3.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
					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

1998

Prepared:

Project Number: 98302
Project Title: PWS Cutthroat Trout, Dolly Varden Char Inventory
Agency: US Forest Service

FORM 3B
Personnel
& Travel
DETAIL

4/15/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed
Description	FY 1998
Commodities Total	$0.0

1998

Project Number: 98302
Project Title: PWS Cutthroat Trout, Dolly Varden Char Inventory
Agency: US Forest Service

FORM 3B
Contractual &
Commodities
DETAIL

Prepared:

4/15/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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

1998

Project Number: 98302
Project Title: PWS Cutthroat Trout, Dolly Varden Char Inventory
Agency: US Forest Service

FORM 3B
Equipment
DETAIL

Prepared:

4/15/97

Ecology and Demographics of Pacific Sand Lance, *Ammodytes hexapterus* Pallas, in Lower Cook Inlet, Alaska

RECEIVED
APR 1 0 1997
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	98306
Restoration Category:	Research
Proposer:	USGS Biological Resources Division
Lead Trustee Agency:	DOI
Cooperative Agencies:	ADF&G
Duration:	3years (1998, 1999, 2000)
Cost FY 98:	$32,800
Cost FY 99:	$30,000
Cost FY 00:	$20,000
Geographic Area:	Kenai Peninsula, Lower Cook Inlet, Chisik Island, Barren Islands, Kachemak Bay
Injured Resource:	Multiple (forage fish and upper trophic Level predators)

ABSTRACT

The purpose of this study is to characterize the basic ecology, distribution, and demographics of sand lance in lower Cook Inlet. Recent declines of upper trophic level species in the Northern Gulf of Alaska have been linked to decreasing availability of forage fishes. Sand lance is the most important forage fish in most nearshore areas of the northern Gulf. Despite its importance to commercial fish, seabirds, and marine mammals, little is known or published on the basic biology of this key prey species.

INTRODUCTION

An estimated 250,000 seabirds were killed by *Exxon Valdez* oil pollution. Based on comparisons of pre-spill (1970s) and post-spill (1989-1995) data, long-term effects on seabirds attributed to oil pollution included: i)population declines, ii) reduced breeding success, and, iii) delayed breeding phenology.

However, some purported effects of the spill may have been due in large part to natural changes in the Gulf of Alaska marine ecosystem-- in particular, declines in forage fish abundance (Piatt and Anderson 1996). The rate at which seabird populations will recover from effects of oil mortality are unknown, but is probably linked to population dynamics of forage fish species, of which sandlance is the most important.

Sand lance (genus *Ammodytes*) are zooplanktivorous, semi-demersal, schooling perciforms. They are ubiquitous to the boreo-arctic regions of the North Atlantic and North Pacific and are particularly abundant in coastal regions. There are three genera of sand lance; Hyperoplus sp., Gymnammodytes sp., and Ammodytes sp. distributed in the Northeast Atlantic from Novaya Zemblya to Spain. Ammodytes sp. is also distributed in the Northwestern Atlantic from West Greenland to Cape Hatteras, North Carolina (Leim and Scott 1966, Winters and Dalley 1988) and in the North Pacific from the Bering Sea to southern California (Wilimovsky et al. 1988). Although several species of *Ammodytes* have been described for the North Atlantic, a different species, *Ammodytes hexapterus* is the only species found in the Gulf of Alaska.

Sand lance serve as an important trophic link between zooplankton and marine vertebrate piscivores (Winters 1983) particularly on continental shelf ecosystems (Springer et al. 1996). In the North Pacific, sandlance are forage for fish, seabirds, and marine mammals. Seabirds consuming sand lance include red-faced cormorant (Hunt et al. 1981), black-legged kittiwake, common murre, thick-billed murre, pigeon guillemot, horned puffin, tufted puffin, brachyramphus murrelets, and rhinoceros auklet (Wilimovsky et al. 1988, Springer 1991, Piatt and Anderson 1996). Marine mammals consuming sand lance include Stellar sea lion, minke, sei, and humpback whales (Wilimovsky et al. 1988). Commercially important fish preying on sand lance include Pacific cod, halibut, lingcod, rockfish, and salmon (Wilimovsky et al. 1988).

Due to the commercial fishery for sand lance in the North Atlantic, much is known about sand lance in this region. In the North Pacific, however, sand lance are of little commercial importance. Despite their role as a forage species, there is a paucity of published information on their biology and population dynamics in this area.

Physical factors such as temperature and bottom substrate have been shown to have a marked affect on distribution of Atlantic sand lance species. Sand lance move out from nearshore areas of lower Cook Inlet during July, perhaps in response to fluctuations in sea temperature and changing physiological requirements. Therefore an investigation of sand lance behavior and biology in relation to the environment is critical to a complete understanding of relationships between upper trophic level predators and sand lance.

NEED FOR THE PROJECT

A. Statement of Problem

Lack of recovery of species injured in the *Exxon Valdez* oil spill is currently thought to be linked to changes in forage fish abundance or composition. Changes in species composition or abundance of forage fish will have marked effects on predators, in terms of the time needed to find and consume fish, as well as in the relative energy value of that fish once consumed. Therefore, an understanding of the factors affecting forage fish distribution, abundance, and quality is vital to an understanding of predator distribution, abundance and recovery.

B. Rationale

It is important to study the ecology and demographics of sand lance because i) sand lance are one of the most important prey species consumed by seabirds, marine mammals, and commercial fish in Alaska; ii) changes in sand lance abundance and distribution therefore have direct effects on predators; and, iii) natural environmental changes may have reduced sand lance populations in recent years. These population changes may limit the ability of higher predators to recover from oil spill impacts.

C. Summary of Major Hypotheses and Objectives

Our major hypothesis is that sand lance availability to higher predators is governed by behavioral and biological responses of sand lance to their environment. Predation on sand lance by various seabirds is being studied as part of the APEX program (Project 96163 M). This project will focus on sand lance in Kachemak Bay, lower Cook Inlet.

The major objectives are:

1. To establish how seasonal and diel movements of sand lance impact their availability as a food source for marine piscivores.

2. To assess or measure physical parameters (e.g., temperature, substrate type, salinity, and turbidity) that are associated with feeding and spawning habitats.

3. To measure caloric content of sand lance throughout the year and assess their overall food value to marine piscivores. Food value will be compared with other forage fish collected in Lower Cook Inlet.

4. To investigate Meristic and genetic characteristics to establish if distinct populations of sand lance occur within the Cook Inlet and northern Gulf of Alaska.

5. To estimate acoustic abundance and productivity (e.g., larvae production, habitat use) of sand lance in different areas of Cook Inlet.

6. To complete compilation of a bibliography of sand lance literature from published and unpublished sources.

D. Completion Date

Field work for this project will be completed in FY 99. Compilation and analysis of all data and production of a final report will be finalized in FY00.

COMMUNITY INVOLVEMENT

Local knowledge of sand lance spawning sites, and areas where found buried at low tide will be invaluable to this project. Communications with local residents during the summers of 1995 and 1996 have provided information on at least two sites where sand lance spawn. Spawning was observed and documented by this project at one of these sites in the fall of 1996.

FY 97 BUDGET

Contractual	$30,700
G. Admin.	2,100
Total	32,800

The entire working budget (30.7K) will be transferred to Memorial University of Newfoundland through a Cooperative Agreement. These funds will be used to support the graduate student conducting the research (stipend, benefits, tuition, & fees = 29.3K), and to cover travel for the student to attend APEX meetings in Alaska (Nfld to AK, 1.4K). Travel funds are being transferred directly to Memorial, because the BRD has no mechanism by which we can arrange travel for a non-employee working in a foreign country.

Conferences and Meetings

Money has been budgeted for the graduate research assistant to attend the EVOS Annual Restoration Workshop and the APEX Annual Peer Review Meeting. Because of possible restriction of academic requirements, these meetings will only be attended if time allows.

Publications

At this time it is projected that results from this study will be fully prepared and submitted to peer review journals by October 2000. It is expected that papers will be prepared each year and submitted covering different aspects of the research. Journals that would be a good forum to present results from this project include Copeia, Fisheries Bulletin, Journal of Marine Science, and Canadian Journal of Zoology. The bibliography will be made available in report form, and in electronic format (Pro-Cite).

PROJECT DESIGN

A. Objectives

1. To establish how seasonal and diel movements of sand lance impact their availability as a food source for marine piscivores.

2. Measure demographic parameters of sand lance including age composition, growth rate, patterns of growth, and sex ratios.

3. Meristic and genetic characteristics will be used to establish if distinct populations of sand lance occur within Cook Inlet and throughout the northern Gulf of Alaska.

4. Critical feeding and spawning habitat of sand lance will be described in relation to physical parameters (e.g., temperature, substrate type, salinity, and turbidity).

5. Estimates will be made of sand lance productivity and abundance within the Cook Inlet.

6. The caloric content of sand lance will be investigated throughout the year to evaluate their value as forage for marine piscivores.

B. Methods

FIELD COLLECTIONS:

Sand lance will be caught using a variety of nets to sample beaches, nearshore areas, and offshore waters:

Beach Seines:
A beach seine (37m long, 28.6mm stretch mesh tapered wings, 6mm stretch mesh cod end in middle) will be used for all beach seining. Two types of beach seine will be used; a standard net with netting uninterrupted from the float line to the lead line, and a modified seine with a lined lower section. The modified type of seine can be used on rocky bottoms or where there are mussels beds. This will allow for collection of sand lance from a wide variety of locations within the study area. Seines will be made in sets of two at each location at least every two weeks during the summer (May to October), and once a month during the winter (November to April), conditions and light permitting. Seines will be made at high and low tide until a comprehensive dataset is established to evaluate differences in sand lance catch between the tidal states.

Permanent sample locations within Kachemak Bay will be at Halibut Cove, Peterson Bay, China Poot Spit (winter samples), and Eldred Passage, Yukon Island, and Seldovia Bay (winter and summer samples). These sites provide a wide range of physical conditions (exposure, water regimes, substrates etc.) with which to evaluate physical conditions preferred by sand lance. Comparative collections of sand lance will also be made in the Barren Islands (East Amatuli Cove) and Chisik Island (Snug Harbor). Sand lance will also be obtained from APEX colleagues working in Prince William Sound, and opportunistically from other locations in Alaska.

Fish Stomachs:
Halibut stomach contents will be used to establish presence of sand lance in deeper offshore waters. This method uses stomachs from halibut caught by charter boats during the summer. Results from 1996 show larger sand lance to disappear from the nearshore during July (a critical month for chick-rearing seabirds), however, these fish were not found in mid-water trawls or cast net samples. Using halibut will provide valuable information to the summer movements of sand lance.

Trawls:

Nearshore Areas:

A 42.5 feet long, 200 ft^2 opening, 3.2mm mesh cod end Kodiak Trawl will be used to sample the nearshore, outside the area covered by the beach seine. This net will be pulled by two boats (Sand lance and David Gray).

Offshore Waters:

University of Alaska, Fairbanks flatfish trawls (Brenda Norcross) as well as Alaska Department of Fish and Game shrimp and herring trawls (Paul Desjardin) are made routinely in Kachemak Bay. The location and depth of any sand lance caught in these trawls is routinely collected, and these data will be made available to us. Sand lance caught will be frozen and provided to us for later analysis.

Historical data from NOAA plankton trawls currently being compiled by Paul Anderson (NMFS) will be made available to us. This data will provide valuable information on the early distribution and abundance of sand lance larvae.

Digging:

Sand lance bury themselves in sandy substrates although the timing and reasons for such behavior and not fully understood. We will dig for sand lance on "clamming" tides in Halibut Cove, Peterson Bay, and in China Poot Bay as well as at other sites discovered through interaction with local clam diggers. This method of collection is important in winter months when sand lance are not found in beach seine samples. Critical substrate parameters (grain size, substrate composition etc.) will be measured at the same time as collections are made.

Hydroacoustics:

Surveys of the nearshore using hydroacoustic equipment (DT4000) will be used to estimate biomass of sand lance in these areas, and examine seasonal and diel variability in sand lance abundance nearshore. These surveys will be made over a fine scale grid in the nearshore areas in conjunction with the two-weekly beach seinings and cast netting. In conjunction with other data collected, we will be able to estimate the total abundance of sand lance in the nearshore zones of the study area. Hydroacoustic data will also be analyzed for bottom type using new Biosonic analysis software. This will allow us to investigate substrate preferences for sand lance and available habitat.

Cast Netting:

During 1996, pilot studies using cast nets on schooled fish at sites of seabird feeding mellées proved highly effective. This method will be fully integrated into this study during the summer of 1997 providing information on age structure, abundance, and timing of availability for sand lance to seabirds.

Other methods:

Underwater video was used in Prince Willian Sound for the assessment of forage fish schools during 1996. Dependent on the availability of this equipment and water visibility we will use this method to study sand lance schooling behavior, movements, and distribution in 1997.

LABORATORY ANALYSIS:

Lengths and weights of sand lance will be noted for 100 individuals (minimum if possible) collected at each site. These results will be used to establish length-weight relationships as well as growth over time.

Age determinations will be based on otolith interpretations according to the methodology of Macer (1966) and Scott (1968, 1973). Otoliths with poorly defined annuli will be omitted from the age determinations.

Gonad development and stage of maturity will be classified according to the following stages; 0, immature; 1, maturing (developing); 2, ripe; 3, running; 4, spent; and 5, recovering. Specimens will be assigned these categories according to gonad condition described by Macer (1966).

Meristic parameters will be noted for populations of sand lance collected from different geographic areas within Alaska. These values will be compared with each other as well as to other *Hexapterus* species found in the North Pacific. Genetic comparisons between different populations will be done by a collaborator.

Caloric content will be established in collaboration with Dan Roby at Oregon State University. This work will be used to assess the relative value of sand lance to marine predators over a season as well in comparison to other forage species.

BIBLIOGRAPHY:

Available literature in the form of published papers and reports will be searched using on-line search facilities at Memorial University of Newfoundland and BRD (Anchorage). References will be compiled using Pro-Cite and published as a report, and in electronic format. Pro-Cite will allow other researchers to easily search the bibliography for individual specific needs.

C. Contracts and Other Agency Assistance

The project will be carried out by a Ph.D. student. A Cooperative Agreement has been established to provide funding for this student at Memorial University of Newfoundland under supervision from Dr. George Rose.

D. Location

The project is a portion of an ecosystem study of lower Cook Inlet (EVOS APEX project 96163 M). Sand lance research will be focused on Kachemak Bay because they are common there, and the area is logistically easy to work in. Comparative collections of sand lance will be attempted at Chisik Island and the Barren Islands. Sand lance will also be collected from sites in the center of the Cook Inlet. These collections will be from the stomachs of halibut and from incidental catches in ADF&G or UAF shrimp, herring, and flatfish trawls. Opportunistic samples of sand lance will also be kept for this project from the Western Aleutians and Bering Sea from trawls made by the R.V. Tiglax (through cooperation with AMNWR).

SCHEDULE

A. Measurable Project Tasks for FY 98

1. Bibliography will be finalized and delivered at the 1998 APEX Review Meeting.

2. Reports on sand lance maturity, spawning, and age structure will be submitted for publication.

B. Project Milestones and Endpoints

For FY 98:

1. Consolidate all information collected in 1995, 1996, and 1997.

2. Establish areas where information in the literature and prior work of this project are weak and develop protocols to fill these gaps.

3. Collect fish as per research plans through December of FY98.

4. Based on results of 1997 field season, develop modified plan for the 1998 field season, particularly in regard to hydroacoustic surveys.

5. Prepare results of seasonal proximate analysis of sand lance for publication.

Work in FY99 will be a continuation of the FY 98 work. The major objective of the FY 99 field work will be to establish productivity of sand lance in the Cook Inlet area based on hydroacoustic and fishing information. These results will be contrasted between different areas to assess how environmental conditions and regimes impact productivity and ultimately the availability of sand lance to marine predators. Field work will finish for this study in the winter of FY99/FY00 and a final report will be prepared.

C. Project Reports

The first reports will be produced in 1998 in the form of peer reviewed manuscripts in scientific journals. Subsequently, all manuscripts from this project will be collectively submitted as a Ph.D. thesis in FY00.

The bibliography will be available by March, 1998.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Close coordination has, and will continue to be developed between ADF&G, UAF, NMFS, and USFWS for collections of sand lance offshore and in other areas of Alaska. Work on sand lance will also continue to be coordinated with other APEX investigators working in Prince William Sound such as Dan Roby, Bill Ostrand, and David Irons.

ENVIRONMENTAL COMPLIANCE

Alaska Department of Fish and Game will provide collection permits for fish within the study area.

PERSONNEL

John Piatt- Research Biologist, Alaska Science Center, National Biological Service, Anchorage. Responsible for overall coordination of research project.

Martin Robards- Research Student, Memorial University of Newfoundland. Project Manager responsible for coordinating fishing effort, analysis of fish, data analysis, and report preparation.

Signed: ________________

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Date prepared: _______________

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1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998						
Personnel		$0.0						
Travel		$0.0						
Contractual		$30.7						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$29.4	$30.7		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
General Administration	$3.5	$2.1						
Project Total	$32.9	$32.8		$30.0	$20.0	$0.0		
Full-time Equivalents (FTE)		0.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: Contract to support Cooperative Agreement with Memorial University of Newfoundland

1998

Prepared: 1 of 4

Project Number: 98306
Project Title: Ecology and demographics of Pacific Sand Lance, Ammodytes hexapterus, Pallas, in lower Cook Inlet,. Alaska
Agency: USGS (BRD)

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/9/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		0.0	0.0	0.0	
					Personnel Total	$0.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
					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

1998

Project Number: 98306
Project Title: Ecology and demographics of Pacific Sand Lance, Ammodytes hexapterus, Pallas, in lower Cook Inlet,. Alaska
Agency: USGS (BRD)

FORM 3B
Personnel
& Travel
DETAIL

4/9/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FY 1998
Cooperative Agreements with Memorial University of Newfoundland (entire amount is transferred to facilitate support of graduate student, and to make it easier for travel arrangements to be made from Newfoundland. The breakdown for use of these funds is as follows: Student support (stipend, benefits, tuition, other fees) - 29.3 K Travel (Nfld to AK for APEX meetings) - 1.4 K	30.7
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$30.7

Commodities Costs:	Proposed
Description	FY 1998
Commodities Total	$0.0

1998

Project Number: 98306
Project Title: Ecology and demographics of Pacific Sand Lance, Ammodytes hexapterus, Pallas, in lower Cook Inlet,. Alaska
Agency: USGS (BRD)

FORM 3B
Contractual &
Commodities
DETAIL

4/9/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			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

1998

Project Number: 98306
Project Title: Ecology and demographics of Pacific Sand Lance, Ammodytes hexapterus, Pallas, in lower Cook Inlet,. Alaska
Agency: USGS (BRD)

FORM 3B
Equipment
DETAIL

Prepared:

4/9/97