# 19.05.02

# FY 97

# Detailed Project Descriptions

19.5.2


# *Exxon Valdez* Oil Spill Trustee Council

**Restoration Office**
**645 G Street, Suite 401, Anchorage, Alaska 99501-3451**
**Phone: (907) 278-8012 Fax: (907) 276-7178**


**MEMORANDUM**

TO: Recipients of Binders of FY 97 DPDs

FROM: Sandra Schubert Sandra
Project Coordinator

RE: Changes to Binders

DATE: May 15, 1996



Since the binders of FY 97 DPDs were distributed, seven changes have been requested and are attached.

**97001** **Recovery of Harbor Seals from EVOS: Condition and Health Status**
A memo describing revisions to the DPD was submitted by UAF. The original budget submittal remains unchanged.

**97064** **Monitoring, Habitat Use, and Trophic Interactions of Harbor Seals**
A memo describing revisions to the DPD and a reduced budget were submitted by ADF&G.

**97139A1** **Little Waterfall Barrier Bypass Improvement**
A corrected version of the DPD was submitted by ADF&G. The original budget submittal remains unchanged.

**97158** **Monitoring Nearshore Ecosystems in Katmai National Park**
The copy of the DPD included in the binder was missing some pages.

**97162** **Investigations of Disease Factors Affecting Declines of Pacific Herring Populations**
A missing page of the DPD was provided by ADF&G.

**97250** **Project Management**
The project management budget was prepared.

**97251** **Akalura Lake Sockeye Salmon Restoration**
A corrected version of the DPD was submitted by ADF&G. The original budget submittal remains unchanged.

6/6/96
Per Sandra - No DPD yet - Mac C working on.
97250

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The following corrections have been made to the spreadsheet that accompanied the binders. A revised spreadsheet will be available for the May 23 meeting at which the draft work plan will be developed.

**97007B** **Site Specific Archaeological Restoration**
Classification has been changed from "continuing" to "new", as FY 96 was intended to be the close-out year for this project

**97090** **Mussel Bed Restoration and Monitoring**
Classification has been changed from "continuing" to "new", as FY 96 was intended to be the close-out year for this project

**97238** **Kachemak Bay Shellfish Nursery (facilities cluster)**
Project had been incorrectly categorized in the subsistence cluster

**97243** **Water Resources of Prince William Sound (SEA-related cluster)**
Project had been incorrectly categorized in the pink salmon cluster

**97251** **Akalura Lake Sockeye Restoration**
Proposer corrected to read S. Honnold; abstract modified slightly

In addition, a number of technical corrections were made to the "FY 97 Request" field of the spreadsheet following Traci Cramer's review of the detailed budget forms. Corrections are due to factors such as addition of GA to non-agency projects and correction of errors in addition.

| Project Number | Original Request | Corrected Request |
|---|---|---|
| 97064 | 351.6 | 351.5 |
| 97115 | 1,165.7 | 1,167.9 |
| 97151-BAA | 514.8 | 537.6 |
| 97156 | 250.0 | 267.5 |
| 97158 | 56.3 | 56.4 |
| 97161 | 103.8 | 104.4 |
| 97169-BAA | 151.6 | 153.0 |
| 97181-BAA | 299.1 | 299.4 |
| 97224 | 118.8 | 110.0 |
| 97228 | 96.3 | 96.7 |

| | | |
|---|---|---|
| 97230 | 270.7 | 270.6 |
| 97232 | 2,200.0 | 2,256.5 |
| 97233 | 11.7 | 11.8 |
| 97243 | 841.3 | 814.5 |
| 97248 | 62.9 | 66.8 |
| 97271 | 108.4 | 116.0 |
| 97277 | 317.9 | 318.5 |
| 97281 | 119.0 | 115.8 |
| 97284 | 500.0 | 511.8 |
| 97303-BAA | 120.2 | 120.5 |
| 97305 | 89.5 | 90.1 |
| 97320 | 3,768.1 | 3,766.4 |
| 97210 | 203.5 | 203.4 |

changes

Institute of Marine Science

UNIVERSITY OF ALASKA FAIRBANKS
Fairbanks, Alaska 99775-1080



May 10, 1996

TO: Molly McCammon
*Exxon Valdez* Restoration Office
Anchorage

FROM: Dr. Michael Castellini
University of Alaska, Fairbanks.

SUBJECT: Modification to DPD for 97001, Harbor seals

Recently, you should have received a memo from Kathy Frost at ADF&G in Fairbanks requesting a change in the scope to her DPD 97064 on harbor seals. As noted by Kathy, we have recently returned from our 1996 spring harbor seal field sampling in PWS. During that trip, we reviewed our respective 1995 reports and started to plan the details for our future commitments to this work. It that discussion, we agreed to request a change in scope in our collaborative harbor seal projects.

After reviewing our data, we agreed that work on pups should be emphasized. Kathy has provided you information on the population biology of the species and her rationale on why the survival and health of pups is a critical component in future studies. In this memo, I add our reasoning behind the request for change in the physiological studies.

Our laboratory has recognized that the health of pups as a vital component of understanding pinniped populations. To that end, we have been funded by the National Science Foundation to study population health indices in Weddell seal pups in the Antarctic and by the National Marine Mammal Laboratory to study the health of Steller sea lion pups here in Alaska. We also have National Institute of Health funding to look at the development of diving physiology in northern elephant seal pups and American Heart Association funding to examine cardiac function in seal pups. In addition, as you know, the Alaska SeaLife Center will be a major rehabilitation and research site for Alaska harbor seal pups. We are working on general development issues in pinnipeds that directly address their health and survival. One of the MS students in our laboratory is completing a thesis project on the survival of Weddell seal pups and has a paper in press dealing with survival up to weaning. Finally, we have published several recent papers in international physiological journals dealing with development of seal pups. Thus, we have a long

standing interest in the biology of pinniped pups and have ongoing projects that can interface with work on harbor seal pups.

We propose to carry out our health status studies on harbor seal pups using both the adult protocols and techniques we have used on pups from many other species. This would include veterinary clinical blood sampling, length, girth and mass measurements, blubber thickness, water chemistry, contaminant testing and blood metabolite monitoring. In addition, we would seek additional non-EVOS support to monitor basic physiology of the pups while they are on-board the ship (heart rate, respiration, body temperature). I have accepted a Ph.D. student for the fall who already has a MS in harbor seal biology and has extensive training in pup handling. He would become the lead person for our harbor seal pup component.

As Kathy noted, a change in the field season protocols would significantly decrease the logistical costs associated with our collaborative grants. However, because almost all of those field costs are borne by 97064, there would be little change in the cost basis of 97001. There would be fewer samples for analysis and this could lead to some costs savings. Unfortunately, I cannot estimate that at this time since it depends on how many pups are captured. Our 1997 DPD budget was about 2-3% below what we had originally requested and this change in scope could drop that to about 5% below.

Please let me know your opinion of this request for a change in scope to begin work on harbor seal pups.

cc: Joe Sullivan
Kathy Frost

# Recovery of harbor seals from EVOS: Condition and health status.

| | |
|---|---|
| Project Number: | 97001 |
| Restoration Category: | Research |
| Proposer: | University of Alaska, Fairbanks |
| Lead Trustee Agency: | ADF&G |
| Cooperating Agencies: | NONE |
| Alaska SeaLife Center: | Yes in FY98 |
| Duration: | 2 Years |
| Cost FY 97: | $201,800 |
| Cost FY 98: | $ 48,100 |
| Geographic Area: | Prince William Sound |
| Injured resource: | Harbor seals |



## ABSTRACT

This project focuses on the health of harbor seals, a marine mammal species that is not recovering in Prince William Sound. Personnel from the University of Alaska in cooperation with the Alaska Department of Fish and Game will continue and expand work with harbor seals to assess their health, blood metabolites, blubber chemistry and size in relation to their ecological and nutritional requirements. The project addresses potential health and nutritional problems that may be impeding harbor seal recovery. In FY97, the project greatly expands collaborative work with Native hunters through the Alaska Native Harbor Seal Commission and will initiate work in FY98 at the Alaska SeaLife Center.

## INTRODUCTION

HISTORY OF PROJECT. This proposal is a continuation of 96001, which itself was a combination and extension of projects 95001 and 95117-BAA. It deals with body condition and health indices of harbor seals (Phoca vitulina) in Prince William Sound in relation to their non-recovery status. The central hypothesis of the proposal has been that given the declining population status of harbor seals in the impacted area, do these animals show signs of health, nutritional or body condition deterioration that could be contributing to their poor recovery?

The project is written with significant logistical and scientific collaboration from project /064 which deals with monitoring population levels, habitat use and trophic interactions of harbor seals. Project /064 provides access to the animals and a broad-based ecological view relevant to harbor seals in this geographic area. The goals of the combined collaborative projects have been to investigate ecosystem-wide questions addressing the recovery of harbor seals. These issues include the direct impact of oil spills, human interactions, food, competition, climatic factors, disease and habitat loss. In 96001, we began collaboration with the Alaska Native Harbor Seal Commission to obtain harbor seal samples from Native hunters. This aspect of the program has been extremely successful and we anticipate increased collaborative efforts in 97001.

The original project (95001) began our work on body condition and blood chemistry indicators of nutritional problems, disease and growth for harbor seals inside and outside of PWS. The University of Alaska has provided personnel to take blood and blubber samples and to measure and weigh the seals. Blood and blubber samples are analyzed at UAF and models of body shape, blubber thickness and body condition are generated and tested. Appropriate control samples in time and space have always been a concern for this project. Therefore, we have set up identical sampling protocols in collaboration with ADF&G for harbor seals outside of PWS and have collected samples from southeast Alaska and around Kodiak for comparative purposes.

Project 96001, when combined with 95117-BAA, gained an additional component to examine blubber chemistry in harbor seals both inside and outside of PWS and historical samples of blubber collected from before the *Exxon Valdez* Oil Spill (EVOS). The central hypothesis of this component has been that because seals utilize fat and blubber as their primary energy source, then nutritional problems may be reflected by alterations in blubber chemistry. The collection of blubber samples has been the primary interface point with Alaska Native hunters.

Finally, it is critical to understand that our laboratory is involved in determinations of seal and sea lion health in pinniped populations from around the world. We work on similar questions in regions far removed from PWS and on many different species in an effort to understand relationships between ecological health, nutrition and body condition of marine mammals. For UAF, the PWS/EVOS question is part of a broad study about adaptations of marine mammals to their ecosystem. These EVOS projects provide opportunities for us to test our comparative theories of marine mammal health and to provide the Trustee Council with the data they need

for issues concerning recovery in PWS.

RESULTS FROM PREVIOUS SUPPORT. An annual report with detailed results of 95001 has been prepared and submitted to the Trustee Council. Project 96001 is currently active. The following major points should be stressed at this time.

To date, morphometric data has been processed for nearly 800 Alaskan harbor seals from either collections done through this project or from database information supplied by our collaborating investigators. We collected over 40 samples in 1995 from seals handled in spring and fall field seasons and an additional 15 samples from non-EVOS NMFS supported collaboration outside of PWS. A detailed spectrum of blood analysis, morphometric modeling and blubber chemistry has been successfully initiated. We have been heavily utilizing the WHISKERS database (Native knowledge of local resources developed by ADF&G) and correlating our findings this program. One fully refereed paper is in press, 2 have been submitted for review and a series of abstracts have been presented at various scientific meetings dealing with this work. Brian Fadely, the Ph.D. student associated with this project, was awarded the American Association for the Advancement of Science Alaska Region Best 1995 Student Paper for this work and also received both a Rasmuson Fellowship and a Global Change Fellowship for his thesis work on harbor seals in Alaska.

The primary findings of 96001 have been that blood chemistry indicate significant distinctions between seals collected from different regions of PWS. These regional differences seem to coincide with the EVOS funded SEA results showing differences in forage fish availability. However, we do not suggest that the seals in the region are "unhealthy" to the point of being suspect for subsistence use. Our data show population level differences in key metabolites...this is not to say that the animals are "sick", only that there may be environmental impacts on their physiology. Data recently released on harbor seals from Scotland show variations in a similar suite of blood metabolites with "good and bad" years from preferred forage fish species.

FY97 PLANS. In FY97 we propose to continue the sampling protocol carried out in 95001 and 96001 in order to test for the impact of annual and seasonal variation on health indicators in harbor seals. In addition, we will greatly expand our collaborative efforts with Native hunters to obtain blubber samples and continue to utilize the WHISKERS database to relate our findings to traditional environmental knowledge. We will expand our 96001 work into ultra-structure of seal blubber and complete the work on blubber chemistry.

FY97 will be the last routine field season for this project. FY98 support will be for project reports and publications. In FY98 we will also request support for work at the ASLC to work with stranded and rehabilitated harbor seals. We need to understand the medical status of stranded and rehabilitated animals so that we can better place the medical profiles of wild animals in context.

## NEED FOR THE PROJECT

### A. Statement of problem

Harbor seal (Phoca vitulina) populations in Alaska show evidence of decline over portions of their range. Prior to the EVOS event, population declines of 85% had been reported from Tugidak Island (Pitcher 1990), and declines may also have occurred in the eastern Bering Sea and Aleutian Islands (Hoover-Miller 1994). Prince William Sound harbor seal populations, further impacted by EVOS (Frost and Lowry 1994a,b), have essentially stabilized at decreased levels, but have shown no signs of population recovery (Frost et al., 1995). Trend-site counts in PWS indicate that declines occurred both in pup and non-pup portions of the population (Frost et al., 1995). Assessment and interpretation of harbor seal body condition, blubber chemistry and nutritional status data can help resolve multiple hypotheses proposed to explain these declines, and to help focus future studies.

### B. Rationale

Changes in ecosystems or in prey availability due to natural or anthropogenic causes can be reflected in the body condition or nutritional status of top trophic-level consumers, such as harbor seals. However, indices used to assess body condition may also vary with season, age, or sex (Pitcher 1986; Trites and Bigg 1992; Beck et al. 1993; Renouf et al. 1993) independent of foraging ability or prey availability. Therefore, normal ranges of body size, shape and blubber chemistry distribution must be quantified before useful inter-annual comparisons can be performed. Likewise, blood chemical and hematological parameters also change significantly in response to environmental or nutritional effects (Seal et al. 1975; Geraci et al. 1979; McConnell and Vaughan 1983; Kuiken 1985; Roletto 1993). Chemical profiles and complete blood counts can identify potential imbalances in organ systems or metabolic pathways if the effects of non-health related variation can be quantified (Payne and Payne 1987; Kerr 1989; Castellini et al. 1993). We have been extremely successful in modeling these types of ranges and variations in 95001 and 96001

### C. Location

The field effort supported directly by 97001 will take place in PWS at many different locations where the remaining groups of seals can be located. Samples will also be obtained from collaborative non-EVOS agreements from Kodiak and Southeast Alaska through ADF&G. Collaborative work with Native hunters will provide samples from throughout the PWS and other regions of Alaska.

## COMMUNITY INVOLVEMENT

As noted above, we have been working with the Alaska Native Harbor Seal Commission to obtain samples from its cooperating hunters. This community involvement project has been set up to facilitate the exchange of information from the scientists back to the community and to

help with the collection of data for scientists. This exchange has been supported by the EVOS Trustee Council and has been extremely successful.

## PROJECT DESIGN

### A. Objectives

Objectives include the original five as re-iterated below and an additional 6th added for FY97. We also include a 7th objective for FY98.

1. Collect hematological data to reinforce and test reference ranges of blood chemistries and hematologies of harbor seals inside and outside of PWS and determine variation attributable to sampling technique, age, sex, or season and location of capture.

2. Model changes in body condition using morphometric measurements.

3. Assess body condition using morphometric measures of body shape, density and fat content, and determine the effects of age, sex, season and location.

4. Compare blood and morphological indices of health and condition in light of the above to examine inter-annual changes, potential EVOS-related impacts, and to help interpret changes in population status.

5. Obtain blubber samples from contemporary animals inside and outside of PWS for energy analysis and compare these findings with archived samples.

6. Work in collaborative projects with Native hunters through the Alaska Native Harbor Seal Commission.

7. In FY98, to begin work on rehabilitated animals at the Alaska SeaLife Center.

### B. Methods

Seals will continue to be captured during spring and fall. Laboratory analyses and statistical analysis will be conducted throughout the remainder of the year.

Field Techniques. Harbor seals are live-captured by net entanglement, in conjunction with EVOS Project \064, using methods previously described by Frost and Lowry (1994b). Once captured, seals are transported to shore or ship, anaesthetized if required (using Ketamine and Diazepam), weighed with an electronic hanging scale, and morphometric measurements gathered. Blood is drawn from the extradural vein into Vacutainer® blood collection tubes.

Body Condition. Linear and curvilinear length, a series of girths at 7 locations, and mass are

collected from each animal. Blubber depths at 2-3 sites at each girth ring are measured using a portable ultrasound unit (Scanoprobe II, Model 7310, Scanco, Inc.). These measurements are quickly and easily carried out in the field. Using a portable WINDOWS 95 data-base, we can immediately place the animal onto a fitting program relative to all previously cataloged seals. Subsequently, the data are fit into models of how length, girth and mass are inter-related for harbor seals and are used to evaluate body condition. Additionally, measurements of total body impedance (BIA) are made by recording the resistance across two pairs of electrodes placed near the seal head and tail, allowing estimation of body fat.

Hematology. Blood hematocrit (% red blood cells by volume) are measured in the field using a portable centrifuge. Samples of whole blood are taken for hemoglobin analysis and the remainder is centrifuged to prepare plasma and serum. Samples are frozen at liquid nitrogen temperatures for later laboratory analyses. Plasma samples are sent to a veterinary laboratory for assessment of "standard" health indices (such as cholesterol level, salts, and enzymes characteristic of tissue damage) and also analyzed at our lab for indicators of dehydration (water content), malnutrition (BUN, ketones), acute phase reactions (haptoglobin) and hormone imbalance (angiotensin, ANP). Standard panels that assay plasma sodium, potassium, chloride, phosphorous, creatinine, cholesterol, direct and total bilirubin, total protein, albumin, globulin, alkaline phosphatase, glucose, lactate dehydrogenase, gamma globulin transferase (GGT), creatinine phosphokinase (CPK), aspartate aminotransferase (SGOT) and alanine aminotransferase (SGPT) are performed by automated machine analysis at the Fairbanks Memorial Hospital (FMH) using an Ektachem Analyzer. Complete blood counts of white and red blood cells, platelet and differential white blood cell counts are performed by technicians at FMH from blood collected in EDTA Vacutainers using a Coulter Model S-Plus-4 Counter, and from blood smears produced in the field.

It should be emphasized that the above methods are routine for the marine mammal group at UAF and that we conduct similar assays hundreds of times/year on seal and sea lion species from around the world. Thus, we have the expertise, the databases and the consistency to best analyze these samples from the PWS and non-EVOS animals. Statistical comparisons of hematological values, body condition and shape are routinely performed using PC-based software. The ultimate goal is to derive useful indices of condition and hematology, that when controlled for other sources of variation such as sex, age, location and season of capture, will enable inter-annual and regional comparisons of nutritional and health status.

Blubber chemistry. Additional testing of the food limitation hypothesis is accomplished by comparison of blubber quality between archived, historical blubber samples collected during the mid-late 1970's, to blubber samples biopsied during current research projects inside and outside of PWS. Our hypothesis is that since blubber is a major component of the body tissues of seals (27-30% of body mass (Pitcher 1986)), contains 90% of the lipid fuel sources in seals (Beck et al. 1993), and lipid utilization makes up approximately 85% of the energy utilized by seals (Ryg et al. 1990), then changes in the lipid content, blubber density and energy content should reflect seasonal and inter-annual changes in body condition of the seals. It is known that the blubber content of an animal and the lipid content of blubber varies with season, age and sex (Pitcher 1986; Ryg et al. 1990; Beck et al. 1993). The archived historical blubber

samples have complete data sets on animal condition associated with them, and these data are also collected for the contemporary animals.

Collection of historical samples. Alaska Department of Fish and Game has archived, frozen samples of harbor seal blubber collected well before the EVOS event that are available for this analysis.

Collection of contemporary samples. Blubber samples are routinely acquired from live animals captured in conjunction with Project No. 95064 and other non-oil spill related projects. Additional samples of blubber have been collected by the Native hunters through the Alaska Native Harbor Seal Commission.

Analysis of blubber. Samples of blubber are analyzed for quality and density of energy. Four tests were originally described in 96001 and a 5th has been added for 97001.

1. Density of blubber.
2. Total lipid content of blubber.
3. Hydration state of blubber.
4. Total energy content of blubber.
5. Microscopic determination of ultra-structure.

Blubber density will be determined by simple mass and volume measurements of blubber samples. Total lipid content of blubber is determined by organic extraction of lipids using a SOXHLET apparatus and standard extraction techniques. Blubber hydration state is determined by mass difference between wet and dry weights of samples dried in a drying oven. Finally, the total energy content of blubber is determined by bomb calorimetry of the sample to determine calories available. Work in progress (96001) indicates that these methods are easily applied to seal blubber. Historical specimens will be closely examined for signs of dehydration or oxidation (freezer-burn), and either sub-sampled from acceptable sites, or rejected. Because phocid blubber lipid content is homogenous both in location on the body and depth of sampling (Jangaard and Ke 1974; Beck et al. 1993), variability in sampling site should not confound analyses. One-way and multi-factorial analyses of variance will be performed to assess the affects of age, sex, season and year on these measures of blubber quality. Morphometric data available from the historical animals and from those sampled currently will enable calculation of total blubber energy stores for these same comparisons. Date from the microscopic examinations of blubber are used to assess the ratio of collagen (connective tissue) to adipocytes (lipid cells) and to help to visually determine the quality of the sample.

Potential analytical difficulties. Blubber samples store for long periods may be subject to deterioration and oxidation, depending on storage techniques and temperature. Dehydration would directly impact water content and density analysis, but should not alter the lipid analysis or bomb calorimetry since samples are freeze-dried for those procedures. However, interpretation back to a wet-weight basis would be problematic. Historical samples will be examined for signs of dehydration and sub-samples taken as far away from the edges as

technically feasible. Significantly dehydrated samples will be rejected. We will also use control samples of recently collected blubber from harbor seals and other species to determine wet-mass to dry-mass ratios, and compare these to values measured from archived samples to index hydration. If some of the samples are dehydrated, then lipid and energy content will be compared to recent samples on a dry-weight basis only. It is also possible that because phocid blubber is typically less than 3% water (Beck et al, 1993), minor dehydration will not significantly effect results. The ultra-structure microscopic analysis will be used to help determine the physical status of the archived samples relative to the fresh samples

In addition, there is information from the WHISKERS database that suggests a quality difference in blubber from animals shot at various times of year. We want to examine blubber from spring and fall to determine if there are physical differences visible in microscopy that can quantify these observations.

### C. Cooperating Agencies, Contracts, and Other Agency Assistance.

As noted above, this project works in critical collaboration with /064 in the field efforts necessary to collect the animals. In FY97, there is also an increased collaboration with the projects supported under Native subsistence use in PWS and the Alaska Native Harbor Seal Commission.

## SCHEDULE

### A. Measurable Project Tasks for FY97

We anticipate two field seasons for collection in FY97 (spring and fall). All ship-based field work will end in the late summer of 1998. All morphometric data and blood chemistry data will be acquired and prepared for the final analysis in FY98. All microscopic analysis will be finished by the end of FY97.

| | |
|---|---|
| October: | Analysis and statistical study of fall blood samples. |
| November: | Collection of archived blubber samples. |
| December: | Analysis of blubber water content. |
| January: | Winter EVOS workshop. |
| January: | Preparation of blubber samples for bomb calorimetry. |
| February: | Modeling of body morphometrics. |
| March: | Samples outside of PWS. |
| April: | Analysis and statistical study of blood samples. |
| April: | Collection of field samples outside of PWS. |
| April: | Annual report. |
| May: | Collection of field samples inside PWS. |
| June: | Analysis of all blood samples. |
| July: | Modeling of body morphometrics and blubber data. |
| August: | Modeling of body condition indices. |

September: Collection of field samples inside PWS.
October: Collection of field samples outside PWS.

For FY 1998:
October: Analysis and statistical of fall blood samples.
Nov - Dec: Modeling of body condition.
January: Winter EVOS workshop.
Feb: Publication preparation, final reports, presentations.
May-June: Rehabilitated animals at ASLC.

**B. Project Milestones and Endpoints**

All 6 of the major objectives will be met by the end of FY97. The final objective, work at the ASLC, will commence in FY98.

**C. Completion Date.**

All 6 of the major objectives will be met by the end of FY97. The final objective, work at the ASLC, will commence in FY98.

## PUBLICATIONS AND REPORTS

Papers in press:

Castellini, J.M., H.J. Meiselman and M.A. Castellini. Understanding and interpreting hematocrit measurements in pinnipeds. *Marine Mammal Science.*1996

Submitted papers:

Zenteno, T., M.A. Castellini, L.D. Rea and B.S. Fadely. Plasma haptoglobin levels in threatened Alaskan pinniped populations. Journal of Wildlife Diseases. Submitted 1/96

Abstracts from professional meetings:

Fadely, B.S. and M.A. Castellini. Health status and body composition of Gulf of Alaska harbor seals. Eleventh Biennial Conference on the Biology of Marine Mammals. Orlando, FL.

Fadely, B.S. and M.A. Castellini. Long-term body condition changes in Prince William Sound and Gulf of Alaska harbor seals. American Association for the Advancement of Science 46th Annual Arctic Science Conference.

Planned FY97 papers.

Fadely, B.S. and M.A. Castellini. Body condition and morphometrics of Alaskan harbor seals. Physiological Zoology.

Fadely, B.S., et al. Microscopic studies on the ultrastructure of pinniped blubber. Journal yet to be decided.

## PROFESSIONAL CONFERENCES

In FY97, we are requesting support for the PI and the Ph.D. student primarily responsible for this project (B.S. Fadely), to attend a national conference on physiology and biomedicine to present papers and posters on population level health indices in harbor seals. This will be the last conference for Fadely before he graduates and will represent a summation of his thesis on body morphometrics and physiology of harbor seals. Dr. Castellini will present his work on a session dedicated to comparative physiology and will summarize the work from his laboratory on pinniped health relative to potential environmental stresses.

## COORDINATION AND INTEGRATION OF RESTORATION EFFORT

As noted before in the body of the proposal, this project has a critical collaboration with project \064 and with other ADF&G projects outside of PWS. Without \064, we would not have access to seals and would not have the ecological based data necessary for successful interpretation of our results. The work by other ADF&G projects outside of PWS are also essential for our comparative work with harbor seals so that we can model changes in oiled vs non-oiled areas. Collaboration with ADF&G to obtain the archived blubber samples is also essential to the project. There is critical collaboration with the Alaska Native Harbor Seal Commission to exchange information and samples.

## EXPLANATION OF CHANGES IN CONTINUING PROJECTS

There are no fundamental changes in the direction of FY97 and FY98 from the descriptions provided in 95001 and 96001. There are increased levels of community collaboration (through the Alaska Native Harbor Seal Commission), the addition of microscopic examination of seal blubber and the use of the ASLC in FY98 to work with rehabilitated animals.

**PRINCIPAL INVESTIGATOR**

Dr. Michael Castellini
Associate Professor of Marine Science
Institute of Marine Science
University of Alaska
Fairbanks, AK 99775

Phone: 907-474-6825
FAX: 907-474-7204
e-mail: mikec@ims.alaska.edu

**PERSONNEL**

Michael Castellini, Ph.D., specializes in metabolic chemistry problems associated with marine mammals. He is a tenured Associate Professor of Marine Science at UAF and has worked in this field for over 20 years.

J.M. Castellini, M.Sc., is a UAF Research Associate and has worked on marine mammal biochemistry/physiology projects since 1986. She is currently the laboratory director and provides for daily project monitoring.

B.S. Fadely, M.Sc., the primary Ph.D. student involved in this project, has previously performed studies involving nutritional physiology of northern fur seals and California sea lions. Currently he has been involved in assessing the health status of harbor seals in the Gulf of Alaska using morphometric and hematological techniques.

S. Trumble, M.Sc., is a Ph.D. student with a strong background in the biology of harbor seals. He is experienced with all aspects of animal capture, handling, boat operations and harbor seal behavior.

M.SC student. To be named. This student will provide laboratory and field support as necessary and will develop a M.Sc. project based on the field operations.

Publications relevant to this proposal:

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Castellini, M.A. Physiological health status of Steller sea lions and other pinnipeds in Alaskan waters: program objectives. Tenth Biennial Conference on the Biology of Marine Mammals. 1993.

Davis, R.W., Brandon, E.A.A., Kanatous, S., Adams, T., Brandon, D.W., Williams, T.M., Castellini, M.A., Loughlin, T.R., Calkins, D.G. and J. Sease. Female reproductive effort and pup growth in Steller sea lions. Tenth Biennial Conference on the Biology of Marine Mammals. 1993.

Williams, T.M., Davis, R.W., Castellini, M.A., Loughlin, T.R., Calkins, D.G. and J. Sease. The relationship between body condition and thermoregulatory costs in Steller sea lion pups. Tenth Biennial Conference on the Biology of Marine Mammals. 1993.

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# 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Personnel | $6.3 | $0.0 | | | | | | |
| Travel | $0.0 | $0.0 | | | | | | |
| Contractual | $18.1 | $188.6 | | | | | | |
| Commodities | $0.0 | $0.0 | | | | | | |
| Equipment | $0.0 | $0.0 | | | | | | |
| Subtotal | $24.4 | $188.6 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| General Administration | $2.2 | $13.2 | | | | | | |
| Project Total | $26.6 | $201.8 | $15.9 | $15.9 | $0.0 | $0.0 | $0.0 | |
| | | | | | | | | |
| Full-time Equivalents (FTE) | | 0.0 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:
An RSA will be written to the University of Alaska.

**1997**

Prepared:



Project Number: 97001
Project Title: Recovery of Harbor Seals from EVOS: Condition and Health Status
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/11/96

## 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| **Personnel Costs:** | | GS/Range/ | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | Step | Budgeted | Costs | Overtime | FFY 1997 |
| | | | | | | 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 | FFY 1997 |
| | | | | | 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 |

**1997**

Prepared:



Project Number: 97001
Project Title: Recovery of Harbor Seals from EVOS: Condition and Health Status
Agency: Alaska Department of Fish and Game Project Number: 97127

FORM 3B
Personnel
& Travel
DETAIL

4/11/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed FFY 1997 |
|---|---|
| Description | |
| RSA with the IMS of the University of Alaska | 188.6 |
| When a non-trustee organization is used, the form 4A is required. **Contractual Total** | $188.6 |

| **Commodities Costs:** | Proposed FFY 1997 |
|---|---|
| Description | |
| **Commodities Total** | $0.0 |

**1997**

Project Number: 97001
Project Title: Recovery of Harbor Seals from EVOS: Condition and Health Status
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities
DETAIL

Prepared: 4/11/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| 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 |
| 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 |
|---|---|---|
| | | |

**1997**

Project Number: 97001
Project Title: Recovery of Harbor Seals from EVOS: Condition and Health Status
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

Prepared: 4/11/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Personnel | $2.6 | $114.4 | | | | | | |
| Travel | $0.0 | $5.8 | | | | | | |
| Contractual | $2.0 | $13.4 | | | | | | |
| Commodities | $1.5 | $17.3 | | | | | | |
| Equipment | $10.0 | $0.0 | | | | | | |
| Subtotal | $16.1 | $150.9 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| Indirect | $2.0 | $37.7 | | | | | | |
| Project Total | $18.1 | $188.6 | $48.1 | $0.0 | $0.0 | $0.0 | $0.0 | |
| | | | | | | | | |
| Full-time Equivalents (FTE) | | 83.0 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:

**1997**

Project Number: 97001
Project Title: Recovery of Harbor Seal from EVOS: Condition and Health Status
Name: Institute of Marine Science

FORM 4A
Non-Trustee
SUMMARY

Prepared: 4/11/96

## 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| Personnel Costs: | | | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | | Budgeted | Costs | Overtime | FFY 1997 |
| M. Castellini | Principal Investigator | | 5.0 | 7.4 | | 37.0 |
| J. Castellini | Research Associate | | 6.0 | 4.1 | | 24.6 |
| B. Fadely | PhD Student | | 12.0 | 1.3 | | 15.6 |
| R. Trumble | PhD Student | | 12.0 | 1.2 | | 14.4 |
| TBA | Master's Student | | 12.0 | 1.0 | | 12.0 |
| | | | | | | 0.0 |
| Student Aid | PhD Student - 2 semesters | | 12.0 | 0.2 | | 2.4 |
| Student Aid | PhD Student - 2 semesters | | 12.0 | 0.5 | | 6.0 |
| Student Aid | Master's Student - 2 semesters | | 12.0 | 0.2 | | 2.4 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 83.0 | 15.9 | 0.0 | |
| | | | | | Personnel Total | $114.4 |

| Travel Costs: | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| EVOS workshop January 1997 - Principal investigator - Fbks/Anch | 0.2 | 1 | 4 | 0.1 | 0.6 |
| | | | | | 0.0 |
| Airfare for 3 students - Fbks/Anch to get to and from field sites | 0.2 | 6 | | | 1.2 |
| in spring and fall. | | | | | 0.0 |
| | | | | | 0.0 |
| Airfare for 1 student - Fbks/Anch to work with blubber samples | 0.2 | 3 | 6 | 0.1 | 1.2 |
| | | | | | 0.0 |
| FASEB conference - New Orleans - Student PhD presentation | 0.7 | 1 | 7 | 0.1 | 1.4 |
| FASEB conference - New Orleans - Principal investigator presentation | 0.7 | 1 | 7 | 0.1 | 1.4 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | Travel Total | $5.8 |

**1997**

Prepared:



Project Number: 97001
Project Title: Recovery of Harbor Seal from EVOS: Condition and Health Status
Name: Institute of Marine Science

FORM 4B
Personnel
& Travel
DETAIL

4/11/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Veterinary laboratory analysis for blood samples collected in PWS - 150 samples @ $30-40 (depending on analysis) | 5.3 |
| Bomb calorimetry to analyze blubber samples 175 samples @ $20 | 3.5 |
| Long distance phone and communication | 1.0 |
| Package delivery , courier (FedEx, DHL, etc) | 0.4 |
| Cargo shipping - to ship equipment to and from field sites and to ship samples for analysis | 2.1 |
| Microscopy 100 samples @ $5 | 0.5 |
| Publications/page charges | 0.6 |
| **Contractual Total** | $13.4 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Assay kits for chemical analysis of blood samples | 6.5 |
| Hormone assays for chemical analysis of blood samples | 6.0 |
| Organic solvents for lipid extraction of blubber samples | 0.8 |
| Freezer inventory supplies for storing and archiving blood and blubber samples | 0.5 |
| Laboratory expendables necessary for chemical analysis of blood and bubber samples | 1.0 |
| Computer supplies necessary for database management and analysis | 1.0 |
| Field gear - including foul weather gear, shipping crates, barrels | 1.5 |
| **Commodities Total** | $17.3 |

**1997**

Project Number: 97001
Project Title: Recovery of Harbor Seal from EVOS: Condition and Health Status
Name: Institute of Marine Science

FORM 4B
Contractual & Commodities DETAIL

Prepared: 4/11/96

| 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 |
| 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 | |
|---|---|---|
| | | |

1997

Project Number: 97001
Project Title: Recovery of Harbor Seal from EVOS: Condition and Health Status
Name: Institute of Marine Science

FORM 4B
Equipment
DETAIL

Prepared:



4/11/96

## Archaeological Index Site Monitoring

| | |
|---|---|
| Project Number: | 97007A |
| Restoration Category: | Monitoring |
| Proposer: | ADNR- Office of History and Archaeology |
| Lead Trustee Agency: | ADNR |
| Cooperating Agencies: | DOI-FWS, DOI-NPS, USFS |
| Alaska SeaLife Center: | |
| Duration: | 3rd-year, 10-year project |
| Cost FY 97: | $192,200 |
| Cost FY 98: | $145,000 |
| Cost FY 99: | $135,000 |
| Cost FY 00: | $135,000 |
| Cost FY 01: | $135,000 |
| Cost FY 02: | $135,000 |
| Cost FY 03: | $135,000 |
| Cost FY 04: | $135,000 |
| Geographic Area: | Prince Willam Sound, Kenai Peninsula, Kodiak Island |
| Injured Resource: | Archaeological Resources |



**ABSTRACT**

Monitoring of archaeological sites on public land injured by vandalism and oiling will concentrate on a sample of index sites in the three regions of the spill. Oiled sites will be tested for re-introduced oil. The ten year project will end at five years if monitoring shows no continued injury.

## INTRODUCTION

Damage to archaeological sites as a result of cleanup activities after the Exxon Valdez Oil Spill has been amply documented in damage assessment studies performed since the spill. Damage from vandals has continued to be documented at several sites on public lands during the past several seasons. Although damage from vandals at other sites has not been documented, they are still active in the region and their level of depredations needs to be monitored. Monitoring of damaged sites as a gauge of vandal activities in the spill area was identified as a primary strategy for site restoration during 1995 and is being continued to provide a long term assessment of the problem. A consensus was reached among agency archaeologists and concurred with by the peer reviewer that the most efficient way to monitor vandalized sites would be to select "index" damaged sites to provide an indication of the level of vandal activity in the spill area. Additional land parcels containing additional damaged sites are currently being acquired by the Trustee Council. Documentation for damages to the new sites is contained in Exxon reports and damage assessment reports by agencies. Several sites in that category are included in proposed work during 1997.

The archaeological peer reviewer for the Trustee Council recommended during the 1995 science workshop that monitoring continue at oiled sites to check for new movement of buried oil into site deposits. His concern was that subsurface oil would move into archaeological deposits and compromise possible data recovery. That recommendation is followed in the 1997 work proposal.

Monitoring of archaeological sites injured by the spill or spill related activities will target a small number of sites on public lands which are determined to represent those that are most vulnerable to looting or oiling. Those index sites (Figure 1) will serve as a gauge for levels of vandalism in the spill area. Index sites oiled during the early time immediately after the spill in March 1989 were monitored during 1995 and will be returned to again during 1997 after a two year hiatus. Sites in Prince William Sound will include SEW-440, SEW-469, and SEW-068. The latter site has not been re-visited since 1991. Outer Kenai Peninsula sites are SEL-178 and SEL-215. In the Kodiak Island area sites AFG-098 and AFG-081 will be visited by the State. The U.S. Fish and Wildlife Service will re-visit KOD-171 and if 1996 finding show the need, AFG-129. Sites AFG-026, AFG-027, AFG-028, and AFG-143 also will be re-visited for the first time since 1993. Both the State and USFWS propose to visit several damaged sites which are located on newly acquired habitat parcels. The State proposes to visit AFG-173 which is on newly acquired property on Shuyak Island. The U.S. Fish and Wildlife Service proposes to assess damage at Kiavak Bay on three sites, KOD-098, KOD-099, and KOD-100. Those sites were in an area where uncontrolled cleanup occurred and have recently been purchased as habitat acquisitions.

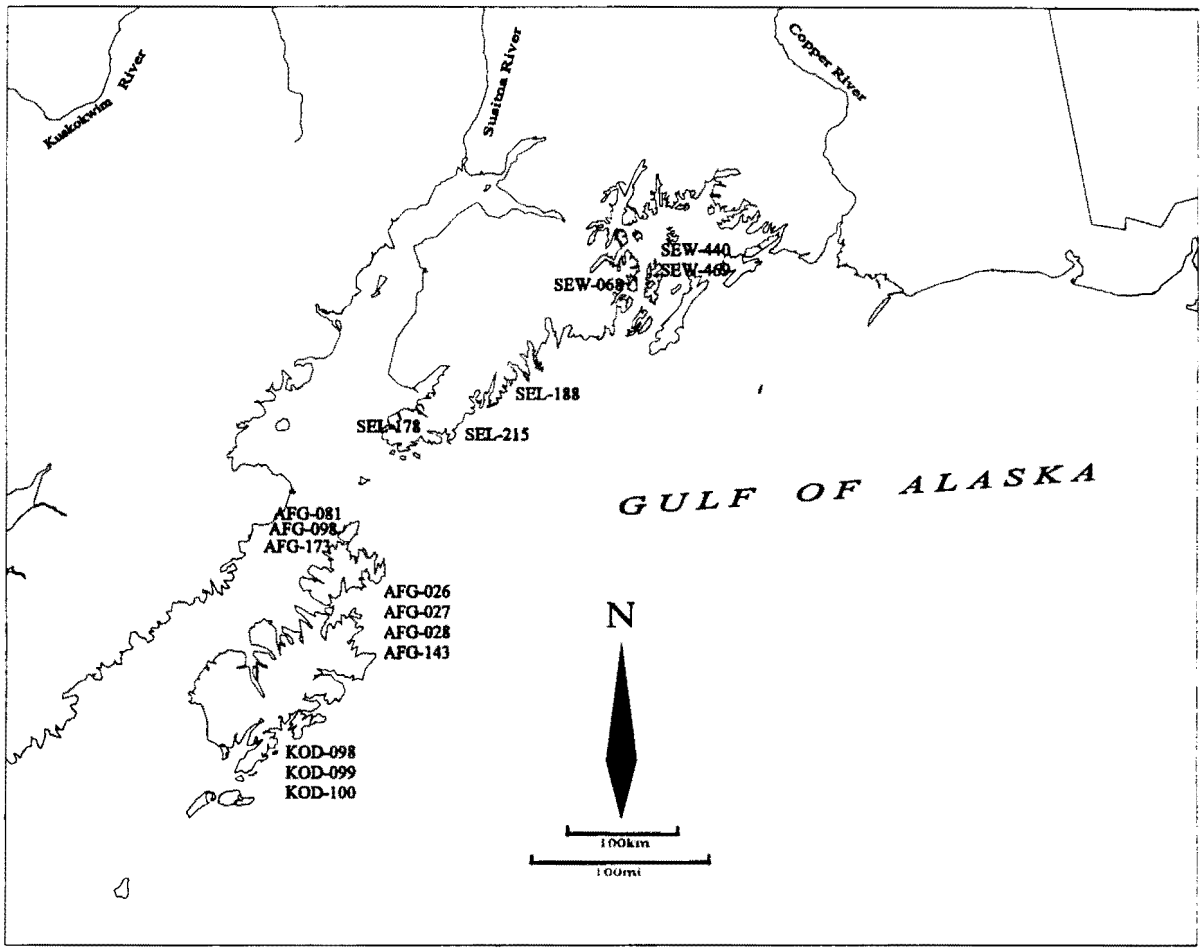


**Figure 1.** Archaeological sites to be visited during 1997.

## NEED FOR THE PROJECT

### A. Statement of Problem

Sites monitored under project 97007 are index archaeological sites thought to be representative of archaeological sites on the public lands in the spill area which have been oiled or are being vandalized. Some sites were oiled during the spill and are being monitored to check for recent movement of subsurface oil into site deposits.

Vandalism during cleanup appears to have been associated with people placed near sites while living on chartered boats. Circumstantial evidence indicates that some crew members, many of whom are residents of coastal communities, were involved in looting of sites. Agency resource managers fear that looting associated with cleanup continued on and spread to other sites of the area.

Oil was found in beach sediments at several of the sites selected as index localities although none was initially documented in site deposits. A goal of this project is to monitor those sites to detect movement of the persistent oil into cultural deposits from the surrounding sediments.

### B. Rationale

Loss of sites to vandals and pollution of sites from remaining oil removes the ability of archaeologists to recover data about the prehistory from those sites. The number of sites in the area is finite and will not increase. Reasonable efforts must be made to protect the cultural heritage data base from degradation. Sites in the area continue to be lost to erosion, making loss from this human degradation more critical.

### C. Location

The project occurs in Prince William Sound, on the outer coast of the Kenai Peninsula, and in the Kodiak Island archipelago. Most sites are located in very remote areas. The one village effected by this project would be Chenega Bay with the visit to the SEW-068 site.

## COMMUNITY INVOLVEMENT

The sites being monitored under this project are remote except for the site SEW-068. That site is near Chenega Bay and very near the old Chenega location. During the 1991 investigation of the site, a representative of the village was invited to go along with the field crew. A representative will again be invited to accompany the investigator for the short visit.

## PROJECT DESIGN

### A. Objectives

The overall intent of the archaeological site monitoring program is to maintain a current assessment of the status of vandalized sites in the oil spill area and sites oiled during the spill. Continuing and current site status is required to protect the sites from degradation. The objectives of the FY97 project are:

1. Monitor vandalized sites to identify continuing vandal activity in order to protect the sites. Information about index sites will be projected for management planning to the larger inventory of sites in the spill area.
2. Monitor sites contaminated by oil during the Exxon Valdez Oil Spill to identify any encroachment of subsurface oil into the cultural deposits from surrounding sediments.

The intent of the project at its conclusion is to have maintained a presence at the vandalized sites for a long enough period of time to gauge levels of vandalism and discourage that activity by our presence. The long range intent by FY2004 is to reduce that activity to zero. Oiled sites will be considered restored when they have remained oil free for the life of the project. Oil in surrounding sediments will be considered stable or immobile by that time.

### B. Methods

A strategy was identified during the 1994 restoration workshop of designating index sites vulnerable to looting which will be monitored bi-annually as a check over a broader area. The second group of sites may vary over time in order to maintain flexible response to new information such as fresh reports of vandalism or new findings on patterns of looting. The second group of sites provides a cross-check to monitoring data collected at the index sites. Focusing annual monitoring on 4 index sites and using a 2-year monitoring schedule on the additional 4 sites, expenditures will be significantly reduced while maintaining continuity of tracking levels of vandalism over the years. Vulnerability to looting will be the primary criteria of selection with managerial jurisdiction a secondary concern. Sites which were oiled will be monitored for oil so that behavior and effect of oiling can be observed over the long term in archaeological deposits.

Testing for presence of oil in site sediments will be done with the HNU-Hanby field test kit which can identify the presence of petroleum hydrocarbons and give an estimate of the relative concentration of the contaminants in the soil. Once the field tests show positive for oil, plans will be made to obtain funding so that the Auke Bay lab can send personnel to collect suitable samples for identifying the source of the oil and more accurately determine the amount present. This procedure was suggested by Auke Bay lab representatives at the 1995 workplan session so that suitable samples could be properly collected and processed.

Documentation of site status at the localities monitored for vandalism will include re-locating previously established reference points and referring all observations to those points. Field

maps will be drawn or surveyed as appropriate. Photo and video documentation will be referenced to datum points and will duplicate earlier perspectives as closely as possible. Test localities will be mapped in reference to site reference points.

**SEW-440** The Chugach National Forest archaeologist will visit the site to monitor for vandalism. Testing of beach sediments collected during 1994 and 1995 proved positive on the beach which has been bioremediated. Additional sediment samples will be collected for further testing.

**SEW-469** This site will be re-visited in 1997 to check for signs of vandalism. The location of vandal activity documented during 1990 will be re-examined and photographed with reference to established photo points.

**SEW-068** This site was visited during 1991 to assess vandal damage to exposed intertidal deposits and test sediments for presence of oil. The site will be briefly visited during 1997 and site status monitored. Beach sediment will be collected for testing with the HNU-Hanby field test kit for petroleum hydrocarbons.

**SEL-188** The National Park Service will return to this site to sample current status of oiled beach sediments. During 1995 oil identified as from the *Exxon Valdez* was present on that beach. The beach will also be examined for any evidence for vandal disturbance of exposed artifacts.

**SEL-215** This site will be returned to in 1997 to monitor the exposed remains documented in 1994. Sediment samples will also be collected for testing with the HNU-Hanby field test kit. Photographic documentation of site status will be generated from established reference points on the site.

**SEL-178** The Port Dick Cabin Site, SEL-178 will be visited to monitor vandal damage to the site. During 1995, damage to a previously undocumented part of the site deposits was noted. Status of that damage will be documented with maps and photography. Areas of artifact exposure in other parts of the site, documented during 1991 will be re-checked and re-documented.

**AFG-081** The AFG-081 will be re-visited during 1997 to monitor the location of 1991 vandalism. The damage was restored during 1994 by covering the area with fill and logs. The area was re-damaged during 1995 and replacement of the restorative cover may be necessary during 1997. Site status will be documented through photography.

**AFG-098** The site was visited during 1995 to document reported damage from the prior winter. Sediment samples from the intertidal zone tested negative for presence of petroleum hydrocarbons. The site will be re-visited during 1997 to monitor site condition through photography and mapping of any damage found.

**AFG-173** This site was visited during 1990 at which time vandal damage was noted and poorly documented. The damage will be re-assessed and documented so that a restoration procedure can be devised if necessary.

**AFG-026** This site and the next three sites are in the Alaska Maritime National Wildlife Refuge were visited during 1993 and all previous disturbance mapped. Disturbance was noted while vessels of the cleanup fleet were anchored in the immediate area. Vandal injury of the middens occurred from tunneling and surface digging into the midden. The current status of the sites will be documented and compared with prior conditions.

**AFG-027** See AFG-026 description.

**AFG-028** See AFG-026 description.

**AFG-143** See AFG-026 description.

**KOD-171** The Chief Cove Site will be re-visited to monitor evidence for continuing disturbance of the midden. Slumpage in the midden deposits was documented during 1995 however the agent of disturbance was not established. Findings will be mapped on the existing map which is based on the field map created by the Dekin, et al., damage assessment study done in 1991.

**KOD-098** This site is exposed and is in an area recently purchased under the habitat acquisition program and incorporated into the Kodiak National Wildlife Refuge. The area was subjected to unsupervised cleanup by local crews. the site will be examined for damage from vandals. Reported damage will be documented to standards applied to other damaged sites.

**KOD-099** This site is very close to KOD-098 and KOD-100 and needs the same type of damage assessment and documentation. See KOD-098 description.

**KOD-100** This site is close to KOD-098 and KOD-099 and will be accorded similar assessment of damage and documentation. See KOD-098 and KOD-099 description.

### C. Cooperating Agencies, Contracts, and Other Agency Assistance

Cooperating agencies under this project are the DOI-U.S. Fish and Wildlife Service, DOI-National Park Service, and the USDA- Forest Service. Each of the federal agencies has management responsibilities for resources on lands assigned to them, including cultural resources. Each of those agencies has on staff qualified archaeologists who will conduct archaeological activities on agency lands. The Alaska Department of Natural Resources is designated the lead agency only to coordinate all agency activities and oversee compilation of results. Each agency will oversee its own budget and fieldwork.

No major contracts are anticipated by any agency for this project. The only contractual activity will be aircraft or boat charters processed by individual agencies on a per hour or day basis. Normal agency contracting procedures will be followed. The same will be true when contracting for radiocarbon dating or sediment analysis services. Radiocarbon dating will be done in commercial facilities, none of which exist within Alaska.

## SCHEDULE

### A. Measurable Project Tasks for FY 97 (October 1, 1996 - September 30, 1997)

| | |
|---|---|
| October 1, 1996 - December 31, 1996: | Complete requirements for NEPA requirements and prepare draft report for FY 96 field activities. |
| April 15, 1997: | Submit annual report of FY 96 activities for peer and Chief Scientist review. |
| May 1, 1997 - June 1, 1997: | Finalize arrangements for fieldwork; make changes in FY 96 report for submission to OSPIC. |
| June 1, 1997 - September 30, 1997: | Complete fieldwork and followup office work. Submit charcoal and sediment samples for analysis. |

### B. Completion Date

The archaeological index site monitoring has been scheduled for completion in FY 2004. That is the time span which agency experience suggests a pattern of vandal activity will be demonstrated and EVOS related. Findings of negative results at specific sites for a period of at least three years will delete that index site from further monitoring. A report of cumulative findings is planned at the half way point of project duration in 1998. A final report closing out the project will be written during FY 2004 unless dictated sooner.

## PUBLICATIONS AND REPORTS

No formal publications are anticipated for this monitoring project. An annual report will be produced by April 15, 1998 as dictated in the submittal instructions for project proposals. At the end of the continuing project, a final closeout report will be prepared.

## PROFESSIONAL CONFERENCES

No professional conferences will be attended nor papers presented in respect to this monitoring project.

## NORMAL AGENCY MANAGEMENT

Federal and state laws assign general responsibility for dealing with cultural resource matters to the various land managing agencies. None of the agencies cooperating in this monitoring project has ever funded a program of site monitoring or data collection at the sites identified in the project proposal. The sites identified have been specifically linked to the *Exxon Valdez* Oil Spill which clearly is outside the normal agency responsibility. The duration of this monitoring project has a estimated length of ten years or a period of sustained negative finding of damages.

## COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Because monitoring of sites are for specific locations for short periods, chances of coordinating travel or facilities with other restoration projects is very limited. Where possible, sharing of boat and airplane charters will be coordinated with other restoration projects within agencies.

## EXPLANATION OF CHANGES IN CONTINUING PROJECTS

No major changes in methodology have been proposed from the 96007 detailed project description other than sites monitored. Part of the originally established procedure of using "index" sites was that monitored sites would vary between years to make coverage more efficient. That variation is reflected in the sites selected for FY 97. Several site clusters, both clusters are on Kodiak National Wildlife Refuge, have been incorporated into the FY 97 project which involve assessing reported damages for sites newly acquired under the habitat acquisition project. Those sites were not previously considered because of a restriction on monitoring sites not on public lands. Those sites now are publicly owned.

## PROPOSED PRINCIPAL INVESTIGATOR

Douglas R. Reger
Office of History and Archaeology
Alaska Department of Natural Resources
3601 C Street, Suite 1278
Anchorage, AK 99503-5921
(907) 269-8725
FAX (907)269-8908
E-mail: oha@alaska.net

Douglas R. Reger
Archaeologist II
Office of History and Archaeology
Alaska Division of Parks and Outdoor Recreation
3601 C Street, Suite 1278
Anchorage, AK 99510-7001

1981 PhD.- Anthropology, Washington State University

PROFESSIONAL EXPERIENCE:

| | |
|---|---|
| 1964 | Field and museum assistant, Univ. of Alaska, Fairbanks |
| 1965 | Field assistant, Univ. of Alaska, Fairbanks |
| 1966 | Field assistant, Alaska Methodist Univ. |
| 1966-67 | Laboratory/research assistant, Alaska Methodist Univ. |
| 1969 | Short field surveys, Cordova and Katmai, AK |
| 1970 | Field School instructor, Alaska Methodist U., Tangle Lakes |
| 1970-71 | Excavated site 49KEN-029, near Kenai, AK |
| 1971 | Salvage archaeologist, Alyeska Pipeline Project |
| 1971-74 | Teaching assistant, Washington State Univ. |
| 1972 | Assistant Highways archaeologist, Washington State Univ. |
| 1973 | Project Archaeologist, Homer Society for Natural History |
| 1974-75 | Regional archaeologist, USDA Forest Service, Alaska Region |
| 1975-82 | Alaska State archaeologist, Alaska Division of Parks |
| 1978-82 | Deputy State Historic Preservation Officer, Alaska |
| 1982-86 | Archaeologist, Alaska Division of Geological and Geophysical Surveys |
| 1986- | Archaeologist, Alaska Division of Parks and Outdoor Recreation |

PUBLICATIONS/REPORTS:

| | |
|---|---|
| 1972 | *An archaeological survey in the Utopia area, Alaska,* **Anthropological Papers of the University of Alaska**, 15(2), with R.D. Reger |
| 1974 | *Prehistory of the northern Kenai Peninsula,* In **Prehistory of the North American Subarctic: the Athapaskan Question**, edited by J.W. Helmer, S. VanDyke, and F.J. Kense, Univ. of Calgary, p. 16-21 |
| 1977 | *An Eskimo Site near Kenai, Alaska,* **Anthropological Papers of the University of Alaska**, 18(2): 37-52 |
| 1983 | *Norton: a changing southeastern boundary,* **Arctic Anthropology** 19(2): 93-99, with Joan B. Townsend |
| 1987 | *Archaeology of a late prehistoric subsistence locality, the Clam Gulch Site (49KEN-045),* **Anthropological Papers of the University of Alaska** 21:89-103 |
| 1992 | Effect of crude oil contamination on some archaeological sites in the Gulf of Alaska, 1991 investigations. Office of History and Archaeology Report No. 30. Alaska Division of Parks and Outdoor Recreation, with J. David McMahan and C. E. Holmes |

Terje (Ted) G. Birkedal
Chief, Division of Cultural Resources
Alaska Region, National Park Service
2525 Gambell Street
Anchorage, AK 99503

| | |
|---|---|
| 1968 | B.A. - Anthropology, University of Colorado |
| 1970 | M.A. - University of Colorado |
| 1976 | PhD. - Anthropology, University of Colorado |

## Field Experience

1965--1992: Survey and excavation experience includes Western Slope of Rockies, Colorado; High Grass Plains, Colorado; Colorado Plateau Area of American Southwest; Delta Area of Louisiana; Southwestern Norway; Bella Bella Region of Canadian Northwest Coast; Guam(Micronesia); and various locations in national parks of Alaska. Includes both prehistoric and historical archaeological experience.

## Professional Experience

| | |
|---|---|
| 1971-75 | Instructor, Department of Anthropology, University of Guam |
| 1976-82 | Archaeologist and later Branch Chief, Branch of Indian Archaeological Assistance, Southwest Region, National Park Service, Santa Fe |
| 1982-85 | Chief, Branch of Archaeological Resource Management, Southwest Region, National Park Service, Santa Fe |
| 1986-92 | Regional Archaeologist, Alaska Region, National Park Service, Anchorage |
| 1992-Present | Chief, Division of Cultural Resources, Alaska Region, National Park Service, Anchorage |

(Majority of Federal career has been spent on the conduct, management, and administration of large archaeological projects.)

## Professional Affiliations

Society for American Archaeology
Alaska Anthropological Association
National Trust for Historic Places
Sigma xi: Scientific Honorary Society

Charles E. Diters
Regional Archaeologist/ Regional Historic Preservation Officer
Alaska Regional Office
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, AK 99503

| | |
|---|---|
| 1971 | A.B. - Anthropology, Dartmouth College |
| 1977 | A.M. - Anthropology, Brown University |

## Field Experience

| | |
|---|---|
| 1970 | Excavation, Healy Lake Village Site, University of Alaska |
| 1970 | Archaeological Survey, Alyeska Pipeline Project, University of Alaska |
| 1971 | Archaeological Survey, Aniginigurak and Mosquito Lake Sites, University of Alaska |
| 1977 | Archaeological Survey, National Petroleum Reserve, Alaska, National Park Service |
| 1978 | Archaeological Survey, National Petroleum Reserve, Alaska, National Park Service |
| 1978 | Excavation, Russian Bishop's House, Sitka National Historic Park, Alaska, National Park Service |
| 1980-82 | Archaeological survey and project clearances, Chugach National Forest, Alaska |
| 1982-Present | Archaeological survey and project clearances, National Wildlife Refuges throughout Alaska |

## Other Appointments

| | |
|---|---|
| 1989 | Alaska State Museum Collections Advisory Committee, Vice-Chair, 1989-91, Chair, 1991 |
| 1991-92 | Board of Directors, Alaska Anthropological Association |
| 1991 | Iditarod National Historic Trail Advisory Committee |

## Professional Affiliations

Society for American Archaeology
Alaska Anthropological Association
Arctic Institute of North America

Linda Finn Yarborough
Archaeologist
Chugach National Forest
U.S.D.A. Forest Service
3301 C Street, Suite 300
Anchorage, AK 99503-3998

| | |
|---|---|
| 1973 | B.A., Anthropology, State University of New York |
| 1974 | M.A., Anthropology, University of Toronto |
| Present | PhD. Program, Anthropology, University of Wisconsin, Madison |

## Field Experience

Archaeological survey, testing, and excavations throughout many regions of Alaska

Specialty interest areas: Pacific Rim prehistory, prehistory of Prince William Sound and southcentral Alaska, faunal analysis

## Current Position

1992-Present Assistant Forest Archaeologist and Cooperative Education Student, Chugach National Forest, Anchorage, Alaska

## Publications / Reports

Numerous papers, reports, and articles. List available

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | PROPOSED FFY 1997 TRUSTEE AGENCIES TOTALS | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | ADEC | ADF&G | ADNR | USFS | DOI | NOAA |
| | | | | | $115.0 | $27.2 | $50.0 | |
| Personnel | $75.3 | $100.9 | | | | | | |
| Travel | $24.4 | $26.8 | | | | | | |
| Contractual | $25.7 | $37.9 | | | | | | |
| Commodities | $6.5 | $8.9 | | | | | | |
| Equipment | $0.0 | $0.0 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
| Subtotal | $131.9 | $174.5 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| General Administration | $2.1 | $17.7 | | | | | | |
| Project Total | $134.0 | $192.2 | $148.0 | $158.0 | $138.0 | $158.0 | $138.0 | $0.0 |
| | | | | | | | | |
| Full-time Equivalents (FTE) | 1 | 1.4 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 |

Comments: This project is a continuation of Project 95007A and 96007A.

**1997**

Prepared: 1 of 17

Project Number: 97007A
Project Title: Archaeological Index Site Monitoring
Lead Agency: AK Department of Natural Resources

FORM 2A
MULTI-TRUSTEE
AGENCY
SUMMARY

4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Personnel | $51.3 | $60.9 | | | | | | |
| Travel | $12.1 | $13.0 | | | | | | |
| Contractual | $19.4 | $25.2 | | | | | | |
| Commodities | $4.5 | $5.0 | | | | | | |
| Equipment | | $0.0 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
| Subtotal | $87.3 | $104.1 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| General Administration | | $10.9 | | | | | | |
| Project Total | $87.3 | $115.0 | $100.0 | $90.0 | $90.0 | $90.0 | $90.0 | |
| Full-time Equivalents (FTE) | 0.7 | 0.8 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:

**1997**

Prepared: 2 of 17

Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: AK Department of Natural Resources

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| **Personnel Costs:** | | GS/Range/ | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | Step | Budgeted | Costs | Overtime | FFY 1997 |
| Douglas R. Reger | Archaeologist II | 18M | 6.0 | 6.5 | | 39.0 |
| Judith E. Bittner | Chief, History and Archaeology | 21K | 1.5 | 7.4 | | 11.1 |
| J. David McMahan | Archaeologist I | 16K | 2.0 | 5.4 | | 10.8 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 9.5 | 19.3 | 0.0 | |
| | | | | | **Personnel Total** | $60.9 |

| **Travel Costs:** | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| Travel to Kodiak to monitor sites | 0.4 | 4 | 40 | 0.115 | 6.2 |
| Travel to Homer to monitor sites | 0.2 | 6 | 33 | 0.115 | 5.0 |
| Travel to Fairbanks for collection curation | 0.450 | 2 | 8 | 0.115 | 1.8 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | $13.0 |

**1997**

Prepared:



Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: AK Department of Natural Resources

FORM 3B
Personnel
& Travel
DETAIL

4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Air charter (Kodiak 20 hours, Homer 15 hours @ $275) | 9.6 |
| Curation costs, estimated | 5.0 |
| Sediment analysis, chemical 6 @ $500 | 3.0 |
| Radiocarbon dating, 12 samples @ $300 | 3.6 |
| Film processing | 3.0 |
| Report duplication | 1.0 |
| When a non-trustee organization is used, the form 4A is required. **Contractual Total** | $25.2 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Field supplies | 2.5 |
| Office supplies | 2.5 |
| **Commodities Total** | $5.0 |

**1997**

Prepared:

Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: AK Department of Natural Resources

FORM 3B
Contractual & Commodities DETAIL

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **New Equipment Purchases:** | Number | Unit | Proposed |
|---|---|---|---|
| Description | of Units | Price | 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 |
| 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 |
| | | |

**1997**

Prepared: 5 of 17

Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: AK Department of Natural Resources

FORM 3B
Equipment
DETAIL

4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Personnel | $12.0 | $18.0 | | | | | | |
| Travel | $5.0 | $5.1 | | | | | | |
| Contractual | $2.2 | $3.3 | | | | | | |
| Commodities | | $0.0 | | | | | | |
| Equipment | | $0.0 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
| Subtotal | $19.2 | $26.4 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| General Administration | | $2.9 | | | | | | |
| Project Total | $19.2 | $29.3 | $20.0 | $20.0 | $20.0 | $20.0 | $20.0 | |
| Full-time Equivalents (FTE) | 0.1 | 0.3 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:

**1997**

Prepared: 6 of 17

Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: DOI- Fish and Wildlife Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/10/96

## 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| **Personnel Costs:** | | GS/Range/ | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | Step | Budgeted | Costs | Overtime | FFY 1997 |
| Charles E. Diters | Archaeologist | GS-12 | 3.0 | 6.0 | | 18.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 3.0 | 6.0 | 0.0 | |
| | | | | | **Personnel Total** | $18.0 |

| **Travel Costs:** | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| Travel to Kodiak to monitor sites | 0.4 | 6 | 12 | 0.225 | 5.1 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | $5.1 |

**1997**

Prepared:



Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: DOI- Fish and Wildlife Service

FORM 3B
Personnel
& Travel
DETAIL

4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Air charter (Kodiak 10 hours @ $275) | 2.8 |
| Film processing | 0.5 |
| When a non-trustee organization is used, the form 4A is required. **Contractual Total** | $3.3 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| **Commodities Total** | $0.0 |

**1997**

Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: DOI- Fish and Wildlife Service

FORM 3B
Contractual & Commodities DETAIL

Prepared:



4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| **New Equipment Purchases:** | Number | Unit | Proposed |
|---|---|---|---|
| Description | of Units | Price | 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 |
| 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 |
| | | |

**1997**

Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: DOI- Fish and Wildlife Service

FORM 3B
Equipment
DETAIL

Prepared: 9 of 17

4/10/96

## 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 |
|---|---|---|
| | | |
| Personnel | $0.0 | $9.5 |
| Travel | $0.0 | $3.3 |
| Contractual | $0.0 | $4.3 |
| Commodities | $0.0 | $1.9 |
| Equipment | $0.0 | $0.0 |
| Subtotal | $0.0 | $19.0 |
| General Administration | | $1.7 |
| Project Total | $0.0 | $20.7 |
| | | |
| Full-time Equivalents (FTE) | 0 | 0.1 |
| | | |
| Other Resources | | |

| LONG RANGE FUNDING REQUIREMENTS | | | | | |
|---|---|---|---|---|---|
| Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| $0.0 | $20.0 | $0.0 | $20.0 | $0.0 | |
| | | | | | |
| | | | | | |
| Dollar amounts are shown in thousands of dollars. | | | | | |
| | | | | | |

Comments:
The National Park Service is monitoring on the McArthur Pass Site, SEL-171, on an alternating year basis according to the restoration plan intent for index sites. The agency did not monitor during FY 96 but last monitored the site during FY 95.

**1997**

Prepared: 10 of 17

Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: DOI-National Park Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Personnel Costs:** | | GS/Range/ | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | Step | Budgeted | Costs | Overtime | FFY 1997 |
| | Archaeologist | GS-13 | 0.7 | 6.3 | | 4.4 |
| | Archaeologist | GS-11 | 1.0 | 5.1 | | 5.1 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 1.7 | 11.4 | 0.0 | |
| | | | | | **Personnel Total** | $9.5 |

| **Travel Costs:** | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| Travel to Seward to monitor site | 0.150 | 4 | 12 | 0.225 | 3.3 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | $3.3 |

**1997**

Prepared:



Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: DOI- National Park Service

FORM 3B
Personnel
& Travel
DETAIL

4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Air charter, two trips @ $1.0 | 2.0 |
| Film processing | 1.3 |
| Photo printing | 1.0 |
| When a non-trustee organization is used, the form 4A is required. **Contractual Total** | $4.3 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Office supplies | 1.0 |
| Field supplies | 0.9 |
| **Commodities Total** | $1.9 |

**1997**

Prepared:

Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: DOI- National Park Service

FORM 3B
Contractual & Commodities DETAIL



4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| **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 |
| 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 |
|---|---|---|
| | | |

**1997**

Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: DOI- National Park Service

FORM 3B
Equipment
DETAIL

Prepared: 4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Personnel | $12.0 | $12.5 | | | | | | |
| Travel | $7.3 | $5.4 | | | | | | |
| Contractual | $4.1 | $5.1 | | | | | | |
| Commodities | $2.0 | $2.0 | | | | | | |
| Equipment | | $0.0 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
| Subtotal | $25.4 | $25.0 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| General Administration | $2.1 | $2.2 | | | | | | |
| Project Total | $27.5 | $27.2 | $28.0 | $28.0 | $28.0 | $28.0 | $28.0 | |
| Full-time Equivalents (FTE) | 0.2 | 0.2 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments: Project is a continuation of 95007A and 96007A.

**1997**

Prepared: 14 of 17

Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: U.S. Forest Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| **Personnel Costs:** | | GS/Range/ | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | Step | Budgeted | Costs | Overtime | FFY 1997 |
| Linda F. Yarborough | Archaeologist | GS-11 | 2.6 | 4.8 | | 12.5 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 2.6 | 4.8 | 0.0 | |
| | | | | | **Personnel Total** | $12.5 |

| **Travel Costs:** | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| Travel to Cordova to monitor sites | 0.224 | 2 | 22 | 0.225 | 5.4 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | $5.4 |

**1997**

Prepared:



Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: U.S. Forest Service

FORM 3B
Personnel
& Travel
DETAIL

4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Air charter to Prince William Sound (10 hours @ $275) | 2.8 |
| Film processing | 0.5 |
| Report processing | 0.8 |
| Publication | 1.0 |
| When a non-trustee organization is used, the form 4A is required. **Contractual Total** | $5.1 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Field supplies | 1.0 |
| Office supplies | 1.0 |
| **Commodities Total** | $2.0 |

**1997**

Prepared:

Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: U.S. Forest Service

FORM 3B
Contractual & Commodities DETAIL



4/10/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| **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 |
| 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 |
|---|---|---|
| | | |

**1997**

Project Number: 97007
Project Title: Archaeological Index Site Monitoring
Agency: U.S. Forest Service

FORM 3B
Equipment
DETAIL

Prepared: 4/10/96

## SITE SPECIFIC ARCHAEOLOGICAL RESTORATION

| | |
|---|---|
| Project Number: | 97007B |
| Restoration Category: | Restoration management actions; archaeology |
| Proposer: | Chugach National Forest |
| Lead Trustee Agency: | USFS |
| Duration: | 1 year |
| Coast FY 97: | $27,200 |
| Cost FY 98 and future years: | none |
| Geographic area: | Prince William Sound |
| Injured Resource/Service: | Archaeological resources |



ABSTRACT

Funding is requested for an additional phase of the Forest Service's archaeological restoration at sites SEW-440 and SEW-488. Project 97007B is a continuation of projects 96007B, 95007B and 94007B. The final report on the restoration project having been completed in FY1996, this phase of the project will complete presentation of the results to the professional and general public. The Principal Investigator will prepare two professional papers for publication, one paper for presentation at a conference, and make trips to Oil Spill communities to present information about the project results to the public, as strongly suggested by the Trustee Council.

## INTRODUCTION

The proposed phase is the final part of the restoration project previously funded as 94007B, 95007B, and 96007B. Restoration field work was completed in FY94 and FY95. The report on the analysis of data resulting from those field seasons is scheduled to be completed in FY96. This report will have limited distribution, and will not be widely available to professional archaeologists, beyond those in Alaska working on similar topics. During FY96 the Trustee Council and their staff called for Principal Investigators to write papers concerning their projects for professional journals, and to educate the public regarding the outcome of these projects. The work proposed for FY97 is the preparation of two papers for publication and one for presentation at the Society of American Archaeology. It will also include presentation of the project results to six Oil Spill communities in coordination with the Community Involvement facilitators.

## NEED FOR THE PROJECT

### A. Statement of the Problem

Restoration work at archaeological sites SEW-440 and SEW-488 has resulted in a wide variety of data being collected. The project report being prepared in FY96 addresses the restoration goals of full field site damage assessment; recovery, analysis and curation of artifacts; the nature of each site; and the extent to which the identified damage has compromised or destroyed information contained in the sites. The sensitive nature of archaeological resources requires that information to be kept confidential. Therefore, two versions of the FY96 report will be prepared, one for public distribution, and the other for professional archaeologists and land managers who have a need to know this information. However, this report will be part of what is commonly called "grey literature", meaning that it will not be widely available or easily discovered by other professionals. The Trustee council has recognized this need, and now actively encourages publication of project results in peer-reviewed journals as soon as scientifically appropriate and ligistically possible. The scientifically appropriate time for presentation on material regarding the nature of the archaeological sites will be in 1997, following preparation of the 1996 project report.

In addition, the Trustee Council is encouraging efforts to increase communication with spill-area residents about restoration efforts and to incorporate traditional and local knowledge into projects. Visits to Oil Spill communities to present the results of the archaeological restoration project will create an opportunity to interact with members of the general public who are interested in the project, but have not necessarily been able to attend restoration project meetings in Anchorage. It will also provide an opportunity for keepers of traditional and local knowledge

to contribute to project results.

### B. Rationale

Having gained scientific and cultural knowledge which adds significantly to the human and biological understanding of the prehistory of Prince William Sound, it is important to disseminate that knowledge to both the general public and other professionals. As the 1996 project report will be in the "grey literature" venue, it is important, as the Trustee Council has noted, to also have related papers in peer reviewed professional journals. Additionally, the Trustee Council has noted that it is important to increase communication with the Oil Spill community residents, both in terms of scientific information from Principal Investigators and local and traditional knowledge from residents.

## COMMUNITY INVOLVEMENT

Various community involvement leaders and facilitators have encouraged the dissemination of archaeological restoration project information through travel to Oil Spill communities and presenting data to the public in a lecture format followed by discussion. Presentations in schools would also be arranged. This will allow the public to ask questions and better understand the restoration effort. Such a forum will also allow an opportunity for the public to provide traditional and local knowledge to the Principal Investigator.

## PROJECT DESIGN

### A. Objectives

1. Relate specific data from restoration project archaeological sites to regional and theoretical research questions in two papers for peer-reviewed publication in professional journals.

2. Prepare a paper for presentation at the Society for American Archaeology (SAA) regarding the EVOS archaeological restoration project, its rationale, and results.

3. Prepare and make presentations to schools and public audiences in six Oil Spill communities to increase communication and provide an opportunity for input of local and traditional knowledge.

### B. Methods

The research papers will address regional and theoretical archaeological questions using the data

from the EVOS restoration project sites. One paper will consider taphonomic processes affecting the preservation of archaeological data. It will focus primarily on variability in patterns of biological species acquisition and use, transport and processing techniques. The other paper will consider changes in past climate and related changes in resource availability; questions of seasonal availability and human use of biological species, especially long-term trends in the proportional use of marine resources; and cultural response to late Holocene climatic and tectonic changes.

The paper for conference presentation will describe the restoration process for these two damaged sites, from the initial identification and assessment process through description of the results. It will focus on the significance of the knowledge gained in the areas of cultural understanding and of the effects of possible future oil spills on cultural resources. Preparation of public and school presentations will involve developing a slide show which visually relates the steps involved in archaeological restoration. The accompanying talk will explain, without the use of jargon, the reason for the mitigation, the action taken, and the results. The presentations will be developed in consultation with the community interaction facilitators, to ensure that residents$_F$ interests and concerns about the project are being addressed.

### C. Cooperating Agencies, Contracts, and Other Agency Assistance

No contracts are anticipated as necessary to accomplish this phase of the project. Forest Service will be the only agency involved.

## SCHEDULE

### A. Measurable Project Tasks for FY 97

| | |
|---|---|
| Oct. 1-Jan.21: | Prepare research papers for peer-review professional journals |
| Jan. 22-25: | Attend Annual Restoration Workshop |
| Jan. 27-31: | Prepare presentations for Oil Spill communities |
| February 3-14: | Presentations/discussions in Oil Spill communities |
| Feb. 17-March 21: | Prepare paper for SAA |
| May 1-5: | Attend Annual SAA |

### B. Project Milestones and Endpoints

| | |
|---|---|
| February 17: | Completion of Oil Spill community presentations |
| March 31: | Submission of articles to peer-review journals |
| May 5: | Presentation of paper at SAA |

### C. Completion Date

The project will be completed in FY97.

## PUBLICATIONS AND REPORTS

The papers described above will be prepared for submission in FY97. It is presently anticipated that they will be submitted to the journals American Antiquity and Archaeology for publication after going through the review process as described in the Restoration Office guidelines of March 29, 1996.

## PROFESSIONAL CONFERENCES

The Society for American Archaeology is the major archaeological association in the Western Hemisphere. It is based in the United States, but is international in membership. Its annual meeting will be held in 1997 from May - in (city?). The Principal Investigator will present a paper at the meeting regarding the EVOS archaeological restoration project, its rationale and results, as discussed above.

## NORMAL AGENCY MANAGEMENT

The entire scope of the archaeological restoration project is outside the Forest Service's normal management activities. No assessment and testing work would have been conducted at these sites had it not been for the Exxon Valdez Oil Spill and resultant damage. This project has been necessary for the Trustee Council to fully document recovery of injured archaeological resources.

## COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Project 97007B is a continuation of 96007B, 95007B, and 94007B. The existing Forest Service heritage program does not dovetail with this project. The Forest archaeologists perform fieldwork and related analysis and report writing on a project funded basis.

## EXPLANATION OF CHANGES IN CONTINUING PROJECTS

It was originally anticipated that this project would be completed in FY96. While the project report will be finished by that date, no provision was made in any previous budget for submission of project related papers to peer-review journals, or any particular communication with Oil Spill communities. During the past year, these two issues have assumed a higher priority than they have had in previous years. The research situation at the end of FY96 will put this project in a good position to meet these priorities, as now highly encouraged by the Trustee Council.

## PROPOSED PRINCIPAL INVESTIGATOR

Linda Finn Yarborough
Assistant Forest Archaeologist
Chugach National Forest

## PERSONNEL

The personnel used for the project will meet the professional qualifications standards specified under the Secretary of the Interior FS Guidelins for Archaeology and Historic Preservation. See attached qualifications descriptions.

Key personnel:
Linda Finn Yarborough, Assistant Forest Archaeologist, Chugach National Forest
Responsible for writing peer-reviewed papers and a professional conference paper, and preparing presentations for Oil Spill communities.

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 |
|---|---|---|
| Personnel | | $19.2 |
| Travel | | $4.5 |
| Contractual | | $0.0 |
| Commodities | | $0.6 |
| Equipment | | $0.0 |
| Subtotal | $0.0 | $24.3 |
| General Administration | | $2.9 |
| Project Total | $0.0 | $27.2 |
| Full-time Equivalents (FTE) | | 0.3 |
| Other Resources | | |

LONG RANGE FUNDING REQUIREMENTS

| Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
|---|---|---|---|---|---|
| | | | | | |

Dollar amounts are shown in thousands of dollars.

Comments: Publish results of past project, provide information on project results to Prince William Sound public.

**1997**

Project Number: 97007B
Project Title: Archaeological Site Restoration, Publication/Education
Agency: US Forest Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY
4/15/96

Prepared:4/10/96, K.Holbrook

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Personnel Costs: | | GS/Range/ | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | Step | Budgeted | Costs | Overtime | FFY 1997 |
| L. Yarbourgh | Archaeologist | GS-11 | 4.0 | 4.8 | | 19.2 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 4.0 | 4.8 | 0.0 | |
| | | | | | **Personnel Total** | $19.2 |

| Travel Costs: | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| Travel to Chenega | 325.0 | 1 | 2 | 225.0 | 775.0 |
| Travel to Tatitlek | 320.0 | 1 | 2 | 225.0 | 770.0 |
| Travel to Cordova | 224.0 | 1 | 2 | 225.0 | 674.0 |
| Travel to English Bay | 81.0 | 1 | 2 | 225.0 | 531.0 |
| Travel to Port graham | 81.0 | 1 | 2 | 225.0 | 531.0 |
| Travel to ,Nashville, Tenn. | 714.0 | 1 | 5 | 103.0 | 1,229.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | $4,510.0 |

**1997**

Prepared:



Project Number: 97007B
Project Title: Archaeological Site Restoration, Publication/Education
Agency: US Forest Service

FORM 3B
Personnel
& Travel
DETAIL

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| When a non-trustee organization is used, the form 4A is required. **Contractual Total** | $0.0 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Film and repoduction | 0.2 |
| misc supplies | 0.3 |
| Gas for vehicle, RT to Homer | 0.1 |
| **Commodities Total** | $0.6 |

**1997**

Project Number:97007B
Project Title: Archaeological Site Restoration, Publication/Education
Agency: US Forest Service

FORM 3B
Contractual & Commodities DETAIL

Prepared: 4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **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 |
| 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 |
|---|---|---|
| | | |

**1997**

Project Number: 97007B
Project Title: Archaeological Site Restoration, Publication/Education
Agency: US Forest Service

FORM 3B
Equipment
DETAIL

Prepared: 4/15/96

# Survey of octopuses in intertidal habitats.

| | |
|---|---|
| Project Number: | 97009-D |
| Restoration category: | Research |
| Proposer: | Prince William Sound Science Center |
| Lead Trustee Agency: | USFS Pacific North West Research Station |
| Cooperating Agencies: | |
| Alaska SeaLife Center: | |
| Duration: | 3rd year, 3-year project |
| Cost FY97: | $49,800 |
| Cost FY98: | $0 |
| Cost FY99: | $0 |
| Cost FY00: | $0 |
| Cost FY01: | $0 |
| Cost FY02: | $0 |
| Geographic Area: | Prince William Sound |
| Injured Resource/Service: | Subsistence resources, intertidal & subtidal organisms, octopus |

## ABSTRACT

This project addresses concerns that octopus and chiton have been depleted by EVOS and that subsistence uses are impaired. In this proposal, close-out costs are requested for FY97, the third year of the project. The first year (FY95) was to establish the feasibility of working with octopus in the Sound, identify suitable study sites, and evaluate techniques. The second year (FY96) is focusing on the factors in nearshore habitats that are important to octopus, and on the turnover rates of octopus in those habitats.

## INTRODUCTION

The proposal requests support for close-out of Project 009-D, Survey of octopuses in intertidal habitats. Data collected during the first two years of this project will be used to assess techniques for octopus surveys, identify suitable sites for octopus work (FY95), and to measure densities, describe nearshore habitats and estimate turnover rates in the nearshore (FY96). In FY97, we will analyze field data collected from May 1995 through December, 1996, and prepare reports and publications. At the close of field work, we expect to have data from over 75 sites in Prince William Sound and Port Graham, including data on marked individuals from repeat visits to three sites. This proposal does not request support for any additional field work.

During the project's first year, 57 sites were sampled for octopus using either intertidal surveys, subtidal surveys by SCUBA diving, or pot fishing. A total of 31 octopus (*Octopus dofleini*) were weighed and sexed. Densities calculated from 47 sites were on average below those reported in the scientific literature from Clayoquot Sound, British Columbia. Based on samples of feeding litter, octopus were feeding on small crabs and bivalves close to their dens in both the intertidal and subtidal. No individuals of reproductive size were found. Octopus were associated with intertidal areas adjacent to eel grass and kelp beds, with cobble substrate, plentiful kelp cover, and shallow slope. Data collected during the summer of 1995 suggested that the intertidal may function as a predation refuge for juvenile octopus. Sampling for 1996 was designed to test these habitat associations, and measure turnover rates in nearshore habitats. During sampling in 1995, no visible signs were found of continuing exposure to surface or near-surface oil, and octopus densities were not significantly different between northeast sampling sites (all along unoiled shorelines) and sites in the southwest (along shorelines that received varying amounts of oil). Chiton were found on about 50% of the intertidal sites, but with few exceptions the larger species used for subsistence (bidarki and gumboot chiton) were rare.

## NEED FOR THE PROJECT

### A. Statement of Problem

Surveys and interviews in Tatitlek and Chenega Bay conducted during the 1980's prior to the *Exxon Valdez* oil spill (EVOS) indicate that between 50 and 90% of households used octopus as a subsistence resource, while 25 - 50% used gumboot or bidarki chiton. Both of these subsistence resources are included as injured, non-recovering species under the general headings of Subtidal Organisms and Intertidal Organisms. Subsistence use of these resources resulted in the knowledge that these species have declined in apparent abundance. Very little is known about the dynamics of octopus populations in intertidal areas. For example, it is not known whether intertidal refuges are important or marginal habitat to juvenile octopus, nor how long octopus are resident in intertidal areas. Without information of this type the course of recovery cannot be predicted, nor can these resources be managed effectively.

### B. Rationale/Link to Restoration

Restoration goals for subsistence services include healthy populations of subsistence resources, subsistence harvest of those resources, as well as involvement of subsistence users in the Trustee Council's restoration process. The primary objective of this project is to provide information on the status of octopus as a subsistence resource to users and resource managers. Studies are targeted on octopus, but data are collected on chiton where opportunity permits. Information on octopus will include an estimate of the availability of octopus in nearshore habitats, the variability of octopus density, key components of intertidal habitat, and turnover rates of individuals. This project provides opportunities for subsistence users to participate in determining study areas and conducting sampling; and incorporates local ecological knowledge in its design. All information on the results will be available to Chenega Bay and Tatitlek and Port Graham residents through the principal investigator.

### C. Location

Field work took place in Prince William Sound and Port Graham, including the villages of Port Graham, Chenega Bay and Tatitlek. Analyses will be done in Cordova.

## COMMUNITY INVOLVEMENT

This proposal was a direct result of public input received via the EVOS Trustee Research Priorities workshop (April 1994). During the field portions of this project, we hired residents of Tatitlek, Chenega Bay, and Port Graham to provide information on habits of octopus, native subsistence harvest practices, and to provide field support (a skiff, lodging, and assistance with surveys). Subsistence users contributed to decisions about study design and sampling location.

## PROJECT DESIGN

### A. Objectives

The main objectives of this project have been to assess techniques for octopus surveys, identify suitable sites for octopus work (FY95), and to measure densities, describe nearshore habitats and estimate turnover rates of octopus in the nearshore (FY96). During FY97, we are requesting funds for closeout of the project, to complete analyses on two years of field work and prepare reports and publications. In FY97, therefore, our objectives are:

1. Report the local density and distribution of octopus through analysis of survey data recorded during two field seasons (FY95, FY96), and identify characteristics of octopus habitat in nearshore areas;

2. Estimate injury and turnover rates by analyzing tag and release data which will be collected in the 1996 field season (FY96).
3. Prepare two or more manuscripts for submission to professional journals to report results of this project.

## B. Methods

As no additional field work is proposed, we describe briefly how data will be analyzed. For detailed field methods of each of the activities conducted under this project, please see the detailed project description for the appropriate year (95009-D and 96009-D) and the 1995 annual report (Scheel, D, B. Dodge, T.L.S. Vincent. 1996. Survey of octopus in the intertidal in Prince William Sound, Alaska. *Exxon Valdez* Oil Spill Restoration Project annual report (Restoration Project 95009-D). Prince William Sound Science Center, Cordova, AK.)

1. Octopus habitat - An incomplete factorial design will be analyzed using ANOVAs to examine the role of substrate, slope and vegetative cover in determining local octopus abundance in intertidal habitats. A paired T-test will be used to examine differences between densities at intertidal sites and adjacent subtidal sites. These analyses will indicate the necessary components of octopus habitat, and whether octopus densities differ between intertidal and subtidal sites.

2. Turnover rate - A standard mark-recapture survey design will be used to calculate rates of loss and settlement at sites chosen for repeated sampling of marked individuals. Unique IDs on tags will allow us to record the movements of individual octopus that are relocated. These surveys will be repeated at the same site over intervals of one to three days within a tide cycle and at intervals of one to six months across cycles during the FY96 field season. These data will allow us to calculate rates of loss (movement or predation) and settlement (new arrivals).

3. Publication - At least two manuscripts will be prepared for submission to professional journals (see below, Publications and Reports). One will deal with the characteristics of intertidal octopus habitats, a topic dealt with only casually in the scientific literature to date. The second will present an overview of the biology of octopus in Prince William Sound, including data from this study and incidental observations about octopus collected in several other studies, including the SEA program and NBS sea otter research. Additional manuscripts will be prepared if warranted by the results of this work.

## C. Cooperating Agencies, Contracts and other Agency Assistance

None

## SCHEDULE

### A. Measurable Project Tasks for FY97 (October 1, 1996 - September 30, 1997)

| | |
|---|---|
| 1 Oct - 31 Dec 1996: | Analyses from summer field work. |
| 1 Jan - 15 Apr 1997: | Preparation of final report and draft manuscripts |
| 16 Apr - 30 Sep 1997: | Revisions to final report as necessary; preparation of manuscripts for submission to professional journals. |

### B. Project Milestones and Endpoints

31 Dec 1996: Field work (under FY96 funding) completed and FY96 Annual report submitted to USFS Pacific Northwest Research.
15 Apr 1997: Final Report (FY97) submitted.
30 Sept 1997: Completion of contract, including response to comments from reviewers if any.

### C. Completion Date

The project will be completed September 30, 1997 (FY97).

## PUBLICATIONS AND REPORTS

Scheel, D, R. Dodge, T.L.S. Vincent. 1996. Survey of octopus in the intertidal in Prince William Sound, Alaska. *Exxon Valdez* Oil Spill Restoration Project annual report (Restoration Project 95009-D). Prince William Sound Science Center, Cordova, AK. (To be submitted 15 April 1996).

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 annual report (Restoration Project 95009-D). Prince William Sound Science Center, Cordova, AK. (To be submitted 31 December 1996).

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 95009-D). Prince William Sound Science Center, Cordova, AK. (To be submitted 15 April 1997).

Scheel, D., T. Vincent, and R. Dodge. Habitats and turnover rates of nearshore *Octopus dofleini* in Prince William Sound. (Intended for submission to *Veliger* prior to project closeout).

Scheel, D., T. Vincent, and R. Dodge. The Biology of *Octopus dofleini* in Prince William Sound. (Intended for submission to *Marine Ecology Progress Series* prior to project closeout).

Scheel, D. T. Vincent. An experimental assessment of response to cover in *Octopus dofleini*. (Intended for submission to *Animal Behavior* prior to project closeout).

## PROFESSIONAL CONFERENCES

Support is requested for the Principal Investigator to attend the Anchorage Restoration Workshop when it is scheduled, and to attend one national or international conference in the summer of 1997. Most Societies have not yet decided on the locations and exact dates for their 1997 conferences. It is anticipated that the conference will be located in the Lower 48. Results from the field work and the themes of the conferences will determine the most appropriate one to attend. Possibilities are: Ecological Society of America Annual Meeting (July 1997) or the Thirty-fourth Annual Meeting of the Animal Behavior (August 1997). Presentation will focus on the importance of intertidal habitats to octopus.

## COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Several of the analyses intended for this project rely on data collected under the restoration effort, primarily SEA program (94320, 95320) including data collected by Mark Willette, Alaska Department of Fish & Game and Ted Cooney, University of Alaska Fairbanks; and sea otter data collected by NBS (Jim Bodkin, Anchorage).

## EXPLANATION OF CHANGES IN CONTINUING PROJECTS

This project remains scheduled for closeout in FY97, as proposed earlier.

## PRINCIPAL INVESTIGATOR

David Scheel
Prince William Sound Science Center
P.O. Box 705
Cordova, AK 99574
*tel:* (907) 424-5800
*fax*: (907) 424-5820
dls@grizzly.pwssc.gen.ak.us

**PERSONNEL**

| | |
|---|---|
| Principal Investigator: | David Scheel; See attached C. V. for qualifications. |
| SCUBA Divers: | Dan Logan, USFS; Roger Trani, Cordova Water Sports (volunteer); others, TBN |
| Project Biologists: | Rebecca Dodge, Kathy Hough, Tania Vincent (volunteer) |

(Assist with sampling, data entry, analyses, report & publication preparation)

**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

1995-1996 *Exxon Valdez* oil spill restoration research on octopus, seabirds, and killer whales ($410,000); NEPA assessment for Shepard Point Road ($400,000).
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

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Personnel | $9.3 | $0.0 | | | | | | |
| Travel | | $0.0 | | | | | | |
| Contractual | $131.6 | $49.8 | | | | | | |
| Commodities | | $0.0 | | | | | | |
| Equipment | | $0.0 | | | | | | |
| Subtotal | $140.9 | $49.8 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| General Administration | $1.4 | $3.5 | | | | | | |
| Project Total | $142.3 | $53.3 | | | | | | |
| | | | | | | | | |
| Full-time Equivalents (FTE) | | 0.0 | | | | | | |
| | | | Dollar amounts are shown in thousands of dollars. | | | | | |
| Other Resources | | | | | | | | |

Project close out costs .
Data Analyses , report writing, and publication preparation by Prince William Sound Science Center.
Figures under 'Authorized FFY 1996' show only 3A cost. Budgets for this project forwarded through the USFS will show 2A costs from FY96.

**1997**

Project Number: 97009-D
Project Title: Survey of octopus in intertidal habitats
Agency: USFS-Copper River Delta Institute, Pacific Northwest Research Station

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared: M.Bishop



4/9/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| Personnel Costs: | | GS/Range/ | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | Step | Budgeted | Costs | Overtime | FFY 1997 |
| | | | | | | 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 | FFY 1997 |
| | | | | | 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 |

1997

Prepared:
M.Bishop



Project Number: 97009-D
Project Title: Survey of octopus in intertidal habitats
Agency: USFS, Copper River Delta Institute, Pacific Northwest Research Station

FORM 3B
Personnel
& Travel
DETAIL

4/9/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Analysis and report writing by Prince William Sound Science Center | 49.8 |
| When a non-trustee organization is used, the form 4A is required. **Contractual Total** | $49.8 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| **Commodities Total** | $0.0 |

**1997**

Project Number: 97009-D
Project Title: Survey of octopus in intertidal habitats
Agency: USFS, Copper River Delta Institute, Pacific Northwest Research Station

FORM 3B
Contractual & Commodities DETAIL

Prepared:
M.Bishop 3 of 8

4/9/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| 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 |
| 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 |
|---|---|---|
| | | |

**1997**

Project Number: 97009-D
Project Title: Survey of octopus in intertidal habitats
Agency: USFS, Copper River Delta Institute, Pacific Northwest Research Station

FORM 3B
Equipment
DETAIL

Prepared:
M.Bishop



4/9/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| Personnel | $43.1 | $37.6 | | | | | | |
| Travel | $9.9 | $2.4 | | | | | | |
| Contractual | $54.5 | $1.5 | | | | | | |
| Commodities | $2.2 | $0.0 | | | | | | |
| Equipment | $0.0 | $0.0 | | | | | | |
| Subtotal | $109.7 | $41.5 | | | | | | |
| Indirect | $21.9 | $8.3 | | | | | | |
| Project Total | $131.6 | $49.8 | | | | | | |
| Full-time Equivalents (FTE) | | 6.0 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:
Above costs (Form 4A) are for non-Trustee organizations (the PWS Science Center). Indirect is calculated as 20% of direct costs. Support for analysis and report writing includes 3 months for the PI and 2 months for the project biologist. An additional 1 month for the PI is requested for preperation of publications. Travel costs to Anchorage are for workshop attendance. No funds are specifically designated for community involvement during the closeout phase of this project.

**1997**

Project Number: 97009-D
Project Title: Survey of octopus in intertidal habitats
Name: David Scheel, Prince William Sound Science Center

FORM 4A
Non-Trustee
SUMMARY

Prepared: D. Scheel



4/9/96

# 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| Personnel Costs: | | | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| | Name | Position Description | Budgeted | Costs | Overtime | FFY 1997 |
| | David Scheel | Principal Investigator | 4.0 | 6.8 | | 27.2 |
| | TBN | Project Biologist | 2.0 | 5.2 | | 10.4 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | Subtotal | 6.0 | 12.0 | 0.0 | |
| | | | | | Personnel Total | $37.6 |

| Travel Costs: | | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|---|
| | Description | Price | Trips | Days | Per Diem | FFY 1997 |
| | Cordova-Anchorage | 0.2 | 1 | 4 | 0.2 | 1.0 |
| | RT to National conference (based on ABS conference, Flagstaff AZ) | 0.8 | 1 | 5 | 0.1 | 1.3 |
| | Conference registration | 0.0 | 0 | 0 | 0.0 | 0.1 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | Travel Total | $2.4 |

**1997**

Project Number: 97009-D
Project Title: Survey of octopus in intertidal habitats
Name: David Scheel, Prince William Sound Science Center

FORM 4B
Personnel
& Travel
DETAIL

Prepared: D. Scheel



4/9/96

## 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| Contractual Costs: | Proposed FFY 1997 |
|---|---|
| Description | |
| LD telephone, fax | 0.3 |
| shipping or freight | 0.3 |
| photocopies | 0.3 |
| report printing, publication costs | 0.6 |
| **Contractual Total** | $1.5 |

| Commodities Costs: | Proposed FFY 1997 |
|---|---|
| Description | |
| **Commodities Total** | $0.0 |

**1997**

Prepared: D. Scheel

7 of 8

Project Number: 97009-D
Project Title: Survey of octopus in intertidal habitats
Name: David Scheel, Prince William Sound Science Center

FORM 4B
Contractual & Commodities DETAIL

4/9/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **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 |
| 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 | |
|---|---|---|
| | | |

**1997**

Project Number: 97009-D
Project Title: Survey of octopus in intertidal habitats
Name: David Scheel, Prince William Sound Science Center

FORM 4B
Equipment
DETAIL

Prepared: D. Scheel



4/9/96

**COMPREHENSIVE KILLER WHALE INVESTIGATION IN PRINCE WILLIAM SOUND, ALASKA (Submitted under the BAA)**

Project Number: 97012a

Restoration Category: Monitoring, Research

Proposer: North Gulf Oceanic Society

Lead Trustee Agency: NOAA

Alaska Sea Life Center:

Duration: 1 year

Cost FY 97: 147,243

Geographic Area: Prince William Sound, Alaska

Injured Resource/Service: Killer Whales, Harbor Seals



## ABSTRACT

This project continues the monitoring of the damaged AB pod and other Prince William Sound killer whales that has occurred on a yearly basis since 1984. It provides further analysis of a GIS database on killer whales. When coupled with genetic and acoustic data, the analysis will evaluate recovery of killer whales, recognize changes in behavioral ecology, estimate killer whale predation on harbor seals, and estimate impacts of the harbor seal decline on the potential recovery of killer whales. Year round residency of killer whales will be assessed using a remote hydrophone system. Environmental contaminant levels in the blubber of specific whales will be determined and potential effects on recovery evaluated.

## INTRODUCTION

This project is a continuation of the comprehensive killer whale investigation initiated in 1995 in Prince William Sound and continued in FY96. Killer whales were monitored under EVOS Trustee Council funding in 1989, 1990, and 1991 (damage assessment) and in 1993 and 1995 (restoration monitoring) with a reduced annual monitoring program initiated in 1996.

On March 31, 1989 AB pod was observed in oil sheens and six pod members were missing. A total of 14 whales were lost from resident AB pod in the two years following the Exxon Valdez oil spill and there was no recruitment into the pod during those years. Since that time the social structure within the AB pod has shown signs of deterioration. Maternal groups have traveled independently, and pod members have not consistently traveled with closest relatives. Although 4 calves were recruited during the period 1992-1994, there were 5 additional mortalities in 1994. The rate of mortality observed in this pod after the oil spill far exceeds that recorded for other resident pods observed in Prince William Sound over the past 11 years or for 19 pods in British Columbia over the past 20 years.

Nine whales from the transient AT group have not been observed since 1989. One additional AT whale has not been sighted since 1990. One of these is known to be dead. However transient killer whale social structure is not fully understood and we cannot be completely certain that the other whales are dead. Analysis in FY95 strongly suggests that they have either died or emigrated from the area on a permanent basis.

This project will continue the monitoring program necessary to map the changes (recovery or non-recovery) of Prince William Sound killer whales on a reduced annual basis. The data and some of the samples necessary to complete other aspects of this project will be collected simultaneously with the monitoring effort.

In 1995-96 twelve years of systematic data collected under public and private funding were placed in a specially designed GIS system at the Prince William Sound Science Center. This data base will allow examination of feeding habits and other behaviors of killer whales before and after the Exxon Valdez Oil Spill and relate them to geographic area. We are interested in how the distribution of foraging and other behaviors have changed over time, and particularly whether those changes were correlated with the oil spill or with the decline in harbor seals as measured at index sites in the Sound. The two groups of killer whales in the Sound believed to be most exposed to the oil (AB pod, AT group) have both shown changes in behaviors, distributions and mortality rates since the spill. An important product of this project will be to continue to refine data used to assess the impact of killer whale predation on non-recovering harbor seals in Prince William Sound. In addition we will examine potential effects of the declining harbor seals on the population of marine mammal eating killer whales. The products of this study will be consolidated with models developed for harbor seals (96064). Some additional collection of killer whale biopsy samples and observation and collection of killer whale prey remains is requested in FY97. Sampling will allow completion of our examination of contaminant levels in Prince William Sound killer whales. Biopsy tissue sampling of additional transient whales and the remaining unsampled pods (AN10, AN20 and AJ) are the objectives of this limited additional effort.

By the end of FY96, we will have completed the mitochondrial DNA analysis of Prince William Sound killer whales and initiated nuclear DNA analysis. Our preliminary results show fixed differences in mitochondrial DNA between members of the resident and transient groups. Because mitochondrial DNA is maternally inherited it accurately reflects patterns of female dispersal. Thus, it is commonly used as a first step in population analyses. It does not, however, shed light on male dispersal. Male dispersal, genetic divergence and variation can be assessed directly by analysis of nuclear DNA, and we intend to combine both mitochondrial and nuclear analyses. Microsattelite markers in nuclear DNA will aid in the investigation of a wide variety of population properties, including mating systems, inbreeding levels, effective population size, and the extent of population subdivision (Queller et al. 1993). The uniqueness of pods or groups (particularly AB pod and the AT group) will be tested and the and the potential vulnerability of populations to extinction from random causes or from increases in mortality associated with human activity examined.

There is worldwide concern that specific PCB and dioxin congeners may have negative effects on reproduction in mammals. The recovery of killer whales in Prince WIlliam Sound and the long-term health of the population is dependent on unimpeded reproductive processes. By examining contaminant levels in Prince William Sound killer whales, we will determine if high levels of contaminants exist in either the resident or transient population, and establish a baseline against which future changes can be measured. Samples will be obtained from individually identified living whales that can be resampled to assess future changes. The ability to sample and potentially resample specific known individuals and their known kin is a unique aspect of this project. Baseline contaminant levels and contaminant loading patterns will be determined in cooperation with the NMFS/NOAA Environmental Contaminant Laboratory in Seattle.

There is very limited sighting information for killer whales during the November through March period in Prince William Sound. In 1995, NGOS, as part of a pilot project, installed a remote hydrophone (underwater microphone) in southwestern Prince William Sound in order to record vocalizations of killer whales and to examine their year-round use of the area. The hydrophone is anchored to the sea floor off the north end of Latouche Island and transmits a radio signal to two receiving stations, one at the AFK salmon hatchery, and one in the Chenega Bay Community School. Since October, volunteers at the hatchery and the school have monitored the radios and recorded over nine hours of whale calls. Winter use of the southwestern Sound by resident killer whales was documented (at least 2 pods are identifiable by calls in the recordings). These recordings also detail residency of humpback whales in the area and include the recordings of humpback whale song development in Prince William Sound.

In FY97 we propose the continuation of the remote hydrophone project and installation of more reliable and sophisticated equipment. The existing system will be replaced and the hydrophone will be anchored in deeper water, in order to reduce wave noise. Because the hydrophone is being monitored at the Chenega Bay Community School, we propose to initiate an educational program at the school, in order to involve the students more closely in this project, from monitoring the system and collecting data, to interpreting the whale sounds that they collect. Residents of Chenega Village will be hired to assist in the project. Further analysis of pod specific dialects will be completed to clearly establish pod identities of whales in the recordings (NGOS is using a 12 year

database of killer whale recordings to establish these dialects). Recordings will be analyzed to document which specific killer whale pods and groups were present through out the year, and specifically, when AB pod was present in the Sound. The long-term goal of this aspect of project is to determine the year-round habitat use of southwestern Prince William Sound by AB pod and other killer whale groups.

## NEED FOR THE PROJECT

### A. Statement of Problem

The AB pod of killer whales was injured by the EVOS. Although it had shown signs of recovery from 1991 to 1993, recent mortalities have reduced the number of surviving AB pod whales to 21. At least 9 of the AT group of transient killer whales have either died or left the Sound since 1989. This project will continue to monitor the status of AB pod and the AT group.

The behavior of killer whales in Prince William Sound appears to have changed since the spill. The decline in AB pod has been accompanied by changes in pod structure. The AT group decline also appears to involve changes in behavior and distribution. Changing numbers or distributions of prey such as harbor seals and salmon may also be a factor. We do not know as yet whether whales are entering and using the Sound less than in past years, if they are using different areas of the Sound, or if such changes can be related to changes in the Sound ecosystem (e.g. the decline in harbor seals, changes in wild and hatchery salmon production).

The genetic analysis of Prince William Sound's killer whales will help determine whether the surviving members of AB pod are closely related to other resident whales in the Sound, or whether they are genetically distinct. It will also assess the genetic uniqueness of the AT pod. There is good evidence based on vocalization and behavior (Saulitis, 1993) to suggest that AT pod may in fact be distinct, not only from all resident pods, but from transient type killer whales inhabiting other parts of the Gulf of Alaska, and the waters of SE Alaska and British Columbia. The loss of either AB pod or the AT group could represent a serious overall loss of genetic diversity.

Another gap in our understanding of killer whale behavior and ecology is the extent of their use of the Sound in the winter months. Our remote hydrophone system will determine which whales are present during the winter months.

Some environmental contaminants have been linked to reproductive dysfunction in mammals. This project will assess levels of environmental contaminants in the killer whales particularly in the transient (marine mammal eating) killer whales that show little reproduction.

In addition predation by killer whales may be a significant factor in the non-recovery of harbor seals, another damaged resource. Harbor seals have continued to decline since 1989 in Prince William Sound (16-20% reduction from 1989-1994). This study will provide refined information on killer whale predation rates on harbor seals.

The analysis of historical data, continued observations and sampling of killer whale prey items, biopsy sampling and genetic and contaminant analysis, and acoustic studies will examine factors important in the recovery of killer whales and harbor seals.

## B. Rationale/Link to Restoration

Annual killer whale population monitoring will determine recovery status of AB pod and the AT transient group. The actual status of AB pod appears to be non-recovering at this time. Changes will only be clarified by continued monitoring. A low level annual monitoring program (expanded with matching funds) is proposed and a part of the FY97 project. Since all pods and whales are not observed in every year, annual monitoring will prevent extensive data gaps and allow certain determination of recruitment and mortalities in a much shorter time frame. An annual killer whale identification database of twelve years duration now exists. Continuation of this approach will provide consistency in analysis and interpretation. Because killer whales are a long-lived species with low reproductive and mortality rates, this monitoring must be consistent and long-term to be meaningful. Data are available from a thirteen year period that document the locations and behaviors of killer whales that use Prince William Sound. Analysis of these data will help to better monitor the recovery of killer whales from the spill and to evaluate suggested restoration actions for killer whales. Scrutiny of these data will also provide clues to explain changes in distribution and behavior of the AT group and AB pod. Killer whale predation is a possible contributing cause of the non-recovery of the spill damaged population of harbor seals. Conversely, the decline of harbor seals may have contributed the decline of transient killer whales in the Sound.

Demonstration of clear population or pod specific genetic differences will strengthen behavioral observations that resident killer whales differ from transients and do not prey on seals, and thus help to estimate the predation pressure on harbor seals from killer whales. Accurate estimates of the predation pressure on harbor seals will in turn facilitate effective strategies for harbor seal restoration.

The southwestern part of Prince William Sound is an important habitat for resident and transient killer whales during the summer months. Both feeding and social behaviors have been consistently documented in Knight Island Passage and Montague Strait from April through October. While photographic monitoring of the killer whale population of Prince William Sound has been carried out since 1984, little is known of the year-round behavior and distribution of this species. Vessel-based research during the winter months in Prince William Sound is prohibitive due to stormy weather conditions and lack of daylight.

We propose to acoustically assess the year-round habitat use of southwestern Prince William Sound by specific killer whale groups using a remote hydrophone system. We have already completed a pilot project, with successful acoustic monitoring in the winter 1995-1996. Additional years of monitoring are critical to this assessment, as between-year differences in killer whale winter distribution are likely to occur.

Annual population monitoring, genetic analysis, and interpretation of historical data on seasonal killer whale distribution and feeding behaviors, and remote hydrophone monitoring of killer whale movements will present a comprehensive overview of the recovery status of killer whales in Prince William Sound through 1997. In addition, a detailed picture of killer whale predation on harbor seals will be developed and the potential effect the harbor seal decline on killer whales assessed. Restoration objectives

for killer whales in Prince William Sound are currently being revised, based on the apparent non-recovering status of the population.

### C. Location

This project is part of an ongoing killer whale research in Prince William Sound, Alaska. The project is centered in southwestern Prince William Sound and directly involves the village of Chenega.

## COMMUNITY INVOLVEMENT

There is great public concern and interest for killer whales in Prince William Sound. We will involve tourboat and recreational operators and residents by exchanging sighting information on a daily basis and providing a catalogue of individual whales to enhance enjoyment of whale observation. Our annual presentation of research results in Cordova, Chenega, and (in FY97) Tatitlek will continue.

With our supervision, the residents of Chenega and students at the Chenega school will become directly involved in the killer whale project by monitoring and maintaining a remote hydrophone system and participating in the data analysis. Chenega and Port San Juan residents will be contracted to maintain the system.

In addition, the role of the killer whale in local native story and tradition will be recorded through interviews with native elders and others in the villages of Chenega and Tatitlek.

## PROJECT DESIGN

### A. Objectives

1. Continued monitoring and status determination of resident killer whales particularly AB pod. Examine the demographics of this pod in relation to other resident killer whale pods.

2. Monitor the AT group of transient killer whales to determine if there is further emigration or mortality or if there are signs of recovery to pre-spill distribution and abundance.

3. Assess the year round residency of killer whales (by pod) in the southwestern Sound using a remote hydrophone system monitored at Chenega Community School and the Port San Juan hatchery

4. Collect important additional biopsy samples and continue analysis and interpretation of contaminant levels in killer whale blubber

5. Complete analysis of behavioral /predation data in a geographical framework using the Arc Info GIS system and the historcal data base to:

a) Identify whether residency time and area use in Prince William Sound has changed across years for each resident pod and transient group where there is sufficient data.

b) Test the hypotheses that identified changes are correlated with changes in the availability of the primary prey species for that group.

6. Finalize analysis and statistical interpretation of genetic and behavioral data on segregation of killer whale populations (resident and transient) in Prince William Sound.

7. Refine figures on harbor seal predation by killer whales used in harbor seal population model (Project 97064) and examine the possible impact of harbor seal decline on the transient killer whale population in Prince William Sound.

8. Collect stories and information from elders and others in Chenega, Eyak and Tatitlek villages on the role of killer whales in the traditions and spiritual history of local native groups

## B. Methods

Killer Whale Monitoring

The goal of this aspect of the study is the photoidentification of each individual in each pod/group, that regularly uses the Sound, particularly AB pod and the AT1 group. Knowledge of the demographics of all regularly sighted pods and groups may be necessary to meet new recovery definitions.

Thus, it is important that researchers maximize the time actually spent with killer whales (particularly AB pod) to insure thorough identification of all individuals. Methods proposed to obtain photographic data necessary to meet monitoring objectives will be similar to those used by the NGOS in Prince William Sound for the past twelve consecutive years. Searches for whales will not be made on random transects, but based on current and historical sighting information. In addition whales will be located by listening for killer whale calls with a directional hydrophone (calls can be heard up to 10 miles away), or by responding to VHF radio calls from other vessels reporting sightings of whales. We have developed network of cooperating vessel owners that regularly report whale sightings. In addition requests for recent killer whale sightings will be made routinely on hailing Channel 16 VHF.

A vessel log and chart of the vessel track will kept for each day the research vessels operate. The elapsed time and distance traveled will be recorded and vessel track plotted. Record will be made of the time and location of all whale sightings and the weather and sea state noted at regular intervals (see attached data sheets).

Specifics of each encounter with killer whales will be recorded. The killer whale encounter data sheet developed in 1995 and specifically tailored to GIS data entry requirements will be used. Data recorded will include date, time, duration, and location of the encounter. Rolls of film exposed and the estimated number of whales photographed will also be recorded. A chart of the whales' trackline during the encounter will be completed and the distance traveled by the vessel with the whales will be calculated.

General behavior of the whales (i.e. feeding, resting, traveling, socializing, milling) will be recorded by time and location.

Photographs for individual identification will be taken of the port side of each whale showing details of the dorsal fin and white saddle patch. Photographs will be taken at no less than 1/1000 sec using Ilford HP5, a high speed black and white film, exposed at 1600 ASA. A Nikon 8008 autofocus camera with internal motor drive and a 300 mm f4.5 autofocus lens was used. When whales are encountered, researchers will systematically move from one subgroup (or individual) to the next keeping track of the whales photographed. If possible, individual whales will be photographed several times during each encounter to insure an adequate identification photograph. Whales will be followed until all whales are photographed or until weather and/or darkness makes photography impractical.

All photographic negatives will be examined under a Wild M5 stereomicroscope at 9.6 power. Identifiable individuals in each frame will be recorded. When identifications are not certain, they will not be included in the analysis. Unusual wounds or other injuries will be noted. Photographic negatives will be analyzed using a photographic database that spans twelve years. Identities of each whale that appears in every frame of usable film will be recorded and stored in VAX computer system. Final analysis and assessment will follow Matkin et al. (1994).

The primary vessel used to secure identification photographs will be a 27' diesel inboard/outboard powered vessel that can sleep two individuals (R.V. *Whale 2).* With sleeping accommodations and large fuel capacity, the R.V. *Whale 2* will return to camp or to Chenega Village (fuel storage) infrequently which greatly increases available time searching for or photographing whales. Although this vessel will primarily collect photoidentification data, it will collect feeding habit observations and samples and biopsy samples for the predation studies. The operator of this vessel, Eva Saulitis, has nine years experience in the Sound conducting photoidentification of killer whales and humpback whales and collecting food habit data. This vessel will operate a total of 60 days, from early July through early September. From historical data these dates are judged to be to be the most likely time to encounter AB pod as well as many of the other resident pods that use the Sound. Photographic data will also be collected from the 43' R.V. *Lucky Star* and its associated skiff (17 days in the field) when it does not interfere with the primary goal of this vessel of taking biopsy samples for contaminant and genetic studies and providing feeding habit observations and prey sampling. The R.V.*Lucky Star* will also deliver fuel to designated locations and provide other logistical support for the operation of the R.V. *Whale 2.*

The report for the monitoring segment will include a summary of field effort, and summary of the pods and individuals encountered and a status report on AB pod and the AT1 group. Changes within AB pod will be examined with consideration for the age and sex structure of the pod and maternal groups within the pod. Frame by frame input of identification data from exposed film into VAX and IBM PC computer systems will occur and identifications tabulated by pod and by individual. Copies of identification data as well as field data sheets will be made available to the EVOS Trustee Council and/or lead agency. Frame by frame identification data will also be made available.

Analysis will be designed and completed to address questions regarding long-term changes in whale behavior. We will examine measures of whale behavior and distribution by comparing sightings per unit effort and behavior frequencies in the pre- and post-spill periods for each pod where there is sufficient data. Comparison between years in each time period (pre- and post-spill) will be used to indicate whether any group of whales has shifted their areas of use within the Sound or reduced use of the Sound altogether. Similar calculations will indicate whether feeding or other behaviors have changed in frequency or moved in location over the years. For example, the grid-based analysis used for calculating search effort can be repeated on occurrences of each behavior category in each cell. As appropriate and allowed by sample sizes, these can be split by month and year of sampling. Parametric and non-parametric statistics will be used to evaluate the evidence for the hypothesized changes in behavior.

We will use available data on the distribution of prey to examine whether changes in whale behavior correlate with changes in prey distributions. Prey distribution data is generally limited, particularly long-term data, so the resolution of these analyses will be limited. However, several possible sources of data exist: SEA program data base for some fish species, expected to include detailed data on the Spring through Fall distribution of salmon, herring, and pollock; ADF&G data on harbor seals from trend count sites and, recently, satellite telemetry,or as reflected in the distribution of subsistence harvests; and annual salmon or herring harvests by the fishing fleet.

We will relate whale distributions to prey distributions through the spatial overlay capabilities of Arc/Info. Whale distributions will be obtained from the data base through a grid-based analysis of encounters per unit effort (see above). Prey distributions will be obtained by the most appropriate means from the candidate data set. The prey and predator distributions can then be overlaid in Arc/Info to examine hypotheses regarding the spatial associations of whales and their prey or of whales and other important features of their habitat (e.g. rubbing beaches, etc.).

As part of the behavioral ecology component of the FY97 project, least two manuscripts will be prepared for submission to professional journals (see below, Publications and Reports). One will deal with the historical distribution of killer whale pods in the Sound. The second will present the geographic distribution of foraging behaviors. Additional manuscripts will be prepared if warranted by the results of this work.

Another aspect of this work will involve evaluation of the hypothesis that killer whale predation is impacting the recovery of harbor seals in Prince William Sound following the EVOS. The detail of this analysis may be limited by both the available data on killer whales and the available data on harbor seals. However, the killer whale observational data will be used to estimate the number of harbor seals taken by killer whales. The results will be used to refine the figures used in the harbor seal mortality model to ascertain whether killer whales are a limiting factor in the recovery of harbor seals.

Estimates of predation rates will be obtained by calculating the observed predation events per day of killer whale observation. To the extent the data will allow, factors influencing the predation rate (e.g. resident v. transient whales, group size, location, time

of year) will be examined. Combined with the information on whale distributions available in the database, estimations will be made of the predation rate on harbor seals.

Contaminant Analysis

Samples will be analyzed for selected chlorinated hydrocarbons (CHs) by a screening method using high performance liquid chromatography coupled with photodiode array detection (Krahn et al. 1994). The CH analytes include dioxin-like and other selected PCB congeners, DDTs and their metabolites (e.g. DDes, DDDs) and hexachlorobenzene (HCB). These analytes are potentially toxic, persist in the environment, and are bioaccumulated by marine mammals. The dioxin-like PCB congeners are stereo chemically similar to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and have been shown to exhibit TCDD-like toxicity.

The NGOS has entered into a cooperative agreement with the NMFS/NOAA Environmental Contaminant Laboratory (John Stein, director) to examine contaminant levels in killer whale biopsy samples taken in Prince William Sound. Thus far, all blubber from biopsy samples taken under Trustee Council funding have been provided to the NMML/NMFS pilot project examining lipid/fatty acid composition. Although some blubber samples taken independently are currently being used for contaminant analysis, they include only a few samples from transient (marine mammal eating) whales. Also, they do not include sufficient known whale lineages that will allow examination of contaminant downloading on offspring and other detailed effects. We expect transient (marine mammal eating) killer whales to show the most significant contaminant loads and sufficient samples from these whales are vital to the project. The additional sampling regime we propose should provide the additional samples needed to provide excellent baseline contaminant level data and examine patterns in contaminant loading among whales of known lineage. Since known individual whales are being sampled, future resampling can examine individual specific changes in contaminant levels over time.

Biopsy sampling and processing in FY97 will be conducted from the 43' R.V. *Lucky Star* and associated console skiff. Additionally, the R.V. *Whale 2*, the primary platform for the completion of the monitoring fieldwork will obtain biopsy samples when possible. Skin samples obtained from biopsies will be used to expand sample size in our continuing genetic analysis.

The R.V. *Lucky Star* can house 4 scientists and has work space and equipment sufficient for complete workup of samples taken by biopsy as well prey samples. Freezing facilities for storage of samples are available on both the R.V. *Whale 2* and F.V.*Lucky Star.* Most biopsy sampling will actually occur from a 17' fiberglass console skiff that will be launched from the R.V. *Lucky Star.*

The biopsy sampling for the chemical and genetic analysis will be collected without handling or tranquilizing the whales. A small dart will be fired from a specially outfitted pneumatic rifle. The setup is similar to that used to deliver tranquilizing drugs to terrestrial mammals in wildlife research. A lightweight plastic dart (approx. 10 cm long by 1.2cm dia.) is fitted with a beveled tubular sterile stainless steel tip that will take a small core of skin and blubber (approximately 1.8cm long and 0.5cm diameter). The sterilized dart will be fired from a range of 16-20m. The dart hits the animal in the upper back (in the area of the saddle patch), excises a small tissue sample and bounces off. The

dart floats with the sample contained until retrieved. Identification photographs using data-back equipped cameras will be taken of all whales biopsied to insure accurate identification of the individual. The whales will be approached by researchers in the manner currently authorized under permit No. 840 (held by the North Gulf Oceanic Society) for photoidentification and biopsy sampling of killer whales.

Genetics

To date we have been successful in acquiring biopsy samples of the two of the focal groups, AT group and AB pod. We have also obtained some samples for comparison from transient killer whales from the Gulf of Alaska, and from five additional resident pods (AE, AD, AI, AK, AS). We lack samples from the two largest pods in the Sound, however: AJ and AN (now AN10 and AN20). For this reason, and because of the need for additional samples for contaminant analysis, additional biopsy sampling is planned in FY97. The methods will be identical to those used in FY95 (described in Barrett-Lennard et al. 1996).

The procedures in the final phase of our genetic analysis involve examination of miocrosattelite loci. From each biopsy sample, 6-8 microsatellite loci that have proven to be informative in the British Columbian study will be amplified using the polymerase chain reaction (PCR). The PCR products will be radioactively labeled and separated by polyacrylamide gel electrophoresis, and sized by reference to sequences of plasmid DNA. Both the mitochondrial and microsatellite genotypes thus obtained will be compared statistically using maximum likelihood analysis routines in the software package PHYLIP (Felsenstein1995), to determine the genetic distance between putative populations, and between the two focal pods and other pods in their populations. Average levels of genetic relatedness based on microsatellite loci within and between pods will be also be analyzed using the RELATEDNESS software package (Goodnight and Queller, 1994). Analysis of samples will be conducted concurrently with samples from killer whales biopsied off British Columbia. The University of British Columbia has state-of-the-art DNA analysis facilities that are available for use in this study, and faculty with a wide range of genetic expertise that are available for consultation. The comparison between Prince William Sound killer whales and those found to the southeast will provide important information concerning patterns of gene flow, and help to determine whether the killer whales of Prince William Sound are unique stocks.

Remote Hydrophone

Pod specific dialects for resident killer whales have been determined from tape recordings made by several researchers in the Prince William Sound area and in Southeast Alaska during the spring and summer months of the years 1984 to 1995. Specific calls from Prince William Sound transient (AT group) killer whales also have been catalogued ( Saulitis 1993). A total of 141 hours of recordings have been screened using a Kay Elemetrics Real Time Sound Spectrum Analyzer, Model 5500. Samples from this screening process were digitized using the Canary acoustic spectrum analysis software (The Cornell Bioacoustics Workstation). Calls from different killer whale pods and transient groups were categorized using the same method used by John Ford in

British Columbia, Canada. It involved arbitrary acoustical identification paired with a visual and statistical comparison of sound spectra.

To assess year round residency of killer whales, a remote hydrophone will be attached to the sea floor near Sleepy Bay, Latouche Island. An anchored and encased cable will run from the transmitter on shore to the hydrophone at a depth of about 20 meters. The transmitter will be enclosed in a waterproof case and placed atop the bluff at the north end of Latouche Island. It will be powered by deep cycle batteries stored in waterproof containers. A solar panel will charge batteries in summer months, in winter, residents of Chenega Village will be contracted to recharge and replace batteries.

During summer months the hydrophone will be monitored from the R.V. *Whale 2* via broad band receiver as an aid in locating whales. During winter months it will be monitored at the Chenega Community School under supervision of principal/teacher Mr. Don Kinsey and at Port San Juan Hatchery by Chuck Pratt and Sarah Mariner. The receivers will be connected to cassette recorders so that calls can be recorded. The receiver will be monitored on a regular scheduled basis and a log of operation maintained.

Some analysis will take place in the school, and will be directed by Eva Saulitis. Identities of the pods will be determined by calls. Analysis will be completed using Macintosh "Canary" sound analysis software. The frequency of occurrence of each pod by month will be recorded. Because pod sizes will be determined by photographic monitoring in summer months, estimates of numbers of whales using the area by month will be developed.

As suggested by Martha Vlassof, information from native elders and other residents on the role of killer whales in their mythology, stories and history will be gathered by interview. Interviews will be conducted in Chenega Village and Cordova during our regular visits. A special trip will be made to Tatitlek to conduct these interviews and present results of our research program. The summaries of the interviews will be submitted as an addendum to our annual report in FY97

Most equipment needed to complete the contracted field research will be provided by the North Gulf Oceanic Society, including binoculars, nets, directional hydrophones, photographic equipment and biopsy equipment. The remote hydrophone, transmitter, receivers, and recorders will be purchased as special equipment for this project Additional supplies and minor equipment will be purchased as necessary. Apple Macintosh and IBM compatible computers owned by NGOS as well as the full array of computers and the GIS system available at the PWSSC will be used in data analysis.

## C. Contracts and Other Agency Assistance

The entire project will be completed under the auspices of the North Gulf Oceanic Society. The Prince William Sound Science Center will be responsible for maintaining the geographic information system database, and for completing analyses and report on geographic aspects of killer whale behavior. NGOS will provide a technician to enter data collected in 1996 into the GIS database using the menu interface provided by the Science Center. Genetic analysis will be completed by Pacific Ecological Services at the University of British Columbia. The NGOS will contract residents of Chenega Village

and Port San Juan to monitor the remote hydrophone system during the October to May period. Contracts for vessel leases will be issued by the North Gulf Oceanic Society or the Society will use its own boats for the project.

## SCHEDULE

### A. Measurable Project Tasks for FY97

| | |
|---|---|
| October 1- 30: | Finalize mtDNA analysis and report, initiate mircrosattelite analysis. |
| October 1-30: | Summarize monitoring data for 1996 and historic pod association data. Summarize previous years contaminant analysis data |
| Oct. 1 - Dec. 31: | Area use analyses; select best available data for prey distributions. Summarize and analyze killer whale behavioral data. |
| Oct. 18 (tentative) | Review meeting in Anchorage. |
| January 1997: | Attend Annual Restoration Workshop |
| Jan. 1 - March 31: | Convert prey data to geographic information system format; begin draft of manuscript on area use. |
| April 14-21: | Killer whale biopsy emphasis fieldwork |
| April 1 - June 30: | Analyze correlations with prey. . Analyze winter recordings from remote hydrophone. |
| May 15 - July 1: | Arrange for Restoration and Personal Use Licenses from Chenega Corporation. Analyze previous year's recordings. Replace hydrophone. |
| July 1 - Sept.30: | Write reports; begin draft of manuscript on geographic distributions of foraging behaviors. |
| July 21-August 30: | Killer whale monitoring emphasis field work. Monitor hydrophone from research vessel. |
| September 7-15 | Killer whale biopsy emphasis field work |
| September 15-27: | Presentations and interviews with elders at Chenega, Cordova, and Tatitlek.. Set up receiving stations in Chenega and Port San Juan. Contract village residents as t technicians. Train volunteers and technicians who will maintain batteries. |
| October-May: | Volunteers, students, technicians at Port San Juan and Chenega will maintain system and collect data. Educational presentation data analysis at Chenega school in May. |
| Oct. 15- Nov.15: | Analysis and interpretation of contaminant samples(1997). Genetic analysis of additional samples (1997) |
| Nov.1-Dec.15: | Preparation of killer whale annual report on all aspects of the project. Submission of draft report |
| February 25 1988: | Submission of final report for FY 97. |

The R.V. *Whale 2* will operate for 40 days in July and August ( July 23 to September 3). An additional 20 days of operation (July 5-23) will be funded by matching monies. The primary function of this vessel will be killer whale

photoidentification monitoring. This time period is generally a period of high encounter rate with AB pod and other resident pods and will complement the schedule of the R.V. *Lucky Star*. In addition the R.V. *Whale 2* will collect biopsy samples and feeding data when it does not interfere with the monitoring segment of this project and monitor the remote hydrophone project. The early and late season fieldwork for the R.V. *Lucky Star* will be aimed at sampling transient killer whales. Resident whales generally are sighted more frequently in the July-early September period.

### B. Project Milestones and Endpoints

Although this project is presented as a one year program, publication of much of the work cannot be finalized within FY97. Monitoring can be summarized by year and approached on a year by year basis with a major publication by FY98. The GIS behavioral analysis will be completed and publications readied by the end of FY97 . Contaminant analysis and genetic analysis should both be completed by the end of FY97, however, publications will probably not be possible until FY98. Data from the remote hydrophone probably will not be sufficient for final reporting and publication until at least late FY 98

## PUBLICATIONS AND REPORTS

Matkin, C.O. , G. Ellis and E. Saulitis. Pod structure of Prince William Sound resident killer whales. (Intended for submission to Marine Mammal Science)

Saulitis, E. , C. O. Matkin, K. Heise, L. Barrett-Lennard, G. Ellis. Feeding habits of Prince William Sound killer whales. (Intended for submission toCanadian Journal of Zoology)

Scheel, D., C. Matkin, & E. Saulitis. Distribution of killer whale pods in Prince William Sound over a twelve-year period, 1984-1995. [Intended for submission to Marine Mammal Science].

Scheel, D., C. Matkin, & E. Saulitis. Distribution of predation risk from killer whales in Prince William Sound, Alaska. [Intended for submission to Marine Mammal Science].

Barrett-Lennard, LG, Matkin, CO, Saulitis, EL, Ellis, GM Genetic isolation between sympatric populations of killer whales in Prince William Sound, Alaska. ( Intended for Marine Mammal Science, possibly not ready until FY98)

## COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The monitoring of killer whales and analysis of historic and current data on killer whale behavior is part of an program to investigate killer whale recovery and the interactions of killer whales and harbor seals. It will be integrated with the harbor seal trophic studies (project 96064, Kathy Frost, project leader). In 1997 this project will rely on approximately $14,500 in matching funds from foundations or other private sources. In addition, an estimated $15,000+ in analytical fees will be absorbed by the NOAA/NMFS environmental contaminant lab as part of a cooperative agreement. The offset of expenses by matching funds in long term research has subtantial potential. As a non-profit research institution familiar with private funding sources and cooperative programs, NGOS can work with the Trustee Council cooperation to maximize potential for matching funds in the future.

## PROPOSED PRINCIPAL INVESTIGATORS:

Proposed Project Leader
Craig O. Matkin
North Gulf Oceanic Society
P.O. Box 15244, Homer, Alaska 99603
Phone/Fax (907) 235-6590
ISCOM@ACAD2.ALASKA.EDU

David Scheel
Prince William Sound Science Center
P.O. Box 705
Cordova, AK 99574
tel: (907) 424-5800
fax: (907) 424-5820
dls@grizzly.pwssc.gen.ak.us

**PERSONNEL**

Craig Matkin (M.S. University of Alaska), is the project leader. Matkin will be responsible for supervising the completion of all fieldwork and insuring successful operation of boats and equipment. He will be the operator of the R.V. Lucky Star and supervise directly all work completed from that platform or the attendant skiff. He will direct data analysis and assemble all material for annual and comprehensive reports and be responsible for completion and submission of these reports. He will represent this project and present the work to the EVOS Trustee Council.

Matkin has studied killer whales in Prince William Sound since 1977. He initiated systematic killer whale photoidentification in Prince William Sound, and is a founding member of NGOS. Recently he completed the "The Biology and Management of Killer Whales in Alaska" for the U.S. Marine Mammal Commission. His most recent pertinent publication is of the EVOS killer damage assessment results ("The Status of Killer Whales in Prince William Sound 1984-1992", Craig O. Matkin, G. M. Ellis, M.E. Dahlheim, and J. Zeh in T.R. Loughlin. ed. Marine Mammals and the Exxon Valdez.) Mr. Matkin also teaches at the University of Alaska, Lower Kenai Penninsula Campus.

David Scheel (Phd. University of Minnesota) is an Associate Scientist, at the Prince William Sound Science Center. Scheel will be responsible for the analyses of behavioral and distribution data for examination of killer whale predation. . Scheel will provide detailed interpretation of his analyses for the final report.

Scheel's research projects have included predator-prey dynamics of Serengeti lions and their prey, habitat selection models of Texas mammals, frequency and density dependence in models of community evolution, social behavior and resource habitat use of primates in Gombe. He has extensive experience with GIS systems.

Eva L. Saulitis (M.S. University of Alaska) , a director of NGOS, has conducted fieldwork on killer whales in Prince William Sound each season since 1987. She will be the principal field biologist for the monitoring segment of this project (photoidentification) and will operate the research vessel *Whale 2* and supervise the remote hydrophone project. She will make ready and maintain all necessary equipment, complete photoidentification work and all logs and data sheets as required and coordinate her activities with that of the other research vessel *Lucky Star.* Saulitis will also provide research assistance aboard the R.V. *Lucky Star* when its cruises do not occur at the time of operation of the R.V. *Whale 2.* She will also help assure accurate entry of historical data into the GIS system.

Saulitis recently completed her MS thesis "The Behavior and Vocalizations of the AT Group of Killer Whales in Prince William Sound, Alaska." She coauthored the "Biology and Management of Killer Whales in Alaska" for the U.S. Marine Mammal Commission. She has done extensive analysis of killer whale calls and has operated research vessels in Prince William Sound since 1988.

Lance Barrett Lennard (MS, University of British Columbia). Lance (an American citizen) is a Phd. candidate at the University of British Columbia. He will conduct or supervise all genetic lab work at the University of British Columbia for the killer whale predation segment of this project. He will also provide interpretation of those results. He has extensive experience taking biopsy samples from free ranging killer whales and will participate in biopsy work conducted aboard the R.V. Lucky Star and R.V. Whale 2.

Barrett-Lennard has researched killer whales for 9 years, specializing in their acoustics and genetics. He has operated research vessels in Prince William Sound and British Columbia. He is currently completing an extensive investigation and modeling of killer whale predation on Steller sea lions in Alaska and is conducting genetic analysis on over 100 killer whale biopsy samples taken in British Columbia over the past 3 years.

Graeme Ellis has participated in killer whale photoidentification studies in Canada and Alaska for over 20 years. Ellis will do all final identifications of individual killer whales. He will examine all negatives on a repetitive frame by frame basis and supervise the input of the final identification data into the VAX computer system. With Matkin he will update all life history information on individual whales and provide positive identifications from photographs of each whale biopsied.

Currently Ellis directs whale identification work at the Pacific Biological Station in Nanaimo, British Columbia and has done final identifications on Prince William Sound killer whale photographic negatives since 1983. He has more experience than any other individual identifying Prince William Sound killer whales from photographic negatives and his accuracy has been certified by repeated testing.

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Saulitis, E. 1993. The behavior and vocalizations of the AT group of transient killer whales in Prince William Sound, Alaska. MSC. Thesis, Institiute of Marine Science, University of Alaska, Fairbanks.

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Proposed Project Manager
Dr. Byron Morris
NOAA/Oil Spill Office
P.O. Box 210029 11305 Glacier Hwy. Auke Bay AK 99821
Phone: (907) 789-6600
FAX: (907) 789-6608
BMORRIS@ABL.AFSC.NOAA.GOV

# 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 |
|---|---|---|
| Personnel | $32,610.0 | $47,370.0 |
| Travel | $3,080.0 | $4,865.0 |
| Contractual | $46,412.0 | $72,375.0 |
| Commodities | $5,720.0 | $10,125.0 |
| Equipment | $0.0 | $1,795.0 |
| Subtotal | $87,822.0 | $136,530.0 |
| Indirect | $6,581.0 | $10,713.0 |
| Project Total | $94,403.0 | $147,243.0 |
| Full-time Equivalents (FTE) | | 14.2 |
| Other Resources | | $14,500.0 |

| LONG RANGE FUNDING REQUIREMENTS | | | | |
|---|---|---|---|---|
| Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 |
| | | | | |

Dollar amounts are shown in thousands of dollars.

Prepared: 4/10/96

# 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

| Personnel Costs: | | | | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|---|
| Name | | Position Description | | Budgeted | Costs | Overtime | FFY 1997 |
| Craig | Matkin | P.I., | Field Biologist | 5.0 | 4200.0 | | 21,000.0 |
| Graeme | Ellis | Photo Analyst | Field Biologist | 1.5 | 3500.0 | | 5,250.0 |
| Eva | Saulitis | Field Biologist | Community Liason | 3.1 | 2800.0 | | 8,680.0 |
| | | Field assistant | | 1.8 | 1500.0 | | 2,700.0 |
| | | Data entry technician | | 0.3 | 2800.0 | | 840.0 |
| | | Acoustic Analyst | | 2.0 | 3400.0 | | 6,800.0 |
| | | Biometrician | | 0.5 | 4200.0 | | 2,100.0 |
| | | | | | | | 0.0 |
| | | | | | | | 0.0 |
| | | | | | | | 0.0 |
| | | | | | | | 0.0 |
| | | | | | | | 0.0 |
| | | | Subtotal | 14.2 | 22400.0 | 0.0 | |
| | | | | | | **Personnel Total** | $47,370.0 |

| Travel Costs: | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| Homer/Vancouver | 620.0 | 2 | 6 | 75.0 | 1,690.0 |
| Fairbanks/Homer | 380.0 | 1 | | | 380.0 |
| Fairbanks/Cordova | 410.0 | 2 | | | 820.0 |
| Homer/Anchorage | 140.0 | 2 | 6 | 100.0 | 880.0 |
| Cordova/Tatitlek | 240.0 | 1 | 1 | 75.0 | 315.0 |
| Cordova/Chenega | 240.0 | 2 | 4 | 75.0 | 780.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | $4,865.0 |

[redacted]

Prepared: 4/10/96

[redacted]

[redacted]

# 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | | Proposed |
|---|---|---|
| Description | | FFY 1997 |
| | Prince William Sound Science Center (GIS/ behavioral analysis and interpretation) | 29,400.0 |
| | Pacific Ecological Services (genetic analysis and interpretation) | 13,200.0 |
| | Chenega Village (hydrophone maintenance) | 2,200.0 |
| | 27' research vessel (Whale 2) 40 days @ 360/day w/o operator | 14,400.0 |
| | 43' research vessel (Lucky Star) w/ console skiff for 17 days (775/day) w/o operator | 13,175.0 |
| | Note: Matching monies will be used to extend Whale 2 field season by 20 days | |
| | **Contractual Total** | $72,375.0 |

| **Commodities Costs:** | | Proposed |
|---|---|---|
| Description | | FFY 1997 |
| | Phone | 1,180.0 |
| | Field Food $12/person/day | 1,680.0 |
| | Fuel | 2,850.0 |
| | Postage/Shipping | 480.0 |
| | Film and Processing | 2,100.0 |
| | Photographic Printing | 450.0 |
| | Field supplies/genetic supplies | 645.0 |
| | Land use liscense Chenega Corporation | 100.0 |
| | Hydrophone and cable | 380.0 |
| | Battery Charger and Deep cycle batteries for hydrophone | 260.0 |
| | **Commodities Total** | $10,125.0 |

[redacted]

Prepared: 4/10/96

[redacted]

[redacted]

# 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

| **New Equipment Purchases:** Description | Number of Units | Unit Price | Proposed FFY 1997 |
|---|---|---|---|
| Professional cassette recorder | 1 | 365.0 | 365.0 |
| FM band transmitter and receivers | 1 | 1430.0 | 1,430.0 |
| | | | 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** | $1,795.0 |

| Existing Equipment Usage: Description | Number of Units | |
|---|---|---|
| | | |

[redacted] [redacted] [redacted]

Prepared: 4/10/96



9-7012

**Project Title: Mechanisms of Impact and Potential Recovery of Nearshore Vertebrate Predators**

| | |
|---|---|
| Project Number: | 97025 |
| Restoration Category: | Research |
| Proposer: | Leslie E. Holland-Bartels and NVP Scientists[1] |
| Lead Trustee Agency: | National Biological Service, DOI |
| Cooperating Agencies: | ADFG, NOAA, USFS |
| Alaska SeaLife Center: | |
| Project Duration: | 3rd year, 5-year project |
| Cost FY 97: | $1,997,200 |
| Cost FY 98: | $1,997,200 |
| Cost FY 99: | $450,000 |
| Geographic Area: | Western Prince William Sound |
| Injured Resource/Service: | Sea otter, River otter, Harlequin duck, Pigeon guillemot, intertidal organisms, subtidal organisms |


## ABSTRACT

The Nearshore Vertebrate Predator Project (NVP) makes an integrated assessment of trophic, health, and demographic factors across a suite of apex predators injured by the spill to determine mechanisms constraining recovery and to improve our knowledge of the status of recovery. Primary hypotheses are: 1) Recovery of nearshore resources injured by EVOS is limited by recruitment processes; 2) Initial and/or residual oil in benthic habitats and in or on benthic prey organisms has had a limiting effect on the recovery of benthic foraging predators; and 3) EVOS induced changes in populations of benthic prey species have influenced the recovery of benthic foraging predators.




[1]NVP scientists and affiliations are listed under the PERSONNEL Section

## INTRODUCTION

The nearshore ecosystem served as a repository for much of the oil spilled by the T/V *Exxon Valdez* in March 1989. Mortalities occurred across a suite of apex predators, as well as in benthic invertebrate populations, including mussels, clams, and crabs. The initial changes in composition and abundance of species which resulted from these acute mortalities and habitat disturbances likely continue to modify important structuring processes in the nearshore populations (i.e., competition, predation, and recruitment), thus constraining recovery (Table 1).

This 5-year project, *Mechanisms of Impact and Potential Recovery of Nearshore Vertebrate Predators* (NVP), was approved by the Trustees in March 1995 and began data collection in late summer, 1995. The project examines the status of recovery of four selected top vertebrate predators (sea otter, river otter, pigeon guillemot, and harlequin duck) in the nearshore environment of Prince William Sound (PWS) and is designed to better assess their recovery and determine mechanisms constraining that recovery.

Work completed in FY 95 and early FY 96 included completion of an extensive data management plan and a data archiving and file serving system to facilitate exchange and integration of project data among the fifteen project scientists. Certain project components were initiated (sea otter, harlequin duck, avian copredators); however, primary focus was on pilot efforts to refine prey sampling strategies for further study. There will be three full field seasons (FY 96, 97, 98) in the NVP study with project closeout in FY 99.

## NEED FOR THE PROJECT

### A. Statement of Problem

The nearshore marine ecosystem of PWS plays a critical role in the commercial, subsistence, and recreation economy of southcentral Alaska. Because of shorelines and coastal physiography, the nearshore ecosystem served as a repository for much of the oil spilled during the *Exxon Valdez* oil spill (EVOS). As a result, many of the injured resources under study by the EVOS Trustees Council are components of the nearshore system. Thus, the NVP study describes a research approach for assessing the biological and ecological significance of trophic issues and contaminants present in the nearshore environment. We focus on the status of system recovery and a suite of injured apex predators as indicators of environmental stress--the invertebrate feeding sea otter and harlequin duck, and fish feeding pigeon guillemot and river otter. The first three of these species are not considered to have recovered from the spill, and the recovery of the fourth is unknown (Table 1). NVP takes a multispecies, integrated approach to assess several potential key mechanisms constraining recovery of the nearshore system.

Table 1. Injury and evidence for lack of recovery from the Exxon Valdez Oil Spill, 1989 in four top nearshore vertebrate species as evidenced through demographic, bioindicator, and trophic evidence.

| Injured Resource | Injury to Nearshore Ecosystem and Lack of Recovery as Evidenced in Four Key Species | Status/Recovery Strategy |
|---|---|---|
| Pigeon guillemots | **DEMOGRAPHIC**<br>•1,500-3,000 killed by EVOS in 1989<br><br>•Populations in PWS have declined from c.15,000 in the 1970s to c.3,000-5,000 in 1993 based on boat surveys. Declines have been greater in oiled vs non-oiled areas of PWS (Klosiewski and Lang, unpubl. data; Sanger and Cody 1993).<br><br>•Number of breeding pairs on Naked Island (largest guillemot breeding aggregation in PWS) have declined c.50% since the late 1970s and give no evidence of recovery (D.L. Hayes, USFWS, pers. comm.)<br><br>**BIOINDICATOR**<br>•Average growth rates of chicks have declined since the spill (Oakley and Kuletz 1993) and remained lower at Naked Islanded (oiled) versus Jackpot Island (non-oiled) during the 1994 breeding season (D.L. Hayes, USFWS, unpubl. data).<br><br>**TROPHIC**<br>•No direct evidence collected. However, nearshore demersal fish, primary prey of this species, demonstrate a high incedence of hemosiderosis in oiled eelgrass beds of Herring Bay (Jewett et al. 1994). This suggests continued exposure to hydrocarbons. Nearshore demersal fish comprised ~half the diet of chicks on Naked Island.<br><br>•Sandlance, a schooling fish that burrows in nearshore sandy sediments, formerly comprised c. a third of the diet of chicks on Naked Island. Since the spill, the proportion in the diet has declined. | •Stable or continuing decline<br><br>•Conduct research to find out why recovering; likely causes climatic /oceanographic, prey limitations and predation.<br><br>•Recovery judged by stable or increasing populations. |
| River otters | **DEMOGRAPHIC**<br>•Although some were killed, there was no catastrophic mortality--river otters continued to live in areas that were through 1990 (Testa et al. 1994)<br><br>•Initially modified use of habitat by avoiding heavily oiled shorelines (Bowyer et al. 1995). Selected habitat differently on oiled vs non-oiled areas by concentrating their activities on steeper tidal slopes and using areas with greater exposure to wave action (Bowyer et al. 1994), where oil was less likely to persist (Wolfe et al. 1994)<br><br>•In 1990, home ranges in oiled areas were 2x those in non-oiled areas, suggesting a loss of habitat on oiled sites (Bowyer et al. 1995)<br><br>•Continued exposure has adverse health effects; lower body mass. Lower body mass often related to lower reproductive output in large mammals (Docktor et al. 1987)<br><br>•Throughout broad areas of PWS, latrine sites (an index of population density) were abandoned at a rate of three times greater on oiled versus non-oiled areas (Duffy et al. 1994a).<br><br>**BIOINDICATOR**<br>•Continued exposure has adverse health effects; higher haptoglobin (an acute-phase protein indicator of damage) than otters in non-oiled (Duffy et al. 1993).<br><br>**TROPHIC**<br>•Diets in oiled vs non-oiled areas were similar through 1990, but differed markedly by summer 1991 (Bowyer et al. 1994). A number of taxa were absent from the diet in oiled areas.<br><br>•Nearshore demersal fish, primary prey of this species, demonstrate a high incidence of hemosiderosis in oiled eelgrass beds of Herring Bay (Jewett et al. 1994). This suggests continued exposure to hydrocarbons. | •Unknown status<br><br>•Rely on natural recovery, indications of recovery are when habitat use, food habitats and physiological indices return to prespill conditions. |

| Injured Resource | Injury to Nearshore Ecosystem and Lack of Recovery as Evidenced in Four Key Species | Status/Recovery Strategy |
|---|---|---|
| Sea otters | **DEMOGRAPHIC**<br>•Up to 4,000 acute mortalities<br><br>•Various surveys suggest abundance of sea otters has not recovered to pre-spill numbers. Densities in 1995 were found to be lower in oiled than in unoiled areas (.5/km$^2$ vs. 3.4/km$^2$, respectively; J. Bodkin, pers. comm.).<br><br>•Significant differences in juvenile survival between oiled and un-oiled areas in 90/91 and 92/93.<br><br>•Proportions of prime aged animals among dead returning to pre-spill levels(Ballachey et al. 1994).<br><br>**BIOINDICATOR**<br>•Hemotological and serum chemistries suggest otters in oiled areas had higher incidence of inflammatory and/or infectious conditions.<br><br>**TROPHIC**<br>•Primary foods include mussels, clams, and urchins, as well as other subtitdal organisms. Sea otters feed in the lower intertidal and subtidal areas, areas that were especially contaminated by the oil spill (Wolfe et al. 1994) and may still be exposed to hydrocarbons through their feeding (EVOSTC 1994a).<br><br>•In areas where recovery has not occurred, increases in sea urchin densities (a preferred prey) have been observed (Jewett pers. comm.). | •Stable, not recovered in heavily oiled areas.<br><br>•Conduct research to find out why not recovering; hypotheses include continued hydrocarbon ingestion; spill-caused changes in benthic prey.<br><br>•Recovery judged when population abundance and distribution are comparable to prespill, and when all ages appear healthy. |
| Harlequin ducks | **DEMOGRAPHIC**<br>•1,000 acute mortalities in Harlequins<br><br>•875 acute mortalities in other species<br><br>•Summer populations of harlequin ducks, which may be year-round residents, were lower than expected in the oiled area of Prince William Sound between 1989 and 1991 (Klosiewski and Laing 1994).<br><br>**BIOINDICATOR**<br>•Patten (1994) found hydrocarbon metabolites in sea ducks collected in oiled areas and also suggested that reproductive effort and productivity of harlequin ducks were lower in oiled areas.<br><br>**PREDATOR/PREY**<br>•Although harlequin ducks rely on benthic invertebrates that may continue to transport hydrocarbons through their food chain, no specific assessment evidence of the potential for trophic-related constraints to recovery exists. | •Unknown status<br><br>•Conduct research to find out why not recovering; hypothesis related to oil-contaminated prey.<br><br>•Recovery judged for harlequins when no difference between spill and non-spill areas. |

## B. Rationale/Link to Restoration

Effective implementation of the EVOS Trustee Council's policy that "Restoration should contribute to a healthy, productive and biologically diverse ecosystem...", is complicated by the diversity and trophic interdependence of the numerous injured resources within the nearshore system. Beyond these ecological constraints, we are practically constrained by a lack of accurate and precise pre-spill population demographic data for many injured resources upon which to judge the progress of restoration. However, sufficient evidence exists to suggest that a wide variety of nearshore vertebrate predators and crucial subtidal and intertidal invertebrate prey are not recovered (Table 1). The three factors most likely to be limiting recovery are intrinsic demographic constraints, continued hydrocarbon exposure, and food

limitation. The NVP project will examine these factors as mechanisms constraining recovery. Concurrently, data collected on these factors will provide information regarding the status of recovery.

**Demography**--Demography will be examined by comparing population densities and parameters affecting population growth rates between oiled and unoiled areas. The rate of recovery of nearshore vertebrate predators may be constrained by oil-related factors (continued toxicity of oil and food availability) as well as non-oil related processes. The latter include death and birth processes as affected by factors such as intrinsic reproductive capacity and mortality due to adverse weather conditions. It may be, for example, that death and birth rates do not differ among injured and non-injured subpopulations of nearshore vertebrate predators, but that the rate of population increase is too slow to have allowed for complete recovery of the injured nearshore vertebrate predator populations, in the absence of continued effects of oil. In other words, the nearshore vertebrate predator populations may not be fully recovered, but may be recovering as quickly as possible under naturally-occurring conditions.

**Continued Hydrocarbon Exposure**--The question of continued exposure to oil will be assessed by comparing indicators of exposure to oil and individual health between oiled and unoiled areas. Today, hydrocarbon impacts may still exist. Between 8-16% of the 10.8 million gallons of crude oil spilled by the *T/V Exxon Valdez* remains buried in marine sediments. Such oil is not subject to degradation by marine organisms and remains in a form that is toxic to many vertebrates. Moreover, microbial analyses suggest that oil in sediments along oiled shorelines is still several orders of magnitude more common than in unoiled areas, suggesting oil may still be available for biological transport from benthic invertebrates through the food chain. In fact, various bioindicator and health measures suggest that continued injury may be occurring among vertebrate predators.

**Food Availability**--Food limitation will be considered by examining population densities and size class structures of dominant prey species. Considerable dietary overlap and potential competition for food exists among the top predators of the nearshore system. There is also evidence to suggest that population densities of many nearshore vertebrate predators are limited by food. Evaluation of abundance and size distribution data for prey items also may be useful for providing additional indirect evidence for estimating recovery of some predator species. For example, it is well documented that sea otters prefer sea urchins as prey and that in the presence of strong predation by sea otters, both the abundance and average size of sea urchins is reduced. Other suggestions of food limitation exist for sea ducks. There is circumstantial evidence that pigeon guillemots nesting at Naked Island in central PWS are food-limited. There is evidence that population densities of at least some important vertebrate prey species declined as a result of the EVOS. For example, mussels, an important component of the diets of sea otters and sea ducks, were less abundant at oiled areas relative to unoiled areas following the EVOS. Many of the prey species of the nearshore vertebrate predators, including crabs, limpets, chitons, and mussels have failed to recover fully in some habitats.

## C. Location

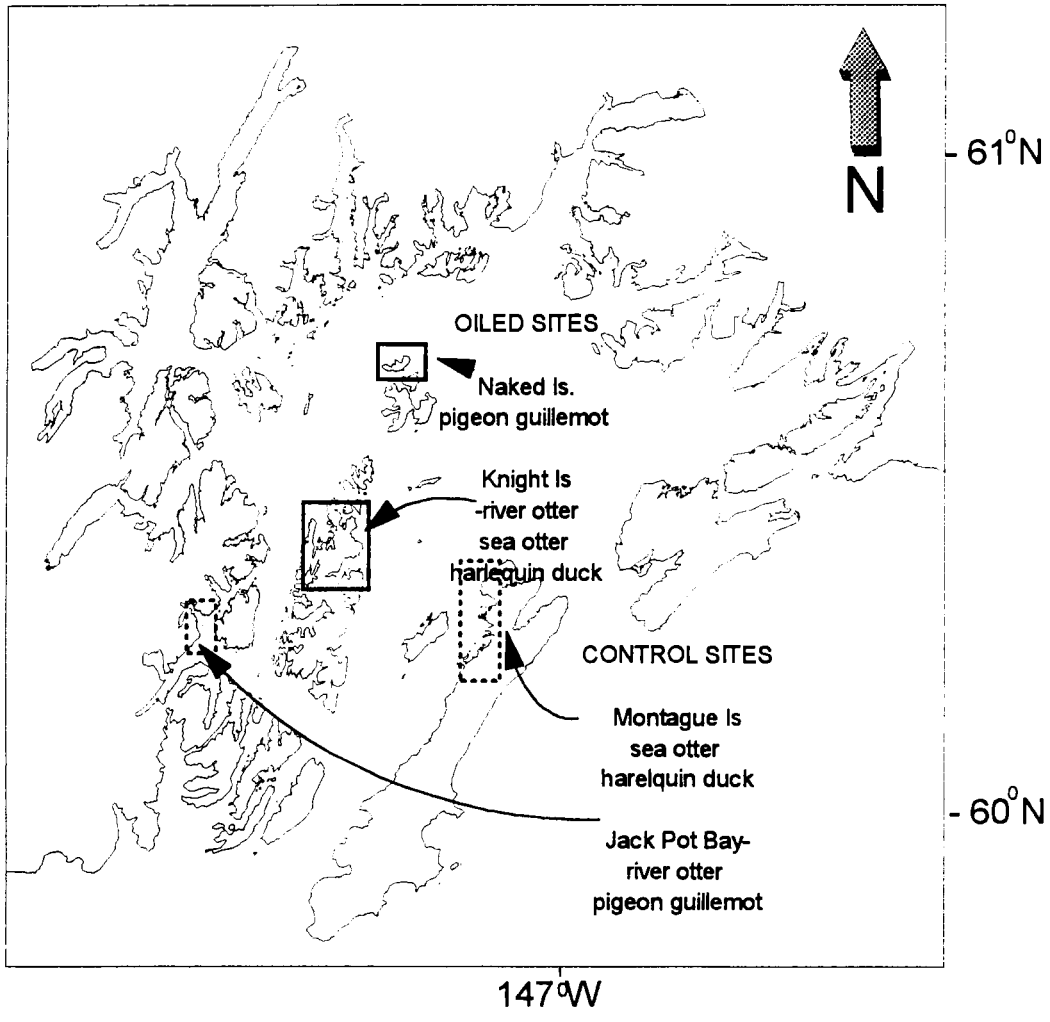
This project will be conducted in western PWS (Figure 1). For all four predator species, assessments will be made at two areas, one oiled and one unoiled. Northern Knight Island will be the oiled area for sea otter, river otter and harlequin duck assessments, and Naked Island will be the oiled area for pigeon guillemots. Montague Island will be the unoiled area for sea otter and harlequin duck assessments, whereas Jackpot Bay will be the unoiled area for pigeon guillemots and river otters.

## COMMUNITY INVOLVEMENT

The project concept was developed as a result of the April 1994 "Science for the Restoration Process" workshop, a public forum. Continued discussion of the project occurred through the 1995 and 1996 Work Plans and the public review process of the Trustee Council. The Nearshore Vertebrate Predator Project was presented at January 1995 and 1996 Trustees sponsored Restoration Workshops in Anchorage.

Project investigators have communicated with members of various PWS communities, including sea otter hunters, to obtain local information and biological samples pertinent to the project, to identify volunteer and local-hire options, and to explain the approach taken by NVP to assess the nearshore environment's response to EVOS. Efforts to incorporate traditional ecological knowledge continue through meetings with the community involvement coordinator, Martha Vlasoff, at the EVOS Restoration Office. Local hire of Cordova community members and businesses (boat and air charter, telemetry observers) is ongoing. As results become available, we will welcome opportunities to interact with the communities to present and discuss our findings.

Figure 1. Location of "oiled" and "control" study sites for NVP



## PROJECT DESIGN

### A. Objectives

For our test species, the document "Proceedings of the Workshop: Science for the Restoration Process" suggested that three factors had high potential as factors constraining recovery: 1) recovery of nearshore resources injured by EVOS is limited by recruitment processes; 2) initial and/or residual oil in benthic habitats and in or on benthic prey organisms has had a limiting effect on the recovery of benthic foraging predators; and 3) EVOS induced changes in populations of benthic prey species have influenced the recovery of benthic foraging predators.

Based on that consensus, we will ask "are vertebrate populations recovering, and if so, are they recovering as quickly as possible given potential rates of population increase?" We will do this by measuring population density and demographic factors (e.g., size and age distributions, birth rates, survival rates) at both oiled and unoiled areas to examine possible reasons for lack of recovery, and assess progress toward recovery given demographic restraints. In conjunction with this "recovery monitoring" approach, we will also ask the questions "is it oil?" and "is it food?" that limit recovery (Figure 2). This will be addressed through evaluation of demographic measures, health assessments, biomarkers of oil exposure, and availability of prey for the four nearshore vertebrate predators in oiled and unoiled areas of PWS.

**Objective 1.** Determine status of recovery of injured populations of nearshore vertebrate predators, by determining if there are differences between oiled and unoiled areas in:

a. Abundance or indices to abundance.
b. Demographic characteristics.
c. Measures of health.
d. Abundance or size distribution of prey.

**Objective 2.** Determine if recovery of nearshore vertebrate predators is constrained by demographic factors unrelated to oil toxicity or food supply.

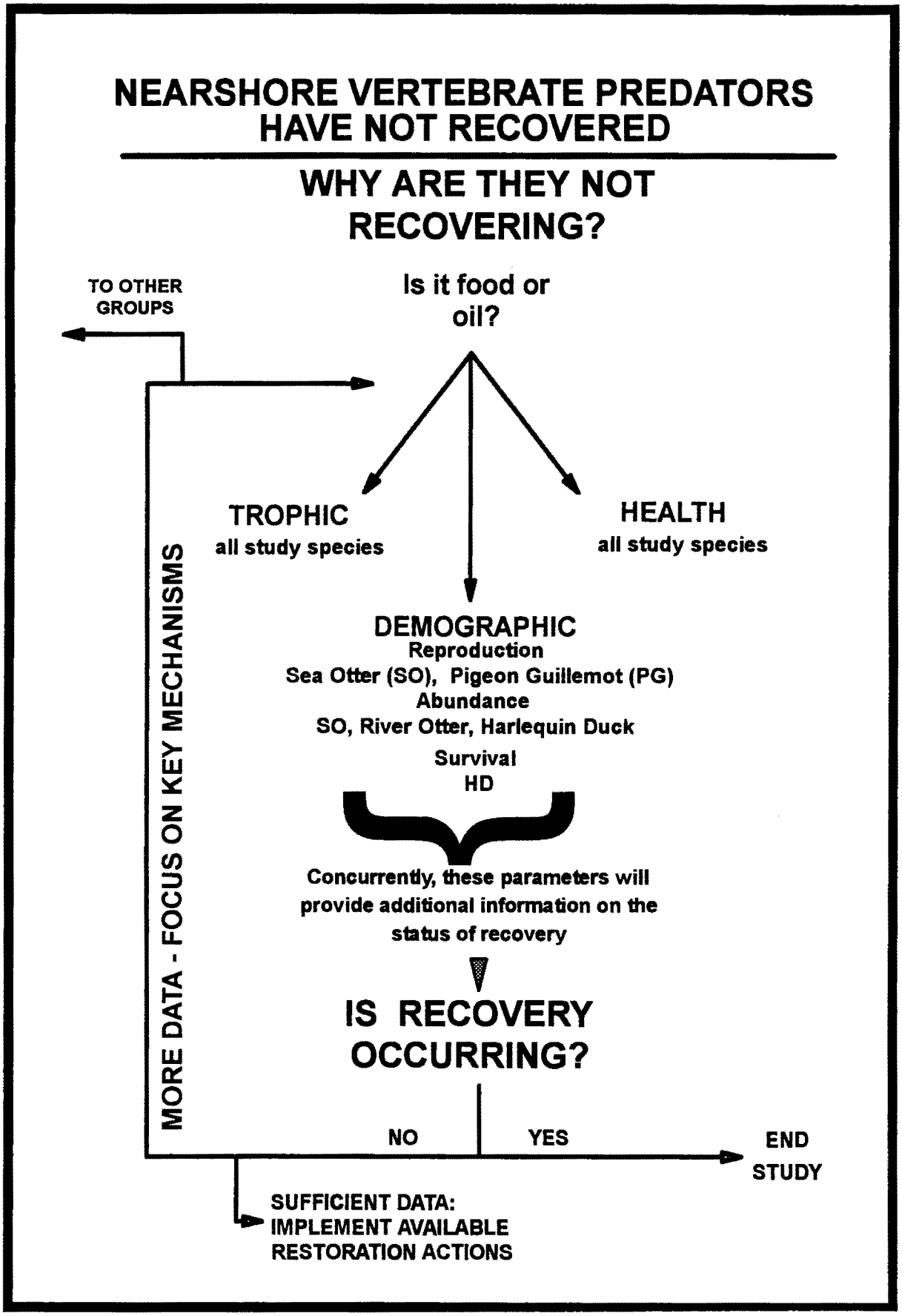
**Objective 3.** Determine if recovery of nearshore vertebrate predators is constrained by continued oil toxicity, by determining if there are differences between oiled and unoiled areas in:

a. Bioindicators of exposure to oil in predator species.
b. Bioindicators of exposure to oil in prey species.
c. Hydrocarbon levels in prey species.

**Objective 4.** Determine if recovery of nearshore vertebrate predators is constrained by food availability.

We will address all major objectives for each of the four predator species selected for study. Methods are detailed below.

**Figure 2. Graphic depicting general approach taken in the NVP project.**



## B. Methods

Methods for 97025 are outlined in detail in Holland-Bartels et al. (1995) and are summarized below and in Table 2. The generalized study design calls for comparing predator abundance, demographic measures, health, indicators of oil exposure, and prey abundance within a selected oiled area and a selected unoiled area. We are constrained to using selected areas, rather than a random sample of all potential oiled and unoiled areas, for several reasons. First, the mobility of nearshore vertebrate predators makes it difficult to clearly define subpopulations of these species within PWS. For example, sea otters can range up to 40 km, making it difficult to select clearly defined replicate "oiled" subpopulations. Second, habitats within PWS are extremely diverse, making it difficult to segregate effects of oiling from other environmental factors, especially in cases where habitats in oiled and unoiled areas are clearly different. Third, the areas representing the total of all oiled and unoiled areas are extremely large, and it would be impossible to effectively sample from the entirety of these areas given reasonable monetary constraints.

Table 2. Summary of methods for the NVP project, listed by species and approach.

| APPROACH | SEA OTTERS | HARLEQUIN DUCKS | PIGEON GUILLEMOTS | RIVER OTTERS |
|---|---|---|---|---|
| DEMOGRAPHY | AERIAL SURVEYS<br>SURVEYS OF ANNUAL REPRODUCTION RATES<br>CARCASS RECOVERY TO EVALUATE MORTALITY PATTERNS | HABITAT USE AND ABUNDANCE IN OILED AND UNOILED AREAS<br>OVERWINTER SURVIVAL OF FEMALES | CHICK GROWTH RATES<br>REPRODUCTIVE SUCCESS<br>ADULT ATTENTIVENESS TO CHICKS<br>MEAL DELIVERY RATES AND MEAL SIZE | LATRINE SITE ABANDONMENT AS ABUNDANCE INDEX |
| HEALTH AND OIL EXPOSURE | BLOOD AND IMMUNE FUNCTION ASSAYS<br>P450 ASSAYS<br>MORPHOMETRICS AND CONDITION | BLOOD ASSAYS<br>P450 ASSAYS<br>BODY COMPOSITION | BLOOD ASSAYS<br>P450 ASSAYS | BLOOD, IMMUNE FUNCTION ASSAYS<br>P450 ASSAYS<br>MORPHOMETRICS |
| TROPHIC INTERACTIONS | ABUNDANCE, DISTRIBUTION, SIZE CLASS STRUCTURE--CLAMS, MUSSELS, SEA URCHINS, CRABS<br>PREY SELECTION AND FORAGING SUCCESS<br>FACTORS AFFECTING PREY ABUNDANCE: VARIATION IN RECRUITMENT AND GROWTH OF INVERTEBRATE PREY; COMPETING PREDATORS | ABUNDANCE AND SIZE CLASS DISTRIBUTION OF PRIMARY INVERTEBRATE PREY | ABUNDANCE OF PREY FISHES | ABUNDANCE OF PREY (DEMERSAL FISHES) |

In using selected areas, we are restricted to making statistical inferences to these areas only, and not to the oiled and unoiled regions as a whole. Extrapolation of results to the broader oiled and unoiled parts of PWS will therefore rely on "best professional judgement". However, given the alternative of what would assuredly be an unworkable experimental design, we feel this is the only reasonable approach.

Study locations will be within generalized "oiled" and "unoiled" areas. The oiled area is identified as the Naked Island-Northern Knight Island group (Figure 1). Oiling was heaviest here, and population levels of sea otters are much lower here than at unoiled areas in PWS. Harlequin duck densities also are lower in this area. The unoiled area will be along the northwestern shore of Montague Island for sea otters and harlequin ducks, and around Jackpot Island for river otters and pigeon guillemots.

We have selected areas to maximize sampling efficiency from a logistical perspective as much as possible. For example, sea otter and harlequin duck study areas overlap completely and the oiled study area for river otters overlaps with part of the oiled study area for sea otters and harlequin ducks. However, complete overlap of oiled and unoiled areas was not possible because no two areas had appropriate habitat for all four predator species.

The following sections describe methods that are general to several of the study species (e.g. various health and oil exposure methods, Table 3; and habitat characterizations) as well as species specific methodologies. Detailed standard operating procedures are on file and available upon request.

***General Methods for Determining Health and Exposure to Oil.***--We will examine a common suite of biomarkers (Table 3) for each of the nearshore vertebrate predator species to determine the health and oil exposure of oiled and unoiled populations. Health will be evaluated through hematology and immune function assays as well as morphometrics (weights, lengths, etc.) and, for harlequin ducks, body composition measurements. Oil exposure will be evaluated by measurements of cytochrome P450-1A's, enzymes that are specific indicators of exposure to aromatic hydrocarbons. P450 assays will be done for the four predator species and on vertebrate prey (selected fish species). Additional tests of oil exposure will include ELISA assay of pelage or plumage swabs and, if warranted based on outcome of P450 assays, analysis of hydrocarbon levels in archived prey samples.

Because Barrow's goldeneyes will be collected, primarily for assessments of sea duck predation pressure on bivalves, we also will be able to compare of bioindicators of health and exposure between study areas for this species. Tissue samples and blood will be taken immediately upon collection.

General methods for assessing health and oil exposure are presented here. Methods specific to each species will be addressed in sections on each species, below.

Table 3. List of assays, measurements for evaluation of health and oil exposure.

| Assay or Biomarker | Laboratory or Location | Sea Otters | Harlequin Ducks | Pigeon Guillemots | River Otters | Demersal Fishes |
|---|---|---|---|---|---|---|
| | | n=60 | n=100 | n=75 nestlings n=25 adults | n=30 | n=40 |
| Blood - CBC, WBC | Commercial lab/ Purdue | X | X | X | X | |
| Serum Chemistry | Commercial lab | X | X | X | X | |
| Interleukin-6 | UAF | X | X | X | X | |
| Haptoglobin | UAF | X | X | X | X | |
| Immunoglobulin Quantitations | Purdue | X | X | | | |
| Serum electrophoresis | Purdue/ UAF | X | X | | X | |
| Lymphocyte Transformation Assay | Purdue | X | X | | X | |
| Cytochrome P450 Immunohistochemistry | Woods Hole | X | X | X | X | X |
| Cytochrome P450 Western Blotting | UAF | X | | X | X | |
| Cytochrome P450 Quantitative PCR | Purdue | X | | | X | |
| External oil (ELISA) | In field/ UAF/NBS | X | X | X - Adults | X | |
| Morphometrics (weights, lengths) | In field | X | X | X | X | |
| Body Composition | In field/NBS | | X | | | |

**Collection of Blood Samples.**--Samples will be collected at capture from sea and river otters (30 ml) by standard jugular venipuncture techniques, and from pigeon guillemots (1 ml) and harlequin ducks (3 ml) by brachial or jugular venipuncture. Blood volumes collected on sea and river otters will be sufficient to conduct conventional hematology, immune function and cytochrome P450 assays. For harlequin ducks and pigeon guillemots, because blood volumes will be limiting, the primary focus will be on conventional hematology.

**Hematology and Serum Chemistry.**--For the CBC's (complete blood cell counts), WBC's (white blood cell counts) and serum chemistries, one EDTA tube, one serum tube and two blood smears from each animal will be prepared in the field. Samples will be submitted to commercial clinical laboratories (Corning Clinical Laboratories for the sea otter and river otter samples, and a laboratory specializing in avian samples for the harlequin and pigeon guillemot samples) for analyses.

Haptoglobins in serum will be measured at UAF. Haptoglobins (Hp) are alpha glycoproteins that stoichiometrically bind free hemoglobin (Hb) in a haptoglobin-hemoglobin complex (Gordan and Koj 1985). Excess hemoglobin will be added to the serum sample in a 1 part of a 10% hemoglobin suspension to 20 parts of undiluted serum, and allowed to mix for 5 min. Two microliters of the sample mixture are then electrophoresed on agarose gels at 100 volts for 1 hr. After fixing the protein complex with 7.5% trichloroacetic acid, gels will be stained for hemoglobin using o-dianisidine, as described by the manufacturer (Helena Laboratories Technical Bulletin Number 5445). The Hp-Hb complex, which migrates in a different region from hemoglobin, is quantified by densitometry and results are expressed as mg of hemoglobin binding capacity per 100 ml of serum as described by the manufacturer (Helena Laboratories Technical Bulletin Number 5445; Valeri et al. 1965).

Serum samples will be analyzed for Interleukin-6 (IL-6) at UAF using an immunochemical assay (Quantakine ELISA). Samples will be run in duplicate on a microtiter plate coated with a monoclonal antibody for IL-6. After washing away any unbound protein, an enzyme-linked polyclonal antibody for IL-6 will be used to detect IL-6 levels.

The serum samples from sea otter, river otters, and harlequin ducks will be batch tested at Purdue University for serum electrophoresis (SEP) and immunoglobulin quantitation using standard methodologies. Serum protein electrophoresis offers information on relative protein distribution and allows for the calculation of absolute values (Melvin 1987). Many disease states may alter the electrophoretic pattern (Turnwald and Barta 1989). Acute phase, complement, immunoglobulin and coagulation proteins can all be assayed using SEP.

**Immune Function Assays.**--From sea and river otters, a total of 20 ml of blood collected with 40$\mu$ of preservative-free heparin/ml as the anticoagulant will be used to isolate buffy coat leukocytes. Blood samples will be processed using a technique modified from Truax et. al. (1993) on cryopreservation of buffy coat cells, stored in liquid nitrogen, and shipped to Purdue University. For analysis, frozen cells will be thawed rapidly in a 37°C water bath and immediately placed on ice. The sample will then be transferred to a 15 ml centrifuge tube and diluted to 10 ml with Hank's balanced salt solution (HBSS) containing 40 $\mu$ of heparin/ml. The sample will then be layered over 4 ml of a ficoll gradient and centrifuged at 1600 x g for 30 minutes. The cells at the interface will be collected and washed 3 times in HBSS. Following the final wash the cells will be resuspended in RPMI 1640 medium supplemented with 10% (v/v) fetal clone, 2 mM L-glutamine, 25 mM 2-mercaptoethanol and antibiotics. Enumeration and viability will be assessed using trypan blue dye-exclusion. Lymphocyte proliferation assays will be performed using the mitogens PHA, Con A and PWM in 5 day cultures. All assays will be done in triplicate. Proliferation will be

assayed by adding tritiated thymidine to the cultures at 16 hours prior to harvesting. Results will be recorded as counts per minute (cpm). Control wells will contain medium only.

**Cytochrome P450 Assays.**---The cytochrome P450 isoenzymes are biological markers of exposure to hydrocarbons. Two approaches will be taken to evaluate cytochrome P450 levels:

1) Immunohistochemistry: The induction of cytochrome P4501A (CYP1A) in tissues of the predator species will be evaluated by immunohistochemistry. Candidate tissues to be used include skin punches from flipper of sea otters and from ear of river otters; liver from collected Barrow's goldeneyes; foot web biopsies from captured harlequin ducks and pigeon guillemots; and liver from demersal fishes (sample at collection). Tissue samples will be preserved in 10% neutral buffered formalin immediately after collection and shipped to Woods Hole Oceanographic Institute for analysis.

2) Quantitative RT-PCR to measure cytochrome P450: The purpose of this approach is to use an alternate method (quantitative polymerase chain reaction) to measure cytochrome P450 expression in peripheral blood lymphocytes. The lymphocytes will be isolated from blood samples drawn from animals captured from oiled and non-oiled areas. The method to be used will be adapted from Vanden Heuvel et al. (1993). Total RNA will be extracted from isolated peripheral blood lymphocytes and a reverse transcriptase-polymerase chain reaction (RT-PCR) assay will be used to quantify cytochrome P450 levels. Advantages of this technique are: (1) the use of peripheral blood samples for analysis; (2) the small sample size required for detection and (3) potentially increased sensitivity as compared to other methods.

**Assays of External Oil.**--Personnel at the CA Dept. of Fish and Game have recently adapted an ELISA assay to detect oil contamination of pelage under field conditions (J. Mazet, CDF&G, pers. comm). Controlled tests of the procedure show sensitivities in the range of less than or equal to .7 parts per million. To sample the pelage or plumage, a 4x4 gauze swab is saturated with isopropanol and applied for 15 seconds. These swabs can then be assayed immediately (ELISA field kit) or frozen for later analysis. We will sample pelage or plumage of all captured sea otters, river otters, harlequin ducks and adult pigeon guillemots; however, ELISA analyses will be limited to a subset of the collected samples. If initial ELISA results are positive for contamination, or if the P450 assays indicate continuing hydrocarbon contamination, the remaining samples can be tested to evaluate external contamination as a route of oil exposure.

**Body Condition/Composition.**--Body condition will be used to assess population health in oiled and unoiled areas in PWS. For river otters, sea otters, and pigeon guillemots, condition will be estimated based on morphometrics (weights, lengths). For harlequin ducks, body composition will be estimated using nondestructive condition indices that incorporate body mass, morphometrics, and measures of total body electrical conductivity (TOBEC; Walsberg 1988, Roby 1991). A major advantage of the TOBEC technique is that measurements can be obtained rapidly and repeatedly without harm to the subject. Also, validation studies to date indicate that the accuracy of the technique can be high ($r^2 = 0.996$) (Bracco et al. 1983, Walsberg 1988, Roby 1991) if subjects are positioned consistently within

the measurement chamber and plumage is dry. Condition index models will be derived based on collection (outside the spill area) of 25 harlequin ducks in 1996.

*Specific Methods for Sea Otters.--*

**Aerial Survey:** The aerial sea otter survey methodology consists of two components: (1) strip transect counts and (2) intensive search units. Sea otter habitat is sampled in two strata, high density and low density, distinguished by distance from shore and depth contour. Survey effort is allocated proportional to expected sea otter abundance by adjusting the systematic spacing of transects within each stratum. Transects with a 400 meter strip width on one side of a fixed-wing aircraft are surveyed by a single observer at an airspeed of 65 mph (29 m/sec) and altitude of 300 feet (91 m). The observer searches forward as far as conditions allow and out 400 m, indicated by marks on the aircraft struts, and records otter group size and location on a transect map. A group is defined as one or more otters spaced less than three otter lengths apart. Observation conditions are noted for each transect and the pilot does not assist in sighting sea otters. Intensive search units (ISU's) are used to estimate the proportion of sea otters not detected on strip transect counts. ISU's are flown at intervals dependant on sampling intensity, throughout the survey period. An ISU is initiated by the sighting of a group and is followed by five concentric circles flown within the 400 m strip perpendicular to the group which initiated the ISU. The pilot uses a stopwatch to time the minimum one minute spacing between consecutive ISU's and guide the circumference of each circle. ISU circle locations are drawn on the transect map and group size and behavior is recorded on a separate form for each ISU. Number observed on the strip count and number observed during the circle counts are recorded for each group.

**Estimation of Annual Production of Sea Otters:** Estimates of annual reproduction, as indicated by ratios of independent to dependent sea otters, and patterns of habitat use will be obtained from small boat surveys. Surveys will be conducted in July and August. Sample units correspond to coastline transects established by Irons et al. (1988) and extend offshore out to the 100 m depth contour or ½ the distance to the opposing shoreline, whichever is less. A subset of sample units will be randomly selected to be surveyed in each of the study areas. The survey vessel maneuvers about 200 to 300 m offshore, and out to the offshore boundary as necessary to observe and classify all otters within each selected sample unit. Boat speed is maintained at $<15$ mph. Surveys are conducted only when calm to light winds and sea state less than Beaufort 2 exists. Two observers use high resolution binoculars to classified otters as either dependent or independent. Crews will record the number of dependent and independent sea otters found in each sample unit. Each sample unit is classified by coastline physiography (protected bay, open coast, or island) and bathymetry ($<31$ m for more than 50% of the sample unit's length at 200 - 300 m offshore, or $>31$ m for more than 50% of the sample unit length). Ratios of independent to dependent sea otters is obtained for each stratum and for each habitat type by summing over all sample units within each stratum or habitat type. Proportions of dependent sea otters is calculated for each transect. Kruskal-Wallis tests will be used to evaluate differences in proportions among areas.

**Beach Surveys of Sea Otter Mortality**: Mortality patterns, based on age distributions of the dying portion of the population, will be evaluated through recovery of beach-cast sea

otter carcasses in western PWS. Beaches in the Green Island area of western PWS, surveyed for carcasses in 1976-84 by Johnson (1987), and again in 1990-96 (Monson and Ballachey 1996, J. Bodkin, pers. comm.), will be surveyed in 1997. In addition, a limited number of beaches on Knight, Naked, and Montague Islands will be surveyed in 1997. Beaches will be surveyed once during late April or early May after snow melt but prior to summer revegetation, which may hide carcasses washed high on the beach by winter storms. Data recorded for each carcass include: 1) relative location of carcass on the beach, 2) relative condition and completeness of carcass, 3) position of remains relative to previous year's vegetation, 4) relative age (adult, subadult, pup), 5) sex, and 6) specimens collected (e.g., entire carcass, skull, baculum, none). Skulls (when present) will be taken from all carcasses and a tooth extracted for aging (Garshelis 1984). Any fresh carcasses collected will be necropsied as soon as possible and tissue samples collected for potential toxicology and histopathology studies. Subsequent to final age analyses, otters are classed as: 1) juvenile: ages 0 and 1; 2) prime: ages 2-8; and 3) older: ages 9 and above. The distribution of age classes will be compared with other post-spill collections (1990-96) and pre-spill collections (1976-84), using Fisher's Exact Test (2-tailed).

**Indicators of Health and P450 Induction:** Sixty sea otters will be captured with either tangle nets, hand-held dip nets or underwater diver-held traps, all methods which have been used routinely in previous capture efforts. Sea otters will be sedated with a combination of fentanyl and diazepam and will be reversed with naltrexone following collection of data and samples. Sea otters will be tagged with unique color/number coded polyethylene tags in their hind flippers, and a coded transponder chip will be implanted subcutaneously in the right groin area. Flipper tags are often lost, so the transponder chips provides a permanent identification in the event that the animal is recaptured or recovered. Both methods of tagging have been used routinely in previous studies of sea otters, without deleterious effects. Morphometric data collected will include age class, sex, length, weight, girth, canine width and baculum length (in males). Morphological characters will include head color and tooth wear. The mouth will be checked for oral lesions, and if observed they will be surgically biopsied and preserved in formalin for histological examination. A premolar tooth will be removed for age estimation.

A blood sample of up to 30 cc will be collected by jugular venipuncture from each sea otter and processed as described in the general methods section; conventional hematology, immune function assays and cytochrome P450 assays will be done. A skin punch is removed from the webbing of the flipper when inserting the flipper tag; this punch will be preserved in formalin for P450 assays. While sedated, the pelage of the sea otter will be sampled for external oil contamination.

**Sea Otter Foraging:** Sea otter foraging success and intensity will be measured using focal animal foraging observations, and activity scan sampling techniques (Altmann 1974) adapted for sea otter work in past studies (Calkins 1978, Estes et al. 1986). Both will consist of shore-based, nearshore observations at randomly selected sites (coordinated with the invertebrate sampling sites) within each of the two study areas.
Foraging success: Sea otter prey will be determined at both study areas. The primary method of data collection will be observational, following standard operating procedures.

Observations will be made from shore with the aid of high resolution telescopes (Questar Corporation) and 10X binoculars. Data will be collected at both locations within a six week period during the months of June, July and August, beginning in 1996. Data recorded will include sex, age class of focal animal (adult or juvenile), number of prey and relative prey size (A: $< 2$ cm, B: $\geq 2$ to $< 4$ cm , C: $\geq 4$ cm to $< 8$ cm, D: $\geq 8$ to $< 12$ cm, and E: $\geq 12$ cm), dive time, surface time, success rate and prey item to lowest taxon. Prey size will be visually estimated based on an estimated mean forepaw width in sea otters of 4.5 cm. Repeated dives will be recorded for a focal animal until a maximum of 50 identifiable prey items are observed per individual or until the animal is lost or discontinues foraging. Focal animal selection, when more than one otter is feeding at an observation site, will be random. A minimum of 500 identifiable prey items will be recorded at each of the two selected geographic areas. Foraging observations will be randomly distributed among vantage points within each study area. Compiled foraging data will be compared to the invertebrate data collected, particularly as it pertains to species composition and size class composition. Adult animals will be categorized as male, independent female or female with a pup. Juveniles will be identified as small dark-headed otters estimated to be less than 24 months of age. Dependent otters will be classified as such. Data will be collected only during daylight hours, during all tidal cycles. Tidal state will be recorded for all observation periods.
Foraging intensity: Shore-based scan samples will be collected from randomly selected sites within each study area. Scan samples will consist of 15 2-hour observation periods to determine the number and proportion of otters feeding within each area. Every 10 minutes throughout a 2-hour observation period, the total number of feeding and non-feeding otters, and the location of feeding otters within a prescribed area will be recorded. Opportunistic forage observations will be conducted throughout the scan period. The location of each otter at the time of observation will be mapped using range finding binoculars and/or natural or placed landmarks. The summary data for each observation period will include; 1) the mean number and proportion of feeding otters present 2) the total number of otter foraging minutes during the scan where an observation of 1 otter foraging at 1 scan time will equal 10 minutes of otter foraging time. (i.e. 3 separate otters observed foraging at 2 scan times = 1 otter foraging hour, or 1 otter observed foraging at 6 scan times = 1 otter foraging hour.) From the location of otters, the number of otters, and proportion of feeding otters a density of feeding otters/km$^2$ habitat type/daylight hour can be calculated.

**Availability of Subtidal Clams:** We will estimate abundance and size structure of existing subtidal clam populations in nearshore habitats of PWS. Taxa to be evaluated will include, but will not be limited to: *Saxidomus giganteus*, *Protothaca staminea*, *Tresus capax*, *Clinocardium* spp., *Mya* spp., *Macoma* spp., and *Serripes groenlandicus*.

Based on results of the sidescan sonar habitat survey conducted in 1995 (see 1996 NVP Annual Report), we will select the two most prominent unconsolidated substratum types as sample strata. Within each stratum in each study area (i.e., Montague Island and Knight Island) we will sample at two depths, 6 and 12 m, in five replicate sites chosen from within each of the defined strata. Site selection initially will be random, but arbitrary adjustments may be necessary to ensure that site environmental attributes (e.g., exposure, current velocity) are

comparable among the two study areas. A complete sample set will consist of 2 study areas x 2 strata x 5 sites x 2 depths = 40 samples.

Individual samples will be gathered by scuba divers. A temporary 50 m transect line will be placed at a pre-determined sample site. Individual sample frames (0.25 $m^2$ surface area) will be placed at random locations along the line and at random distances (5 m maximum) from the line. Numbers of frames sampled will be determined on the basis of preliminary studies. For obvious clams within each frame, calibrated rods will be placed in siphon holes to determine depth of individual clams below the sediment surface. Each sample will include a small sediment core taken prior to suction for subsequent determination of grain size distribution and organic carbon content. Each frame will be cleared by suction to a depth of at least 50 cm. The depth will be adjusted as necessary, based on preliminary sampling and rod probing, to ensure collection of all large clams within the frame. Suction will be done with a venturi dredge, with output filtered through a bag with mesh of approximately 0.5 cm. Bags will be brought to the surface and live clams will be sorted by hand from debris. Clams will be sorted by species and measured (maximum shell length, to nearest mm) with machinist's Vernier calipers. Clam count and size data will be recorded on standardized pre-printed data sheets. Clam data will be analyzed by species to determine mean and variance of density and size per site. Based on results of tests for normal distribution, mean density and size will be compared among replicate sites within study areas, and between study areas, using an appropriate parametric or nonparametric analysis of variance. Clam size data also will be analyzed with an appropriate cohort analysis to determine interannual variation in recruitment intensity.

We will determine the rate and pattern of recruitment to natural substrata in study sites as indicated above. We will use small diver-deployed coring devices to sample for newly-settled clams. Cores will be approximately 0.01 - 0.02 $m^2$ in surface area, sampling to a depth of 10-20 cm. Individual cores will be located in the same way as sampling frames for suction samples. Cores will be capped with fine mesh screening and inserted gently, by hand, to minimize loss of organisms due to surface disturbance. Once in place, cores will be contained and extracted, carried to a surface vessel, washed through a 0.5 mm screen, and retained materials stained and preserved for laboratory sorting. In the laboratory, samples will be sorted for juvenile clams and specimens identified. Density data by taxon will be compared within and among study areas in a manner analogous to suction samples, described above. An appropriate time series technique will be employed to assess interannual differences in recruitment intensity.

**Availability of Intertidal Clams:** Information collected during previous intertidal studies in Prince William Sound (e.g., Houghton et al. 1993) and our reconnaissance surveys there in 1995 was used to formulate the sampling strategy for 1996-98. The hard-shelled, littleneck clam Protothaca staminea is the target species. Twenty-four randomly selected 100-m long sites will be sampled during a 9-day low-tide series in June and July 1997; 12 sites will be located in the oiled Bay of Isles and 12 along the unoiled portion of western Montague Island. These sites represent approximately one-third of the clam habitat in each area. Five 0.25 $m^2$ replicate quadrats will be sampled at each site to a sediment depth of 10 cm. All sediment will be washed through a series of screens and all clams will be returned to the

University of Alaska Fairbanks for counting and sizing. Clam density and size structure will be compared between areas.

**Availability of Sea Urchins and Crabs:** General design criteria for sea urchins: While we suspect that the majority of the urchin population in our study area occurs in aggregations, we are not certain of this and need to conduct a rigorous random sampling of the region in order to estimate overall population densities. Furthermore, because of the highly clumped nature of sea urchin populations, we will need to sample relatively large areas to help us locate aggregations of sea urchins. Therefore, we propose a staged sampling program designed to randomly sample the study areas, find aggregations, and then sample these aggregations more intensively. The initial stage of sampling will be a stratified random sampling, with strata defined as deep subtidal, shallow subtidal, and intertidal. This will be followed by intensive sampling of urchins within areas where aggregations were observed, and within "preferred" intertidal sea urchin habitats.

Initial stage stratified random sampling: Thirty sampling sites were selected from within each of two areas (Montague and Knight Island). The sites were 100 m long stretches of coastline that equally spaced along the shoreline. The starting position for the first transect at each site was selected at random.

We will sample along three randomly placed 50-m long transects at each site: One between + 0.5 and - 0.5 m, one between - 0.5 and -5 m, and one between - 5 and - 10 m. Transects will run roughly parallel to shore, along a selected depth contour. We will count and collect all urchins within a 0.5 m wide band along each transect. If the number of urchins on a given transect exceeds 10 per transect, then a complete census of the transect will be replaced with sampling within 10 randomly placed 0.25 $m^2$ quadrats. The quadrat position will be at a random point between 0 and 0.45 m along the tape, and at 5 m intervals thereafter.

At the start of each transect, we will note the substrate type, slope, vegetation type, and exposure. Substrate type will be determined by noting the general type (sand, mud, cobble, rock) in a 1 $m^2$ area at the start of the transect. In cases where there is cobble, the average, minimum and maximum sizes of cobble within the quadrat will be noted. Slope will be determined by visual estimation of the terrain and divided into three categories: High = $\geq$ 30°, moderate (between 15 and 30°) and low ($<$ 15°). Vegetation will be the dominant species of seaweeds or eelgrass within the quadrat. Exposure will be classified as sheltered, moderate or exposed based on *a priori* determination from navigation charts. Notes will be made as to changes in substrate type or vegetation along the transect.

All urchins collected from transects will be returned to the boat and the test diameter of each urchin will be measured. Measurements will be made to the nearest mm using a vernier caliper. After being measured, the first 5 urchins collected from each site will be frozen for future hydrocarbon analysis. Others will be returned to the approximate location from which they were collected.

Second stage sampling: At each of two to four sites within each area that are designated as "preferred intertidal habitat," and at each location where we observed greater than ten urchins in our stratified random sampling, we will conduct more intensive sampling efforts. The four "selected" sites per areas will be chosen at random from a list of sites developed based on census of shoreline habitat in each area.

In the intertidal zone at each site, we will first map the boundaries of the shoreline at +0.5 m, 0 m, and -0.5 m tidal levels. This will be done by staking out the shoreline at the time corresponding to the predicted tidal level and then obtaining GPS coordinates for the positions of each stake. Next, we will map the boundaries of the area inhabited by urchins. The positions of boundaries will be staked and coordinates for each stake will be noted using GPS. We will place a stake at the perceived center of the habitat. From this stake, we will estimate the distance from the center to the boundary along each of 6 different compass courses. The initial course will be determined by multiplying a random proportion by 60. The second course will be 60 degrees from the first, etc.

Twelve random sampling sites will be selected from the transects. The urchins from within each quadrat will be collected and placed into pre-labeled buckets with sea water. These will be taken back to the boat where they will be measured and counted. We will take a video of the entire site, and a close up of each quadrat. In addition, a sample of the sediment underlying rocks will be taken from each odd numbered quadrat (in upper right hand corner).

In the subtidal zone adjacent to each intertidal site where we observed urchins, we will sample along two transects running perpendicular to shore. The transects will originate at 10 m to either side of the perceived center of the intertidal population, and run a total length of 50 m, or until we reach a depth of -10 m. We will count the number of urchins in quadrats placed at 2 m intervals along the transects. Depth, substrate type, slope, and vegetation type will be noted on each transect.

At locations where we note subtidal populations of sea urchins in our initial stratified random sampling, we will attempt to map the aggregations by sampling along a series of transects laid out in a grid over the bottom. The exact distribution of lines on the grid, and of sampling quadrats will be based on initial reconnaissance surveys at the site. The intensity of sampling (number and spacing of grid lines and sampling quadrats) will depend on our initial estimation of the size of the aggregation and sea urchin density. Urchins in one to two quadrats (one per depth stratum) will be tagged as described for intertidal populations.

Sampling of crabs (and dominant sea stars): Crabs and dominant sea stars will be counted in a 1-m wide swath on transects used for stratified random sampling of sea urchins. The entire 50-m length of each transect will be sampled regardless of whether urchins are sampled over the entire length.

**Availability of Mussels:** Within the Montague and Knight Island study areas mussel abundance will be estimated using stratified random sampling with optimal allocation. Each length of coast will be initially divided into two strata based on shoreline type: 1) rocky

(including bedrock and boulder) and 2) unconsolidated or mixed substrates (including various mixtures of sand, granules, pebbles and cobbles). Eighty shoreline segments 200 m long will be sampled in each study area. The shoreline segments will be sampled systematically. Within each shoreline segment a transect will be laid perpendicular to shore at 20 m intervals along the shore. The transect will span the mussel zone. Mussel densities will be estimated using 500 $cm^2$ quadrats. The quadrats will be placed randomly along each transect. The mussels in each quadrat will be collected and subsequently washed over a series of sieves ranging in mesh size from 4 to 0.5 mm. The mussels collected from each quadrat will be placed in plastic bags and frozen for subsequent processing in the laboratory.

In the laboratory the mussels collected from each quadrat will be counted and the maximum shell length of each mussel will be measured to the nearest 0.1 mm with a digital caliper that communicates with a data logger. Lengths of smaller mussels (<6 mm) will be obtained with an image analysis system. Mussels will be dried at 60 C and weighed at 24 h intervals to the nearest 0.001 g on a precision balance. This procedure will continue until mussel weights have stabilized. Subsequently, mussel tissue will be digested in 10% potassium hydroxide and the remaining shell dried to a constant weight. Tissue dry weight will be obtained by subtracting shell dry weight from mussel dry weight.

If differences in the size-frequency distributions of mussels are observed between areas then individual mussels from each stratum in each area will be tagged to measure growth. Mussel lengths will be measured with a digital caliper, tagged with small numbered disks and released at intervals of four months. Tagged individuals will be retrieved at the end of each four month period and length will be measured. The growth study will begin in spring 1997.

Analysis of variance will be used to compare mussel abundances between study areas. A nonparametric ANOVA will be substituted if the data do not meet the assumptions of the parametric anova and standard transformations do not normalize the data and stabilize variance. Size-frequency distributions will be compared using the chi-square statistic after decomposition of the distributions to be compared into subpopulational nodes. Growth curves of mussels will be compared using analysis of covariance following curvilinear regression.

**Predation on Bivalves by Avian Copredators.**--Sea otter and several marine avian groups (e.g. sea ducks, shorebirds, and gulls) may overlap broadly in their diets, especially with respect to bivalves. To assess predation pressure of these potential copredators on populations of selected bivalves (mussels and sub- and inter-tidal clams) and possible confounding effects on interpretation of sea otter effects, models including diet, bird numbers, and estimates of caloric needs will be derived to estimate numbers, biomass, and size classes of invertebrate prey. In concert with data documenting invertebrate prey abundance and size class and sea otter diets, we can determine the extent of structuring by this predation and its potential confusion with sea otter structuring. In FY 96, a general assessment of the abundance, distribution, and approximate consumption of prey relative to this copredator issue will be conducted. If that assessment indicates that the avian copredator issue remains a valid one, then in FY 97, the following work will be proposed to refine the impacts of avian copredators on the sea otter trophic hypothesis.

In 1997, diets of Barrow's goldeneyes, glaucous-winged gulls, mew gulls, surfbirds, and surf scoters will be determined by collecting birds on the invertebrate study sites. Approximately 50 Barrow's goldeneyes will be collected during two periods during winter (November and February). Up to 20 birds of all other species will be taken in spring at Montague Island only. Birds will be shot from foraging flocks. Immediately after collection, the esophagus, proventriculus, and gizzard will be tied off separately, removed as a unit, and injected with alcohol to halt digestion. Samples will be removed from the digestive tract the same day and stored in alcohol. Diet analysis will consist of sorting and identifying samples and quantifying: length, width, and wet mass of each item and wet mass, volume, and dry mass of each taxa per sample. Based on the results of the 1996 field season to assess the timing, abundance, and distribution of other avian predators, some take of other species may be appropriate.

In winter, we will conduct surveys of sea ducks and other target avian copredators within the Knight and Montague Island study sites in November and February; the number of replicates per period will be weather dependent. Two observers will conduct the counts in a skiff following standard boat survey methods for marine birds. Methods will be consistent with those used by Klosiewski and Laing (1994) and Agler et al. (1994). During counts, observers will collect information on species, number, and location of all ducks observed. Surveys to target the spring influx of shorebirds will be conducted from mid-April to late May, and again in July. Surveys will be conducted every other day at Montague, twice weekly at Bay of Isles and weekly at Herring Bay.

Foraging behavior of *Mytilus* and sea urchin predators in relation to *Mytilus* and sea urchin abundance and distribution across the intertidal zone will be determined using focal animal and scan observations. Observations will be made at invertebrate sampling sites at Montague and Bay of Isles during both the spring and summer field season. Plots 100 x 100m will extend shoreward from the tideline 50m and out from the tideline 50m. Scan observations will be made every one-half hour over a six hour period. In between scan samples, a 2-minute focal animal sample will be used to gather information on food intake rates and mussel sizes captured. Prey items will be identified to species when possible and mode of consuming prey (e.g., ingested whole, extracted) also will be recorded.

If 1996 trial exclosure experiments are successful, we will directly assess the impacts of avian predator and sea otter on mussel and sea urchin density and size distribution using exclosures in experiments from early April through September at Montague Island and Bay of Isles. Two types of cage treatment will be used to separate the seasonal effects of sea otter predation from avian predation, with a third treatment consisting as an uncaged treatment. Treatments will be arranged in blocks containing all three treatments, located at the same tidal elevation, and separated by 2m. At both Montague Island and Bay of Isles, a total of 25 replicate blocks will be placed in avian foraging habitats previously sampled by the mussel and sea urchin components. Mussel and sea urchin size and densities will be determined within each exclosure immediately after placement and prior to each treatment's removal. Exclosures will be checked bi-monthly.

*Specific Methods for Harlequin Ducks.--*

**Capture:** Several aspects of the harlequin research require capture of birds. Harlequin ducks, like nearly all Anatids, molt their wing feathers (primaries and secondaries) simultaneously, rendering them flightless. During the molt, harlequin ducks congregate and are susceptible to capture by herding flocks of flightless birds into pens. This method will be employed to capture harlequin ducks for this study.

Capture methods follow those used successfully by researchers in British Columbia and Washington, and by this project in fall 1995. Sea kayaks will be used to slowly herd molting flocks towards a trap. The trap consists of two 100' wings which lead birds into a holding pen in shallow water. The trap location will be noted daily on marine navigation charts.

Chronology of harlequin duck molt differs among age and sex cohorts, with males generally molting earlier than females. Period of duck capture should maximize capture of adult females, which molt from late August through late September.

Captured harlequin ducks will be removed from the trap, separated by gender, placed in holding pens, and transported by boat to the main vessel for processing. Birds will be banded with USFWS aluminum bands and with individually coded plastic tarsus bands (orange with white letters), as part of a cooperative effort with the Alaska Department of Fish and Game (ADFG). Sex will be identified based on plumage characteristics and age will be determined by bursal probing. Adults do not have a bursa; SY birds will be distinguished from third year subadults by the depth of the bursa (SY bursa $>$ 2 cm; TY bursa $<$ 1 cm). All birds will be weighed and culmen, diagonal tarsus, and wing length (flattened, straightened, to longest primary) will be measured.

**Adult Female Winter Survival:** Winter survival rates of adult female harlequin ducks will be assessed using radio telemetry. Variation in adult female survival is particularly influential on population growth rates and, thus, it is critical to assess to understand population recovery.

A total of 100 birds will be radioed, with approximately 50 each in oiled and unoiled study sites. We will use implantable radio transmitters with external antennas. Radios will be programed to transmit for at least 210 days and will weigh approximately 15g, which is $\leq 3\%$ of the body weight of the smallest molting female harlequin duck. Transmitters will be equipped with temperature sensitive mortality switches; pulse rate will change from 45 to 90 beats per minute when the transmitter temperature drops below 85 degrees F. Range from ground to air will exceed 20 km.

Transmitters will be implanted in the body cavity with an external antenna protruding from the lower back. Implanted transmitters have been successfully used in waterfowl studies and are less disruptive than backpack transmitters, especially for diving ducks. Surgeries will be conducted by certified veterinarians experienced in avian implant surgeries, following procedures outlined in the Alaska Science Center, NBS standard operating protocol.

Radio telemetry flights will be conducted weekly through winter. Flights will detect each marked individual and note status and general location. For birds indicated as dead, more exact locations will be determined to facilitate carcass recovery by boat or float plane as soon as possible. Data will be analyzed using a Kaplan-Meier staggered entry design (Pollock et al. 1989). Effects of oiling history and health measures (e.g., condition) will be examined with log-rank tests.

**Distribution and Abundance:** Results from winter 95/96 surveys demonstrate differences in density among and within study sites. Presumably, harlequin duck distribution should be related to oiling history and/or food abundance if these are having an effect. The effects of the oil spill may be expressed as either direct toxic effects ("is it oil?") or a reduction in benthic invertebrate abundance ("is it food?") or an interaction of both. Confounding this approach, physical habitat parameters also may influence harlequin duck distribution. This objective is designed to determine factors that explain harlequin distribution and abundance during winter. Survey data will be used in an analysis that incorporates the effects of food abundance, oiling history, physical habitat, and their interactions on harlequin distribution.

We will conduct surveys to estimate harlequin duck numbers and map distribution. These surveys also will be used to estimate numbers of other sea ducks to estimate copredation of sea otter invertebrate prey (see avian copredator section). We will use 2 skiffs, a 17 ft. Boston Whaler and a 16 ft. inflatable Zodiac, for survey craft. Surveys will include a census of all shoreline areas (<200 m from shore) and a systematic line-transect survey of offshore waters within each study area. We will count all birds and mammals within the space extending 100m each side, 100m ahead of, and 100m above the boat. For shoreline transects, we will map the number, location, and age and sex ratios of harlequin ducks on mylar overlays of aerial photos. Offshore transects will be spaced at 0.5 km. We will use GPS to navigate transects and will record all observations (for all species) on tape.

Counts for the shoreline stratum will represent a complete census of birds within 200 m of shore. For offshore transects, we will use a ratio estimator to expand mean densities of birds to unsurveyed offshore areas within each site. Variance for estimates of abundance will be calculated as the sum of the variance of the means for shoreline and offshore strata for all replicate surveys.

**Body Condition Variation:** Body condition assessment relies on the derivation of a statistical model that predicts body composition (lipid and protein levels) using morphological measures, body weight, and measures of total electrical body conductivity (TOBEC). Derivation of condition indices will occur after collection of a reference sample of 25 molting harlequin ducks from Kodiak Island in 1996. The best fitting predictive model will be applied to estimate body composition of all captured harlequin ducks, allowing an accurate and nonlethal assessment of body condition.

Morphology and body weight of captured harlequin ducks will be measured as described above. TOBEC readings will be taken following procedures outlined in the operators manual. Each bird will be passed through the TOBEC analyzer six times to insure an accurate reading.

Birds will be restrained with a velcro straps to insure a common position for all birds during analysis.

Because there may be an intrinsic change in body composition through the molting period, i.e., body condition may be tied to stage of molt as well as exposure to contaminants, we will compare regression models across oiling treatments. Stage of molt will be indexed by primary length. Linear models describing body condition variation through molt will be derived; slopes and intercepts will be compared between oiled and unoiled areas for each age and sex cohort.

**Biosample Collection:** Blood (3 cc) will be drawn from the jugulars of 100 adult female harlequin ducks. Two samples of whole blood will be taken immediately from the syringe in hematocrit tubes, and refrigerated; these samples will be shipped to the lab as soon as possible. Three whole blood smears will be created. Two blood smears will be sent to the blood lab and another will be stored and forwarded to Purdue following the field season. Three to four drops of blood will be placed in a snaptop tube with buffer for genetic analysis. Remaining blood in the syringe will be placed in a vacutainer containing heparin anticoagulant. The blood will be centrifuged to separate plasma and blood cells. Plasma will be distributed into 4 snaptop tubes: one (at least 200 microliters) for the blood lab, one for protein electrophoresis and immune function work at Purdue, one for haptoglobin and interleukin-6 analysis at UAF, and one to be archived for auxiliary analyses. Plasma for the blood lab will be refrigerated and shipped as soon as possible and all other plasma will be frozen. Remaining red blood cells will be frozen. All samples will be labeled with the unique metal band number.

Oil exposure will be evaluated through examination of cytochrome P450-1A's, enzymes that are specific indicators of exposure to aromatic hydrocarbons. Foot web biopsies will be taken from female harlequin ducks undergoing surgeries for radio implants. Tissue samples will be preserved in 10% neutral buffered formalin solution immediately upon collection. All samples will be analyzed at Woods Hole laboratory.

Presence of external oil will be determined with ELISA assays. Plumage will be sampled from the 100 females implanted with radios for survival analysis. A one-ply section of 4x4 gauze will be saturated with 4 ml of isopropanol and applied to the plumage for 15 seconds. Samples will be wrapped in aluminum foil and frozen for later analysis.

**Harlequin Duck Prey Abundance:** Vegetation and airlift samples will be taken from randomly selected sites at each of either two or three locations (Montague Island, Bay of Isles, and possibly Green Island) to determine the relative abundance of preferred harlequin duck prey at each site. In addition, these data will be used as input for a habitat utilization model that identifies habitat features that determine local abundance of harlequin ducks.

The primary prey items for harlequin ducks are epifaunal bivalves and gastropods. Studies of the diets of harlequin ducks in Prince William Sound indicate that the most frequently encountered prey in the guts of harlequins are littorine snails, lacunid snails, chitons, limpets,

and mussels (*Mytilus trossulus*). Herring eggs were also found to be important, but these are only available seasonally. Another mussel (*Musculus* spp) was found only occasionally in their guts. However, this is very abundant on eelgrass blades at certain sites in the Sound, and we suspect that it may be a locally important food source for harlequins.

The predominant prey items are among the dominant taxa in the lower intertidal and shallow subtidal zone in Prince William Sound. Our preliminary surveys in the shallow subtidal, along with data from the intertidal zone (Highsmith et al 1995) indicate that the major prey items are commonly encountered in the intertidal and shallow subtidal zones. *Mytilus* and littorines are common in the lower intertidal while chitons, limpets, and lacunid snails are more abundant subtidally. We suspect that the ducks feed in relatively shallow water, and move up and down the shoreline as the tide rises and falls.

The areas selected for study include two or three 25 km sections of coastline; one in Bay of Isles, one on Montague Island, and possibly a third site on Green Island. Inclusion of the Green Island site depends on assessment of harlequin duck distribution data gathered in winter 1995-1996, and on consideration of data needs for modeling efforts.

We will sample at 15 sites within each area. These will be selected by dividing the coastline into approximately 250 contiguous 100-m segments, selecting one of the first 16 segments at random, and then sampling at this and 14 other segments that are equally spaced along the shoreline (about 1600 m apart). At Bay of Isles and Montague, these will be the same sites as sampled for sea urchins, and will be a subset of sites that are to be sampled for intertidal mussels.

At each site, we will extend two transects running perpendicular to shore, from +0.5 m to -2.5 m depths. These will be offshore extensions of two transects used for the sampling of intertidal mussels. We will sample from within 5 - 0.25 $m^2$ quadrats on each transect. The quadrats will be placed at equally spaced positions along each transect.

Divers will collect all algae and eelgrass from each quadrat and place it in a small mesh bag (pre-labeled). The divers will then scrape all visible epifauna from the substrate and suck these into a small mesh bag using an airlift.

The samples will be preserved and returned to the laboratory where they will be sorted. All dominant prey taxa (*Mytilus, musculus*, limpets, chitons, lacunid snails, and littorines), within each of 4 size classes (less than 0.5 cm, 0.5 to 1.49 cm, 1.5 to 2.49 cm, 2.5 to 3.49 cm, and equal to or greater than 3.5 cm) will be counted. All identifications will be made to this taxonomic level only. The dry weight of each taxon will determined.

***Specific Methods for Pigeon Guillemots.--***

**Indices of Abundance and Health:** Field studies will be conducted during the breeding seasons in PWS. Fifty active and accessible nests will be located and marked during early incubation at the oiled (Naked Island) and unoiled (Jackpot Island/Icy Bay) study area in each of the three breeding seasons. Field work will be coordinated with on-going U.S. Fish

and Wildlife Service studies of factors limiting recovery of pigeon guillemots in PWS (D. Lindsey Hayes, PI), as part of APEX (97163). Active and accessible nests will be closely monitored until the young fledge or the nesting attempt fails.

An attempt will be made to locate, identify, and map all active guillemot nest sites on Jackpot Island and on the western and northern shores of Naked Island. Active nest sites will be identified during the chick-rearing periods (regardless of whether the nest site is inaccessible) because active nest sites can be readily identified by the presence of adults transporting fish in their bills. Trends in the numbers of active nest sites, as well as nest site and colony abandonment rated, will serve as indices to population trends at each study area. Differences in trends of numbers of breeding pigeon guillemots at unoiled (Jackpot Island) and oiled (Naked Island) areas will be used as a demographic indicator of potential effects of the spill. In addition, guillemot adults that are captured at active nests for blood sample collection will be banded with USFWS leg bands for future identification. Pigeon guillemots are highly philopatric and usually return to breed in the same nest crevice each year, or one in close proximity. Consequently, mark-recapture rates can be used to estimate adult survivorship at the two study areas.

Differences in reproductive success at the unoiled and oiled areas will be measured as several components: 1) the proportion of breeding age birds that produce a clutch, 2) size of clutches (one or two eggs), 3) the proportion of laid eggs that successfully hatch, 4) the proportion of chicks that successfully fledge, and 5) the proportion of fledged young that survive the post-fledging period. Variables (1) and (5) are extremely difficult to measure, although fledgling body fat reserves can be used as an index to post-fledgling survival. Variables (2), (3), and (4) can be estimated in an unbiased manner (by employing the Mayfield method), if active nests are checked regularly after they are found. Active and accessible guillemot nests will be checked every four days during incubation to determine status, every other day during the hatching period to determine hatching success, and every four days during the nestling period to determine nestling survival rates and to weigh and measure chicks for monitoring growth and development. The following parameters will be measured at accessible nests as indices of parent-offspring condition: 1) growth rates of body mass, wing length, and primary feathers in nestlings, 2) accumulation of fat reserves in fledglings, 3) total mass (corrected for body size) and body composition of adults during the chick-brooding period, and 4) fledging age and body mass. Clutch size hatching success, fledging success, and overall reproductive success will be compared between the oiled and unoiled study areas. Recent work on pigeon guillemots nesting on Naked and Jackpot islands (D. L. Hayes, unpubl. data) ensures that an adequate sample size of guillemot nests will be found shortly after laying.

Data on age-specific body mass, wing length, and primary feather length of nestlings will be separated by year and study area, and fit to Gompertz sigmoidal growth models. Growth constants (K), inflection points (I), and asymptotes (A) of fitted curves will be statistically analyzed for significant differences among years and study areas.

To more accurately assess the health of individuals and potential effects of oil exposure, we will collect blood from guillemots at the oiled and unoiled study areas. We will use blood

sampled from nestlings and adults to determine levels of acute phase blood proteins, such as haptoglobin, albumin, and metalothionine, that are indicative of exposure and tissue damage. We also will measure cytokines and liver enzymes. We will supplement our blood molecular work with cellular studies, such as red cell volume, hematocrits, and immune functions. Differences in biomarker levels of blood collected from oiled and unoiled areas will be used to evaluate the effects of the spill on contaminant levels in the food supply.

Blood samples (1 ml) from guillemot nestlings will be collected by brachial vein puncture at ages 20 and 30 days post-hatch (guillemot chicks normally fledge at 30-40 days post-hatch). Blood samples will be collected in heparinized tuberculin syringes, transferred to Eppendorf centrifuge tubes for transport to the base camp, and centrifuged to separate plasma and cells. Plasma and cells will be frozen separately in propane freezers at the base camps. In the lab, plasma and blood cell samples will be analyzed for molecular and cellular biomarkers (e.g., characteristic morphological lesions of red blood cells associated with hemolytic anemia caused by oil ingestion [Leighton 1985]). Hematology and serum chemistry will be performed by a commercial lab specializing in avian samples. If volumes collected permit, we also will perform haptoglobin, IL-6 and immunoglobin typing assays. Results from biomarker studies will be used to test biostatistical models that predict population health.

The impact of potential contaminant exposure on breeding adults will be monitored using a combination of direct and indirect methods. Attentiveness of adults will be monitored during the incubation period. Frequency of chick meal delivery and meal size will be determined during the chick rearing period by a combination of monitoring adult nest visitation rates and periodic weighing of chicks. Individual variation in exposure of adults (and nestlings) to petroleum hydrocarbons will be monitored by periodically collecting food samples from adults as they return to the nest site to feed nestlings and by collecting prey samples at sea. In the lab, samples of nestling food will be analyzed to determine levels of aliphatic and aromatic hydrocarbon fractions using a latroscan MK-5 TLC/FID Analyzer System. During the chick-brooding period (0-7 days post hatch), adult guillemots will be captured in the nest crevice, banded for later identification, and blood samples (1 ml) collected from the brachial vein. Blood samples will be analyzed for molecular and cellular biomarkers of contaminant exposure using the same techniques applied to nestling blood samples. These measurements will allow us to monitor the impact of various levels of contaminant exposure on physiological condition of nestlings and foraging efficiency of adults.

**Prey Abundance:**

Demersal Fish: Demersal fishes will be sampled at approximately 32 sites at Herring Bay, 32 sites in the Jackpot area, and 16 sites in Naked Island area. We will sample at randomly selected sites which will be selected as follows.

1. Divide the coastline within each area into segments 500 m in length. Include the shorelines of major islands which are included within existing GIS shoreline coverages. Note that a segment may include shorelines from several adjacent islands.
2. Label each 500-m long segment with a number.
3. Randomly select 32 segments from Herring and Jackpot, and 16 from Naked.

4. Multiply a random proportion by 480 m to establish a random starting point within each site.

At each site, we will count the number of benthic fishes on two transects running perpendicular to shore. The transects will begin at the shoreline, and extend a distance of 30 m. In cases where the shoreline is extremely steep, the transects will be cut short, and dives will be limited to depths of 15 m. A diver will enter the water at the randomly selected starting point along the shore. The approximate position will be located using a differentially corrected GPS. The diver will swim a 30-m tape directly offshore. The diver will then run a course approximately 90 degrees to the left (while facing offshore) , and will swim along the depth contour for 40 kicks. The diver will then swim a second tape directly inshore until she/he hits the shoreline. This diver will count fish in the water column over a 2 m wide swath along the bottom. A second diver will follow the first and will count all benthic (demersal) fishes along a 1 m wide swath on each transect. Algae or other vegetation will be moved aside to count fishes hiding beneath, but no rocks will be turned. The fish counted will be divided into three size classes: $<$ 8 cm; 8 - 15 cm; and $>$ 15 cm. Fish will be identified to the family level.

Along each transect, Diver 2 will note the dominant vegetation type and the dominant substrate type. Diver 1 will also note the depth at 30 m from shore, or in cases where the depth exceeds 15 m, the distance from shore that the 15 m depth was observed. The substrate types will be classified as boulder, cobble, gravel, or sand/mud. Vegetation will be classified according the dominant algal taxa.

At the completion of his/her dive, Diver 1 will continue to swim approximately 20 m to the left (while facing shore) and attempt to spear any fish within the area, focusing on sculpins and gunnels. The diver will search and spearfish for 5 minutes. All fish collected will be returned to the boat, placed on ice, and (as soon as possible) frozen for possible hydrocarbon analysis. The collection of additional specimens may be required in order to obtain sufficient sample sizes for analysis. If so, selected sites will be revisited at the completion of the random sampling effort and additional fish will be collected.

If a depth of 15 m is not attained within the 30 m long transect, the sampling crew will obtain a position for this contour using a fathometer and GPS. The crew will run a small boat with a fathometer directly offshore of the sampling site until the 15 m depth is obtained, and will note the position of this location.

This sampling will be conducted between July 16 and July 26, using 2 teams of 3 divers. Two divers will sample approximately 4 sites per day on average. The third diver will tend. Divers will dive no more than two consecutive days.

The average density of each size class and family of fish in each area will be computed. We will test for differences between areas using a t-test, with the average density from two replicate transects at each site as variates. The extent of accessible habitat within each area will be determined by multiplying the average distance from shore to the 15 m depth contour

within each area times the extent of shoreline within the area (defined as 50,000 m). The total abundance of fish within each area will be determined as the product of the average density and the areal extent of potential habitat within each area. We may also wish to break out the abundance of fish by habitat, based on habitat characteristics determined for each transect and sampling site, if the data permit. We will compute the average size of fish from randomly sampled sites within each area. The differences in size distributions of fish between areas will be determined using a categorical analysis. Fish will be divided into the three size classes (< 8, 8 - 15, and > 15 cm) and the proportion of fish in each size class determined.

Schooling Fish: The sampling of abundance and size distribution of schooling fishes will be conducted using aerial surveys, visual surveys from a boat, and acoustic methods. Most of this work will be conducted by cooperating investigators in the SEA and Forage Fish programs. We will assist these efforts by conducting "ground truth" data on fish species and abundance.

The data from these surveys will be used to provide an index of availability of schooling fishes to pigeon guillemots.

*Specific Methods for River Otters.--*

**Latrine Site Characteristics and Density:** We will conduct searches of shorelines using the methods described in detail by Bowyer et al. (1994, 1995). Latrine sites will be characterized with respect to their topography, terrestrial vegetation, intertidal substrate, exposure to wave action and distance from freshwater. Vegetation and intertidal substrate will be assessed for a 10-m arc with its pivotal point at mean high tide and extending in the appropriate direction (shore or ocean). This point will be aligned with the most obvious entrance to the latrine site. Relative cover of vegetation will be estimated visually; any category that does not compose 25% of the supratidal portion of the 10-m arc will be scored as 0. More abundant vegetational types will be assigned a rank of 1 to 4 (1 = 25%, 2 = 50%, 3 = 75%, 4 = 100% cover). Vegetated slopes will be measured from a point at mean high tide to a point 10-m distant toward the latrine site with a hand-held compass (nearest 5°). The tidal slope will be measured similarly from mean high tide to a point extending 10 m into the intertidal zone. Tidal state will be noted so that measurements can be corrected if necessary. The aspect of the latrine site will be recorded in eight compass quadrants, and exposure to wave action ranked into three broad categories from protected to exposed.

**Morphometrics:** Otters will be captured in 1997 using Hancock live traps and 11 & ½ Sleepy Creek leghold traps placed on trails at latrine sites and monitored by means of trap transmitters that signals when a trap has been sprung. All otters will be processed at the site of capture. The otters in Hancock traps will be immobilized in the trap with a hand injection of telazol. Anesthetic darts issued from a blow gun will be used to immobilize otters captured in leghold traps. Weights and measurements (see Duffy et al. 1993) will be taken and the blood sample drawn from the jugular vein. Sexes will be distinguished by the relative position of urogenital openings and palpation of the baculum (Larson 1984). Age determinations will be based on tooth wear and overall size of otters (Stephenson 1977).

**Biomarkers of Health and Cytochrome P450 Induction**: During the past 15 years, xenobiotics have been shown to alter immune function (Fowles et al. 1993). Environmental chemicals interact with various parts of this complex system resulting in either suppression or hypersensitivity of immune activity and surveillance. A panel of biomarkers, including leukocyte counts, macrophage function, electrophoretic measurements of serum immunoglobins, and ELISA assays of interleukins will provide data on the health status of organisms and permit comparison of species. Cytochrome P450 levels will be assayed as described in the *General Methods* section, above.

We will perform haptoglobin assays, IL-1 and IL-6 assays and immunoglobin typing assays on the blood samples. Hematologies and clinical chemistries will be performed by NBS contracted lab and macrophage function assays will be developed. We will examine porphyrin levels in fecal samples, as well as PAH's on the animals (pelage swabs) and in fecal samples.

The following biomarker analyses will be performed on the samples (Fossi and Leonzio 1993): blood plasma protein and liver enzymes, cell counts and Heinz bodies, and interleukin levels. Haptoglobins, IL-6, and several blood enzymes have been used successfully as biomarkers for river otters (Duffy et al. 1993, 1994a, 1994b). We will continue using this productive approach.

**Prey Abundance:** Surveys to examine abundance and health of river otter forage fishes will be conducted as described earlier.

***Publication of Previous Research.--***
**Sea Otter:** Three publications on post-spill status of sea otters in PWS will be completed during FY 97; all 3 focus on health and/or survival of sea otters and thus pertain directly to the interpretation of data that will be collected in 1997-98 as part of the NVP:

**Title:** Herpes virus in sea otter populations: Incidence and prevalence.
**Authors:** B. Ballachey, NBS; K. Harris; Armed Forces Institute of Pathology; others.
**Background:** The release of sea otters treated at rehabilitation centers after the oil spill engendered concerns about the introduction of diseases into wild sea otter populations. At the centers, sea otters were found to have oral lesions, later identified to be caused by a herpes virus. Prior to the release, sea otters in the wild were examined and also found to show evidence of similar lesions; on this basis, release of rehabilitated animals proceeded. Nevertheless, there has been continuing controversy over the question of disease transmission to wild sea otter populations. Subsequently, sea otter populations from WA state to the Aleutians have been examined by NBS researchers; evidence of the herpes virus has been found in all populations, confirming the existence of the disease in wild populations prior to the spill. In addition, viral DNA has been isolated from oral biopsies and the viral agent was confirmed to be herpes.
**Required:** Data analysis, manuscript preparation.

**Title:** Hematology and serum chemistry of sea otters in Prince William Sound.

**Authors:** B. E. Ballachey, A.H. Rebar.
**Background:** As part of a study on post-spill juvenile sea otter survival conducted in 1992-93, blood samples were collected from adult sea otters and pups in eastern and western PWS. Preliminary examination of these data demonstrate some significant differences in white blood cells (eosinophils, basophils) and serum enzymes (AST, GGT) between eastern (unoiled) and western (oiled) areas. Additionally, blood data collected on sea otters in PWS by NBS researchers in 1990 and 1991 is available, and some consistencies are seen when cross year comparisons are made.
We propose to summarize hematology and clinical chemistry data from sea otters captured in PWS between 1990-1992, and discuss differences in consideration of potential effects of oil exposure. Analysis of these data and preparation of this manuscript is particularly important as it will provide a basis for comparison of blood values to be obtained on sea otters as part of the NVP project.
**Required:** Additional data analyses, manuscript preparation.

**Title:** Survival of juvenile sea otters in Prince William Sound
**Authors:** B.E. Ballachey, N.J. Goodson, A.M. Doroff and J.L. Bodkin
**Background:** Survival rates of juvenile sea otters in eastern (unoiled) and western (oiled) PWS were estimated in 1992-93, by radiotelemetry of sea otter pups in the two areas. Pups were monitored through 1.5 years of age. Pups in unoiled areas were found to have higher survival rates. An initial draft of this manuscript has been prepared; however, further effort is required to incorporate additional data (including information on post-weaning movements of pups) and to finalize the manuscript for journal submission.
**Required:** Additional data analysis, manuscript revision.

## C. Cooperating Agencies, Contracts and Other Agency Assistance

The NVP project is a collaborative research project of scientists from a variety of Federal, State, university, and private research centers. Trustee agencies include the National Biological Service whose responsibilities include lead agency, data archives and management, Chief Scientist, sea otter, harlequin duck, pigeon guillemot and various invertebrate components. In addition, NBS is responsible for the research work order that funds the river otter studies through the Alaska Cooperative Fish and Wildlife Research Unit at the University of Alaska Fairbanks, and contracts to Purdue University and Woods Hole Oceanographic Institute to assess health and oil exposure parameters. The USDA Forest Service scientist is responsible for a portion of the copredator/trophic factor aspect of NVP. Alaska Department of Fish and Game oversees contract research through the University of Alaska Fairbanks and Coastal Resources Associates, Inc. to provide the fisheries and intertidal invertebrate data. Finally, the NOAA scientist completes the research team, providing data on trophic factors constraining recovery of the top predators.

Various survey aircraft and vessels will be chartered from the private sector. Professional services contracts and Research Work Order mechanisms will be used to transfer funds from Trustee Agencies to university and private cooperators on the NVP project. These will include

contracts to Purdue University, University of Alaska, University of Washington, Oregon State University, Woods Hole Oceanographic Institute, Coastal Resources Associates, Inc. and others.

## SCHEDULE

### A. Measurable Project Tasks for FY 97

This project will continue its 1995 and 1996 work through 1998, with completion of data analyses and final reports in 1999.

FY 1997-1998

October:
1. Harlequin: Continue survival monitoring.
2. Sea otter: Aerial survey of western Prince William Sound.

November:
1. Harlequin: Continue survival monitoring, skiff surveys and collections of Barrow's goldeneyes.

December:
1. Harlequin: Continue survival monitoring.
2. *All project components: Submission of brief field season summary reports.*
3. *Project meeting to discuss field season outcomes and develop/revise proposed approach.*

January:
1. Harlequin: Continue survival monitoring.
2. Invertebrate predator: Complete sampling of all study sites
3. *Reporting of project findings at Restoration Workshop*
4. *Project Review with Trustee Chief Scientists and Reviewers*

February:
1. Harlequin: Continue survival monitoring, skiff surveys, and collections of Barrow's goldeneyes.

March:
1. Harlequin: Continue survival monitoring.

April:
1. River otter: Live trapping for morphometrics and tissue sampling.
2. Sea otter: Beach-cast carcass survey.
3. Avian co-predators: Boat surveys, collections and behavioral observations.
4. *FY 97 -- Submission of 1996 Progress Report.*
5. *FY 98 -- Submission of 1997 Progress Reports*

May:
1. River otter: Live trapping for morphometrics and tissue sampling.
2. Pigeon Guillemot: Active nest surveys.
3. Avian co-predators: Boat surveys, collections and behavioral observations.

June:
1. Pigeon Guillemot: Active nest surveys, blood sampling, prey sampling, and nest monitoring.
2. Sea Otter: Prey selection and foraging success.

July:
1. Pigeon Guillemot: Active nest surveys, blood sampling, prey sampling, and nest monitoring.

2. Sea otter: Aerial survey of Prince William Sound, capture for morphometrics and tissue collection. Prey selection and foraging success.
3. Mussel/clam/urchin/fish/duck food and invertebrate predators: Vessel charter to sample study areas.
4. Avian co-predators: Boat surveys and behavioral observations.

August: 1. River otter: Latrine sites located, sampled, and monitored.
2. Pigeon Guillemot: Active nest surveys, blood sampling, prey sampling, and nest monitoring.
3. Sea otter: Boat based surveys of sea otter reproduction.
4. Harlequin: Vessel charter for harlequin duck capture.

September: 1. Harlequin: FY 97 final year--Complete capture, continue survival monitoring through FY 98.

FY 1998

Oct-March: Final data analysis
April-Aug: Prepare final report
Sept 30: Submit draft final report

## B. Project Milestones and Endpoints

FY 95: Preliminary field season
FY 96: Full field season
FY 97: Full field season (see detailed schedule above)
FY 98: Full field season (see detailed schedule above)
FY 99: Closeout/Final data analyses and report submission

Major project objectives will be met following full analyses of data collected through FY 98. Specific questions (e.g., invertebrate structuring by copredators) may be answered sooner. We will use adaptive management processes to define the scope of work in continuing years. Oversight by the NVP chief scientist (Dr. Leslie Holland-Bartels) and annual meetings of the NVP principal investigators with the EVOS peer reviewers will ensure satisfactory progress is made toward the NVP objectives, and that the objectives remain relevant to the overall restoration effort.

## C. Completion Date

This project was proposed for one preliminary field season (1995) and three full field seasons (1996-1998), with closeout and final report preparation in 1999.

## PUBLICATIONS AND REPORTS

At this time, we have completed only the preliminary study period (1995 field season), and we cannot anticipate publication schedules for data to be generated in FY 96 and FY 97. The annual reports will be produced as indicated in the above schedule.

## PROFESSIONAL CONFERENCES

The fifteen senior scientists on this project will likely present NVP project results at various forums in 1997. However, other than the annual EVOS meeting in January in Anchorage, presentations at professional conferences have not been identified or scheduled at this point. We propose to notify the Trustees of presentations and forums as they are scheduled.

## NORMAL AGENCY MANAGEMENT

The 1995 proposal was developed as a collaborative effort of a variety of research scientists from State, federal, university, and private centers under the facilitation of the National Biological Service of the Department of Interior. The NBS has no management function or responsibilities but provides information for the management of DOI trust species as its primary mission. The NVP is a focused 5-year project to identify factors constraining recovery of selected species and provide additional tools to assess status. Upon completion, the developed tools can be transferred to the appropriate management agency for further implementation.

## COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Because of the broad scope and large number of scientists ($>15$) involved in the NVP project, a concerted effort has been made over the past 1.5 years to ensure maximum coordination and integration of efforts, including logistical support for field operations, within the project. This has been accomplished by holding regular project meetings (2-3/year) and by establishing efficient electronic communications and file servers for the project. Additionally, coordination with the APEX (96163), SEA (96320), Harlequin duck (96161, 96427) and other projects is ongoing for specific NVP project components (including prey fish, pigeon guillemots, harlequin duck sample collection and shared research platforms and field camps). The NVP chief scientist regularly attends ecosystem project meetings organized by the EVOS restoration office for the purpose of coordination.

Although no formal efforts have been made to obtain matching funds from non-Trustee sources for this project, many project expenses are being covered by the National Biological Service and other agencies and universities involved in the project. Such expenses include provision of equipment (including 4 whalers, inflatable skiffs, dive gear and sea otter capture gear) and full or partial salary costs for many of the project scientists.

## EXPLANATION OF CHANGES IN CONTINUING PROJECTS

The NVP project continues to follow the original detailed project description of 95025 submitted and approved March 1995, with the addition of 96104 approved in December 1995

for inclusion in the original project as a trial study. Minor editing and clarification of procedures (particularly under the Pigeon Guillemot: Prey Abundance section) have been included in the above methods section; however, the core methods have not changed substantially. The addition of proposed elements of the former 96104 are included under the Predation on Bivalves by Avian Competitors/Sea Otter section. Finally, we have added an element to complete preparation and publication of three manuscripts on sea otter research which are pertinent to interpretation of data to be collected as part of the NVP project, as described in the section above entitled "*Publication of previous research*--Sea Otter".

## PROPOSED PRINCIPLE INVESTIGATORS

**Dr. Brenda Ballachey**
National Biological Service
Alaska Science Center
1011 E. Tudor Rd.
Anchorage AK 99503
(907) 786-3417 brenda_ballachey@nbs.gov

**Dr. Mary Ann Bishop**
Copper River Delta Institute
612 Second St.
P.O. Box 1460
Cordova, AK 99574
(907) 424-7212 /s=m.bishop/ou1=r10f04d02a@mhs-fswa.attmail.com

**Mr. Jim Bodkin**
National Biological Service
Alaska Science Center
1011 E. Tudor Rd.
Anchorage AK 99503
(907) 786-3550 james_bodkin@nbs.gov

**Dr. R. Terry Bowyer**
Institute of Arctic Biology
University of Alaska
Fairbanks, AK 99775.
(907) 474-5311 tbowyer@redback.lter.alaska.edu

**Dr. Thomas A. Dean**
Coastal Resources Associated, Inc.
1185 Park Center Dr., Suite A
Vista, CA 92083
(619) 727-2004 71620.2617@compuserve.com

**Dr. Lawrence Duffy**
Department of Chemistry and Biochemistry
Box 756160
University of Alaska
Fairbanks, AK 99775
(907) 474-7525 fychem@acad3.alaska.edu

**Mr. Daniel Esler**
National Biological Service
Alaska Science Center
1011 E. Tudor Rd.
Anchorage AK 99503
(907) 786-3485 daniel_esler@nbs.gov

**Dr. Leslie Holland-Bartels**
National Biological Service
Alaska Science Center
1011 E. Tudor Rd.
Anchorage AK 99503
(907) 786-3312 leslie_holland-bartels@nbs.gov

**Mr. Stephen C. Jewett**
Institute of Marine Science
University of Alaska
Fairbanks, AK 99775-1080
(907) 474-7841 jewett@ims.alaska.edu

**Dr. A. David McGuire**
Alaska Cooperative Fish and Wildlife Research Unit
216 Irving I Building
University of Alaska Fairbanks
Fairbanks, AK 99775
(907) 474-6242 ffadm@aurora.alaska.edu

**Dr. Lyman McDonald**
Western Ecosystems Technology, Inc.
2003 Central Ave.
Cheyenne, WY 82001
(307) 634-1756 lymanmcd@csn.org

**Dr. Charles E. O'Clair**
Auke Bay Laboratory
11305 Glenn Highway
Juneau, AK 99801
(907) 789-6016 coclair@abl.afsc.noaa.gov

**Dr. Alan Rebar**
Purdue University
Department of Veterinary Pathobiology
1243 Veterinary Pathology Bldg
West Lafayette, IN 47907-1243
(317) 494-7617 rebara@vet.purdue.edu

**Dr. Paul W. Snyder**
Purdue University
Department of Veterinary Pathobiology
1243 Veterinary Pathology Bldg
West Lafayette, IN 47907-1243
(317) 494-9676 pws@vet.vet.purdue.edu

**Dr. Glenn R. VanBlaricom**
Washington Coop. Fish and Wildlife Res. Unit
School of Fisheries, WH-10
University of Washington
Seattle, WA 98195
(206) 543-6475 glennvb@fish.washington.edu

## PERSONNEL

**Dr. Brenda Ballachey,** B.S., M.S. Colorado State University, Ph.D. Oregon State University, is a Research Physiologist at the Alaska Science Center, NBS. She has been project manager and senior scientist for the damage assessment and restoration work on sea otters since 1990. She has authored or coauthored over 15 peer reviewed scientific publications and was responsible for or author on 19 NRDA reports recently completed on sea otter issues.

**Dr. Mary Ann Bishop** is project leader for a portion of the avian copredator aspect of NVP. Bishop received her Ph.D. in Wildlife Ecology from the University of Florida in 1988. She has studied cranes, swans, and shorebirds, and is the Principal Investigator for EVOS 95320Q, Avian Predation on Herring Spawn. Since 1989, Dr. Bishop has worked for the Pacific Northwest Research Station of the U.S. Forest Service including since April 1990 as the research avian ecologist with the Copper River Delta Institute in Cordova Alaska. Since 1994 she has worked for the Copper River Delta Institute through a cooperative agreement between the Center for Streamside Studies, University of Washington and the Copper River Delta Institute.

**Mr. Jim Bodkin,** Research Wildlife Biologist, is the Project Leader for sea otter population research for the Alaska Science Center of NBS. He has over 18 peer-reviewed scientific publications and is involved in an active sea otter research program. He has studied and published on sea otter foraging ecology and community structuring since 1988 and has been principal investigator for sea otter survey methods development.

**Dr. R. Terry Bowyer**, Professor of Wildlife Ecology, University of Alaska Fairbanks. Dr. Bowyer has an extensive publication record (46). He has conducted extensive research on river otters and impacts of EVOS on this species.

**Dr. Thomas A. Dean**, is President of the ecological consulting firm Coastal Resources Associates, Inc, (CRA) in Vista, CA. He has over 20 years of experience in the study of nearshore ecosystems, and has authored over 20 publications, including several papers dealing with sea urchin and kelp interactions. He has extensive experience in long-term monitoring studies with marine plants and invertebrates. He has had a major role in both the shallow subtidal and intertidal EVOS investigations since 1989.

**Dr. Lawrence Duffy**, Professor of Chemistry and Biochemistry at the University of Alaska Fairbanks has been working in the area of toxicology for 15 years and is a member of the International Society of Toxicology. He has studied various bacterial and mammalian toxins. Since the *Exxon Valdez* oil spill, he has published four papers related to developing biomonitors. He is currently funded for two major environmental studies in Alaska. At the University, he teaches "Environmental Biochemistry and Biotechnology" and is a member of the Environmental Chemistry Program and Mammal Group.

**Mr. Daniel Esler** is a Wildlife Research Biologist for the Alaska Science Center, National Biological Service with a MS in Wildlife Ecology from Texas A&M University. He has worked primarily with aquatic birds in the fields of reproductive physiology, habitat selction, nesting ecology, and population dynamics, including 7 years of experience in Alaska and Russia. He has 10 publications in national peer reviewed journals.

**Dr. Leslie Holland-Bartels,** BS University of Massachusetts, MS Louisiana State University, Ph.D. Purdue University is the head of the Marine and Freshwater Ecology Research Program for the Alaska Science Center, NBS and directs research of 17 senior scientists in the areas of seabirds, marine mammals, anadromous fisheries, and associate habitat and population issues. She has 20 years experience in aquatic ecology and over 30 publications in national scientific journals on subjects ranging from contaminants, ecology of invertebrates, fisheries, water quality and aquatic ecology.

**Mr. Stephen C. Jewett** has been a Research Associate at the School of Fisheries and Ocean Science, University of Alaska Fairbanks, since 1975. During this time he has been involved in numerous benthic and intertidal investigations throughout Alaska that emphasize assessment and/or monitoring. He has authored more than 30 publications in scientific journals and books. He has been the coordinator of the federal/state EVOS shallow subtidal investigations in Prince William Sound (1989-1994).

**Dr. Lyman MacDonald**, B.S., M.S. Oklahoma State University, PhD. Colorado State University, is a biometrician with 25 years of comprehensive experience in the application of statistical methods to design, conduct, and analyze environmental and laboratory studies. He has designed and managed both large and small environmental impact assessment and monitoring programs.

**Dr. David McGuire** is Assistant Professor of Landscape Ecology and Assistant Leader of the Alaska Cooperative Fish and Wildlife Reseach Unit at the University of Alaska, Fairbanks. He received his Ph.D. in Biology from UAF in 1989. His research interests include operation of ecological processes at large spatial scales, ecological modelling, and global change biology.

**Dr. Charles E. O'Clair**, B.S. Zoology, 1963 University of Massachusetts, Ph.D. Fisheries, 1977, University of Washington. 1977-present: Fishery Biologist (Research), National Marine Fisheries Service, Auke Bay Laboratory, Juneau, Alaska. Research experience includes seven years of field and laboratory work on the effects of oil pollution and, later, the effects of logging on benthic invertebrates, eleven years of research on the ecology and behavior of Dungeness, king and Tanner crabs in relation to the management of these species, four years of research on the impact of the *Exxon Valdez* Oil Spill on subtidal sediments in Prince William Sound and the Gulf of Alaska and one year on the recovery of subtidal sediments in Prince William Sound.

**Dr. Alan Rebar** is Dean of the School of Veterinary Medicine and Professor of Veterinary Clinical Pathology at Purdue University. He is internationally recognized as an expert in the

field of clinical pathology and toxicology. He has been involved in EVOS studies of sea and river otters since 1991.

**Dr. Paul W. Snyder** is an Assistant Professor of Pathology and Immunotoxicology and Director of the Clinical Immunology laboratory of the Department of Veterinary Pathobiology, Purdue University. He is also a Diplomate of the American College of Veterinary Pathologists. His research interests are in the area of mechanism based studies on the pathology and immunology of xenobiotics on biological systems. He has an NIH-funded project related to the immunobiology of environmental contaminants.

**Dr. Glenn R. VanBlaricom** has conducted research on coastal ecosystems since 1970, and has been involved in research on sea otters and their ecosystems for 17 years. Dr. VanBlaricom studied relationships of sea otters and intertidal mussels in Prince William Sound from 1978 through 1986 and published papers on population size structure and individual growth rate of mussels, and effects of foraging by sea otters. Dr. VanBlaricom worked on sea otter rescue and rehabilitation in the immediate aftermath of EVOS, primarily in the Kenai region, and has published one paper on rehabilitation strategies. Currently Dr. VanBlaricom is Assistant Unit Leader (Wildlife), Washington Cooperative Fish and Wildlife Research Unit, and is Associate Professor of Fisheries in the School of Fisheries, University of Washington. He has 24 peer-reviewed scientific publications.

**Cooperators:**

**Mr. Timothy D. Bowman** is a Wildlife Biologist for the U.S. Fish and Wildlife Service, Migratory Bird Management Project. He has a Master of Science in Wildlife Management, Department of Wildlife, University of Maine, Orono. He was principal investigator for the *Exxon Valdez* oil spill damage assessment study on bald eagles, and has been involved with aerial surveys of waterfowl and seabirds in Alaska. He has 6 publications in national peer reviewed journals.

**Dr. Dan Roby** has conducted research on the physiological ecology and reproductive energetics of high latitude seabirds for the last 15 years. His field research on alcid reproductive biology has been in Alaska, Newfoundland, and Greenland, and he is currently conducting research on pigeon guillemots as bioindicators of nearshore ecosystem health in Kachemak Bay, Alaska. Dr. Roby's research on seabird reproductive energetics in the Arctic and Antarctic has been supported by the National Science Foundation. Roby is currently located at the Oregon Cooperative Wildlife Research Unit, Oregon State University. He has over 25 peer-reviewed scientific publications, 17 of them on topics in seabird ecology.

**Dr. John Stegeman** is a research scientist at Woods Hole Oceanographic Institution. He is internationally recognized as an expert in the area of cytochrome P450 biomarkers of hydrocarbon exposure.

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**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | PROPOSED FFY 1997 TRUSTEE AGENCIES TOTALS | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | ADEC | ADF&G | ADNR | USFS | DOI | NOAA |
| | | | | $476.6 | | $141.5 | $1,225.9 | $119.5 |
| Personnel | $0.0 | $461.1 | | | | | | |
| Travel | $0.0 | $59.3 | | | | | | |
| Contractual | $0.0 | $1,253.2 | | | | | | |
| Commodities | $0.0 | $95.2 | | | | | | |
| Equipment | $0.0 | $6.5 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
| Subtotal | $0.0 | $1,875.3 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| General Administration | $0.0 | $121.9 | | | | | | |
| Project Total | $0.0 | $1,997.2 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 |
| | | | | | | | | |
| Full-time Equivalents (FTE) | 0 | 9.4 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 |

Comments:

**1997**

Prepared: 1 of 37

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Lead Agency: National Biological Service

FORM 2A
MULTI-TRUSTEE AGENCY SUMMARY

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| Personnel | | $294.1 | | | | | | |
| Travel | | $39.2 | | | | | | |
| Contractual | | $745.7 | | | | | | |
| Commodities | | $68.9 | | | | | | |
| Equipment | | $6.5 | | | | | | |
| Subtotal | $0.0 | $1,154.4 | | | | | | |
| General Administration | | $71.5 | | | | | | |
| Project Total | $0.0 | $1,225.9 | | | | | | |
| Full-time Equivalents (FTE) | | 6.0 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:

SO = Sea Otters
HD = Harlequin Ducks
CS = Chief Scientist Oversight
RO/PG = River Otters/ Pigeon Guillemots
SC = Subtidal Clams
IP = Invertebrate Predators

**1997**

Prepared: 2 of 37

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: National Biological Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Personnel Costs:** | | GS/Range/ | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | Step | Budgeted | Costs | Overtime | FFY 1997 |
| **SO:** | **SO:** | | | | | 0.0 |
| Dr. B Ballachey/ Mr. J Bodkin | Supervisory WB | GS-12 | 6.0 | 5.8 | | 34.8 |
| Dr. B Ballachey | Sup. WB - manuscript prep | GS-12 | 3.0 | 5.8 | | 17.4 |
| D Monson/ G Esslinger | Wildlife Biologist (WB) | GS-9 | 12.0 | 3.6 | | 43.2 |
| Vacant | Biological Tech | GS-5 | 6.0 | 2.4 | | 14.4 |
| **HD:** | **HD:** | | | | | 0.0 |
| D Esler | Research WB | GS-11 | 9.0 | 5.1 | | 45.9 |
| T Bowman | Wildlife Biologist | GS-9 | 4.0 | 4.4 | | 17.6 |
| D Derksen | Supervisory WB | GS-14 | 0.5 | 7.4 | | 3.7 |
| Vacant | Biological Techs | GS-5 | 12.0 | 2.1 | | 25.2 |
| Dr. D Mulcahy | Veterinarian | GS-13 | 1.0 | 6.0 | | 6.0 |
| K Trust | Anesthetist | GS-11 | 1.0 | 4.0 | | 4.0 |
| **CS:** | **CS:** | | | | | 0.0 |
| M Whalen | Data Manager | GS-9/4 | 12.0 | 4.0 | | 48.0 |
| Dr. L Holland-Bartels | Chief Scientist | GS-14 | 2.5 | 8.1 | | 20.3 |
| Dr. M Adkison | Modeler | GS-12/1 | 1.0 | 5.2 | | 5.2 |
| M Ronaldson | Secretary | GS-5/10 | 1.0 | 3.1 | | 3.1 |
| D Douglas | GIS Specialist | GS-12 | 1.0 | 5.3 | | 5.3 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 72.0 | 72.3 | 0.0 | |
| | | | | | **Personnel Total** | 294.1 |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: sea otter, har. duck, proj. man, RWO - riv. otter, pig. guil., subtidal clams, inv. pred. components of NVP
Agency: National Biological Service

FORM 3B
Personnel & Travel DETAIL



4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| **Travel Costs:** Description | Ticket Price | Round Trips | Total Days | Daily Per Diem | Proposed FFY 1997 |
|---|---|---|---|---|---|
| SO: ANC/Cordova/ANC | 0.3 | 6 | | | 1.8 |
| Per diem Cordova | | | 50 | 0.1 | 5.0 |
| ARR to Whittier 25' Boat | 0.8 | 2 | | | 1.6 |
| Meetings NVP/ Restoration Workshop | | | | | 2.8 |
| Purdue Travel: P Snyder, A Rebar | 0.9 | 7 | | | 6.3 |
| Per diem Anchorage | | | 35 | 0.2 | 7.0 |
| HD: ANC/Cordova/ANC | 0.3 | 17 | | | 5.1 |
| Train to Whittier (personnel/gear) | 0.1 | 15 | | | 0.8 |
| ARR to Whittier 25' Boat | 0.9 | 1 | | | 0.9 |
| Workshops/ Meetings | | | | | 2.5 |
| Per Diem (many locations) | | | | | 4.0 |
| CS: ANC/ Cordova/ ANC | 0.3 | 2 | | | 0.6 |
| Per diem Cordova | | | 8 | 0.1 | 0.8 |
| | | | | | 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 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | 39.2 |

**1997**

Project Number: 97025

Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: sea otter, har. duck, proj. man, RWO - riv. otter, pig. guil., subtidal clams, inv. pred. components of NVP

Agency: National Biological Service

FORM 3B Personnel & Travel DETAIL

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| RO/PG: Univ. Alaska-Fairbanks Research Work Order | 191.0 |
| SC, IP Univ. Washington Research Work Order | 124.8 |
| SO: Aircraft: Aerial survey (160 hrs @ $200/hr) | 32.0 |
| Transportation (blood, equipment) 20 hrs @ $250/hr | 5.0 |
| Shipping equipment/camps/emergency | 3.0 |
| Warehouse - Cordova | 2.0 |
| Blood assays (commercial lab - 160 @ $30) | 4.8 |
| P450 assays - Woods Hole | 24.9 |
| Hydrocarbon assays - invertebrate prey samples (20 @ $150) | 3.0 |
| Serum chemistry assays (160 @ $22.50) | 3.6 |
| Purdue: Immune assays (100 @ $125) and P450 (lymphocytes; 100 @ $60) | 18.5 |
| Pelage/ plumage assays (ELISA - oil - 80 @ $40) | 2.0 |
| HD: Boat charter (30 days @ $1500 + 30 days @ $1000) | 75.0 |
| Air charter (160 hours) | 44 |
| Radio telemetry observer | 4.0 |
| Body composition analysis | 7.5 |
| Food habits analysis | 2.0 |
| Statistical consultation | 2.0 |
| Training | 2.0 |
| Kayak rental | 2.5 |
| Oregon State University Research Work Order | 12.4 |
| CS: Statistical Consultation (Lyman McDonald - P.I.) | 29.7 |
| Boat Charter (42 days @ $3150/day and 14 days @ $1200/day) | 150.0 |
| When a non-trustee organization is used, the form 4A is required. **Contractual Total** | 745.7 |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: National Biological Service

FORM 3B
Contractual & Commodities
DETAIL

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| SO: Food, 160 days @ $15/day | 2.4 |
| Fuel, 75 days @ 20 gal/day @ $3.00/ gal | 6.0 |
| Misc. office/ field supplies | 1.5 |
| Blood & sample collection supplies | 2.0 |
| Maintenance and repair | 10.0 |
| HD: Fuel, 30 days@ 20 gal/day @ $3.00 /gal | 2.0 |
| Boat maintenance and repair | 2.0 |
| Publications costs | 3.0 |
| Veterinarian Supplies: Antenna collars ($2450), Isoflurane ($2275), Gloves ($400), Drapes ($200), Sutures ($500), Disinfectant ($180), Oxygen ($1000), Monitor Probes ($200), Misc. ($795) | 8.0 |
| Miscellaneous equipment: ( trap-building materials, cold weather gear, rain gear, banding equip.) | 1.0 |
| Radio transmitters (100 @ $200) | 20.0 |
| CS: Total commodities | |
| Workshop presentation materials | 1.9 |
| Software and updates | 2.2 |
| Film and developing | 0.4 |
| Publication costs | 1.0 |
| GIS Mapping supplies | 0.9 |
| Food (60 days @ $15/day) | 0.9 |
| On-line services and access fees | 0.5 |
| Shipping and freight | 0.6 |
| Personnel equip. (waders 2 @ $100, rain gear 2 @ $150, Mustang suits 2 @ $250, gloves 4 @ $15, survival suits 2 @ $375, boots 2 @ $70, sleeping bags 2 @ $150) | 2.3 |
| Reference materials | 0.3 |
| **Commodities Total** | 68.9 |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: National Biological Service

FORM 3B
Contractual & Commodities DETAIL

Prepared:



4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **New Equipment Purchases:** Description | Number of Units | Unit Price | Proposed FFY 1997 |
|---|---|---|---|
| SO: | | | |
| Replacement survival (2 @ $375) and Mustang suits (5 at @ $250) | | | 2.0 |
| Replacement capture nets | 2 | 1.0 | 2.0 |
| HD: | | | |
| Miscellaneous equipment: (boat equip., GPS units, survey optics) | | | 1.5 |
| Doppler Heart Monitor | | | 1.0 |
| | | | 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** | 6.5 |

| **Existing Equipment Usage:** Description | Number of Units | Inventory Agency |
|---|---|---|
| | | |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note:sea otter, har. duck, proj. man., RWO- riv. otter, pig. guill., subtidal clams, inv. pred. components of NVP
Agency: National Biological Service

FORM 3B
Equipment
DETAIL

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Personnel | | $0.0 | | | | | | |
| Travel | | $0.0 | | | | | | |
| Contractual | | $455.0 | | | | | | |
| Commodities | | $0.0 | | | | | | |
| Equipment | | $0.0 | | | | | | |
| Subtotal | $0.0 | $455.0 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| General Administration | | $21.6 | | | | | | |
| Project Total | $0.0 | $476.6 | | | | | | |
| | | | | | | | | |
| Full-time Equivalents (FTE) | | 0.0 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:

General Administration = $21,600, as per Steve Jewett (explained on form 4A, ADF&G Contractor)

**1997**

Prepared: 8 of 37

Project Number: 97025

Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: intertidal clams, urchins/crabs, fishes, components of NVP

Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| **Personnel Costs:** | | GS/Range/ | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | Step | Budgeted | Costs | Overtime | FFY 1997 |
| | | | | | | 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 | 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 |
| | | | | **Travel Total** | 0.0 |

**1997**

Prepared: 9 of 37

Project Number: 97025

Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: intertidal clams, urchins/crabs, fishes, components of NVP

Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Contract with non-trustee agency (explained on form 4A, ADF&G Contractor) | 455.0 |
| When a non-trustee organization is used, the form 4A is required. **Contractual Total** | 455.0 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| **Commodities Total** | 0.0 |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: intertidal clams, urchins/crabs, fishes, components of NVP
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL



4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **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 |
| 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 |
|---|---|---|
| | | |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: intertidal clams, urchins/crabs, fishes, components of NVP
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL



4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Personnel | | $67.5 | | | | | | |
| Travel | | $17.9 | | | | | | |
| Contractual | | $37.6 | | | | | | |
| Commodities | | $17.4 | | | | | | |
| Equipment | | $0.0 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
| Subtotal | $0.0 | $140.4 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| General Administration | | $12.8 | | | | | | |
| Project Total | $0.0 | $153.2 | | | | | | |
| Full-time Equivalents (FTE) | | 1.1 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:

NOAA Contribution:

Principal Investigator, C. O'Clair, 6 mos. = $49.8K: Habitat Program Manager, S. Rice, 0.5 mos. = $5.8K for a total of $56.6K.

**1997**

Prepared: 12 of 37

Project Number: 97025

Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: mussel component of NVP

Agency: National Oceanic & Atmospheric Administration

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Personnel Costs:** | | GS/Range/ | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | Step | Budgeted | Costs | Overtime | FFY 1997 |
| Mussels: | | | | | | 0.0 |
| C Brodersen | Fishery Research Biologist | GS-11/8 | 3.0 | 6.5 | | 19.5 |
| J Freese | Fishery Research Biologist | GS-9/8 | 6.0 | 5.4 | | 32.4 |
| L Ewing | Zoologist | GS-7/4 | 4.0 | 3.9 | | 15.6 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 13.0 | 15.8 | 0.0 | |
| | | | | | **Personnel Total** | 67.5 |

| **Travel Costs:** | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| Mussels: | | | | | 0.0 |
| Anchorage, Workshop & Coordination Meetings, 4 | 0.4 | 4 | 15 | 0.3 | 6.1 |
| Miscellaneous | | | | | 0.6 |
| Seward, Field Trips, 4 | 0.5 | 4 | 20 | 0.1 | 4.0 |
| Miscellaneous | | | | | 0.1 |
| Cordova, Field Trips, 9 | 0.4 | 9 | 35 | 0.1 | 7.1 |
| Miscellaneous | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | 17.9 |

**1997**

Prepared: 13 of 37

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: mussel component of NVP
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Personnel
& Travel
DETAIL

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Mussels: | |
| Vessel Contract for some of the field work (21 days @ $1,500/day) | 31.5 |
| Contracts for sample processing and aging (400 hours @ $14.25/hr) | 5.7 |
| Freight | 0.4 |
| When a non-trustee organization is used, the form 4A is required. **Contractual Total** | 37.6 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Mussels: | |
| Protective clothing | 0.6 |
| Growth and aging supplies | 8.6 |
| Field and lab chemicals and supplies (bags, utensils, jars, etc.) | 4.8 |
| Weight/ measurement supplies (pans, calibration) | 0.6 |
| Publication and presentation costs | 1.3 |
| Shipping/ Holding containers | 1.5 |
| **Commodities Total** | 17.4 |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: mussel component of NVP
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Contractual & Commodities DETAIL

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **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 |
| 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 |
|---|---|---|
| Mussels: | | |
| Computer, Compaq | 2 | NOAA |
| Balance | 1 | NOAA |
| Smith McIntyre Grab | 1 | NOAA |
| Camera | 1 | NOAA |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: mussel component of NVP
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Equipment
DETAIL

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
|---|---|---|---|---|---|---|---|---|
| Personnel | | $99.5 | | | | | | |
| Travel | | $2.2 | | | | | | |
| Contractual | | $14.9 | | | | | | |
| Commodities | | $8.9 | | | | | | |
| Equipment | | $0.0 | | | | | | |
| Subtotal | $0.0 | $125.5 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| General Administration | | $16.0 | | | | | | |
| Project Total | $0.0 | $141.5 | | | | | | |
| Full-time Equivalents (FTE) | | 2.3 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:

Need to borrow from US Forest Service: use of Forest Service cabin (spring only) at Port Chalmers and weatherports for Knight Island (spring and summer), and Port Chalmers (summer).

Borrowing whaler, motor, and GPS units (2) from National Biological Service (for spring).

**1997**

Prepared: 16 of 37

Project Number: 97025

Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: avian copredator component of NVP

Agency: Copper River Delta Institute, US Forest Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Personnel Costs:** | | GS/Range/ | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | Step | Budgeted | Costs | Overtime | FFY 1997 |
| Avian Co-predators: | | | | | | 0.0 |
| M. Bishop | Principal Investigator | GS-12-03 | 7.0 | 6.1 | | 42.7 |
| Vacant | Biologist/ Statistician | GS-9-01 | 3.0 | 3.1 | | 9.3 |
| B. Lance | Biological Technician | GS-7-01 | 7.0 | 2.5 | 0.5 | 18.0 |
| Vacant | Biological Technician | GS-7-01 | 4.0 | 2.5 | 0.5 | 10.5 |
| Vacant | Biological Technician | GS-7-01 | 2.0 | 2.5 | 0.5 | 5.5 |
| Vacant | Biological Technician | GS-7-01 | 2.0 | 2.5 | 0.5 | 5.5 |
| Vacant | Biological Technician | GS-5-01 | 3.0 | 2.0 | 0.5 | 6.5 |
| Vacant | Dispatchers | GS-6 | | | 1.5 | 1.5 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 28.0 | 21.2 | 4.0 | |
| | | | | | **Personnel Total** | 99.5 |

| **Travel Costs:** | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| Avian Co-predators: | | | | | 0.0 |
| Cordova/ Anchorage/ Cordova | 0.2 | 2 | 6 | 0.1 | 1.0 |
| American Ornithologist Union - 1997 Annual Meeting | 0.8 | 1 | 4 | 0.1 | 1.2 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | 2.2 |

**1997**

Prepared: 17 of 37

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: avian copredator component of NVP
Agency: Copper River Delta Institute, US Forest Service

FORM 3B
Personnel
& Travel
DETAIL

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Avian Co-Predators: | |
| Air charter flights to transport staff/ supplies to field sites (12 hours at 250/hr.) | 3.0 |
| Air charter to check exclosures (Montague and Knight Is.) (Jun-Sept), 8 trips @ 430 (1.5 h RT @ 230, 1 h downtime @ 85) | 3.4 |
| Vessel charter to Montague and Knight Islands (4 days @ 1000) | 4.0 |
| Training (CPR, First Aid, Cold Water Survival, Marine Safety) | 0.6 |
| Shipping Samples | 0.1 |
| Gut content analysis - Falco, Fairbanks, AK (80 samples @ 15) | 1.2 |
| Fabricate exclosures (2 weeks @ 500/ week) | 1.0 |
| Whaler repairs, upgrade, and storage (fiberglassing, motor repair, general repairs) 2 @ 700, propellers (2 @ 90) | 1.6 |
| When a non-trustee organization is used, the form 4A is required. **Contractual Total** | 14.9 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Avian Co-Predators: | |
| Film with developing (10 rolls @ $14) | 0.1 |
| Sample bottles and bags | 0.5 |
| Personnel equipment (waders 3 @ $50, mustang suit 1 @ $200, gloves 6 @ $12) | 0.4 |
| Fuel (gasoline - 900 gal @ $1.45, fuel oil - 150 gal @ $1.60, propane - 60 lb @ $2.30) | 1.7 |
| Cabin and tent platform lumber and repair supplies | 0.3 |
| Exclosure materials (100 cages @ $24 ea. includes: Vexar 240 ft. @ $1.80, rebar - 85 sticks @ $19, PVC pipe 720 ft @ $0.20 ea., PVC elbows 400 @ $0.35 ea., cable ties & net twine $80) | 2.4 |
| Field supplies: Mylar ($80), Rite in Rain ($50), rope ($75) | 0.2 |
| Food (spring: 6 people, 45 days, summer 4 people 15 days at $10/person/day) | 3.3 |
| **Commodities Total** | 8.9 |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: avian copredator component of NVP
Agency: Copper River Delta Institute, US Forest Service

FORM 3B
Contractual & Commodities DETAIL

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **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 |
|---|---|---|
| Avian Co-Predators: | | |
| Whaler - 17 ft. | 1 | USFS |
| Whaler - 17 ft. | 1 | DOI-NBS |
| Computer - 486 | 1 | USFS |
| Zodiac | 1 | USFS |
| Global Positioning System (GPS) | 2 | DOI-NBS |
| Outboard, 20 hp. | 1 | USFS |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators Note: avian copredator component of NVP
Agency: Copper River Delta Institute, US Forest Service

FORM 3B
Equipment
DETAIL



4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Personnel | | $68.8 | | | | | | |
| Travel | | $15.4 | | | | | | |
| Contractual | | $47.3 | | | | | | |
| Commodities | | $42.2 | | | | | | |
| Equipment | | $0.0 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
| Subtotal | $0.0 | $173.7 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| Indirect | | $17.3 | | | | | | |
| Project Total | $0.0 | $191.0 | | | | | | |
| Full-time Equivalents (FTE) | | 25.8 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:
See attached form 4B's for detail:
UAF: University of Alaska, Fairbanks RWO. This includes the River Otter and Pigeon Guillemot subcomponents.

**1997**

Prepared: 20 of 37

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Alaska, Fairbanks (UAF)
Agency: National Biological Service Contractor

FORM 4A
Non-Trustee
SUMMARY

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Personnel Costs:** | | | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | | Budgeted | Costs | Overtime | FFY 1997 |
| UAF: | | | | | | 0.0 |
| Provided by ASC | ARC/INFO Tech. | | | | | 0.0 |
| Vacant | Student Tech. (data entry, 380 hrs @ $8.8 | | 2.4 | 1.4 | | 3.4 |
| R. T. Bowyer | Principal Investigator | | | | | 6.6 |
| Vacant | Lab Tech. (range 75, 520 hrs @ $12.08/hr | | 3.3 | 1.9 | | 6.3 |
| Vacant | Account Tech (80 hrs @ $15.35/hr) | | 0.5 | 2.5 | | 1.3 |
| Vacant | Field Tech. (600 hrs @ $9.31/hr) | | 3.8 | 1.5 | | 5.7 |
| Vacant | Field Tech. (600 hrs @ $9.31/hr) | | 3.8 | 1.5 | | 5.7 |
| | benefits | | | | | 7.4 |
| | Graduate Student Fellowship + tuition | | 12.0 | 2.7 | | 32.4 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 25.8 | 11.5 | 0.0 | |
| | | | | | **Personnel Total** | 68.8 |

| **Travel Costs:** | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| UAF: | | | | | 0.0 |
| PI travel RT Fairbanks/ study sites | 0.4 | 2 | | | 0.8 |
| Portage/ Whittier - 2 vehicles | 0.2 | 2 | | | 0.4 |
| Portage/ Whittier - personnel | 0.0 | 13 | | | 0.2 |
| Portage/ Whittier - 2 - 17ft. boats | 1.4 | 2 | | | 2.8 |
| Per diem (student volunteers) | | | 140 | 0.0 | 2.1 |
| Fairbanks/ Anchorage/ Fairbanks | 0.3 | 15 | | | 4.5 |
| Per diem ( Chenega Bay) | | | 6 | 0.1 | 0.6 |
| Per diem (Anchorage) | | | 40 | 0.1 | 4.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | 15.4 |

**1997**

Prepared: 21 of 37

Project Number:
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Alaska, Fairbanks (UAF)
Agency: National Biological Service Contractor

FORM 4B
Personnel
& Travel
DETAIL

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| UAF: | |
| Project assistance for Alaska Dept. of Fish & Game | 10.0 |
| Project Support Services | 8.4 |
| Charter - Anchorage/ Jackpot Bay/ Anchorage - 2 RT | 0.5 |
| Air Charter (Chenega Bay) | 1.1 |
| Duplication / Computer fees | 0.4 |
| Excess baggage/ freight | 1.5 |
| Barge for fuel to field camps - 3 RT @ $2200/trip | 6.6 |
| Publication (page charges, reports, posters) | 1.0 |
| Boat charter in PWS (6 days @ $400/day) | 2.4 |
| Lease 2 vehicles, Fairbanks/ Whittier/ Fairbanks (1500 miles @ $0.50/mile) | 1.5 |
| Maintenance on freezer | 0.4 |
| Maintenance on boat motor | 0.6 |
| Maintenance on Weatherport | 0.2 |
| Maintenance on computer | 0.5 |
| Maintenance of binoculars | 0.1 |
| ELISA analysis of oil on pelage and plumage | 5.3 |
| IG analysis | 2.0 |
| HP analysis | 1.0 |
| Chenega permit | 1.5 |
| Audio visual services (Chenega presentation) | 0.4 |
| Dive and First Aid training - 2 each | 0.9 |
| Telephone services | 1.0 |
| **Contractual Total** | 47.3 |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Alaska, Fairbanks (UAF)
Agency: National Biological Service Contractor

FORM 4B
Contractual & Commodities DETAIL

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| UAF: | |
| Lab supplies/ assay kits | |
| 2 Interleukin kits @ $550/ ea. | 1.1 |
| 2 P450 kits @ $260/ ea. | 0.5 |
| 68 blood panel assays | 2.4 |
| Food (14 weeks @ $600/ week + Chenega volunteer) | 9.9 |
| Pesola scales - 8 ea. @ $50/ea. | 0.4 |
| Whirlpacs | 0.4 |
| Tent, 4-man dome | 0.6 |
| Misc. boat safety supplies | 0.3 |
| MSR Waterworks filtration system (2 ea. + replace) | 0.4 |
| First Aid kits 2 @ $132/ ea. | 0.3 |
| Misc. field camp supplies | 1.0 |
| Rite-in-rain notebooks | 0.3 |
| Rain gear | 1.0 |
| Waders/ hip boots (6 @ $127/ea.) | 0.8 |
| Boat fuel (47 gal/day @ $2.50/gal, 90 days) & fuels for camp sites | 11.1 |
| Outboard motor oil - 300 qt. | 0.6 |
| Propane for camps | 0.5 |
| Propane regular, lines | 0.2 |
| Camp cooking supplies | 0.3 |
| Leg hold traps - 4 doz. @ $150/ doz. | 0.6 |
| Portable diving compressor | 3.0 |
| Software for laptop | 1.0 |
| Blood sampling/ storage supplies | 3.0 |
| Binoculars, Steiner, low-light - 1 @ $500/ea. | 0.5 |
| IBM laptop | 2.0 |
| **Commodities Total** | 42.2 |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Alaska, Fairbanks (UAF)
Agency: National Biological Service Contractor

FORM 4B
Contractual & Commodities DETAIL

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

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

| Existing Equipment Usage: | Number |
|---|---|
| Description | of Units |
| UAF: | |
| GPS receiver | 1 |
| Mustang suits | 6 |
| Weatherport 12' x 18' | 1 |
| Weatherport 12' x 15' | 1 |
| Boston Whalers, 17ft. - and accessories | 2 |
| Outboard motors - 60 hp | 3 |
| Boat trailers | 2 |
| Heaters - propane | 2 |

**1997**

Project Number:
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Alaska, Fairbanks (UAF)
Agency: National Biological Service Contractor

FORM 4B
Equipment
DETAIL



4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Personnel | | $57.0 | | | | | | |
| Travel | | $20.4 | | | | | | |
| Contractual | | $59.2 | | | | | | |
| Commodities | | $13.5 | | | | | | |
| Equipment | | $0.0 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
| Subtotal | $0.0 | $150.1 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| Indirect | | $22.3 | | | | | | |
| Project Total | $0.0 | $172.4 | | | | | | |
| Full-time Equivalents (FTE) | | $30 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:

See attached form 4B's for detail:

UW: University of Washington RWO. This includes the Subtidal Clams (SC) and the Invertebrate Predator (IP) subcomponents.

**1997**

Prepared: 25 of 37

Project Number: 97025

Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators

Name: University of Washington (UW)

Agency: National Biological Service Contractor

FORM 4A
Non-Trustee
SUMMARY

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| Personnel Costs: | | | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | | Budgeted | Costs | Overtime | FFY 1997 |
| UW: | Subtidal Clams: | | | | | 0.0 |
| | Research assistant - salary | | 12.0 | 1.5 | | 18.0 |
| | Research assistant - tuition | | | | | 6.4 |
| | Research assistant - benefits | | | | | 1.4 |
| | Hourly person - salary | | 5.5 | 1.3 | | 7.2 |
| | Hourly person - benefits | | | | | 0.7 |
| | Invertebrate Predators: | | | | | 0.0 |
| | Research assistant - salary | | 12.0 | 1.3 | | 15.6 |
| | Research assistant - tuition | | | | | 6.4 |
| | Research assistant - benefits | | | | | 1.3 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 29.5 | 4.1 | 0.0 | |
| | | | | | **Personnel Total** | 57.0 |

| Travel Costs: | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| UW: | | | | | 0.0 |
| Subtidal Clams: | | | | | 0.0 |
| Domestic travel (field/ planning) | | | | | 8.2 |
| Domestic travel (conferences) | | | | | 1.0 |
| Foreign travel (Western Society of Naturalists, La Paz, Mexico) | | | | | 2.0 |
| Foreign travel (Intl. Otter Symposium (IUCN), Santiago, Chile) | | | | | 2.0 |
| Invertebrate Predators: | | | | | 0.0 |
| Domestic travel (field/ planning) | | | | | 5.2 |
| Domestic travel (conferences) | | | | | 1.0 |
| Foreign travel (Western Society of Naturalists, La Paz, Mexico) | | | | | 1.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | 20.4 |

**1997**

Prepared: 26 of 37

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Washington (UW)
Agency: National Biological Service Contractor

FORM 4B
Personnel
& Travel
DETAIL

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| UW: | |
| Subtidal Clams: | |
| Vessel charter | 47.6 |
| Computer/ Statistical consulting | 2.3 |
| Taxonomic consulting | 1.0 |
| Publication charges | 0.5 |
| Telephone, fax, photocopying, postage, graphics, photographic | 2.0 |
| Invertebrate Predators: | |
| Computer/ Statistical consulting | 3.0 |
| Publication charges | 1.0 |
| Telephone, fax, photocopying, postage, graphics, photographic | 1.8 |
| **Contractual Total** | 59.2 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| UW: | |
| Subtidal Clams: | |
| Sampling gear, SCUBA gear, office supplies | 10.6 |
| Statistical analytical software | 0.7 |
| Invertebrate Predators: | |
| Sampling gear, SCUBA gear, office supplies | 1.9 |
| Statistical analytical software | 0.3 |
| **Commodities Total** | 13.5 |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Washington (UW)
Agency: National Biological Service Contractor

FORM 4B
Contractual & Commodities DETAIL

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **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 |
| 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 | |
|---|---|---|
| | | |

**1997**

Prepared: 28 of 37

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Washington (UW)
Agency: National Biological Service Contractor

FORM 4B
Equipment
DETAIL

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| Personnel | | $159.4 | | | | | | |
| Travel | | $14.4 | | | | | | |
| Contractual | | $179.7 | | | | | | |
| Commodities | | $8.0 | | | | | | |
| Equipment | | $30.0 | | | | | | |
| Subtotal | $0.0 | $391.5 | | | | | | |
| Indirect | | $63.5 | | | | | | |
| Project Total | $0.0 | $455.0 | | | | | | |
| Full-time Equivalents (FTE) | | 33.0 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:
Draft budget from Steve Jewett (21 Mar 96)

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recover of Nearshore Vertebrate Predators
Name: Alaska Department of Fish and Game Contractor

FORM 4A
Non-Trustee
SUMMARY

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**

October 1, 1996 - September 30, 1997

| Personnel Costs: | | | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | | Budgeted | Costs | Overtime | FFY 1997 |
| S. Jewett | Principal Investigator | | 10.0 | 7.3 | | 73.0 |
| H. Feder | Associate | | 1.0 | 8.5 | | 8.5 |
| A. Blanchard | Associate | | 2.0 | 4.5 | | 9.0 |
| Vacant | Technician | | 10.0 | 4.3 | | 43.0 |
| Vacant | Diver | | 1.5 | 7.0 | | 10.5 |
| Vacant | Diver | | 1.5 | 7.0 | | 10.5 |
| Vacant | Student Assistant II | | 7.0 | 0.7 | | 4.9 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 33.0 | 39.3 | 0.0 | |
| | | | | | **Personnel Total** | 159.4 |

| Travel Costs: | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| Fairbanks/ Cordova/ Fairbanks | 0.5 | 12 | | | 6.0 |
| Fairbanks/ San Diego, CA/ Fairbanks | 0.8 | 3 | 18 | 0.1 | 4.2 |
| Fairbanks/ Anchorage/ Fairbanks | 0.2 | 6 | 15 | 0.2 | 4.2 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | 14.4 |

**1997**

Prepared: 30 of 37

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recover of Nearshore Vertebrate Predators
Name: Alaska Department of Fish and Game Contractor

FORM 4B
Personnel
& Travel
DETAIL

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Long Distance phone/ fax | 0.9 |
| Freight/ shipping field gear and samples | 2.0 |
| Publication/ page charges | 0.2 |
| Sediment analysis (83 samples @ $60) | 5.0 |
| Contract with Coastal Resources Associates, Inc. (explained on form 4A, ADF&G Contractor, CRA) | 171.6 |
| **Contractual Total** | 179.7 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| SCUBA Supplies (misc. & 3 replacement suits @ $1500) | 5.0 |
| Lab supplies (alcohol; formalin; counters; vials; dishes; calipers) | 0.7 |
| Digimatic calipers | 0.8 |
| Field supplies (shovels, screens, hoses, rain gear) | 1.5 |
| **Commodities Total** | 8.0 |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recover of Nearshore Vertebrate Predators
Name: Alaska Department of Fish and Game Contractor

FORM 4B
Contractual & Commodities DETAIL

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **New Equipment Purchases:** Description | Number of Units | Unit Price | Proposed FFY 1997 |
|---|---|---|---|
| SCUBA Compressor | 1 | 12.0 | 12.0 |
| 14 ft. Achilles inflatable skiff | 3 | 3.0 | 9.0 |
| 25 hp outboard motor | 3 | 3.0 | 9.0 |
| | | | 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** | | 30.0 |

| Existing Equipment Usage: Description | Number of Units |
|---|---|
| | |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recover of Nearshore Vertebrate Predators
Name: Alaska Department of Fish and Game Contractor

FORM 4B
Equipment
DETAIL

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
|---|---|---|---|---|---|---|---|---|
| Personnel | | $104.6 | | | | | | |
| Travel | | $10.0 | | | | | | |
| Contractual | | $0.0 | | | | | | |
| Commodities | | $41.4 | | | | | | |
| Equipment | | $0.0 | | | | | | |
| Subtotal | $0.0 | $156.0 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| Indirect | | $15.6 | | | | | | |
| Project Total | $0.0 | $171.6 | | | | | | |
| Full-time Equivalents (FTE) | | 24.9 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments:

SU: Sea Urchin Studies
SF: Subtidal Fish Studies
DF: Harlequin Duck Food Studies
IC: Intertidal Clam Studies

**1997**

Prepared: 33 of 37

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recover of Nearshore Vertebrate Predators
Name: Coastal Resources Associates, Inc.
Agency: Alaska Department of Fish and Game Contractor

FORM 4A
Non-Trustee
SUMMARY

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| Personnel Costs: Name | Position Description | Months Budgeted | Monthly Costs | Overtime | Proposed FFY 1997 |
|---|---|---|---|---|---|
| **SU:** | **SU:** | | | | 0.0 |
| Dr. T Dean | Principal Investigator | 2.4 | 7.0 | | 16.8 |
| L. Deysher | Associate | 0.5 | 6.8 | | 3.4 |
| D Jung | Associate | 2.4 | 2.5 | | 6.0 |
| Vacant | Diver | 1.9 | 2.1 | | 4.0 |
| S Carlson | | 1.3 | 2.5 | | 3.3 |
| B Ladd | | 0.3 | 2.0 | | 0.6 |
| | Payroll Tax, Wkmn's Comp, Leave | | | | 4.5 |
| **SF:** | **SF:** | | | | 0.0 |
| Dr. T Dean | Principal Investigator | 1.9 | 7.0 | | 13.3 |
| Vacant | Technician 2 | 1.1 | 2.2 | | 2.4 |
| D Jung | | 2.3 | 2.5 | | 5.8 |
| S Carlson | | 1.1 | 2.5 | | 2.8 |
| B Ladd | | 0.3 | 2.0 | | 0.6 |
| | Payroll Tax, Wkmn's Comp, Leave | | | | 3.3 |
| **DF:** | **DF:** | | | | 0.0 |
| Dr. T Dean | Principal Investigator | 1.9 | 7.0 | | 13.3 |
| Vacant | Technician 2 | 1.3 | 2.1 | | 2.7 |
| D Jung | | 3.0 | 2.5 | | 7.5 |
| R Smith | | 0.5 | 2.2 | | 1.1 |
| B Ladd | | 0.3 | 2.0 | | 0.6 |
| | Payroll Tax, Wkmn's Comp, Leave | | | | 3.3 |
| **IC:** | **IC:** | | | | 0.0 |
| Dr. T Dean | Principal Investigator | 0.8 | 7.0 | | 5.6 |
| D Jung | | 0.8 | 2.5 | | 2.0 |
| S Carlson | | 0.5 | 2.5 | | |
| B Ladd | | 0.3 | 2.0 | | 0.6 |
| | Payroll Tax, Wkmn's Comp, Leave | | | | 1.1 |
| | Subtotal | 24.9 | 68.9 | 0.0 | |
| | | | | **Personnel Total** | 104.6 |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recover of Nearshore Vertebrate Predators
Name: Coastal Resources Associates, Inc.
Agency: Alaska Department of Fish and Game Contractor

FORM 4B
Personnel
& Travel
DETAIL



4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| Travel Costs: Description | Ticket Price | Round Trips | Total Days | Daily Per Diem | Proposed FFY 1997 |
|---|---|---|---|---|---|
| **SU:** | | | | | 0.0 |
| San Diego/ Anchorage/ San Diego | 0.6 | 3 | | | 1.8 |
| Per Diem | | | 8 | 0.1 | 0.8 |
| | | | | | 0.0 |
| **SF:** | | | | | 0.0 |
| San Diego/ Anchorage/ San Diego | 0.6 | 3 | | | 1.8 |
| Per Diem | | | 8 | 0.1 | 0.8 |
| | | | | | 0.0 |
| **DF:** | | | | | 0.0 |
| San Diego/ Anchorage/ San Diego | 0.6 | 3 | | | 1.8 |
| Per Diem | | | 8 | 0.1 | 0.8 |
| | | | | | 0.0 |
| **IC:** | | | | | 0.0 |
| San Diego/ Anchorage/ San Diego | 0.7 | 2 | | | 1.4 |
| Per Diem | | | 8 | 0.1 | 0.8 |
| | | | | | 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** | 10.0 |

**1997**

Prepared: 35 of 37

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recover of Nearshore Vertebrate Predators
Name: Coastal Resources Associates, Inc.
Agency: Alaska Department of Fish and Game Contractor

FORM 4B
Personnel & Travel DETAIL

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| | |
| **Contractual Total** | 0.0 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| All Projects: | |
| Office Supplies | 1.2 |
| Field Supplies | 1.6 |
| Computer Supplies | 2.6 |
| Copy Costs | 0.2 |
| Postage and Freight | 0.2 |
| Insurance | 11.0 |
| Physical Facilities | 17.6 |
| General Administrative | 7.0 |
| **Commodities Total** | 41.4 |

**1997**

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recover of Nearshore Vertebrate Predators
Name: Coastal Resources Associates, Inc.
Agency: Alaska Department of Fish and Game Contractor

FORM 4B
Contractual & Commodities DETAIL



4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **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 |
| 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 |
|---|---|
| | |

**1997**

Prepared: 37 of 37

Project Number: 97025
Project Title: Mechanisms of Impact & Potential Recover of Nearshore Vertebrate Predators
Name: Coastal Resources Associates, Inc.
Agency: Alaska Department of Fish and Game Contractor

FORM 4B
Equipment
DETAIL

4/15/96

# Monitoring of Cutthroat Trout and Dolly Varden Habitat Improvement Structures

| | |
|---|---|
| Project Number: | 97043B |
| Restoration Category: | Monitoring |
| Proposer: | USFS |
| Lead Trustee Agency: | USFS |
| Cooperative Agencies: | None |
| Alaska SeaLife Center: | |
| Duration: | 2nd year, 5-year project |
| Cost FY 97: | $24,000 |
| Cost FY 98: | $24,000 |
| Cost FY 99: | $18,400 |
| Cost FY 00: | $ 8,000 |
| Geography Area: | Western Prince William Sound |
| Injured Resource / Service | Cutthroat Trout and Dolly Varden |



## ABSTRACT

This project provides for monitoring of habitat improvement structures and their effects on cutthroat trout and Dolly Varden populations. These structures were installed in 1995 under EVOS Restoration Project number 95043B. There has been concern raised that habitat structures may inadvertently increase coho salmon populations, and thereby increase competition stress on Dolly Varden, and cutthroat trout populations. This monitoring will seek to address those questions, and concerns.

## INTRODUCTION

In 1989 the oil tanker *Exxon Valdez* ran aground on Bligh Reef spilling millions of gallons of crude oil into Prince William Sound (PWS). The ensuing oil spill damage assessment identified oil spill related injuries to the cutthroat trout (*Onchorhynchus clarki* ) and Dolly Varden char (*Salvelinus malma*) populations among other species in PWS. Information collected in 1989-1991 by the Natural Resources Damage Assessment (NRDA) studies documented lower growth rates for cutthroat trout and Dolly Varden char in oiled areas than in unoiled areas. The reduced growth rates persisted into 1991 when studies were discontinued. It is unknown if growth rates have since returned to normal. Mortality rates for sea-run Dolly Varden char in oiled areas were significantly higher than rates from sites in the non-oiled areas of eastern PWS (EVOS Trustee Council, 1994).

Cutthroat trout in PWS are at the northern extent of the species' North American range. Generally speaking, species inhabiting the extreme limits of their habitat exhibit higher sensitivities to environmental stresses than the same species well within the habitat limits. Little is known of the genetic diversity, distribution, or life histories of cutthroat trout in PWS. The cutthroat trout stocks known to exist within PWS are few in number and appear to be discrete populations with limited interbreeding with other cutthroat stocks. It is highly possible that there have been unique genetic adaptations in these populations due to local conditions and their relative isolation from other stocks. The population in a given stream system rarely number more than 1,000 individuals. Several stocks of cutthroats within PWS appear to be anadromous and have a limited home range within streams (Heggenes et al., 1991). The number of streams within PWS that have cutthroat trout populations is unknown. Of 143 streams surveyed for spawning salmon in 1989, anadromous cutthroat trout were found in only 10 streams. Both adults and subadults of anadromous populations migrate to the ocean for summer feeding (Trotter, 1989; Hepler et al, 1993). Emigration to saltwater occurs in early May through July (Hepler et al, 1993). They return to freshwater in July through November, peaking in September and October (Trotter 1989; Wedemeyer 1993). In Prince William Sound, field observations indicate cutthroat are spring spawners.

During the 1995 field season, USFS, Glacier Ranger District Fisheries crews installed a total of 63 habitat improvement structures at Otter Lake, Gunboat Lakes, Red Creek and Billy's Hole to improve cutthroat trout and Dolly Varden habitat in PWS. The distribution and abundance of cutthroat trout, Dolly Varden and coho salmon were monitored at these locations using standard mark recapture techniques to provide baseline information on the various systems prior to enhancement activities. The existing habitat at each project site was surveyed using a modified Hankin and Reeves (1988) methodology prior to and then again after structure installation to provide a basis of comparison.

The completed stream surveys were also used to determine the proper sampling distribution to trap fish in a stratified random sampling design within the affected stream reaches. Trapping effort was conducted proportional to the availability of the three major habitat types found in each sampling area.

Minnow traps were used to capture the juvenile fish, the trapping effectiveness varies with the stream characteristics at a particular location. It was assumed that a single minnow trap could effectively trap a $10m^2$ area of slow water habitat, and a linear 3m segment of fast water habitat. The difference in trapping effectiveness resulted in fewer traps being used to trap equal sized habitat units in slow water than in fast water providing an equal trapping effort for each habitat type.

The exception to this is the work done at Billy's Hole where initial sampling indicated cutthroat trout in numbers too low to be sampled in a statistically valid manner using the proposed mark recapture design. Nearly 100 traps were set at this location throughout the summer that resulted in the capture of only two cutthroat trout, both juveniles. Instead, trapping was conducted in a non- random manner to maximize capture for cutthroat trout throughout the entire project area prior to any construction. A catch per unit effort (CPUE) was calculated for each species at this location. Sampling in 1996 will follow this same design with the results dictating whether this location should be dropped from the 97 project proposal.
Bailey's modification of the Lincoln-Petersen Mark and Recapture model (as described in Kohler and Hubert, 1993) was used to estimate the populations of coho, cutthroat trout and Dolly Varden juveniles in the affected stream reaches and a coefficient of variation (CV) was calculated for each population estimate. This preliminary sampling produced population estimates for the most part with a CV value of greater than 0.20 which generally is inadequate and indicates low precision of the estimates. This was due to the small sample size (mostly of cutthroat trout) and the low numbers of recaptures. The sampling design for 1996 and this proposal has been modified to address this problem.

The modification will involve adding a second day of trapping during the recapture phase using the same techniques as discussed above thereby increasing the sample size during the recapture phase which should increase the precision of the estimates. Table one in Appendix A. summarizes the mark recapture and CPUE data collected in 1995 for each of the project locations.

Sampling by Glacier Fisheries Crews in 1994 and again in 1995 suggested that cutthroat trout densities were greatest in the moderate gradient tributary stream and in the upper reaches of the inlet streams at these locations. This is consistent with studies that have shown that cutthroat trout juveniles are pushed to less desirable habitats by the more dominant coho salmon juveniles (Glova and Mason, 1976). Interspecific competition with juvenile coho salmon is believed to limit cutthroat trout production in quality pool rearing habitat which is one of the key factors for cutthroat trout survival.

## NEED FOR THE PROJECT

### A. Statement of Problem

Limited information is available on the genetic diversity, distribution, competitive interactions or general life histories of cutthroat trout in PWS. In addition, there is concern that habitat enhancement structures installed under EVOS Project 95043B may inadvertently increase coho salmon populations thereby increasing competitive stress on cutthroat trout populations.

### B. Rationale/Links to Restoration

Additional information on cutthroat trout distribution, habitat utilization and competitive interaction with juvenile coho will assist managers in making decisions for future fisheries enhancement work that may affect cutthroat trout in PWS.

Monitoring prior to and after the installation of improvement structures will provide necessary information to ascertain the effectiveness of the various projects or of a particular structure.

### C. Location

Monitoring will occur at the project sites listed for the Cutthroat Trout / Dolly Varden Habitat Improvement Project, number 95043B.

Otter Creek, Bay of Isle, Knight Island, PWS.
Gunboat Creek, Eshamy Bay, Western PWS.
Red Creek, Esther Passage, NW., PWS.
Billy's Hole, Long Bay, Northern PWS.

## COMMUNITY INVOLVEMENT

On January 20 , 1994 letters were mailed to 156 individuals, agencies and organizations requesting comments on the proposed habitat enhancement for cutthroat trout in PWS that this proposal is designed to monitor.

In January of 1994, the "Chugach National Forest Schedule of Proposed Actions for Environmental Analysis" was mailed to more than 600 individuals, agencies and organizations. This document has since been mailed on a quarterly basis. The mailings included the PWS projects and a contact person for additional information concerning the project.

## PROJECT DESIGN

### A. Objectives

The objective of this project, in general, is to monitor and document the response of cutthroat trout to modifications made to their habitat by enhancement activities.

Specific objectives are:

1. Measure abundance and distribution of cutthroat trout, Dolly Varden and juvenile coho in the proposed project locations for the period specified.

2. Measure and monitor cutthroat trout, Dolly Varden and juvenile coho utilization of newly installed habitat improvements.

3. Measure and monitor the effects that structures have on adjacent aquatic microhabitats.

4. Provide annual project monitoring results.

5. Provide a project completion report and a summary of our findings on the effectiveness of the habitat structures installed in 95.

## B. Methods

The major hypotheses for this project is that the number of cutthroat trout at the project locations will increase due to the habitat improvements made in 1995. To test this hypotheses and meet the projects objectives five working hypotheses have been developed:

Hypotheses 1. The abundance of cutthroat trout at the project sites will increase over the project duration.

Hypotheses 2. The current distribution of cutthroat trout within the project area will change over the duration of the project.

Hypotheses 3. Cutthroat trout and Dolly Varden will be the predominant species to utilize the newly created habitat structures.

Hypotheses 4. Aquatic microhabitats adjacent to areas of improvement will be affected by the structures installed in 1995.

Hypotheses 5. The structures installed in 1995 benefited cutthroat trout at those project locations.

To test hypotheses number one through three, data on the relative abundance, distribution and habitat utilization of cutthroat trout at the project locations was collected during the 1995 field season and are proposed to be collected on an annual basis thereafter for the project duration.

Cutthroat abundance will be estimated using a method described in Hankin's (1986) report, *Sampling Designs for Estimating the Total Number of Fish in Small Streams.* The specific method will be of a two stage stratified random sampling design utilizing auxiliary variables to bias estimators. This method is described in detail as Design B: Ratio Estimation in Hankin's (1986) report. The technique for population estimation in each primary unit will be the mark-recapture method known as the Petersen Index using Bailey's 1951 formula to correct for bias, as described by Ricker (1975). Collection will be conducted using baited minnow traps and fish will be marked by caudal punches. Project area streams have been surveyed and habitats classified using a modified Hankin and Reeves (1988) methodology.

Stream habitat surveys were conducted during the early part of the 1995 field season in conjunction with the installation of the improvement structures. Data collected from the surveys has been analyzed and the associated habitat units characterized. Primary units (those to be sampled) were then selected by stratified random sampling. The strata consist of various pools, riffles, runs and glides that are then categorized as either slow, turbulent or non-turbulent habitat types, see Appendix A. for a description.

The trapping effectiveness of minnow traps varies with stream characteristics, this difference results in unequal trapping effort for various habitat types. To compensate for this, trapping effort is

conducted proportional to the availability of slow, fast and turbulent habitat types in each sampling area. For example, if slow water habitats comprised 30 percent of the total available habitat within a reach, 30 percent of the trapping effort was randomly placed in slow water habitats.

The percentage of a habitat type found within a given reach can be taken from the total area or length of a particular habitat type in that reach to produce a value that is proportional to the entire reach. It was assumed that a single minnow trap can effectively trap a $10m.^2$ area of slow water habitat, and a linear 3m. segment of fast water habitat types. Dividing the proportional value by the appropriate segment length provides the number of traps required to sample the proportional value. The sums of the areas for slow water types and the lengths for the fast habitat types are stratified into primary units based on the trapping segment lengths for each habitat type throughout the entire reach. From these segments a random selection of segments to be sampled is made that corresponds to the number of traps required to sample each habitat type. Traps are then randomly placed on the, right side, left side or center of the stream channel. Each season new sampling segments will be selected based on the method described above. If the areas where improvements occurred do not fall into the random samples they will be trapped separately. The amount of trapping effort is also being recorded at each location, since a proportional and equal trapping effort is being applied throughout the entire reach CPUE data will also provide trends in population structures and distribution for a given location.

These estimations should be done in mid to late summer to minimize bias due to seasonal migration of fish within the stream. Annual population estimates of the primary units for the project duration should provide enough information to detect a change in the relative abundance and distribution of cutthroat trout at the project sites. The improvement structures and their effects on adjacent habitat types will also be monitored by physical measurements and habitat classification. Additionally an annual photographic record of each structure will be established and maintained over the project duration.

Hankin in his (1986) report discusses errors of estimation of the total number of fish in a stream arising from two sources: (1) extrapolation from the small number of sampled sections to the entire stream, and (2) errors of estimated fish numbers within sampled sections. Hankin demonstrated that errors arising from the first source will usually be far grater than those from the second source, and that total errors of estimation can be reduced by making sampled sections equivalent to natural habitat units. By stratifying these habitat units and selecting sampling units randomly the precision of estimators can be improved and information on the distribution of cutthroat trout within the stream can be gathered.

Mark-recapture population estimates for primary units utilizing minnow trapping techniques will lead to errors in estimated fish numbers for sampled sections due to size selectivity and inefficiency of minnow traps to capture all individuals within a population. There is however a correlation between the sampled catch and the true population for a given size of individuals within a population. This is discussed in a 1976 paper by Arthur M. Bloom, *Evaluation of Minnow Traps for Estimating Populations of Juvenile Coho Salmon and Dolly Varden.* Cutthroat trout of 1+ age class fall within this size range. Though electrofishing is a more efficient means of sampling stream fish populations, currently ADF&G restricts the use of electrofishing in streams containing trout. We concur that it would not be wise to use electrofishing when working with a potentially threatened resource.

### C. Cooperating Agencies, Contracts, and Other Agency Assistance

This project will be implemented by the U.S. Forest Service no contracts are expected at this time.

## SCHEDULE

### A. Measurable Project Task for FY 97

April 15 (1997): Report on preliminary findings of population and distribution estimations.
August (1997): Inspect and measure effects of installed structures. Conduct population estimates of primary units.

### B. Project Milestones and Endpoints

August (1996): Inspect and measure effects of installed structures. Conduct population estimates of primary units.
April 15 (1997): Report on preliminary findings of population and distribution estimations. Objectives (1, 2, 3) partially completed. Objective (4) completed.
August (1997): Inspect and measure effects of installed structures. Conduct population estimates of primary units.
April 15 (1998): Report on preliminary findings of population and distribution estimations. Objectives (1, 2, 3) partially completed. Objective (4) completed.
August (1998): Inspect and measure effects of installed structures. Conduct population estimates of primary units.
April 15 (1999): Report on preliminary findings of population and distribution estimations. Objectives (1, 2, 3) partially completed. Objective (4) completed.
August (1999): Inspect and measure effects of installed structures. Conduct population estimates of primary units.
April 15 (2000): Provide a final report for peer review summarizing project results. This will satisfy objectives (1, 2, 3, 5).

### C. Completion Date

Baseline data was collected in 1995 prior to any effects from the habitat improvement work. Data to meet the project objective will be collected in 1996, 97, 98, with a final field survey in 1999. The final report summarizing the project results will be provided for peer review in the year 2000.

## PUBLICATIONS AND REPORTS

No professional publications are planned for at this time. The Forest Service does however understand that results from this project need to be shared with other resource managers to assist them in making decisions regarding enhancement activities where cutthroat trout are present. Annual Reports will be

prepared during each year of the project and provided to the Trustee Council by April 15 of the following year with a final report submitted for peer review by April 15, 2000.

## PROFESSIONAL CONFERENCES

At this time there are no plans to present this project at professional conferences. However a poster board display is planned for in 1996 with updates in 1997 for presentation at the District office and at science conferences.

## NORMAL AGENCY MANAGEMENT

This project provides for monitoring of habitat improvement structures and their effects on cutthroat trout and Dolly Varden populations. These structures were installed in 1995 under EVOS Restoration Project number 95043B. The Forest Service has focused on this species as a result of the injury incurred from the oil spill. The proposal is not part of the normal Forest outyear planning program, therefore no funds have been directed towards this project within the Forest Service budgeting process. Current budgets and Forest Service priorities would not provide an opportunity to conduct this project under normal agency management.

## COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The proposed project is an integration of project number 95043B, Cutthroat Trout and Dolly Varden Habitat Restoration in PWS. Additionally during the summer of 1994, the Forest Service made significant improvements to an existing fishway at Otter Creek, under EVOS Project 94139-B1 to facilitate pink salmon (*Onchorhynchus gorbuscha*) access to previously inaccessible spawning habitat. This project is designed to monitor the long term effects of implementing project number 95043B. The effects from project 94139-B at Otter Creek are beyond the scope of the proposal and will not be consider in the analysis. The proposal is a response from a primary land and resource manager (Forest Service) in Prince William Sound to the effects of the *Exxon Valdez* oil spill.

## EXPLANATION OF CHANGES IN CONTINUING PROJECTS

The FY97 and FY96 proposal differs only slightly. The schedule for report completion and submittal was changed from Dec. 15 to April 15 of that year to coincide with the Trustee Council required report dates. The monitoring plan design remains largely the same with the addition of a second day of trapping during the recapture phase to improve the statistical power of the population estimates.

**PROPOSED PRINCIPAL INVESTIGATOR**

Dan Gillikin, Project Leader
U.S. Forest Service
P.O. Box 129
Girdwood, AK 99587
(907) 783-3242
FAX: (907) 783-2094

**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.

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.

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Cliff Fox
U.S. Forest Service
P.O. Box 129
Glacier Ranger District
Girdwood, AK 99587
(907) 783-3242
FAX: (907) 783-2094

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Dan Gillikin, Project Leader
U.S. Forest Service
Glacier Ranger District
P.O. Box 129
Girdwood, AK 99587
(907) 783-3242
FAX: (907) 783-2094
E-Mail: Portage@Alaska.net

Ray Thompson, Project Manager
U.S. Forest Service
Chugach National Forest
3301 C Street, Suite 300
Anchorage, AK 99503
phone (907) 271-2500
FAX (907) 271-3992

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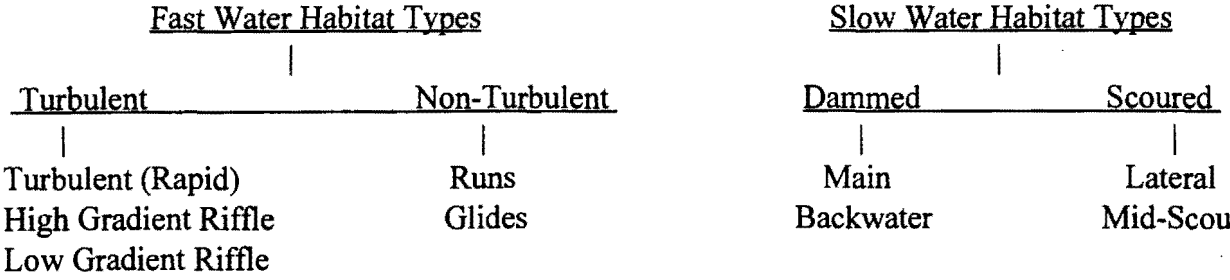
## APPENDIX A

**Table 1. Summary of mark recapture and CPUE data for project 95043B.**

| Project Location | Species | Pop. Est. of sample | Variance of Est. | Coefficient Variation | CPUE | Number of traps set |
|---|---|---|---|---|---|---|
| Otter Ck. | CO | 45 | 324 | 0.40 | 1.18 | 66 |
| | CT | 6 | 9 | 0.50 | 0.17 | 66 |
| | DV | 128 | 1536 | 0.31 | 2.49 | 66 |
| Gunboat | CO | 504 | 6720 | 0.16 | 3.25 | 152 |
| | CT | 50 | 300 | 0.35 | 0.38 | 152 |
| | DV | 48 | 768 | 0.58 | 0.21 | 152 |
| Red Ck. | CO | 14 | 0 | 0.00 | 0.19 | 188 |
| | CT | 105 | 1125 | 0.32 | 0.69 | 188 |
| | DV | 427 | 8169 | 0.21 | 2.35 | 188 |
| Billy's | CO | N/A | N/A | N/A | 14.64 | 82 |
| | CT | N/A | N/A | N/A | 0.71 | 82 |
| | DV | N/A | N/A | N/A | 35.36 | 82 |

**Chart 1. Description of habitat classification technique.**



## 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| Personnel | $18.0 | $15.0 | | | | | | |
| Travel | $3.4 | $0.4 | | | | | | |
| Contractual | $0.0 | $3.0 | | | | | | |
| Commodities | $4.1 | $3.1 | | | | | | |
| Equipment | $1.4 | $0.0 | | | | | | |
| Subtotal | $26.9 | $21.5 | | | | | | |
| General Administration | $2.7 | $2.5 | | | | | | |
| Project Total | $29.6 | $24.0 | $24.0 | $18.4 | $8.0 | | | |
| Full-time Equivalents (FTE) | 0.4 | 0.3 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments: This project is a continuation of 96043.

**1997**

Prepared:4/10/96



Project Number: 97043B
Project Title: CT/DV Habitat Monitoring
Agency: USFS

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/15/96

## 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| Personnel Costs: | | GS/Range/ | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | Step | Budgeted | Costs | Overtime | FFY 1997 |
| Vacant | Fish Biologist | GS-9 | 0.9 | 5.0 | | 4.5 |
| D. Gillikin | Fish Tech | GS-7 | 1.0 | 3.9 | | 3.9 |
| Seasonal | Fish Tech | GS-5 | 2.0 | 3.3 | | 6.6 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 3.9 | 12.2 | 0.0 | |
| | | | | | **Personnel Total** | $15.0 |

| Travel Costs: | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | FFY 1997 |
| ARR train pass | 20.0 | 10 | | | 200.0 |
| ARR train (vehicle) | 80.0 | 3 | | | 240.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | $440.0 |

**1997**

Prepared:



Project Number: 97043B
Project Title: CT/DV Habitat Monitoring
Agency: USFS

FORM 3B
Personnel
& Travel
DETAIL

4/15/96

**1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET**
October 1, 1996 - September 30, 1997

| **Contractual Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| Air charter, $250/hr @ 12 hrs | 3.0 |
| When a non-trustee organization is used, the form 4A is required. **Contractual Total** | $3.0 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| WCF boat fuel | 1.4 |
| WCF truck fuel | 0.2 |
| Camp supplies | 0.4 |
| Camp food | 0.5 |
| misc | 0.6 |
| **Commodities Total** | $3.1 |

**1997**

Prepared:



Project Number: 97043B
Project Title: CT/DV Habitat Monitoring
Agency: USFS

FORM 3B
Contractual &
Commodities
DETAIL

4/15/96

## 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| 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 |
| 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 |
|---|---|---|
| | | |

**1997**

Project Number: 97043B
Project Title: CT/DV Habitat Monitoring
Agency: USFS

FORM 3B
Equipment
DETAIL

Prepared: 4/15/96

# Analysis of Historical Sockeye Salmon Growth Among Populations Affected by Overescapement in 1989

Submitted Under the BAA
Announcement No. 52ABNF600073



| | |
|---|---|
| Project Number: | 97048 |
| Restoration Category: | Monitoring and Research |
| Proposer: | Dr. Gregory T. Ruggerone<br>Natural Resources Consultants, Inc.<br><br>Dr. Donald E. Rogers<br>Fisheries Research Institute<br>University of Washington |
| Lead Agency: | NOAA |
| Duration: | March 1997 to April 1998<br>2nd year, 2-year project |
| Cost FY 97: | $29,800 |
| Geographic Area: | Kenai River, Akalura Lake, Red Lake, Coghill Lake, Chignik Lake, Kasilof River, North Pacific Ocean |
| Injured Resource: | Sockeye salmon from Cook Inlet, Kodiak Island, Prince William Sound, and Chignik |

## ABSTRACT

Overescapement of sockeye salmon occurred in 1989 in several areas of Alaska as a result of the *Exxon Valdez* oil spill. Overescapement appears to have reduced salmon growth, leading to reduced survival in freshwater. However, the lack of information on marine survival of salmon confounds the interpretation of oil spill effects on adult sockeye returns. Our research has shown that scale growth of Chignik sockeye salmon during the first and second years at sea is correlated with adult returns. We propose to analyze marine growth of nine populations, including five populations affected by the Exxon Valdez oil spill, in an effort to separate freshwater and marine effects on adult returns. We also request modest supplemental funds for the completion of scale measurements from the 1996 and 1997 runs.

## INTRODUCTION

The Exxon Valdez Oil Spill Trustee Council (Trustee Council) has identified several sockeye salmon stocks that were influenced by overescapement related to the *Exxon Valdez* oil spill. Injured sockeye salmon stocks include sockeye from the Kenai River in Upper Cook Inlet, and Akalura Lake and Red Lake on Kodiak Island. Additionally, the Trustee Council is funding a restoration project on Coghill Lake near Prince William Sound (lake fertilization to enhance growth), although the declining sockeye runs have not been linked to the oil spill. Although the Trustee Council did not list Chignik Lake as a potentially injured lake, Chignik Lake received more than twice its escapement goal as a result of the oil spill in 1989. Monitoring of Chignik Lake in relation to the overescapement was not conducted prior to this investigation.

Overescapement of sockeye salmon in these lake systems has reportedly led to exceptionally high densities of salmon in the lakes, which in turn has caused reduced growth and survival in freshwater. Although the Alaska Department of Fish and Game (ADF&G) has described negative interactions between successive brood years of sockeye salmon in the Kenai River system, the relationship between sockeye fry abundance and weight in the lakes and resulting marine survival are largely unknown. The lack of information on marine survival prior to, during, and after the 1989 oil spill confounds analyses involving the effect of the oil spill on adult sockeye production.

In December 1996, the Trustee Council funded the project, "Historical Analysis of Sockeye Salmon Growth Among Populations Affected by Overescapement in 1989". Funding was received in March 1996 and the project has just begun. The primary objectives of this project, in addition to measuring sockeye scale growth corresponding to fresh and marine residence, were to:

1. Compare growth of sockeye salmon, as determined by scales measurements, from populations affected by overescapement or oil in the marine environment with that of sockeye salmon not affected

2. Determine the relative magnitude of reduced sockeye growth in freshwater or first year at sea as a result of overescapement or the presence of oil in the marine environment and evaluate the recovery of sockeye growth in years subsequent to the spill.

This project was designed to examine specific effects of the 1989 *Exxon Valdez* oil spill related to growth in freshwater and growth of Coghill sockeye in Prince William Sound. However, after attending the sockeye salmon workshop held at the *Exxon Valdez* Restoration Office, it became apparent that the lack of information on factors affecting sockeye survival at sea was a concern to the

technical committee. Without information on marine survival of salmon, it was difficult to separate freshwater effects from marine effects among adult salmon returning to the affected populations.

The goals of the proposed FY97 projects are to 1) acquire adequate funding to complete measurement of salmon scales from nine populations through return year 1997 (i.e., brood year 1991 or 1992), and 2) describe and compare trends in marine growth of each salmon population in relation to adult returns.

## NEED FOR THE PROJECT

### A. Statement of Problem

Supplemental Funds for Scale Measurements

Natural Resources Consultants (NRC) and the Fisheries Research Institute prepared the FY96 proposal with the following assumptions:

- The budget or proposal could be modified after the project was approved and made open to competitive bid.
- Funding would correspond to the beginning of the school year at the University of Washington
- Personnel at the University of Washington would not receive a substantial pay increase
- Scales would be provided on a timely matter without charge.

These assumptions were incorrect. The project was approved without going to open bid. This approval was appreciated, but the process did not allow us to modify the budget. For example, a detailed budget was never provided for scale measurements of sockeye returning in 1997. The delay in funding also caused Professor Rogers to incur additional costs associated with maintaining a graduate student for this project during fall and winter quarters, 1995-1996. Furthermore, in December 1995 the University of Washington (UW) provided a pay increase to all personnel, including a 22% increase to the employee assisting with scale measurements. Finally, we mistakenly assumed that ADF&G could send us scales on a timely basis; however, given the five month delay of the project and our need to "catch up", we have hired a technician to retrieve scales and associated age and length data from Upper Cook Inlet.

In short, we underestimated the cost to measure the sockeye scales through the year 1997. We therefore request modest funds for support of the technicians that will be measuring scales in 1997.

Analysis of Marine Growth of Sockeye Salmon

Investigators have been assessing the effects of overescapement on sockeye production in the Kenai River, Red Lake, and Akalura Lakes. Dana Schmidt, ADF&G, recently presented interesting findings from their research in Kenai and Skilak lakes regarding interaction between successive sockeye brood years. In short, Schmidt reported that the number of sockeye fry per spawner in Skilak and Kenai lakes during fall was positively related to the spring biomass of the dominant zooplankter, *Cyclops*. Schmidt reasoned that brood year interaction was occurring because most *Cyclops* have a two year life span so that the abundance of *Cyclops* during spring is dependent on the abundance of *Cyclops* during the previous fall, which is dependent on the abundance of sockeye fry during that fall. It was through this mechanism that Schmidt inferred that interaction was occurring between successive brood years of sockeye salmon.

While studies within the nursery lakes are very useful in the examination of escapement effects on juvenile salmon production, additional information is needed to clarify the relationship between spawning escapement and adult returns. Unfortunately, very little is known about year-to-year effects of ocean conditions on adult salmon production. Thus, separation of freshwater effects, such as overescapement, from marine effects is not possible. In other words, good conditions in the ocean may mask poor conditions in freshwater and vice versa.

## B. Rationale

Supplemental Funds for Scale Measurements

Modest additional funds are requested to offset unexpected expenses associated with the measurement of sockeye scales, especially those from the 1996 and 1997 return years. Essentially all supplemental funds for this task would be used for scale measurements; no funds are requested for the project Principal Investigators under this task.

Analysis of Marine Growth of Sockeye Salmon

Growth of sockeye salmon in the ocean, as estimated from adult scales, may be used as an index of conditions affecting salmon survival at sea. For example, Bumgarner (1993) demonstrated the positive relationship between scale growth of Chignik sockeye salmon during the first and second years at sea and adult returns to Chignik and Central Alaska (Fig. 1).

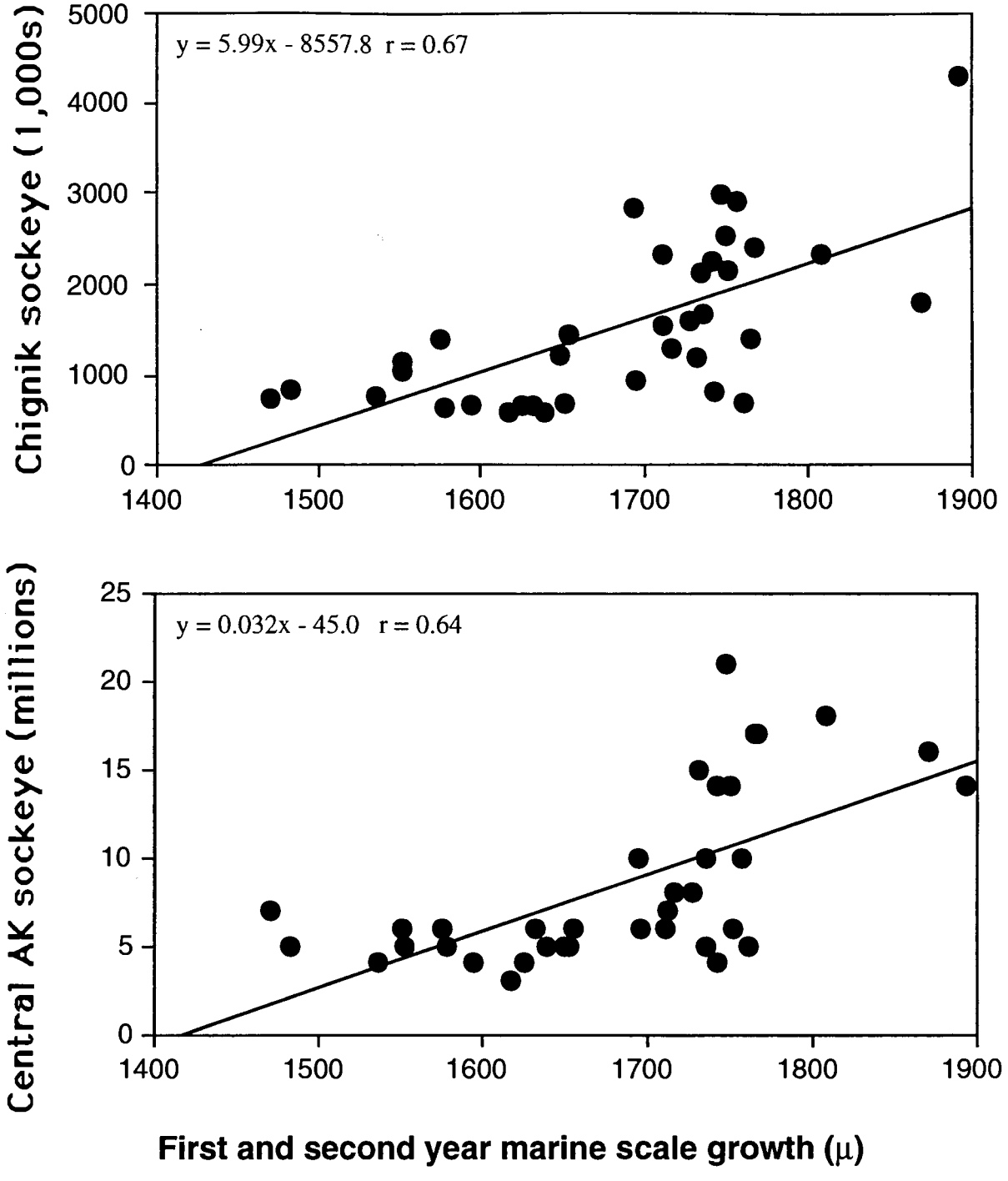



Fig. 1. Relationship between marine scale growth of Chignik sockeye (age-2.3 fish) and sockeye runs to the Chignik watershed and Central Alaska, 1955-1991.

It should be noted that these salmon were sampled from a purse seine fishery, which is not known to be selective for large or small sockeye salmon. Nevertheless, scale growth during the first and second years at sea was not correlated with final fish length ($r = -0.14$), indicating fish sampled from size-selective gill-net fisheries would not bias the results. Rogers and Ruggerone (1993) reported that variation in the final length of sockeye returning to Nushagak Bay was determined primarily during the homeward migration; final length of these fish was density-dependent.

If marine scale growth of sockeye salmon is correlated with run size of sockeye populations, then residuals from this relationship can be used to assess the direction and magnitude of ocean conditions affecting adult production. Correlations of marine growth between the nine stocks of sockeye salmon can be made; inferences about growth at sea, distribution, and survival may be drawn from relationships. These data can then be used to help separate freshwater and marine effects among adults returning from affected populations.

### C. Location

The geographical areas that will be investigated include the Kenai and Kasilof River systems in Cook Inlet, Red Lake and Akalura Lake on Kodiak Island, Coghill Lake in Prince William Sound, Chignik and Bear lakes on the Alaska Peninsula, and Nushagak Bay in Bristol Bay. All of these stocks inhabit the North Pacific Ocean, although the center of their distribution may vary somewhat (French et al. 1976, Ruggerone and Rogers 1994).

## PROJECT DESIGN

### A. Objectives

1. Measure annual and seasonal growth zones of sockeye salmon from nine populations during 1996 and 1997

2. Analyze and report on marine growth of sockeye scales in relation to adult run strength

### B. Methods

Supplemental Funds for Scale Measurements

Methods will be identical to those described in Project 96048.

Analysis of Marine Growth of Sockeye Salmon

Growth of salmon during each year at sea (typically three years plus spring migration period for the selected stocks) will be estimated from measurements of scales. Measurement of marine growth of scales is being made by Project 96048. Thus, funds for this task are for additional analyses of these data and manuscript preparation. Some of the text that follows reviews the methodology employed while measuring the sockeye scales.

Adult sockeye salmon scales will be obtained from ADF&G for each population described above. ADF&G collects these scales as part of their normal management activities. Scales are available back to 1970 for sockeye stocks in the Kenai River, Kasilof River, Chignik Lake, Black Lake, Nushagak Bay, and to 1976 for sockeye in Coghill Lake. Red Lake, Akalura, and Bear Lake scales are available back to approximately 1980-1985.

Approximately 100 scales from the dominant age group of each stock, each year will be measured during Project 96048. This sample size was determined to be adequate by Zimmermann (1991). The scales will be measured by the Optical Pattern Recognition System (OPRS) at Dr. Donald E. Rogers' scale laboratory at the University of Washington. The scale measurement methodology will follow that described by Zimmermann (1991) and Bumgarner (1993), who were graduate students supervised by Dr. Rogers and Dr. Ruggerone.

Annual frequency distributions of scale measurements related to marine growth will be plotted and analyzed for normality. Skewness of the frequency distributions may indicate size-biased mortality. Scale growth within each year at sea and cumulative growth will be regressed on age-specific stock run size and on total sockeye production in Central Alaska. A time series of residuals from these regressions can be used to assess ocean conditions influencing survival during and after the 1989 oil spill.

Correlations in growth at sea will be made between the nine populations. Inferences about growth, distribution, and survival will be made.

We plan to publish the results of the investigation in a peer-reviewed journal and to present the results in at least one conference.

### C. Cooperating Agencies

The proposed project is a continuation of project 96048, which is a joint effort between Natural Resources Consultants (NRC) and Fisheries Research Institute (FRI), University of Washington. ADF&G is assisting this project by providing scale impressions collected from the nine sockeye populations.

Supplemental funds are requested in order to complete scale measurements through year 1997. Nearly all of these funds would go FRI. Funds to analyze and report on marine aspects of the scale database would be shared by the project Co-PI's at FRI and NRC.

## SCHEDULE

### A. Measurable Project Tasks for FY97

| | |
|---|---|
| March - June 1997: | Complete measurements of 1996 scales |
| September - December 1997: | Complete measurements of 1997 scales |
| December 1997 - April 1998: | Analyze and report on marine aspects of scale growth; prepare manuscript for journal publication. |

### B. Project Milestones and Endpoints

| | |
|---|---|
| December 1997: | Complete measurements of all scales |
| April 1998: | Complete manuscript and submit for publication |

### C. Completion Date

April 1998

## PUBLICATIONS AND REPORTS

Analysis and report preparation will be completed during FY97 and early FY98. We anticipate that a final report would be prepared by April 1998.

We plan to publish the results of the investigation in a peer-reviewed journals. We envision at least two publications: one involving freshwater aspects of scale growth measurements (96048) and the other involving marine aspects of sockeye growth (97048). Funding of 97048 would facilitate publication of these investigations.

## PROFESSIONAL CONFERENCES

Dr. Ruggerone plans to present the results from this project at a conference. Funding for a conference presentation was not budgeted in 96048. Funding of 97048 would facilitate presentation at a conference. A conference has not been selected at this time; we anticipate presenting this study at a conference on the west coast during late 1997 or 1998.

## COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This study is complementary to the overescapement studies being conducted by ADF&G on Kenai River system, Akalura Lake, and Red Lake. Much of the information collected by these ADF&G projects have been shared with NRC. Projects 96048 and 97048 also provide information on the effects of the *Exxon Valdez* oil spill on the Chignik Lake population, which has received essentially no investigation.

## EXPLANATION OF CHANGES IN CONTINUING PROJECTS

### Supplemental Funds for Scale Measurements

The budget prepared during May 1995 underestimated the cost of measuring scales through return year 1997. The underestimated budget is related to startup delay from October 1995 to March 1996 and an unexpected, large (22%) pay increase at the University of Washington. Supplemental funding for scale measurements represents 37% of the 97048 budget; this task is considered our highest priority.

### Analysis of Marine Growth of Sockeye Salmon

Project 96048 was designed to examine the effects of the 1989 *Exxon Valdez* oil spill by extending the database of sockeye growth in freshwater back to 1970, depending on the availability of scales from each population. Although project 96048 was funded to measure both freshwater and marine portions of sockeye scales, the analysis was to involve the freshwater zones, plus the first year at sea measurements in relation to Coghill sockeye interaction with oil in Prince William Sound.

Both Dr. Ruggerone and Dr. Rogers have a strong interest in the marine growth of sockeye salmon (e.g., Rogers and Ruggerone 1992). After attending the sockeye salmon workshop held at the *Exxon Valdez* Restoration Office in October 1995, it became apparent that factors affecting sockeye survival at sea confounded the evaluation of salmon stocks recovering from the *Exxon Valdez* oil spill. Project 97048 is designed to address examine growth at sea as an indicator of ocean conditions so that freshwater effects can be separated from marine effects.

## PRINCIPAL INVESTIGATORS

Gregory T. Ruggerone, Ph.D.
Natural Resources Consultants, Inc.
4055 21st Avenue West
Seattle, WA 98199
(206) 285-3480
(206) 283-8263
e-mail: GRuggerone@aol.com

Donald . Rogers, Ph.D.
Fisheries Research Institute
University of Washington
Seattle, WA 98195
(206) 543-7628
(206) 543-7628

## PERSONNEL

The project will be conducted by Dr. Gregory T. Ruggerone, Natural Resources Consultants, and Dr. Donald E. Rogers, Fisheries Research Institute, University of Washington. Both Ruggerone and Rogers have extensive first-hand experience with interpretations of scale measurements and have published several papers involving sockeye salmon scales. This team offers excellent qualifications and has available the needed equipment to conduct the investigation.

Dr. Gregory T. Ruggerone conduct the data analysis and manuscript preparation. He has extensive experience with scale aging and measurement techniques. In 1981, he assisted the stock identification program by scale pattern analysis in the Upper Cook Inlet Management Area. In 1984 and 1985, he performed scale measurements of adult Chignik sockeye salmon for stock management applications (Conrad and Ruggerone 1984). He has guided graduate students at the University of Washington in major studies involving life history interpretations from sockeye salmon scales collected from the Wood River Lakes and Chignik Lakes (Zimmermann 1991, Bumgarner 1993, Ruggerone 1994). Recently he used scale measurements to assess density-dependent growth of Bristol Bay sockeye salmon in the Pacific Ocean (Ruggerone and Rogers 1993). A manuscript on freshwater growth of sockeye from the Nushagak District of Bristol Bay is now in review (Zimmermann et al, in review). Another manuscript involving marine growth of Chignik sockeye salmon is in preparation (Bumgarner et al., in review).

Dr. Donald E. Rogers, University of Washington, will assist with project coordination and the interpretation of sockeye salmon growth measurements. Dr. Rogers has over 35 years experience with sockeye salmon in Alaska. He has been the chairperson of five graduate students whose theses were based on scale measurements.

## LITERATURE CITED

Bumgarner, J.D. 1993. Long-term trends in the growth of sockeye salmon from the Chignik Lakes, Alaska. M.S. Thesis. University of Washington, Seattle.

Bumgarner, J.D. In preparation. Early marine growth and adult returns of sockeye salmon to the Chignik Lakes, Alaska. In preparation.

Conrad, R.H., and G.T. Ruggerone. 1985. Stock composition of the 1984 sockeye salmon run to the Chignik Lakes estimated using scale patterns and linear discriminant functions. Alaska Dept. Fish and Game Technical Report No. 151. 43 pp.

French, R., H. Bilton, M. Osako, and A. Hartt. 1976. Distribution and origin of sockeye salmon in offshore waters of the North Pacific Ocean. INPFC Bulletin No. 34. Vancouver, Canada.

Rogers, D.E., and G.T. Ruggerone. 1993. Factors affecting the marine growth of Bristol Bay sockeye salmon. Fisheries Research. 18: 89-103.

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Willette, M. 1993. Impacts of the *Exxon Valdez* oil spill on migration, growth, and survival of pink salmon in Prince William Sound. Pp. 112-114 in *Exxon Valdez* Oil Spill Symposium. Anchorage, Alaska.

Zimmermann, M. 1991. Trends in the freshwater growth of sockeye salmon from the Wood River Lakes and Nushagak Bay, Alaska. M.S. Thesis. University of Washington, Seattle.

Zimmermann, M., G.T. Ruggerone and D.E. Rogers. 1996. Trends in the freshwater growth of sockeye salmon from Nushagak Bay, Alaska, 1907 - 1984. In review.

Gregory T. Ruggerone, Principal Investigator
Natural Resources Consultants, Inc.
4055 21st Avenue West
Seattle, WA 98199
(206) 285-3480
(206) 283-8263
e-mail: GRuggerone@aol.com

April 9, 1996
Date prepared

# 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| Budget Category: | Authorized FFY 1996 | Proposed FFY 1997 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Personnel | $67.7 | $20.1 | | | | | | |
| Travel | $2.3 | $0.3 | | | | | | |
| Contractual | | $0.0 | | | | | | |
| Commodities | $2.3 | $0.0 | | | | | | |
| Equipment | | $0.0 | LONG RANGE FUNDING REQUIREMENTS | | | | | |
| Subtotal | $72.3 | $20.4 | Estimated FFY 1998 | Estimated FFY 1999 | Estimated FFY 2000 | Estimated FFY 2001 | Estimated FFY 2002 | |
| Indirect | $29.4 | $9.4 | | | | | | |
| Project Total | $101.7 | $29.8 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | |
| Full-time Equivalents (FTE) | 13.0 | 4.0 | | | | | | |
| | Dollar amounts are shown in thousands of dollars. | | | | | | | |
| Other Resources | | | | | | | | |

Comments: Indirect rates: NRC: 44.6% of salary, 5% of travel, subcontracts, etc., UW: 48.5% of total direct.
Fringe benefits, such as FICA and health insurance, are included in the personnel rates of NRC and UW employees.

The task to complete scale measurements represents $10,770 of the total budget shown above.

**1997**

Prepared: 9 April 1996

Project Number: 048
Project Title: Analysis of Historical Sockeye Salmon Growth Among Populations Affected by Overescapement
Name: Natural Resources Consultants, Inc.

FORM 4A
Non-Trustee
SUMMARY

## 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 1996 - September 30, 1997

| Personnel Costs: | | | Months | Monthly | | Proposed |
|---|---|---|---|---|---|---|
| Name | Position Description | | Budgeted | Costs | Overtime | FFY 1997 |
| G. Ruggerone, Ph.D. | Principal Investigator | | 1.0 | 9.4 | 0.0 | 9.4 |
| | | | | | | 0.0 |
| D. Rogers, Ph.D. | Co-Principal Investigator | | 0.5 | 7.3 | 0.0 | 3.7 |
| | | | | | | 0.0 |
| K. Ramstad | Research Assistant (includes tuition fees) | | 2.5 | 2.8 | 0.0 | 7.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 4.0 | 19.5 | 0.0 | |
| | | | | | **Personnel Total** | $20.1 |

| Travel Costs: | | Ticket | Round | Total | Daily | Proposed |
|---|---|---|---|---|---|---|
| Description | | Price | Trips | Days | Per Diem | FFY 1997 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| Conference attendance and presentation | | | | 3 | 0.1 | 0.3 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | **Travel Total** | $0.3 |

**1997**

Prepared: 9 April 1996

Project Number: 048
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Name: Natural Resources Consultants, Inc.

FORM 4B
Personnel
& Travel
DETAIL

## 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| **Contractual Costs: None** | Proposed |
|---|---|
| Description | FFY 1997 |
| | 0.0 |
| **Contractual Total** | $0.0 |

| **Commodities Costs:** | Proposed |
|---|---|
| Description | FFY 1997 |
| | |
| **Commodities Total** | $0.0 |

**1997**

Prepared: 9 April 1996

Project Number: 048
Project Title: Analysis of Historical Sockeye Salmon Growth Among Populations Affected by Overescapement
Name: Natural Resources Consultants, Inc.

FORM 4B
Contractual & Commodities DETAIL

# 1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

| New Equipment Purchases: None<br>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 |
| Those purchases associated with replacement equipment should be indicated by placement of an R. | | **New Equipment Total** | $0.0 |

| Existing Equipment Usage:<br>Description | Number of Units | |
|---|---|---|
| | | |

**1997**

Prepared: 9 April 1996

Project Number: 048
Project Title: Analysis of Historical Sockeye Salmon Growth Among Populations Affected by Overescapement
Name: Natural Resources Consultants, Inc.

FORM 4B
Equipment
DETAIL