19.07.01

FY 98 Final Work Plan

Approved DPDs and Budgets

FY 98 WORK PLAN
INDEX OF DETAILED PROJECT DESCRIPTIONS/BUDGETS (Funded 8/6/97 & 12/18/97)

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Approved TC 8-6-97

Recovery of Harbor Seals from EVOS: Condition and Health Status

Project Number:	98001 - Closeout
Restoration Category:	Research
Proposer:	University of Alaska Fairbanks
Lead Trustee Agency:	ADFG
Cooperating Agencies:	None
Alaska SeaLife Center:	
Duration:	4th year, 4-year project
Cost FY 98:	$51,100
Geographic area:	Prince William Sound
Injured Resource:	Harbor seal

ABSTRACT

Project 98001 will provide the final analysis for three years of field work that sampled harbor seals for condition and health status. It will close out 95–97001 and provide analysis of late arriving samples, completion of analytical and statistical tests, the production of final reports and publication of research papers.

INTRODUCTION

HISTORY OF PROGRAM. This project is the final year of a four year program that focused on quantifying the health and body condition of harbor seals both inside and outside of Prince William Sound (PWS). The central hypothesis of the program 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?

This program was completed with significant logistical and scientific collaboration from project /064 which dealt with monitoring population levels, habitat use and trophic interactions of harbor seals. Project /064 provided 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 were to investigate ecosystem-wide questions addressing the recovery of harbor seals. These issues included the direct impact of oil spills, human interactions, food, competition, climatic factors, disease and habitat loss. Beginning with 96001, we initiated a collaborative study with the Alaska Native Harbor Seal Commission (ANHSC) to obtain harbor seal blubber samples from Native hunters through projects /052A, /210 and /244. This BIOSAMPLING program has been extremely successful and we anticipate that new samples will be provided during late 1997 and early 1998 for inclusion in the close out year for 98001.

The initial year (95001) began our work on body condition and blood chemistry indicators of nutritional problems, disease, and food limitation for harbor seals. We took blood and blubber samples and measured and weighed seals. These samples were analyzed at UAF and models of body shape, blubber thickness and body condition were generated and tested. We set up identical sampling protocols in collaboration with ADF&G for harbor seals outside of PWS and collected samples from southeast Alaska and around Kodiak for comparative purposes.

Project 96001 was modified by combining it with 95117-BAA and therefore gained an additional component that examined blubber chemistry in harbor seals from contemporary samples and in historical samples of blubber collected from before the *Exxon Valdez* Oil Spill (EVOS). The central hypothesis was 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.

The final year of field work, funded through 97001, is currently active. Its major components include blood and blubber sampling through various seasons, the capture of juvenile harbor seals in conjunction with 97064, expanded collaboration with the ANHSC and analytical tests on archived samples of blood and blubber. Brian Fadely, the primary Ph.D. student involved in this work, will graduate in the summer of 1997.

We anticipate that 98001 will focus mainly on the analysis of late arriving blubber samples collected through projects /052A, /210 and /244, the final writing and analysis of results from the three field seasons, production of reports, presentation of data and publication of peer-reviewed articles.

RESULTS FROM PREVIOUS SUPPORT. An annual report with detailed results of 95001 has been accepted by the Trustee Council. The annual report for 96001 is being prepared and project 97001 is currently active. The following major points should be stressed at this time.

We now have the largest data base of blood chemistry, body condition, morphometrics and blubber chemistry on a population of harbor seals ever collected. In some categories, we have over 800 samples. This has enabled us to make robust statistical comparisons of seasonal, regional and individual animal differences in several critical health parameters. Two papers have been published (1, 2), another is in review (3), a Ph.D. is essentially finished and we are now consulting with the National Marine Fisheries Service to assist in setting national health standards for seals and sea lions. The primary blood chemistry findings indicate significant distinctions between seals collected from different regions of PWS. These regional differences coincide with EVOS funded SEA results showing differences in forage fish availability. The results do not indicate that the harbor seals are "sick", but that there are relationships between what the seals are consuming and the corresponding biomarkers that we survey. However, we have also seen biomarkers that suggest adult seals inside PWS may be confronted with a chronic agent or stressor that induces a whole body inflammatory response (2). This pattern has been consistent over time and remains different from animals outside the Sound. This same marker can also be used to differentiate the declining population of Steller sea lions (2). New evidence also indicates that some seals in PWS may be faced with heavy metals or other agents that induce anti-oxidant reactions, but this information is very preliminary and not yet strong enough for further discussion.

There is a significant limitation to our interpretation that cannot be addressed using the current data set: all of our work has focused on adult harbor seals, not pups or juveniles. By design, projects /064 and /001 aimed to capture, sample and model adult harbor seals to test if they were healthy. We do not know if juvenile animals are food stressed or if pups are born healthy or compromised. This will be addressed during the last field season of 97001 as we modify the sampling date and methods in order to capture young pups. We will be submitting new proposals to examine pup biology in FY98, but the conclusions from /001 can only be applied to adult animals.

Given these limitations, the results from this project provide a substantial basis for interpreting the ecological relationships of adult harbor seals in PWS. Overall, our results indicate that adult harbor seals are not food stressed in PWS, but that there are natural variations in health indices that reflect environmental, seasonal and geographic differences.

NEED FOR THE PROJECT

A. Statement of Problem

Prince William Sound harbor seal populations have shown no signs of population recovery (4). The recovery of animals inside PWS is complicated by a general decline in all Alaskan harbor seals, but the decline in the Sound was accelerated after the EVOS event. Our contribution to the study of PWS harbor seals was to address the issue of whether adult animals were healthy,

how they compared in body condition to animals outside the Sound — to animals collected before the spill and to other species. It should be noted that our laboratory conducts similar studies on many species of seals and sea lions around the world and that the harbor seal data are being used in models of general pinniped health issues.

B. Rationale

The rationale for this project has been the hypothesis that there may be a health and/or food problem that has inhibited the recovery of harbor seals in PWS. This hypothesis can be addressed by obtaining blood and tissue samples along with behavioral/feeding data (/064) and comparing the medical/physiological data to control populations both inside and outside of the Sound. A central point to our study has been that indices used to assess body condition may also vary with season, age, or sex (5–8) 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 (9–13). 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 (14–16). We have been extremely successful in modeling these types of ranges and variations in 95001 and 96001

C. Location

The field efforts supported directly by projects 95–97001 have taken place in PWS at many sites. Samples were also obtained through collaborative non-EVOS agreements with ADF&G from Kodiak and Southeast. Collaborative work with Native hunters provided samples from throughout PWS and other regions of Alaska.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

We have been very fortunate in our interactions with the Native community regarding the health of harbor seals. Through the BIOSAMPLING program, the Alaska Native Harbor Seal Commission and the Youth Area Watch, we have been able to obtain a tremendous number of carefully collected blubber specimens from harbor seals. We would never have been able to collect such a large and diverse sample through routine methods. In addition, by combining this work with analysis of TEK through the WHISKERS data base, we have been able to see patterns in harbor seal body condition that were previously impossible to model. On the basis of this work, we were invited to present our data both in 1996 and 1997 to the ANHSC and we hope to do so again in 1998.

PROJECT DESIGN

A. Objectives

The objectives of this program were initially determined in 95001 and 95117-BAA. They were modified when the two projects were combined and again when the BIOSAMPLING program was initiated. In 97001, we predicted that we would begin work on captive harbor seals during FY98 at the ASLC. We have removed this objective from 98001, but will propose it under a new submission.

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. (Dropped from 98001)

B. Methods

Most of the field operations will be concluded during 97001. The methodologies required under 98001 relate mainly to analysis of blubber samples coming from the BIOSAMPLING program and to statistical analyses of our collected data. We have not encountered any unanticipated problems in our field, laboratory or analytical methods and feel that the final work should proceed smoothly. There was some concern in 97001 that the 20 year old archived blubber samples would not be of high enough quality for analysis. This was not the case however, as they were well preserved and proved extremely valuable.

Because the primary Ph.D. student involved in this work (Brian Fadely) will graduate in the summer of 1997, he will be available for the final field season of 97001, but not for the work to be done under 98001. His thesis will form the core of the final EVOS report, but we will need a new

student to work in the laboratory and on the computer data base for the final reports and publications.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

As noted above, this project worked in close collaboration with /064 in the field efforts necessary to collect the animals and with the BIOSAMPLING program to collect blubber samples.

SCHEDULE

A. Measurable Project Tasks for FY98 (October 1,1997 - September 30, 1998)

There are five tasks for 98001.

October 1 - December 31: Obtain and analyze final blubber samples through ANHSC
October 1 - January 31: Final statistical analysis of health data
February 1 - April 15: Production of Final Report
April 15 - June 30: Submission of journal articles
July - September: Close out project, archive data, publish articles.

B. Project Milestones and Endpoints

All the primary objectives of /001will be completed by the end of 98001 including the tasks noted above. The milestones will include reports, manuscripts and professional presentations.

C. Completion Date

The /001 program will end on September 30, 1998.

PUBLICATIONS AND REPORTS

Papers currently submitted that will appear in FY98 if accepted:

Zenteno-Savin, T. and M.A. Castellini. Plasma angiotensin II, arginine vasopressin and atrial natriuretic peptide in free ranging and captive seals and sea lions. Submitted. Comparative Biochemistry and Physiology. Feb. 1997.

Planned FY98 submissions:

Fadely, B.S. and M.A. Castellini. Plasma chemistry and hematology ranges of Gulf of Alaska harbor seals. Canadian Journal of Zoology.

Fadely, B.S. and M.A. Castellini. Effects of body shape and blubber distribution on the performance of condition indices in harbor seals. Physiological Zoology.

Fadely, B.S., J.M. Castellini and M.A. Castellini. Compositional analysis of harbor seal blubber and implications for indexing condition. Comparative Biochemistry and Physiology.

PROFESSIONAL CONFERENCES

Travel has been requested for the PI to attend the ANHSC meetings in March of 1998 to present data on blubber samples collected through the BIOSAMPLING program. The PI is also working with the National Marine Fisheries Service on establishing national guidelines for seal and sea lion health, but travel for these workshops is paid by NOAA.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

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

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

The only changes in 98001 that were not in the original proposal are the alterations to include blubber samples brought in from the BIOSAMPLING program which was created after /001 was initiated and the decision to capture seal pups instead of adults in the last season. Otherwise, there are no alterations in the project.

PROPOSED PRINCIPAL INVESTIGATOR

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Approved R 8-6-97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel	$0.0	$0.0
Travel	$0.0	$0.0
Contractual	$179.4	$47.8
Commodities	$0.0	$0.0
Equipment	$0.0	$0.0
Subtotal	$179.4	$47.8
General Administration	$12.6	$3.3
Project Total	$192.0	$51.1
Full-time Equivalents (FTE)	6.9	2.3

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	

Dollar amounts are shown in thousands of dollars.

Other Resources

1998

Prepared: 9-Apr-97 4/15/97

Project Number: 98001-CLO
Project Title: Recovery of Harbor Seals from EVOS: Condition and Health Status
Agency: Alaska Dept. of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

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

Budget Category:	Authorized FFY 1997	Proposed FFY 1998	LONG RANGE FUNDING REQUIREMENTS					
Personnel	$114.4	$32.7						
Travel	$5.8	$1.3						
Contractual	$13.4	$3.4						
Commodities	$17.3	$0.8						
Equipment	$0.0	$0.0						
Subtotal	$150.9	$38.2	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003	Estimated FFY 2004
Indirect	$37.7	$9.6						
Project Total	$188.6	$47.8						
Full-time Equivalents (FTE)	3.9	1.3						
	Dollar amounts are shown in thousands of dollars.							
Other Funds								

Comments:

Indirect costs are 25% Total Direct Cost, the rate negotiated by the EVOS Trustee Council with the University of Alaska.

Publication costs for report writing are $250 and for other peer-reviewed publications are $1250.
The cost for workshop attendance is $600.
No increases have been made over the projections made in FY 97.

1998

Prepared: 7-Apr-97 4/15/97

Project Number: 98001-CLO
Project Title: Recovery of Harbor Seals from EVOS: Condition and Health Status
Name: University of Alaska, Fairbanks

FORM 4A
Non-Trustee
SUMMARY

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

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FFY 1998
Mike Castellini	Principle Investigator		1.0	7.3		7.3
J.M. Castellini	Research Associate		2.0	3.7		7.4
Vacant	Master's Student		12.0	1.5		18.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		15.0	12.5	0.0	
					Personnel Total	$32.7

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1998
					0.0
EVOS workshop January 1998 - Principal Investigator - Fbks/Anch	0.2	1.0	4.0	0.1	0.6
					0.0
Alaska Native Harbor Seal Commission - Biossampling Report Fbks/Cordova	0.3	1.0	4.0	0.1	0.7
				Travel Total	$1.3

1998

Prepared: 7-Apr-97 4/15/97

Project Number: 98001-CLO
Project Title: Recovery of Harbor Seals from EVOS: Condition and Health Status
Name: University of Alaska, Fairbanks

FORM 4B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed
Description	FFY 1998
Bomb calorimetry to analyze blubber - 50 samples @ $20	1.0
Long distance phone and communication	0.3
Package delivery, courier (FedEx, DHL, etc.)	0.3
Microscopy - 50 samples @ $5	0.3
Publication/page charges	1.5
Contractual Total	$3.4

Commodities Costs:	Proposed
Description	FFY 1998
Organic solvents for lipid extraction of blubber samples	0.2
Laboratory expendables necessary for chemical analysis of blubber samples	0.3
Computer supplies necessary for database management, analysis and publication preparation	0.3
Commodities Total	$0.8

1998

Project Number: 98001-CLO
Project Title: Recovery of Harbor Seal from EVOS: Condition and Health Status
Name: University of Alaska, Fairbanks

FORM 4B
Contractual & Commodities DETAIL

Prepared: 7-Apr.97 4/15/97

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

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

Existing Equipment Usage: Description	Number of Units	

1998

Project Number: 98001-CLO
Project Title: Recovery of Harbor Seals from EVOS: Condition and Health Status
Name: University of Alaska, Fairbanks

FORM 4B
Equipment
DETAIL

Prepared: 7-Apr-97
4/15/97

Revised 6/24/97
Approved TC 8/6/97

Archaeological Index Site Monitoring

Project Number:	98007A
Restoration Category:	Monitoring
Proposer:	D. Reger/ADNR
Lead Trustee Agency:	ADNR
Cooperating Agencies:	DOI, USFS
Alaska SeaLife Center:	No
New or Continued:	Cont'd
Duration:	4th yr. 8 yr. project
Cost FY 98:	$139.7
Cost FY 99:	$151.5
Cost FY 2000:	
Cost FY 01:	
Cost FY 02:	
Geographic Area:	Prince William Sound, Kenai Peninsula, Kodiak Island
Injured Resource/Service:	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 reintroduced oil. This project will end in FY 99 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. Damage at monitored sites continues and confirms that vandals 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 1998.

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 1998 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) are 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 1998. Sites in Prince William Sound will include SEW-004, SEW-469 and SEW-440. The Outer Kenai Peninsula site is SEL-178. In the Kodiak Island area sites AFG-082, AFG-084, and AFG-160 will be visited by the State. The U.S. Fish and Wildlife Service will visit KOD-099, KOD-100, and KOD-171.

NEED FOR THE PROJECT

A. Statement of Problem

Sites monitored under project 98007 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/Link to Restoration

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. Sites in the area continue to be lost to erosion, making loss from this human degradation more critical. Archaeological injuries will be considered restored under the EVOS Restoration Plan when vandalism has been reduced to pre-Spill levels.

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.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The sites being monitored under this project are remote. Monitoring of the sites will not effect any resources other than archaeological resources. Reporting on findings will not involve significant use of traditional ecological knowledge.

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. Several sites from newly acquired habitat areas have been included with previously identified sites. The aim of including those sites is to provide a check on the continued value of the index site strategy. 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. Radiocarbon datable material will be retrieved from sites which have been vandalized to assess the nature, age, and value of disturbed deposits. Procedures for assessing the amount of damage to vandalized sites are provided in implementing regulations for the Archaeological Resources Protection Act. Sites examined on newly acquired land will be documented including radiocarbon sampling and sediment samples for oil detection. Assessment of current status will reveal changes from when Exxon archaeologists visited the sites.

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 1998 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-004 This cave site was documented during the Spill cleanup period as being heavily vandalized at an earlier time. Crews were ordered to avoid that part of the island but were housed in the area. A visit needs to be made to determine whether vandalism has occurred since.

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. Additional damage occurred during 1996.

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 1996. Replacement of the restorative cover will be necessary during 1997. Site status will be re-checked during 1998 and documented through photography.

AFG-084 This location is a house pit site with accompanying midden in Shangin Bay on Shuyak Island. The site was examined by Exxon archaeologists in 1989 and vandalism has been reported (Exxon Segment file notes). The extent of the vandalism is unknown.

AFG-160 The Tetrakof House Pit Site was noted by Exxon archaeologists (Abbott, 1989) as having midden exposed and evidence of vandalism present (McMahan, 1993: 76). Ownership of the land was not clear but will be included in the new Shuyak State Park boundaries with newly acquired habitat. The site has not been examined since 1989.

KOD-099
KOD-100 Two sites, KOD-099 and KOD-100, are located in Kiavak Bay. This area was systematically surveyed by Exxon archaeologists in 1989 (Mobley, et al., 1990: 173), but they failed to relocate KOD-100. The archaeologists stipulated that any cleanup in the area would require monitors but there is no record any monitoring occurred. Unsupervised cleanup did occur in the area. Information from local bear guides indicates that the site has been subject ot repeated vandalism and is actively eroding. The guides have also provided some documentation for KOD-100 and some data on current condition of both sites. An aim of this proposal will be for USFWS archaeologists to confirm information received and assess extent of vandalism.

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 and in 1996. The agent of disturbance, however, 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.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Cooperating agencies under this project are the DOI-U.S. Fish and Wildlife 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 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 98 (October 1, 1997 - September 30, 1998)

Oct. 1, 1997 - Dec. 31, 1997:	Complete requirements for NEPA requirements and prepare draft report for FY 97 field activities.
April 15, 1998:	Submit annual report of FY 97 activities for peer review.
May 1, 1998 - June 1, 1998:	Finalize arrangements for fieldwork; make changes in FY 97 report for submission to OSPIC.
June 1, 1998 - Sept. 30, 1998:	Complete fieldwork and followup office work. Submit charcoal and sediment samples for analysis.

B. Project Milestones and Endpoints

This project is in the fourth year of a ten year project. The projected completion date is in FY2004. A progress evaluation is scheduled during the proposal year to determine the need to continue monitoring individual sites and of the program as a whole. The evaluation will be a review of past and current findings and revised projection of needs.

Dec. 31, 1997	Complete NEPA requirements (FONSI expected).

April 15, 1998	Complete FY 97 annual report, submit for review.
June 1, 1998	Complete fieldwork planning and begin fieldwork.
Sept. 30, 1998	Complete fieldwork and begin annual report.
Dec. 31, 1998	Draft annual report for FY98
April 15, 1998	Final report FY98 due.

C. 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.

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. A report of findings is anticipated for the Annual EVOS Workshop in Spring, 1999.

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 97007 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 98. Responsive to early comments from the Chief Scientist and Trustee staff, sites to be examined have expanded to include several vandalized sites on newly acquired habitat.

PROPOSED PRINCIPAL INVESTIGATOR

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Revisia. 7-24-97
Approved TC 8-6-97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998	PROPOSED FFY 1998 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NOAA
					$88.3	$24.5	$26.9	
Personnel	$70.3	$84.0						
Travel	$18.8	$19.1						
Contractual	$24.9	$19.3						
Commodities	$6.4	$3.4						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$120.4	$125.8	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003	Estimated FFY 2004
General Administration	$1.3	$13.9						
Project Total	$121.7	$139.7	$151.5	$135.0	$151.5	$135.0	$151.5	$135.0
Full-time Equivalents (FTE)	1	1.3						
	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: Project is a continuation of 95007A, 96007A, and 97007A.

1998

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Lead Agency: AK Department of Natural Resources

FORM 2A
MULTI-TRUSTEE
AGENCY SUMMARY

4/14/97

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

Budget Category:	Authorized FFY 1997	Proposed FFY 1998	LONG RANGE FUNDING REQUIREMENTS					
			Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	
Personnel	$51.3	$55.5						
Travel	$12.1	$9.2						
Contractual	$19.4	$12.4						
Commodities	$4.5	$2.0						
Equipment		$0.0						
Subtotal	$87.3	$79.1						
General Administration		9.2						
Project Total	$87.3	$88.3	$91.8	$91.8	$91.8	$91.8	$91.8	
Full-time Equivalents (FTE)	0.7	0.8						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

1998

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: AK Department of Natural Resources

FORM 3A
TRUSTEE
AGENCY
SUMMARY

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
Douglas R. Reger	Archaeologist II	18M	6.0	6.5		39.0
J. David McMahan	Archaeologist I	16K	3.0	5.5		16.5
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		9.0	12.0	0.0	
					Personnel Total	$55.5

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Travel to Kodiak to monitor sites	0.5	4	36	0.115	6.1
Travel to Homer to monitor sites	0.2	4	20	0.115	3.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$9.2

1998

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: AK Department of Natural Resources

FORM 3B
Personnel
& Travel
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Contractual Costs:	Proposed
Description	FFY 1997
Air charter (Kodiak 20 hours, Homer 12 hours @ $275)	8.7
Radiocarbon dating, 4 samples @ $300/sample	1.2
Film processing	1.5
Report duplication	1.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$12.4

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

1998

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: AK Department of Natural Resources

FORM 3B
Contractual & Commodities DETAIL

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

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

1998

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: AK Department of Natural Resources

FORM 3B
Equipment
DETAIL

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998
Personnel	$12.0	$15.0
Travel	$5.0	$4.3
Contractual	$2.2	$2.8
Commodities		$0.0
Equipment		$0.0
Subtotal	$19.2	$22.1
General Administration		$2.4
Project Total	$19.2	$24.5
Full-time Equivalents (FTE)	0.1	0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
$16.5	$16.5	$16.5	$16.5	$16.5

Dollar amounts are shown in thousands of dollars.

Comments:

1998

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: DOI- Fish and Wildlife Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
Charles E. Diters	Archaeologist	GS-12	2.5	6.0		15.0
						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	15.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
Description		Price	Trips	Days	Per Diem	FFY 1997
Travel to Kodiak to monitor sites		0.4	4	12	0.225	4.3
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$4.3

1998

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: DOI- Fish and Wildlife Service

FORM 3B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed
Description	FFY 1997
Air charter (Kodiak 4.5 hours @ $275)	1.3
Film processing	0.5
Radiocarbon Dating (4 samples @ $250/sample)	1.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$2.8

Commodities Costs:	Proposed
Description	FFY 1997
Commodities Total	$0.0

1998

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: DOI- Fish and Wildlife Service

FORM 3B
Contractual &
Commodities
DETAIL

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

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

1998

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: DOI- Fish and Wildlife Service

FORM 3B
Equipment
DETAIL

Prepared:

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

Budget Category:	Authorized FFY 1997	Proposed FFY 1998
Personnel	$0.0	$13.5
Travel	$0.0	$5.6
Contractual	$0.0	$4.1
Commodities	$0.0	$1.4
Equipment	$0.0	$0.0
Subtotal	$0.0	$24.6
General Administration		$2.3
Project Total	$0.0	$26.9
Full-time Equivalents (FTE)	0	0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FFY 1998	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002
$28.0	$28.0	$28.0	$28.0	$28.0

Dollar amounts are shown in thousands of dollars.

Comments:

1998

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: USDA - Forest Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

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

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1997
	Archaeologist	GS-11	2.6	5.2		13.5
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.6	5.2	0.0	
					Personnel Total	$13.5

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1997
Travel toPrince William Sound to monitor site	0.224	3	22	0.225	5.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$5.6

1997

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: USDA - Forest Service

FORM 3B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed FFY 1997
Description	
Air charter,(10 hours @ $275/hour)	2.8
Film processing	0.5
Drafting Support	0.8
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$4.1

Commodities Costs:	Proposed FFY 1997
Description	
Office supplies	0.4
Field supplies	1.0
Commodities Total	$1.4

1998

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: USDA - Forest Service

FORM 3B
Contractual & Commodities DETAIL

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

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

1998

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: USDA - Forest Service

FORM 3B
Equipment
DETAIL

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

Budget Category:	Authorized FFY 1997	Proposed FFY 1998	LONG RANGE FUNDING REQUIREMENTS					
			Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003	
Personnel	$7.0	$0.0						
Travel	$1.7	$0.0						
Contractual	$3.3	$0.0						
Commodities	$1.9	$0.0						
Equipment	$0.0	$0.0						
Subtotal	$13.9	$0.0						
General Administration	$1.3	$0.0						
Project Total	$15.2	$0.0	$15.2	$0.0	$15.2	$0.0	$15.2	
Full-time Equivalents (FTE)	0.2	0.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: Project is a continuation of 95007A, 96007A, and 97007A.

1998

Prepared:

Project Number: 98007a
Project Title: Archaeological Index Site Monitoring
Agency: DOI - National Park Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Revised 6/27/97
Approved TC 8-6-97

Comprehensive Killer Whale Investigation in Prince William Sound, Alaska

Project Number:	98012A-BAA
Restoration Category:	Research
Proposer:	C. Matkin/North Gulf Oceanic Society
Lead Trustee Agency:	NOAA
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	Cont'd
Duration:	6th yr. 9 yr. project
Cost FY 98:	$154.7
Cost FY 99:	
Cost FY 2000:	
Cost FY 01:	
Cost FY 02:	
Geographic Area:	Prince William Sound
Injured Resource/Service:	Killer whales, harbor seals

ABSTRACT

This project continues to monitor the damaged AB pod and other Prince William Sound killer whales to analyze a GIS database on killer whales. In FY 98, critical habitats for transient whales in Prince William Sound will be identified using these data. 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 and FY97. 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 of the 36 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 AB pod has shown signs of deterioration. Maternal groups have traveled independently or with other pods, 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 pod had a net increase of one indivdual in 1996 and currently contains 23 individals. 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 AT1 group have not been observed since 1989. Two additional AT1 whales have not been sighted for five years or more. One of these eleven whales is known to be dead. However transient killer whale social structure is not fully understood and we cannot be certain that the other whales are dead. Statistical analysis 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. When possible, data and samples necessary to complete other aspects of this project will be collected simultaneously with the monitoring effort.

In 1995-96 thrirteen 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. The database contains 663 records of encoutners with killer whales in and near Prince William Sound. Among these are 192 encounters with transient-tyupe whales. Analyses conducted at the end of FY96 found that large-scale spatial distribuition patterns differed between resient and transient whales and were different over time. Work in FY97 (in progress will focus on whether changes in transient whale distributions can be related to available data on harbor seal populations. In FY98 we propose to identify critical habitat for these whales and identify the ways that whales use these habitats.

FY98 will be the final year for collection of killer whale biopsy samples and observation and collection of killer whale prey remains. This final samplng effort will be considerably reduced from FY97. We will attempt to sample specific whales that will fill data gaps and aid in the final evaluation of contaminant levels and the genetic examination of social structre in Prince William Sound killer whales. By the end of

FY97, the results of mitochondrial DNA analysis of Prince William Sound killer whales will be published and nuclear DNA analysis well under way. Current results show fixed differences in mitochondrial DNA between of the resident and transient groups and between three transient and two resident populations. 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 are combining both mitochondrial and nuclear analyses. Microsattelite markers in nuclear DNA is being used to investigate 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 AT1 population) are being tested 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. We are in the process of determining contaminant levels both resident and transient killer whales, and are finding much higher levels in the transient population. Contaminants seem to passed from mother to offspring via lactation and levels follow consistent patterns within genealogies. Samples are 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 are being 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 transmitted a radio signal to two receiving stations, one at the AFK salmon hatchery, and one in the Chenega Bay Community School. Winter use of the southwestern Sound by resident killer whales was documented (at least 2 pods are identifiable by calls in the recordings). The recordings also detailed residency of humpback whales in the area and included the recordings of humpback whale song development in Prince William Sound. In a FY97 a more permanant hyrophone system will be installed using more reliable and sophisticated equipment

In FY98 we propose the continuation of the remote hydrophone project and the installation of a second system in the Point Helen area. 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 13 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 pods.

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 23. At least 11 of the AT1 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 AT1 group.

The behavior of killer whales in Prince William Sound has changed since the spill. High mortality following the spill and an increase in unusual social patterns indicate that the structure of AB pod has deteriorated. Despite considerable effort, re-sightings of AT group have declined and fewer individuals are seen when the group is located.

These patterns reflect changes in killer whale social behavior and distribution - the basic patterns that mark normal use of their habitats in Prince William Sound. Our analyses found that both resident pods and the AT transient group have become harder to find in the Sound (1997 Annual report). As yet no increase has been detected in sightings of other transient groups, suggesting that no transients are increasing their use of the Sound as use by the AT group declines. Further, the occurrence of harbor seals in transient whale's diet may be declining (1997 Annual report). We do not know as yet whether such changes can be related to changes in the Sound ecosystem (e.g. the decline in harbor seals, changes in hatchery production).

Ecological studies on killer whales emphasize the need to identify and protect critical feeding, transit or social areas and rubbing beaches used by these animals (Matkin & Saulitis 1994, Heimlich-Boran 1988). However, habitat associations for transient killer whales have received minimal attention in part due to small sample sizes (e.g. Heimlich-Boran 1988). Data from Prince William Sound, including 160 encounters with the AT transient group and 32 encounters with GOA transient groups, provides an opportunity to identify these critical habitats using 13 years of data and a larger sample of killer whale behaviors than has been analyzed in other similar studies (e.g. Heimlich-Boran 1988 considers transient whale habitat associations from 12 encounters over nine years).

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). We will continue to refine our estimates of killer whale predation rates on harbor seals.

Nuclear DNA analysis of the microsatellite regions 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. It will detail aspects of the resident pod social structure and mating system. MtDNA analysis has demonstrated the genetic uniqueness of the AT1 group from residents as well as from other transients. Nuclear DNA analysis will clarify those differences. The loss of either AB pod or the AT1 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. The remote hydrophone system is a cost-effective means of examining use by resident pods during the winter months.

Some environmental contaminants have been linked to reproductive dysfunction in mammals. In FY98 we will complete our assessment of the levels of environmental contaminants in the killer whales particularly in the transient (marine mammal eating) killer whale populations that show little or no recruitment.

The analysis of historical data, continued observations and sampling of killer whale prey items, 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 AT1 transient group. The actual status of AB pod appears to be non-recovering at this time. Long term patterns will only be clarified by continued monitoring. A low level annual monitoring program (expanded with matching funds) is proposed and a part of the FY98 project. A detailed summary of pod status (last provided in FY95) will be completed in FY98. 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 14 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.

It may be that little that can be done to prevent or reverse the demographic trends that have appeared among PWS transient whales in the 1990s. However, protection of the resources in the Sound that are used by these whales may prevent or minimize further problems, thereby allowing recovery. Data are available from a thirteen year period that document the locations and behaviors of the killer whales that use Prince William Sound. Analysis of these data will help to better monitor the recovery of killer whales from the spill, to evaluate suggested restoration actions for killer whales and to protect resources that attract killer whales to the Sound.

Populations have been separated using mtDNA analysis supporting the 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.

In FY98 we will continue investigating the year-round use of southwestern Prince William Sound by specific killer whale groups using a remote hydrophone system. A second remote hydrophone will be installed at Point Helen to track movements of killer whales through the region. 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 and contaminant analysis, 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 1998. 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 , should be considered based on the apparent non-recovering status of AB pod and the AT1 group.

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 AND TRADITIONAL ECOLOGICAL KNOWLEDGE

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 presentation of research results in Cordova, Homer, and Chenega will continue.

With our supervision, the residents of Chenega and students at the Chenega school will be directly involved in the killer whale project by assisting in 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. Continue reduced monitoring program and determine status of resident killer whale pods, particularly AB pod. Examine the demographics of this pod in relation to other resident killer whale pods.

2. Monitor the AT1 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. Final year of collection biopsy samples from specific indivduals as needed to complete genetic analysis and complete our interpretation of contaminant levels in killer whale blubber

5. Determine extent of nuclear gene flow between the EVOS impacted AB killer whale pod and AT1 transient group and other resident and transient killer whales frequenting Prince William Sound

6. Determine the mating system of Prince William Sound killer whales

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

a) Identify critical habtats used by transient killer whales in Prince Willam Sound and create an interpretive map portraying these habitats b) Draft publication on FY97 work for journal submission

8. Continue to 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 ten 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 *Lucky Star* will operate a total of days. This will be the final year for biopsy sampling from this vessel

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 killer whale encounter data and vessel logs will be made available to the EVOS Trustee Council and/or lead agency. Frame by frame identification data will also be made available on disc. Copies of the GIS program and data base will also be made available by request to NGOS and the PWSSC.

Behavioral Ecology

1.Critical habitats - We will begin by examining the type of behaviors that occur within Prince William Sound, which indicate why the whales spend time in the Sound. Critical area for these behaviors will be identified as areas with relatively high prevalence of the behavior in relation to the total area over which whales were observed. For example, near-shore foraging (e.g. for harbor seals), while declining in frequency, appears to occur most often along certain sections of shoreline, while off-shore foraging (e.g. for Dall's porpoises) is concentrated in more open waters. We will continue to base our analyses on the 2km-x-2km grid developed earlier, and identify larger areas based on the data. Parametric and non-parametric statistics will be used to evaluate differences between areas.

2.Interpretive map - Based on habitats identified in the first objective, a color interpretive map will be developed showing the areas most used by transient whales, the types of behaviors that occur there, and providing details on the resources the whales are using in each area. The map will be developed with Arc/Info. We will produce an 8.5 x 11 color hard-copy and electronic versions of the map.

3.Publication - At least one manuscript will be prepared for submission to a professional journal (see below, Publications and Reports), dealing with habitat use by transient whales in Prince William Sound

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 CB 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 CB 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. Blubber samples from biopsy samples taken under Trustee Council funding in 1995 were provided to the NMML/NMFS pilot project examining lipid/fatty acid composition and unavailable for contaminant analysis. In FY98 we wish to collect the final samples that will increase our sample size of whales with known lineages and from specific groups. This will allow examination of contaminant downloading on offspring and other detailed effects. Transient (marine mammal eating) killer whales have shown the most significant contaminant loads and sufficient samples from these whales are vital to the project.

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 also expand sample size for statistical analysis continuing genetic work. Hopefully it will provide the final specific samples needed in our examination of resident and transient killer whale social structure.

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, AT1 group and AB pod. We have also obtained some samples for comparison from transient killer whales from the Gulf of Alaska, and from seven additional resident pods (AE, AD, AI, AK, AS, AJ and AG). We lack samples from the one of the largest pods in the Sound, AN (now AN10 and AN20) and our sample size from several pods is very small. The sample size sample size for transient whales must be increased for meaningful statistical analysis and animals of particular age and sex are desired. Samples from specific individuals and lineages are needed to detail killer whale breeding systems. For this reason, and because of the need for additional samples for contaminant analysis, the final biopsy sampling is planned in FY98; however, the effort will be reduced from FY97. The methods will be identical to those used in FY97 (described in Barrett-Lennard et al. 1996).

The procedures in the final phase of our genetic analysis involve examination of miocrosattelite loci initiated in FY97. 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).

Two specific hypotheses will be tested in FY98. (1) Resident killer whales do not move between pods. (2) Matings occur between and not within pods.

Hypotheses will be tested using microsatellite DNA-based pedigrees. Samples from AB pod will be given the highest priority in these tests. The first hypothesis predicts that pods consist of maternally-related individuals only, and will be tested by searching the pedigrees of pod members for unrelated individuals. the second hypothess predcts that offsprng and their fathers will be found in different pods. We will test this hypothesis directly: if offshpring and fathers are found in the same pod during the pedigree analysis, the hypothesis will be disproved. Conversely, matches between offspring and fathers in different pods will support the hypothesis. Analysis of samples will be conducted concurrently with samples from killer whales biopsied off British Columbia.

In addition we will use standard ZFX/ZFY sexing protocal to sex juveniles and calves of unknown sex. This is an important tool in refining our understanding of population dynamics and modeling. It is also important in our assessment of killer whale mating systems.

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 1996. Final construction of a catalogue of pod specific calls will occur in FY97. Specific calls from Prince William Sound transient (AT1 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 are 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 and movements of killer whales in the Montague Strait region, a second remote hydrophone will be attached to the sea floor near Point

Helen, Knight 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. 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 teacher Billie Jo Mills 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 by Harold Jurk at the University of British Columbia. The frequency of occurrence of each pod by month will be determined. Because pod sizes will be determined by photographic monitoring in summer months, estimates of numbers of whales using the area by month can be developed.

With guidance from Apila Colorado and Martha Vlassof, additional information from native elders and other residents on the role of killer whales in their mythology, stories and history will be gathered by interview and conversation. Interviews will be conducted in Chenega Village and Cordova during our regular visits. The summaries of the interviews will be submitted as an addendum to our annual report in FY98.

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 1998 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. Acoustic analysis will be completed by Harold Jerk 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 FY98

Oct 97: Ship/transport FY97 samples to genetic and contaminant labs

Oct-March : Extract DNA from new samples. Continue microsatellite analysis of nuclear DNA and mtDNA of new samples. Contaminant analysis of new (FY98)samples.

Oct 1-30: Summarize monitoring data for FY97.

Oct. 1 - Dec. 31: Analysis and writeup of draft FY97 annual report
Finalize FY97 GIS analysis, draft manuscript

Oct. 1 - July 1:Critical habitat analyses.

Jan. 5, 1998: Draft FY97 report due

Jan 1998: Attend Bienniel Society of Marine Mammalogy Conference in Monaco (Matkin), present paper (at same time as restoration workshop).

Jan 1998 Attend restoration workshop (Co PI David Scheel) poster presentation

March1 - March 31: Address review comments on draft FY97 report and submit final annual report.

April -July Conduct pedigree analysis of microsatellite DNA data. Begin interpretive map for critical habitat, begin draft manuscript and report

April 1 - Sep 30 Complete critical habitatreport & critical habitat interpretive map

April 10-20 Killer whale biopsy emphasis fieldwork

May 1 - June 30: Analyze winter recordings from remote hydrophone.

June 98 Attend Conservation Biology Society annual meeting (Scheel)

July 7-Aug 30: Killer whale monitoring emphasis field work. Monitor hydrophone from research vessel.

Aug-Sept Conduct allele frequency analysis of microsatellite DNA from transient assemblages. Complete Critical habitat interpretive map and report.

Aug- Sept : Begin write-up of microsatellite DNA data for submission to primary literature

Sept 7-15 Killer whale biopsy emphasis field work Setup remote hydrophone operation for winter (98/99)

The R.V. *Whale 2* will operate for 40 days in July and August July 7-September 1). A portion of the operational time 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

The FY98 project will conclude the biopsy field program with a limited field season. Future fieldwork will involve limited population monitoring and acoustic monitoring. Final analysis of genetic, contaminant and GIS data will begin in FY98. A paper detailing the mtDNA analysis will be submitted in FY98 . Publication of a paper describing Prince William Sound resident pod dialects should be drafted in FY98; however, data from the remote hydrophone probably will not be sufficient for publication until FY 99. Initial work on the popular account of the research and the updated killer whale catalogue will be initiated in FY98 and completed in FY99, for the tenth anniversary of the Exxon Valdez Oil Spill. Final writeup of all phases of the project (except ongoing photo monitoring and acoustic monitoring) will occur in FY99.

C. Completion Date

All phases of the project should be completed in FY99 except for the ongoing limited monitoring and remote hydrophone projects.

PUBLICATIONS AND REPORTS

Annual Report FY98: (Draft January 1999, Final April 1, 1999)

Final report : April 2000

Scheel, D., C. Matkin, & E. Saulitis. Critical habitats of transient killer whale groups in Prince William Sound, 1984-1996 (Marine Mammal Science)

Barrett-Lennard, L, Matkin, CO, Saulitis, EL, Ellis, GM Genetic isolation between sympatric populations of killer whales in Prince William Sound, Alaska. (Intended for submission to Molecular Biology and Evolution, September 1997)

Barrett-Lennard, L, C.O. Matkin, E.L. Saulitis. Effective population sizes, patterns of gene flow, and prospects for recovery of Exxon-Valdez oil spill impacted AB pod and AT1 group killer whales in Prince William Sound, Alaska. (Molecular Ecology)

Jurk, H., E.L. Saulitis, and C.O. Matkin. Dialects of Prince William Sound resident killer whales. (Draft for Canadian Journal of Zoology)

Ylitalo, G, C.O. Matkin, J. Stein. Patterns in contaminant levels in Prince William Sound killer whales.

PROFESSIONAL CONFERENCES

14th Bienniel Conference on the Biology of Marine Mammals, Monte Carlo, January 25-29, 1988. Joint Conference of the American and European Societies for Marine Mammalogy. P.I. Craig Matkin will present a paper on "Patterns in contaminant levels Alaskan killer whales"

Annual Conference of the Conservation Biology Society, June 1998. Co-PI David Scheel will attend and present a paper on the GIS aspects of the killer whale work.

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 FY98 this project will rely on approximately $12,500 in matching funds from foundations or other private sources. In addition, an estimated $10,000+ in analytical fees will be absorbed by the NOAA/NMFS environmental contaminant lab as part of a cooperative agreement. A cooperative program with the University of British Columbia has allowed substantial

reduction in laboratory costs for genetic analysis. 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:

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Revl 6/30/97
Approved TC 8/6/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$0.0
Travel		$0.0
Contractual		$144.6
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$144.6
General Administration		$10.1
Project Total	$0.0	$154.7
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	

Dollar amounts are shown in thousands of dollars.

Comments:

1998

Prepared: 6/30/97

Project Number: 98012A
Project Title: Comprehensive Killer Whale Investigation
Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

8/14/97

Revision 6/30/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$47,640.0
Travel		$5,940.0
Contractual		$68,738.0
Commodities		$9,550.0
Equipment		$1,840.0
Subtotal	$0.0	$133,708.0
Indirect		$10,847.0
Project Total	$0.0	$144,555.0
Full-time Equivalents (FTE)		13.8
Other Resources		$12,500.0

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002
$96,000.0	$45,000.0	$42,000.0	

Dollar amounts are shown in thousands of dollars.

Comments:

1998

Project Number: 98012a
Project Title: Comprehensive Killer Whale Investigation
Name: North Gulf Oceanic Society

FORM 4A
Non-Trustee
SUMMARY

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 1998
Craig O. Matkin	P.I. Field Biologist		5.0	4400.0		22,000.0
Graeme Ellis	Photo Analys Field Biologist		1.5	3500.0		5,250.0
Eva Saulitis	Field Biologis Community Liason		3.0	2800.0		8,400.0
	Field Assistant		1.5	1500.0		2,250.0
	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		13.8	22600.0	0.0	
					Personnel Total	$47,640.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Homer/Vancouver (RT)	650.0	2	6	75.0	1,750.0
Fairbankds/:HomerRT	380.0	2			760.0
Homer/AnchorageRT	150	2	4	100.0	700.0
Faribanis/CordovaRT	410.0	1			410.0
Faorbanks/Anchorage RT	230.0	2			460.0
Homer/Monaco RT	1260.0	1	4	150.0	1,860.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$5,940.0

1998

Project Number: 98012a
Project Title: Comprehensive Killer Whale Investigation
Name: North Gulf Oceanic Society

FORM 4B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed
Description	FY 1998
Prince William Sound Science Center (GIS/behavioral analysis and interpretation)	25,238.0
Pacific Ecological Services (genetic analysis and interpretation)	16,600.0
Chenega Village (hydrophone maintenance)	3,200.0
27' research vessel (Whale 2) 40 days @ $360.00/day	14,400.0
43' research vessel (Lucky Star) w/console skiff for 12 days (775/day)	9,300.0
Contractual Total	$68,738.0

Commodities Costs:	Proposed
Description	FY 1998
Phone	940.0
Field Food ($14/person/day)	1,520.0
E-mail	120.0
Fuel	2,400.0
Film/Processing/Printing	2,400.0
Field Supplies	320.0
Land use liscense, Chenega Corp	100.0
Hydrophone and Cable	1,100.0
Deep Cycle batteries	180.0
Shipping	470.0
Commodities Total	$9,550.0

1998

Prepared:

Project Number: 98012a
Project Title: Comprehensive Killer Whale Investigations
Name: North Gulf Oceanic Society

FORM 4B
Contractual & Commodities DETAIL

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

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 1998
Professional cassette recorder	1		410.0
FM band transmitter and receivers	1		1,430.0
			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**	$1,840.0

Existing Equipment Usage:	Number
Description	of Units
Professional cassetter recorder	1
FM band transmitters and receivers	1

1998

Prepared: 4 of 4

Project Number: 95012a
Project Title: Comprehensive Killer Whale Investigations
Name: North Gulf Oceanic Society

FORM 4B
Equipment
DETAIL

6/30/97

98025

4/16 file
Approved TC 8-6-9

Mechanisms of Impact and Potential Recovery of Nearshore Vertebrate Predators (NVP)

Project Number:	98025
Restoration Category:	Research
Proposer:	L. Holland-Bartels, et al/USGS
Lead Trustee Agency:	DOI
Cooperating Agencies:	ADFG, NOAA, USFS
Alaska SeaLife Center:	No
New or Continued:	Cont'd
Duration:	4th yr. 5 yr. project
Cost FY 98:	$1,652.9
Cost FY 99:	$450.0
Cost FY 2000:	$0.0
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Sea otter, river otter, harlequin duck, pigeon guillemot, intertidal and 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 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.

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 •1,500-3,000 killed by EVOS in 1989 •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). •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.) BIOINDICATOR •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). TROPHIC •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. •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 •Conduct research to find out why recovering; likely causes climatic /oceanographic, prey limitations and predation. •Recovery judged by stable or increasing populations.
River otters	DEMOGRAPHIC •Although some were killed, there was no catastrophic mortality--river otters continued to live in areas that were through 1990 (Testa et al. 1994) •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) •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) •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) •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). BIOINDICATOR •Continued exposure has adverse health effects; higher haptoglobin (an acute-phase protein indicator of damage) than otters in non-oiled (Duffy et al. 1993). TROPHIC •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. •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 •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** •Up to 4,000 acute mortalities •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.). •Significant differences in juvenile survival between oiled and un-oiled areas in 90/91 and 92/93. •Proportions of prime aged animals among dead returning to pre-spill levels(Ballachey et al. 1994). **BIOINDICATOR** •Hemotological and serum chemistries suggest otters in oiled areas had higher incidence of inflammatory and/or infectious conditions. **TROPHIC** •Primary foods include mussels, clams, and urchins, as well as other subtidal 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). •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. •Conduct research to find out why not recovering; hypotheses include continued hydrocarbon ingestion; spill-caused changes in benthic prey. •Recovery judged when population abundance and distribution are comparable to prespill, and when all ages appear healthy.
Harlequin ducks	**DEMOGRAPHIC** •1,000 acute mortalities in Harlequins •875 acute mortalities in other species •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). **BIOINDICATOR** •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. **PREDATOR/PREY** •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 •Conduct research to find out why not recovering; hypothesis related to oil-contaminated prey. •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

NVP, both in its component projects and as an integrated program, can benefit from community involvement, especially the inclusion of observations and insight from traditional ecological knowledge (TEK). While there remains some uncertainty over the mechanism for incorporating such information, NVP P.I.s will work with Project -052B: Traditional Ecological Knowledge to facilitate the exchange of information relevant to the restoration process.

Specifically for FY98, NVP is interested in holding synthesis workshops in spill-affected communities. Such workshops, the idea for which has been developed in discussions with -052B personnel, would bring together P.I.s and local experts to discuss findings and observations about resources and ecological components and interactions of mutual interest and concern. These workshops would be held in or near affected communities, in a setting designed to facilitate open exchange of information and substantive discussion of findings. Discussions might use a facilitator (perhaps -052B personnel) to prepare participants and to moderate the sessions. The workshops would produce a report of the discussions, which would be presented at a community meeting at the close of the workshop. In addition to making TEK insight available to P.I.s, the workshops would allow P.I.s to share their information with community members through both the workshops and through the community meetings.

Topics for such workshops include: resource distribution, abundance, and trends; ecology and biology of the resource; interactions of the resources and other ecological components; interpretation of trends; comparability and compatibility of TEK and scientific data; and future work needs for scientific research and for incorporating TEK.

Two to four workshops are proposed for FY98, involving the subtidal clam and sea otter components. P.I.s for these components would travel to one or two communities for the workshops, which would last two to three days. Final plans depend on community review and willingness to take part. In addition to working with -052B, the workshops would seek to involve the Youth Area Watch program.

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.

B. Methods

Methods for 98025 are outlined in detail in Holland-Bartels et al. (1995, 1996) 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 •SURVEYS OF ANNUAL REPRODUCTION RATES •CARCASS RECOVERY TO EVALUATE MORTALITY PATTERNS	• HABITAT USE AND ABUNDANCE IN OILED AND UNOILED AREAS •OVERWINTER SURVIVAL OF FEMALES	•CHICK GROWTH RATES •REPRODUCTIVE SUCCESS •ADULT ATTENTIVENESS TO CHICKS •MEAL DELIVERY RATES AND MEAL SIZE	•LATRINE SITE ABANDONMENT AS ABUNDANCE INDEX
HEALTH AND OIL EXPOSURE	•BLOOD AND IMMUNE FUNCTION ASSAYS •P450 ASSAYS •MORPHOMETRICS AND CONDITION	•BLOOD ASSAYS •P450 ASSAYS •BODY COMPOSITION	•BLOOD ASSAYS •P450 ASSAYS	•BLOOD, IMMUNE FUNCTION ASSAYS •P450 ASSAYS •MORPHOMETRICS
TROPHIC INTERACTIONS	•ABUNDANCE, DISTRIBUTION, SIZE CLASS STRUCTURE-- CLAMS, MUSSELS, SEA URCHINS, CRABS •PREY SELECTION AND FORAGING SUCCESS •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.

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 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, Anchorage and Portland, for the sea otter and river otter samples, and Avian Exotic Animal Laboratory, California, 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 40μ 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 μ 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: Aerial surveys will be conducted in the summer of 1998, including (1) a full survey of western PWS, and (2) five replicate surveys of study areas at Knight and Montague Islands. No winter or spring aerial surveys will be conducted in 1998.

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 one half 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 classify 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 1990-97 (Monson and Ballachey 1996, J. Bodkin, pers. comm.), will be surveyed in 1998. In addition, a limited number of beaches on Knight, Naked, and Montague Islands will be surveyed in 1998. 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).

Sea Otter Foraging: Because of potential differences in both observed foraging success and habitat characteristics, primarily benthic slope, we are proposing to implement studies of energetic budgets and diving behavior in our respective study areas in 1998. Implantable time-depth recorders will provide an accurate and unbiased record of an individual's activity over the annual cycle. The most useful data will be the proportion of time that individual sea otters allocate to foraging in our two areas. If prey are equally available, and of equal size, we would predict that time allocated to feeding would not differ between areas. It is also possible that differences in habitat (slope and depth) are reflected in differences we have observed between areas. An accurate record of activity relative to habitat use and availability should allow evaluation of the potential effects of habitat differences between areas.

Time-depth recorders: In 1998, we will capture and surgically implant 15 adult sea otters in each study area with time-depth recorders (TDR's). These instruments will allow us to evaluate potential differences in foraging behavior relative to water depth, and to test for differences in foraging effort allocation between areas. Otters Will need to be recaptured in 1999 to recover the data stored in the TDR's between deployment and retrieval. Recapture in 1999 will be supported by funds from the Alaska Science Center.

Sea otter foraging success will be measured in 1998 with methods similar to those emplyed in 1996 and 1997, using focal animal foraging observations (Altmann 1974) adapted for sea otter work in past studies (Calkins 1978, Estes et al. 1986). We will conduct shore-based,

nearshore observations at randomly selected sites (coordinated with the invertebrate sampling sites) within each of the two study areas.

Foraging success: Foraging observations in 1998 are similar to those done in 1996-97; however, whenever possible, the implanted otters will be targeted as focal animals. 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: ≥ 2 to < 4 cm , C: ≥ 4 cm to < 8 cm, D: ≥ 8 to < 12 cm, and E: ≥ 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.

Capture: In 1998, 30 adult sea otters (15 per study area) will be captured for implantation of time depth recorder units (see "Foraging" section, above). 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. Otters will be sedated with a combination of fentanyl and diazepam and will be reversed with naltrexone following collection of data and samples. They 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. Otters will have a time depth recorder (25 gm) and a VHF radio (100 gm) surgically implanted into the peritoneal cavity for foraging studies (described above). In summer 1999, otters will be recaptured for retrieval of the time depth recorder units (expenses of recapture will be shared by USGS-BRD funds).

Indicators of Health: Morphometric data collected on captured otters will include age class, sex, length, weight, girth, canine width and baculum length (in males). Weight and length will be used to estimate animal condition. 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 conducted.

Subtidal Clam Populations: Subtidal clams have proven a major food source for sea otters. Therefore, determining their density and size class distribution remains a key element of our efforts to assess if food may be constraining recovery of sea otters in the Knight Island area. However, sampling of subtidal clam populations proved problematic in 1996 because of their rare and highly clumped distribution. In June 1997, we will initiate the protocol described below. We believe this protocol will increase the probability of effectively sampling this critical food source. It is possible, however, that dense patches are sufficiently rare or localized that our maximum possible level of random-based sampling, ultimately constrained by available funding, may not be adequate to resolve the NVP questions. Thus, our first effort under the 1998 DPD will be to examine our 1997 field data with regard to number, apparent size, species composition, within-patch clam density and size distribution, and frequency of dense clam patches by study area. Power analyses will assess the need for additional clam population work during the 1998 field season. We will apply the NVP adaptive management procedures during our annual fall project leaders' meeting to evaluate these data. We will either proceed as described below or modify and place greater emphasis on the predator-based sampling and foraging data. The following is our general protocol for the FY 1998 field season at this point.

Adult clam densities and size distributions will be sampled with a diver-deployed Venturi suction dredge as used in 1996 and 1997 field work. We will use two criteria for selection of sampling sites. First, a random subset of the systematically identified shoreline segments will be chosen at each of the, following the general pattern of site selection adopted for 1996 NVP field work. We will sample a minimum of ten sites at each area. Second, an additional subset of shoreline segments will be selected on the basis of observed patterns in sea otter foraging effort in the study areas. Clearly, sea otters are successful in obtaining subtidal clams. We hope that a predator-driven sampling strategy will help us target clam habitat and reduce the high variance we have in our estimates to date. Information on sea otter foraging effort will be provided by the sea otter foraging component of the NVP Project. We will chose segments in which significant foraging effort has been observed prior to our field work. We plan to sample a minimum of twenty such sites, distributed in the same pattern as the first subset described above.

Juvenile clams will be sampled with diver-deployed benthic corers (surface area of 0.009 sq. m to a sediment depth of 10 cm) at each site sampled by dredging. Groups of four randomly-placed cores will be collected at 0, 1.3, 2.6, 4.0, 5.3, and 6.7 m (MLLW). Cores will be sieved through a 0.5 mm screen and samples fixed (10% formalin), and preserved (70% ethanol). These data will allow us to assess recruitment patterns in clams by species, site, and bottom depth. We will also examine sediment grain size and organic carbon to view how these variables contribute to recruitment patterns in clams.

In addition, we will survey for clamshells apparently discarded by foraging sea otters. Three to five randomly-positioned transect lines will extend from the lower intertidal to a depth of 10 m

MLLW at each of the randomly-selected sites. Freshly-discarded adult-sized shells will be collected within 1 m of either side of the line by divers. Such shells are defined as those lacking significant erosion or fouling, with one valve intact, the other valve fractured, and the hinge region intact and still articulated. Similar collections will be made at sites of recently-observed otter foraging activity, as described above. Collected shells will be identified, measured, and the size composition compared between sites. Comparison of data between randomly-selected and otter-foraged sites will allow assessment of patterns of prey patch selection by foraging otters.

During our 1996 sampling we commonly encountered an assemblage of dead clam shells that may represent important information about the dynamics of clam populations in the Sound, and the relationship of sea otter foraging and other sources of mortality to clam population density and age/size structure. The dead clam assemblage was dominated by large individuals (to > 100 mm shell length) of *Saxidomus gigantea*, densities of 20 - 50/sq. m, usually 30-50 cm below the sediment surface. Individuals had shells that were still paired and articulated, in life position, only moderately weathered, and showing no indication of traumatic disturbance. The cause and timing of death in the death assemblage are unknown (perhaps previous earthquake related). Knowledge of timing of death of the clams will permit inferences about likely cause. Collection, identification, and measurement of clams in the death assemblage require only a trivial additional field effort, given that the same plots are excavated for purposes of sampling living clams as indicated above. Thus we will continue to gather data on the death assemblage during our 1997 and 1998 field seasons. We believe that, given the density and size of clams in the death assemblage and its dominance by *Saxidomus*, it is quite likely that the assemblage represents clam populations as they existed prior to the initial return of sea otters in the 1960s and 1970s. Sea otters feed preferentially on large *Saxidomus*, and our 1996 samples from Montague Island indicate such dense patches of large individuals are unlikely in areas where sea otters are common. Thus, these data provide the opportunity to determine if, in the absence of sea otter predation, one is likely to expect significant differences in clam density and size distribution among study areas, or among sediment types within study areas. Resolution of these questions is of substantial importance in interpreting patterns in clam data from our study with regard to the central questions of the NVP project. Recent improvements in isotopic dating techniques for recent-aged samples will allow us to attempt direct measurement of both the date of death and the coincidence of death in the assemblage. Representative samples will be tested with 14-carbon isotopic analyses, using the Dating Laboratory at the Woods Hole Oceanographic Institution. Such analyses are now sufficiently precise to assess both the degree of coincidence in death timing, and to estimate the time of death. As noted above, the added costs for work are limited to laboratory analyses.

Intertidal Clam Populations: Analysis of FY96 and FY97 data will continue, and samples collected in 1997 will be analyzed to determine the relationship between biomass and size in order to allow estimation of standing stock biomass for clam populations.

Sea Urchin Populations: In 1996, there were more large urchins at Knight than at Montague. This pattern was predicted based on the relatively few otters, and the relative lack of predation pressure on sea urchins at Knight Island, and provides additional evidence that sea otters within the Knight Island area have not fully recovered. However, there was a group of male otters observed on Knight Island in 1996, and we suspect that this is a recolonizing group

that will eventually lead to the recovery of otters on Knight Island. We predict that as the number of otters increases at Knight Island, the number of larger sea urchins will diminish and the number of large urchins per otter will eventually be about the same at Knight and Montague Islands.

The idea that the recovery of predator populations can be monitored by examining the size and density distribution of the prey is a novel and untested concept in ecology. Continuing to monitor the relationship between sea urchins and sea otters in Prince William Sound should provide valuable insights to the utility of concept.

Sampling of intertidal transects will continue at 30 systematically selected sites within each area (Montague and Knight Island) in FY98. In addition, several other sites with known aggregations of sea urchins will be sampled in order to obtain reasonable estimates of size-distributions of urchins. The sampling design and sampling methods will be the same as described in our 1996 Annual Report. No subtidal sampling will be conducted.

Samples collected in 1997 will be analyzed to determine the relationship between biomass and size, in order to allow estimation of standing stock biomass for the urchin population.

Crab Populations: Analysis of FY96 and FY97 data will continue, and samples collected in 1997 will be analyzed to determine the relationship between biomass and size, in order to allow estimation of standing stock biomass for the crab population.

Mussel Populations: The methodology used in 1996 and 1997 to estimate mussel abundance, biomass and length-frequency distribution will be reduced in scope to focus on developing a protocol for monitoring shifts in mussel size-frequency distribution as sea otters recover at Knight Island (see mussel monitoring below). Research on mussels in 1998 will focus on a particular mechanism that could produce a size distribution in mussels similar to that observed when sea otters structure the mussel population. Relatively few *Mytilus trossulus* may live long enough to exceed 40 mm in shell length in Prince William Sound. Work with *M. trossulus* (= *M. edulis*, auctt.) in British Columbia has revealed heavy summer and fall mortality in mussels over 4 cm in shell length, independent of predation and diseases such as haemocytic neoplasia (Bower 1989). In some locations over 90% of the mussels in this size range suffered mortality. This high summer mortality may be related to reproductive stress (Emmett et al. 1987, Bower 1989). To determine whether this mechanism is operating in Prince William Sound, we will age mussels using a proven technique (see below). To verify that the growth lines on our mussel shells are true annuli, we will follow individuals marked in 1997 for at least one year to compare growth with that measured with the aging technique, and to estimate size specific mortality rates.

A total of 30 mussels ranging in size from 10 to ≥ 40 mm in shell length will be collected from three areas adjacent to randomly selected quadrats within each study location (Montague Island, Bay of Isles and Herring Bay). The mussels will be frozen in plastic bags for transport to the laboratory. In the laboratory, the mussels will be opened and all tissue removed from the valves.

One valve from each mussel will be imbedded in epoxy resin (Epofix). When the resin has set the imbedded valve will be sectioned longitudinally along the longest axis that bisects the umbo using an Accutom-2 precision cut-off machine with a diamond blade. The plane of section of the block with imbedded valve will then be polished in sequence with 3,600 grit, 6,000 grit, and 12,000 grit polishing paper. The polished surface will then be buffed with 0.05 micron Alumina buffing powder spread on a felt buffing cloth attached to a grinding wheel. The polished valve surface will then be etched with 1.0 % HCl. for 105 sec. Acetone will be dripped on the polished valve surface and a square of diacetate sheet 0.5 mm thick will immediately be placed on the polished surface for 6 min. to receive the impression of the growth lines on the etched valve surface. The resulting acetate peel will be read (growth lines counted) at a magnification of 10 x with a compound microscope in phase contrast. Annual growth will be estimated by measuring the distance between annuli on the un-sectioned valve or acetate peel, depending on the condition of the un-sectioned valve.

To evaluate the accuracy of the aging technique acetate peals will be made of mussels of known age. In addition, mussel growth will be measured at the study locations and compared with growth determined using the mussel aging technique. These growth measurements in the field will help validate the aging technique. The growth of 1,000 mussels ranging in size from 10 to ≥40 mm will be measured at each study location. In 1997, the mussels were carefully removed from the rocks near randomly selected quadrats in three areas at each study location. The mussels were then marked with individually numbered, flexible, polyethylene shellfish tags, and the shell length of each mussel was measured to the nearest 0.1 mm. The mussels were returned to the rocks and caged for two weeks to allow them to reestablish their byssal threads. At the end of that period the cages were removed from half of the group of mussels at each study location. The caged mussels will remain caged until summer 1998 to assess the effect of caging on mussel growth, and, more importantly to measure size-specific mortality of mussels in the absence of major predators. In summer 1998 the annual size increment of all surviving marked mussels will be measured. Growth and size-specific mortality will be compared between caged and uncaged mussels and between study areas.

Growth curves of mussels will be fitted to the von Bertalanffy equation. Growth curves will be compared using analysis of covariance following curvilinear regression. Analysis of variance will be used to compare mortality rates between study areas and caged versus uncaged treatments. 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.

Monitoring Mussels During Sea Otter Recovery: Within the Montague and Knight Island study areas a protocol for monitoring shifts in mussel size-frequency distribution as sea otters recover at Knight Island will be developed in 1998. Mussels will be sampled using a modification of the stratified random/systematic design used to sample mussels in 1996 and 1997. In that design each length of coast was 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). About sixty shoreline segments, 200- m long, were systematically sampled in each study area. Within each shoreline segment

10 transects, each separated by 20 m, were laid perpendicular to shore. Each transect spanned the mussel zone. Mussel densities were estimated using 500 cm^2 quadrats, each quadrat placed randomly along a transect. The mussels in each quadrat were collected, placed in plastic bags and frozen for subsequent processing in the laboratory. In the laboratory the maximum shell length of each mussel was measured to the nearest 0.1 mm with a digital caliper linked to a data logger. Mussels <5 mm in shell length were grouped into two size classes (0-1.9 and 2-4.9 mm).

The chief modification to the above sampling design that will be made for the monitoring study will be to reduce the scope of the sampling effort. This will be accomplished by reducing the total number of shore segments sampled to 60 and by focusing exclusively on large ($\geq$ 40 mm) mussels. This approach should reduce the number of field days allocated to monitoring to 10 d and will reduce the amount of labor required for sample processing to 1/4th that presently required. Enough information should be collected on the spatial distribution of large mussels in the study areas by the end of FY97, that the study areas can be stratified by large mussel density, thus minimizing the loss of power with reduced sample size. As in the larger study conducted in 1996-97, analysis of variance will be used to compare the abundances of large mussels 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.

Specific Methods for Harlequin Ducks.--

Female Winter Survival: Winter survival rates of female harlequin ducks will be assessed using radio telemetry. Variation in 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 during molt at the end of FY97, 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 motion sensitive mortality switches; pulse rate will change from 45 to 90 beats per minute when the transmitter is stationary. Range from ground to air will exceed 20 km.

Transmitters will be implanted in the body cavity with an external antenna. 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 from the time of marking through the end of March 1998. 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 analysis will be an important part of FY98 activities. Data will be entered and analyzed using a Kaplan-Meier staggered entry design (Pollock et al. 1989). Along with traditional analysis methods, we will explore recent model-fitting approaches, using program MARK, to simultaneously assess the effects of area, year, and body condition on survival probabilities.

Distribution and Abundance: Results from winters 95/96 and 96/97 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.

Boat survey data for this objective were collected during FY 96 and FY 97. Habitat and food data will be collected in FY 97 and will continue in FY 98 (see below). Once these data are collected and compiled in a GIS format, we will analyze the relationships between harlequin duck densities, habitat variables, and food abundance.

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 body electrical conductivity (TOBEC). Derivation of condition indices will occur during FY 97. Also, final captures of molting females will occur at the end of FY 97. Thus, data analysis is the primary activity for this objective during FY98.

The best fitting predictive model will be applied to estimate body composition of all captured female harlequin ducks, allowing an accurate and nonlethal assessment of body condition. 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: We detected no difference in bioindicators between treatments for molting adult females in falls of 1995 and 1996. However, we found that survival probabilities were similar between treatments through fall but diverged during mid and late winter, with survival being poorer on the oiled area. Because molting adult females likely had only recently returned to Prince William Sound from breeding areas when captured, we speculated that health effects due to oil exposure or lowered food abundance might not be expressed until the birds had been on the study areas for a longer period. Also, although the survival data suggest differences between areas, we do not know the mechanism responsible for this difference. Thus, for FY 98, we propose to capture ducks during mid and late winter to compare body mass and bioindicator levels between areas.

We will capture harlequin ducks using floating mist nets originally designed to catch marbled murrelets. We were successful in catching harlequin ducks using this method in trial efforts during winter 1997. Will we conduct captures during December 1997 and March 1998, with a goal of capturing 50 per period, 25 from each area.

Blood (3 cc) will be drawn from the jugulars of captured 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 University, one for haptoglobin and interleukin-6 analysis at University of Alaska, Fairbanks, 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 number from the metal leg band placed on each bird.

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 captured ducks. 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 archived.

Harlequin Duck Prey Abundance: Duck food will be sampled for a second year in FY98. The food will be sampled from a minimum of 15 sites within each of two areas, Knight Island and Montague. These will be a subset of the sites sampled for sea urchins and clams. In addition we will sample at 5 sites in each area where high densities of harlequin ducks have been consistently observed.

At each site, we will sample within 3 depth strata: +1.5 to +0.5 m, +0.5 to -0.5 m, and -0.5 to -1.5 m. These depths were selected based on the following rationale. The mean high tide in Prince William Sound is about +3.0 m and the average low tide is about +0.5 m: Harlequin ducks appear to generally feed within several meters from shore, probably at depths of about 2 m. As a result, the ducks probably spend the majority of the time feeding at depths of from +1.5 to -1.5 m.

Sampling will be conducted within three .25 m^2 quadrats placed at random positions within each depth stratum. All algae and eelgrass will be removed from the quadrat and bagged, and the

remaining mollusks will be sampled using a diver operated airlift. All sampling will be conducted during high water.

Specific Methods for Pigeon Guillemots.–

Indices of Abundance, Reproductive Success and Growth Rate: This will be the third breeding season that field studies have been conducted in PWS and Kachemak Bay. Field work will again be coordinated with on-going U.S. Fish Wildlife studies in PWS (David Irons/Kathy Kuletz, PI) and Kachemak Bay (John Piatt) as part of APEX (98163). For studies of nesting success, our goal is to locate forty active and accessible nests during late incubation at the oiled (Naked Island) and unoiled (Jackpot Island/Icy Bay, Kachemak Bay) study areas. Nests will be monitored until the young fledge or the nesting attempt fails.

We will try to locate, identify, and map all active guillemot nest sites on Jackpot Island and on the western and northern shores of Naked Island. In Kachemak Bay, we will monitor pigeon guillemot colonies between Seldovia and Mallard Bay. All historically known nest sites will be visited. Once the chicks have hatched, other active nests can be readily identified by the presence of adults transporting fish in their bills. The placement of some of these nest burrows in recesses of the cliff faces make it impossible to retrieve the chicks. We will use these inaccessible nests for indices other than growth rate. Trends in the numbers of active nest sites, as well as nest site and colony abandonment rates, 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 Kackemak Bay) and oiled (Naked Island) areas will be used as a demographic indicator of potential effects of the spill. Colony attendance will be used to estimate the breeding population. To cover the period of maximum attendance by adults, surveys will be conducted between mid-May and mid-June during morning high tide hours (Prichard 1997).

Differences in reproductive success at the unoiled and oiled areas will be measured as several variables: 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 by the Mayfield method (Mayfield 1965, 1971). Active guillemot nests will be checked every five days beginning late in the incubation period to determine hatching success, nestling survival rates, and to weigh and measure chicks for monitoring growth and development. The following parameters will be measured 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) fledgling age and body mass. Clutch size, hatching success, fledging success, and overall reproductive success will be compared between the oiled and unoiled study areas.

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.

Indices of Health. 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, and albumin 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, including 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. Because rapid physiological development of chicks may lead to variation in blood variables, we will collect blood samples from chicks at 20, 25 and 30 days of age. When practical, we will draw blood from birds that are exactly 20, 25 and 30 days of age (guillemot chicks normally fledge at 30-40 days post-hatch). Otherwise we will draw the first blood sample as close to 20 days of age as possible and draw the other two blood samples 5 and 10 days later. 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 analysis will be performed by Avian and Exotic Animal Lab., Redondo Beach, CA., which specializes in avian samples. If large enough volumes are collected, we will perform haptoglobin and IL-6. The P450 assay will be done on foot web biopsies taken from 30 day old chicks. Tissue samples will be preserved in 10% neutral buffered formalin solution immediately upon collection. 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. 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. Adult guillemots will be captured and blood samples (1 ml) collected. Blood samples will be analyzed for molecular and cellular biomarkers of contaminant exposure using the same techniques applied to nestling blood samples. Assays of external oil will be done with ELISA swabs of the adult's plumage. Foot web tissue biopsies for P450 assay will also be collected from each adult handled. Tissues samples will be preserved in 10% neutral buffered formalin solution immediately upon collection. These samples will allow us to monitor the impacts of various levels of contaminant exposure on physiological condition of nestlings and foraging efficiency of adults.

Capture: Pigeon guillemots are highly philopatric and usually return to breed in the same nest crevice each year, or to one in close proximity. Consequently, mark-recapture rates can be used to estimate adult survivorship at the three study areas. Floating mist nets and burrow mist netting will be employed to capture adults.

A mist net will be pinned around the burrow entrance to entangle the adult as it enters the burrow to deliver fish to its brood. Once the mist net is in place, we will watch the burrow entrance from a blind. The captured birds will be processed at burrows; in addition to the above tissue samples and plumage swabbing, we will weigh each bird and make measurements of culmen, tarsus, and wing length (flattened, straightened, to the longest primary). Any fish found with the adult will be weighed and standard length measured before being sent frozen to Dr. Daniel Roby's lab at Oregon State University for nutrition analysis as part of APEX (98163) protocol.

We will band each bird with a U.S. Fish and Wildlife Service aluminum band and a unique combination of three color bands.

Chick diet: Adult pigeon guillemots carry a single fish in their bill back to the nest to feed their chicks. Before entering the burrow, adults commonly land in the water in front of the colony. Every five days we will conduct all day colony watches (600 hrs-2200 hrs) or 8 hour watches starting at 600 hrs or 1400 hrs on two consecutive days. From our observation posts on land or boat, we will identify these fish using binoculars or a telescope. We will identify the fish to the lowest taxonomic level and estimate their length to the nearest half bill length. Each time a bird arrives at the colony with a fish, we will record arrival time, delivery time, nest number, prey item, and prey size. In addition to collection of fish delivered to burrows (described above) we will verify our estimates of prey size and species identification by collecting fish from chicks using throat liguatures. The species composition of the chick diets and delivery rate with be compared with past studies.

Subtidal fishes: Analysis of FY96 and FY97 data will continue.

Specific Methods for River Otters.--

Capture. River otters will be captured in the oiled (Herring Bay) and nonoiled (Jackpot Bay and vicinity) areas of Prince William Sound using No. 11 Sleepy Creek leg-hold traps (Blundell et al., in review) under permit 97-006 from the Alaska Department of Fish and Game. Twenty otters will be captured in each study site. Traps will be placed on trails at latrine sites and monitored by means of trap transmitters (Telonics, Mesa, Arizona, USA) that signal when a trap has been sprung. Processing of otters normally begins within 1 - 2 hours. Otters will be anesthetized with Telazol (9mg/kg; A. H. Robins, Richmond, Virginia, USA) administered using Telinject darts and a blowgun.

Trapping sites for river otters will be associated with active ($\geq$ 10 recent feces) latrine sites in each study area. A total of 131 latrine sites were identified in Herring Bay area in June 1990 (Bowyer et al. 1995). Sixty five new latrine sites were located in 1996. Eighty-three latrine sites were identified in Jackpot Bay, and in the neighboring bays (Ewan and Paddy) another 69 latrine sites were located. During the initial trapping effort in 1997 and 1998 we will evaluate latrine

sites for use and abandonment by enumerating the presence of fresh scats without actually clearing the sites.

Handling and biosampling. Once anesthetized, otters will be weighed to the nearest 0.1 kg., measured to the nearest mm, and blood samples will be drawn from the jugular vein. Measurements taken will include weight (kg); body length, tail length, and total length (mm); total skull length and zygomatic arch width; canine length and diameter, and distance between canines; and length from hock to toe of the right hind foot. Sex will be distinguished by the relative position of urogenital openings and palpation of the baculum (Larson and Taber, 1980). Females will be checked for evidence of lactation. We will insert a PIT (Passive Integrated Transponder) tag under the skin between the scapulae of each individual to allow identification of recaptured animals within and between seasons.

A total of 22 mls of blood will be drawn from the jugular vein of each otter with care to keep samples sterile. Ten mls will be preserved with heparin (40u/ml or .4ml/10ml of blood) and stored in a red top vacutainer for transporting to the field lab. An additional 2 ml will be preserved with EDTA (purple top vacutainer), and 10 ml of blood will be collected in a red top vacutainer and allowed to clot. Two blood smears will be made for each river otter at the time of blood draw. Age of otters will be determined by removing an upper premolar 1 for cementum annuli aging. A tissue sample will be collected from each river otter for endothelial P450 analysis using a 3mm disposable skin biopsy punch instrument to remove a small circle of skin from the medial surface of the left front limb in the triceps area. The specimen will be preserved in 10% neutral buffered formalin immediately after collection. Swab samples of pelage will be collected for ELISA assay using a 1 by 1 gauze swab saturated with isopropanol and applied to the fur for 15 seconds. Areas of pelage suspected to be contaminated with petroleum will be swabbed as well as the ventral aspect of the neck, the abdomen, a swath along each side and one over the length of the back. Swabs will be handled with gloved hands only, once the pelage has been sampled the swab will be completely enclosed in aluminum foil and frozen for laboratory analysis. Two whiskers, and fur samples (under coat and guard hair) will be collected for stable isotope analysis.

Surgical procedures and radio telemetry implants. Once morphometric data, blood and tissue samples have been obtained, selected adult otters will be prepared for surgical implantation of radio-telemetry transmitters. Only individuals that appear to be in good health will be implanted, with an approximately equal number of males and females receiving transmitters. In Herring Bay, approximately 20 otters will receive radio-telemetry transmitters in 1997. In Jackpot Bay an additional 10 otters will be equipped with transmitters (17 otters were implanted in 1996). Four of the transmitters implanted in 1996 malfunctioned, doubling their pulse rate which will reduce the battery life to one year. If these otters are recaptured their old transmitters will be removed and new transmitters will be implanted if adhesions have not formed that would prevent safe removal of the old transmitter. In 1998 we will replace expired transmitters if the otters are recaptured.

The surgery site will be shaved and surgically scrubbed with Nolvasan soap, alcohol, and a final iodine prep. Near completion of the surgical site preparation, the otter will be checked to

ascertain depth of anesthesia and proper analgesia. If a second dose of anesthetic is required, a combination of Ketamine Hydrochloride (100 mg/ml, Ketaset, Aveco Co., Fort Dodge, Iowa, 50501, USA) at a dose of 10 mg/kg, and Midazolam Hydrochloride (5 mg/ml, Versed, Hoffman-LaRoche, Nutley, New Jersey 07110, USA) at a dose of 0.25 mg/kg mixed in the same syringe (Spelman et al., 1993), will be administered to prevent problems with prolonged recovery associated with subsequent doses of Telazol. The surgeries will be performed by a veterinary technician with specialized training in the procedure, using methods outlined in Testa et al. (1994). All surgeries will use sterile technique. An incision will be made on the side, posterior to the last rib to introduce a hermetically sealed radiotransmitter (IMP/400/L -- Telonics, Mesa, Arizona) into the peritoneal cavity. Each muscle layer will be closed separately with simple interrupted sutures, the skin will be closed with a continuous subcuticular suture line to prevent the otter from accessing any sutures. As a final precaution, the skin incision will be sealed with surgical glue. All methods used in this research have been approved (authorization 95-17+) by an independent Animal Care and Use Committee at the University of Alaska Fairbanks, Fairbanks, Alaska, in compliance with policies recommended by the National Institutes of Health (NIH), the National Science Foundation (NSF), and the Scientists Center for Animal Welfare (SCAW).

River otters captured in the oiled and the nonoiled areas will be handled identically (e.g. morphometrics, tissue samples, blood drawn, PIT tags) with the exception of the surgical implantation of radio-telemetry transmitters in selected individuals. Otters captured within a 5 minute boat ride of camp will be transported to camp for processing when surgical procedures are required. All otters captured further from camp will be processed at capture sites. Otters processed in camp will be returned to the capture site while recovering from anesthesia and contained in a holding box until fully recovered before being released (usually 1 - 3 hours). Otters processed on site will also be contained within a recovery box until ready for release.

To protect our study animals in the Herring Bay and Jackpot Bay areas, a river otter trapping closure is in effect by Emergency Order of the Alaska Department of Fish and Game, along with a Federal Subsistence Trapping Closure by Special Action.

Field Processing and Blood Samples. In the field laboratory, red-top tubes will be centrifuged in the field at low speed (800 x g,) for 20 minutes. Serum will be drawn from the clot of the centrifuged sample and frozen separately. All serum samples, and the clot, will be frozen within 12 hours of obtaining the samples. Serum will be removed from the clot within 6-8 hours. The time of blood draw and the time of sample processing in the field laboratory will be recorded. The plasma will be drawn off of the heparinized sample with care so as not to disturb the buffy coat layer. One ml of the plasma will be mixed with 0.2 ml of DMSO (tissue culture grade) and placed on ice. The buffy coat will be removed from the erythrocyte layer and placed in a snap top tube along with 1 ml of plasma. The plasma/DMSO will then be added slowly (one drop at a time) to the mixture. The mixture will be aliquoted into two cryovials (approx. 1 ml each), placed into a prechilled Nalgene freezing unit and placed into the freezer for 12 hours. The buffy coat samples will be transferred to a liquid nitrogen dewar for storage and eventual transport to the Purdue University laboratory for immunoassays and P450 analyses. Any remaining plasma will be frozen. EDTA samples and one blood smear from each otter will be

flown to a laboratory in Anchorage (Quest Lab c/o Laurie Rubin, 562-2551) for a complete blood count within 72 hours of the blood draw. All serum and plasma will stay frozen in propane freezers in the field and sent, periodically, to University of Alaska Fairbanks when trustworthy couriers are available. Serum samples will be sent to Quest Lab in the fall for Serum Chemistry Panels and other tests as needed.

Radio Telemetry Locations: In 1997, we will implant radio-telemetry transmitters in 20 adult otters in Herring Bay and an additional 10, if possible, in Jackpot Bay, bringing our sample size of telemetered otters in the Jackpot area to 27. The battery life for these transmitters is approximately 2 years. We will obtain locations for these otters on a seasonal schedule. During the first part of May, when females should be seeking den sites for parturition, we plan to fly every 4 days until denning activity is noted. Few data are available on river otters and denning habitat in a marine environment but studies in SE Alaska noted den sites up to 1 km from the shoreline. Presently this is the only method we have to give us some indication of reproductive activity in females. The young are kept in these natal den sites for 7 to 8 weeks before they are brought to the coastal areas and begin foraging for themselves. Once the denning period has passed, aerial telemetry flights will occur once each week during the active field season (May through August) to supplement other data collected during the field season (e.g. prey availability from diving transects and data loggers at some latrine sites). During the remainder of the year flights will be scaled back to twice per month until May when the aerial schedule will resume with the denning phase. Aerial locations obtained with this frequency will allow us to determine accurate home range sizes for otters in each study area. In 1996 all radio-telemetry tracking was done from a boat. When otters were not located near the shore, no radio signals could be detected. We obtained as few as 6 of a possible 26 locations for many otters, resulting in many hours for very few data points and a likely misrepresentation of some otter home ranges. We will continue with a scaled down version of boat-based radio-telemetry tracking in 1997 and 1998. These locations will be obtained 2 to 3 times each week on a random start schedule to minimize possible bias in activities of otters during radio locations. The long daylight hours should allow us to collect data during most of the 24-hour period. If bad weather or darkness prevents us from collecting data at a given start time, we will select the next random starting time for our next telemetry survey. These telemetry locations will allow us to compare 1997 and 1998 home-range size for otters in Herring Bay with home ranges for otters in that location in 1991 and 1992. Additionally, we will compare home range size between the two study areas in 1997 and 1998, relative to prey availability. Moreover, aerial locations of otters in the Jackpot Bay area will ascertain whether any otters are making extensive use of freshwater systems near Jackpot Bay. The limited number of locations on a subset of the 17 telemetered otters in that area in 1996 could be indicative of reliance on the freshwater system. The lower prey base in the freshwater system could potentially lead to smaller body size in otters, thus adding a confounding variable to our comparison of morphometrics between areas. Any differences in blood chemistry or morphometrics between otters in oiled and nonoiled areas will be further validated by again ascertaining whether otters move from the nonoiled area into the oiled area.

Prey Availability Over Time: We will conduct repeated dives on the same random and latrine sites over the 4 month field season. Dive transects in the early part of our field season must be kept to a minimum to accommodate the labor-intensive capture and processing of river

otters. In May 1997, five random and five latrine sites in Jackpot Bay will be sampled following the same procedures used by the subtidal fishes component of NVP. The sites dived by the river otter component in Jackpot Bay will be a subset of the sites that the subtidal fishes component will sample in July of 1997. In June 1997, the river otter component will begin diving in Herring Bay where we will remain for the rest of the field season. Eighteen random and18 latrine sites in Herring Bay will be sampled every two weeks from mid-June through mid-August. We will place data loggers (DCC's) at a subset of the latrine sites ($n = 6$) in Herring Bay where we will be diving. These DCC's will be programmed to scan through all the frequencies of telemetered otters in the study area every 1 minute to record the presence or absence of each otter. The data loggers will quantify otter activity at latrine sites relative to prey availability at those sites. Feces to be used for population estimates (using Microsatellite DNA-fingerprinting) will be collected at three of the dive sites with data loggers. At the other three dive sites with data loggers, feces will be quantified regularly but the feces will not be collected until the end of the season. This may allow us to determine whether collection of feces at these sites influences otter behavior (e.g. increase or decreased use of, or defecation at site). A similar sampling plan is anticipated for 1998.

Population Estimates: We are working closely with another group of scientists at University of Alaska, Fairbanks (Drs. Pamela Groves, Merav Ben-David, and Eric Rexstad) to obtain population estimates for river otters in the two study areas for 1997 and 1998. They will use microsatellite DNA-fingerprinting techniques to identify individual otters from their feces left a latrine sites. Mark-recapture population estimates ("capturing" feces at latrine sites) will be calculated using closed and open-population models. This research is funded by sources outside of NVP.

Subtidal fishes: Analysis of FY96 and FY97 data will continue.

Habitat Modeling.--

Predator, prey and habitat interactions. The sampling of predators and prey has been conducted in an integrated manner in the hopes of achieving a higher order of understanding as to how the Prince William Sound system operates. To date, most of our analyses have been conducted on single species, and have not fully utilized the power of the integrated design. Future analyses will begin to explore the interactions among species in a more integrated way. One class of analyses that we intend to explore are so called "habitat" or "resource selection" models. Examples of potential habitat models, are as follows. First, as an extension of previous work on habitat characteristics for river otters, terrestrial and subtidal habitat characteristics from river otter latrine sites, and from nearby random sites, will be contrasted to determine which characteristics are important to river otters. The second example is for sea otters. The observed spatial distributions of sea otters will be contrasted to measured habitat characteristics, including prey abundance and several physical habitat characteristics on available feeding sites to develop a resource selection function (relative probability of selection of feeding sites). The resource selection function can be used to rank feeding sites on the basis of relative importance (probability of use) to sea otters.

The work will consist of building integrated data bases which include all predator, prey, and environmental data from integrated sampling sites, and producing resource selection models to examine relationships between distributions of animals and associated environmental variables.

Publication of Previous Research.--
Several manuscripts on *Exxon Valdez* oil spill related subjects have recently been published by P.I.'s of the NVP project.

River Otters:
Title: Capturing river otters: a comparison of Hancock and leg-hold traps. In press. Wildl.. Soc. Bull.
Authors: G. Blundell, UAF; others.

Toxicology:
Title: Acute phase proteins and cytokines in alaskan mammals as markers of chronic exposure to environmental pollutants. 1996. Am. Fish. Soc. Symp. 18:809-813.
Authors: L. Duffy, UAF, R. Bowyer, UAF; others.

Invertebrates:
Title: Injury to epibenthic invertebrates resulting from the *Exxon Valdez* oil spill. 1996. Pages 424-439 *In:* Rice, S.D., R.B. Spies, D.A. Wolfe and B.A. Wright, eds. Proceedings of the *Exxon Valdez* Oil Spill Symposium. Amer. Fish. Soc. Symp. 18.
Authors: T.Dean, Coastal Resources Associates, Inc., S. Jewett, UAF,; others.

Sea Otter: Three publications on post-spill status of sea otters in PWS will be completed during FY 98; 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, USGS; 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 USGS 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 USGS 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 U.S. Geological Service whose responsibilities include lead agency, data archives and management, Chief Scientist, sea otter, harlequin duck, pigeon guillemot and various invertebrate components. In addition, USGS 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 98

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

FY 1998-1999

October:	1. Harlequin: Continue survival monitoring.
	2. Sea otter: Aerial survey of western Prince William Sound.
November:	1. Harlequin: Continue survival monitoring and skiff surveys.
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. Reporting of project findings at Restoration Workshop
	3. Project Review with Trustee Chief Scientists and Reviewers
February:	1. Harlequin: Continue survival monitoring and skiff surveys.
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. FY 98 -- Submission of 1997 Progress Report.
	4. FY 99 -- Submission of 1998 Progress Reports
May:	1. River otter: Live trapping for morphometrics and tissue sampling.
	2. Pigeon Guillemot: Active nest surveys.
June:	1. Pigeon Guillemot: Active nest surveys, blood sampling, prey sampling, and nest monitoring.
	2. Sea Otter: Prey selection, foraging success and time-depth recorder implantation.
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..
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 98 final year.

FY 1999

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 the preliminary study period (1995 field season) and one full field season (FY96). We cannot yet 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

Presentations at professional conferences have been proposed for FY98. Requests for funding to attend the meetings has been submitted in the FY98 budget. Included there are titles of professional meetings. We propose to notify the Trustees of presentation titles as they are determined.

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 U.S. Geological Survey of the Department of Interior. The USGS 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 U.S. Geological Survey-Biological Resources Division 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 have been included in the above methods section. Two additions in methods are the implantation of time-depth recorders in sea otters to evaluate their foraging habits; and predator, prey, habitat interaction modeling. The addition of these methods does not change the objectives or scope of the overall project, rather they will increase our understanding of the data we continue to collect under the original project description of 95025.

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Revised 6-12-97
Approved TC 8-6-97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998	PROPOSED FY 1998 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NOAA
				$407.3		$28.5	$1,054.7	$162.4
Personnel	$368.2	$350.2						
Travel	$55.9	$52.2						
Contractual	$1,140.0	$1,068.5						
Commodities	$64.7	$80.1						
Equipment	$2.5	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$1,631.7	$1,551.0		Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
General Administration	$104.6	$101.9						
Project Total	$1,736.3	$1,652.9		$450.0	$0.0	$0.0	$0.0	
Full-time Equivalents (FTE)	0	7.3						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$0.0	$0.0		$0.0	$0.0	$0.0	$0.0	

Comments:
Revised 6/12/97 by Lisa M. Thomas Project Manager

1998

Prepared: 1 of 34

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Lead Agency: U.S. Geological Survey-Biological Resources Division

FORM 2A
MULTI-TRUSTEE AGENCY SUMMARY

6/12/97

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

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$262.7
Travel		$39.8
Contractual		$620.8
Commodities		$67.1
Equipment		$0.0
Subtotal	$1,055.5	$990.4
General Administration	$65.8	$64.3
Project Total	$1,121.3	$1,054.7
Full-time Equivalents (FTE)		5.1
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	

Dollar amounts are shown in thousands of dollars.

Comments:
SO= Sea Otters
HD= Harlequin Ducks
CS= Chief Scientist
RO/PG= River Otters/Pigeon Guillemots
TEK= Traditional Ecological Knowledge
SC= Subtidal Clams

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: U.S. Geological Survey-Biological Resources Division

FORM 3A
TRUSTEE
AGENCY
SUMMARY

ared:

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

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
SO: Mr. J. Bodkin/Dr. B. Ballachey*		GS-12	7.0	5.5		38.5
D. Monson	Wildlife Biologist (WB)	GS-9	12.0	3.6		43.2
J. DeGroot	Biotech	GS-6	6.0	2.0		12.0
Dr. D. Mulcahy	Veterinarian	GS-13	0.5	6.1		3.1
HD: D. Esler	WB	GS-12	12.0	5.4		64.8
T. Bowman	WB	GS-11	2.5	3.2		8.0
D. Dirksen	WB	GS-14	0.5	7.4		3.7
Biotechs		GS-5	5.0	3.7		18.5
CS: Dr. L. Holland-Bartels	Chief Scientist	GS-14	2.5	7.9		19.8
M. Whalen	Data Manager	GS-9	12.0	4.0		48.0
M. Ronaldson	Secretary	GS-5	1.0	3.1		3.1
	Subtotal		61.0	51.9	0.0	
					Personnel Total	$262.7

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
SO: ANC/Cordova/ANC	0.3	8			2.4
Per diem Cordova			50	146.0	7.3
ARR Whittier 25" boat	0.8	2			1.6
workshop/meetings					3.0
HD: ANC/Cordova/ANC	0.3	14			4.2
Per diem					2.0
Worshops/meetings					1.3
CS: ANC/CordovaANC	0.3	1			0.3
Per diem			4	144.0	1.2
Purdue Travel: P. Snyder/A. Rebar	0.8	4			3.2
Per diem/Anchorage			20	217.0	7.6
TEK 4 P.I.'s (charter = $1100 round trip for 4 + 10% tax or $220.00/person RT + 10%)		2			2.5
Per diem			24	135.0	3.2
				Travel Total	$39.8

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: U.S. Geological Survey-Biological Resources Division

FORM 3B
Personnel
& Travel
DETAIL

6/12/97

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

Contractual Costs:	Proposed
Description	FY 1998
RO/PG: Univ. Alaska, Fairbanks Research Work Order	231.3
SC: University of Washington Research Work Order	92.7
SO: summer aerial survey and tracking (180 hrs@$200)	36.0
sample transport (20 hrs@$250/hr) and sample equipment	5.0
shipping equipment/camps/emergency	1.0
warehouse-Cordova	2.0
blood assays(commercial lab- 160@ $30) and serum chemistry	4.8
pelage/plumage assays (ELISA-oil-50@$40)	2.0
HD: boat charter (30 d@1.0)	30.0
air charter (144 hrs@.225)	32.4
radio telemetry observer (144@.025)	3.6
CS: boat charter	138.0
P450 assays- Woods Hole	24.0
Purdue contract (this includes no histopath support), only 40 SO and 40 RO samples.	15.0
TE: 5 participants x 2 workshops x 2 days/workshop x $150	3.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$620.8

Commodities Costs:	Proposed
Description	FY 1998
SO: food, 80 days @$15/day)	1.2
fuel, 75 days @20gal/day@$3.00/gal	6.0
office/field supplies(1.5K), blood and samle collectin supplies (.5K)	2.0
boat maintenance and repair	6.2
radio transmitters(20@$600)	12.0
time depth recorders(20@$1400)	28.0
HD: gear shipment	0.8
fuel (1.0K), trap materials and nets (3.0K)	4.0
miscellaneous (cold weather gear, rain gear,)	2.0
training	1.0
publication costs (Estimating Condition)	1.0
CS: workshop presentation materials/film/developing	1.7
TE: office supplies/postage/phone/fax	0.6
printing (village workshop reports)	0.6
Commodities Total	$67.1

Project Number:98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: U.S. Geological Survey-Biological Resources

FORM 3B
Contractual & Commodities

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

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
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
radio transmitters(6.0K)	10	USGS-BRD
time-depth recorders(14.0K)	10	USGS-BRD

All boats, computers and field equipment donated by USGS-BRD for sea otters, harlequin ducks, river otters and pigeon guillemot components.

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: U.S. Geological Survey-Biological Resources Division

FORM 3B
Equipment
DETAIL

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

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$0.0
Travel		$0.0
Contractual		$387.1
Commodities		$0.0
Equipment		$0.0
Subtotal	$336.0	$387.1
General Administration	$54.5	$20.2
Project Total	$390.5	$407.3
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	

Dollar amounts are shown in thousands of dollars.

Comments:

1998
6 of 34

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

6/12/97

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

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
	Subtotal		0.0	0.0	0.0	
					Personnel Total	$0.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
				Travel Total	$0.0

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed
Description	FY 1998
Contract	$387.1
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$387.1

Commodities Costs:	Proposed
Description	FY 1998
Commodities Total	$0.0

1998

Project Number:98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

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

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

6/12/97

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

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$64.8
Travel		$10.2
Contractual		$60.6
Commodities		$12.8
Equipment		$0.0
Subtotal	$135.1	$148.4
General Administration	$12.8	$14.0
Project Total	$147.9	$162.4
Full-time Equivalents (FTE)		1.8
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002

Dollar amounts are shown in thousands of dollars.

Comments:

NOAA contribution: Principal Investigator, C. O'Clair, 7mos.= $47.6K

Increased contractual costs needed for specialized laboratory processing and analysis of mussels collected for growth, aging, and mortality studies.

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: National Oceanic and Atmospheric Administration

FORM 3A
TRUSTEE
AGENCY
SUMMARY

pared:

6/12/97

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

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
C. O'Clair	Fishery Biologist	GS12/10	2.0	6.8		13.6
C. Broderson	Fishery Biologist	GS11/7	1.5	5.3		8.0
Technician	Fishery Biologist	GS7/1	9.0	2.4		21.6
Technician	Fishery Biologist	GS7/1	9.0	2.4		21.6
		Subtotal	21.5	16.9	0.0	
					Personnel Total	$64.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Jun/ANC/Jun, Workshop & coordination meetings	0.4	4	10	0.3	4.6
Jun/Sew/Jun field work in Prince William Sound	0.7	4	2	0.2	3.2
Jun/Whit/Jun field work in Prince William Sound	0.5	4	2	0.2	2.4
				Travel Total	$10.2

1998

Prepared:

Project Number:98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Personnel
& Travel
DETAIL 6/12/97

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

Contractual Costs:	Proposed FY 1998
Description	
Contract for sample procesing and aging (12 months@ $5048/mon)	60.6
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$60.6

Commodities Costs:	Proposed FY 1998
Description	
growth supplies	3.8
aging supplies	2.7
chemicals	1.0
field and lab supplies	1.8
weight/measurement supplies	0.5
publication/presentation costs	1.0
project support (shipping etc.)	2.0
Commodities Total	$12.8

1998

Project Number: 98025
Project Title: Mechanism of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Contractual & Commodities DETAIL

6/12/97

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

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
computer, compaq	2	NOAA
balance	1	NOAA
camera	1	NOAA

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: National Oceanic & Atmospheric Administration

FORM 3B
Equipment
DETAIL

Prepared:

6/12/97

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

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$22.7
Travel		$2.2
Contractual		$0.0
Commodities		$0.2
Equipment		$0.0
Subtotal	$50.6	$25.1
General Administration	$5.7	$3.4
Project Total	$56.3	$28.5
Full-time Equivalents (FTE)		0.4
Other Resources		

LONG RANGE FUNDING REQUIREMENTS				
Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	

Dollar amounts are shown in thousands of dollars.

Comments:

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: U.S. Forest Service, Pacific Northwest Research Station

FORM 3A
TRUSTEE
AGENCY
SUMMARY

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

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
M. Bishop	Principal Investigator	GS12/2	3.0	5.7		17.1
	Biologist/Statistician	GS9/1	1.0	3.1		3.1
P.Green	Bilogical Technician/Data Manager	GS7/1	1.0	2.5		2.5
		Subtotal	5.0	11.3	0.0	
					Personnel Total	$22.7

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Cordova/ANC/Cordova	0.2	2	6	0.1	1.0
1998 American Ornithologists Union Meeting	0.8	1	4	0.1	1.2
				Travel Total	$2.2

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: U.S. Forest Service, Pacific Northwest Research Station

FORM 3B
Personnel
& Travel
DETAIL 6/12/97

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

Contractual Costs:	Proposed FY 1998
Description	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed FY 1998
Description	
poster materials	0.1
computer-generated slides (20 @$5)	0.1
Commodities Total	$0.2

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: US Forest Service- Pacific Northwest Research Station

FORM 3B
Contractual & Commodities DETAIL

Prepared:

6/12/97

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

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 1998
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: US Forest Service- Pacific Northwest Research Station

FORM 3B
Equipment
DETAIL 6/12/97

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

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$104.8
Travel		$17.1
Contractual		$57.2
Commodities		$31.2
Equipment		$0.0
Subtotal	$0.0	$210.3
Indirect		$21.0
Project Total	$0.0	$231.3
Full-time Equivalents (FTE)		22.6
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	

Dollar amounts are shown in thousands of dollars.

Comments:

1998
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Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Alaska, Fairbanks
Agency: USGS-BRD Contra

FORM 4A
Non-Trustee
SUMMARY

ared:

6/12/97

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

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 1998
T. Bowyer	Principal Investigator		1.7	8.1		13.8
L. Duffy	Principal Investigator		1.1	7.1		7.8
Lab Techinician			3.2	3.3		10.5
Technician			1.9	6.4		12.2
Account Technician			0.5	5.6		2.8
Fieldcrew leader			4.2	2.1		8.8
Lab Techinician			5.4	2.0		10.8
Student Asistant			4.6	2.0		9.2
P. Seizer/G. Blundell Assistanships						28.9
	Subtotal		22.6	36.6	0.0	
					Personnel Total	$104.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Fbx/Homer/Fbx	0.3	1			0.3
Fbx/Cordova/Anc/Fbx	0.3	2			0.6
Fbx/Anc/Whitt (3 boats)	0.5	1			0.5
Fbx/Anc/Whitt (personnel)	0.2	6			1.2
per diem					0.9
Fbx/Anc	0.3	18			5.4
Anchorage per diem			54	0.1	5.4
Duffy-Mechanism of Toxicology Professional meeting					1.1
Bowyer- Wildlife Society					1.7
				Travel Total	$17.1

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Alaska, Fairbanks
Agency: USGS-BRD Contractor

FORM 4B
Personnel & Travel

6/12/97

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

Contractual Costs:	Proposed
Description	FY 1998
AK Dept. Fish and Game Assistance	10.0
air charter/telemetry flights	3.0
air charter personnel transport $800/ea RT X 5	4.0
air charter PIGU blood $110/RT X 14 pick up	1.5
air charter $110 RT river otter blood X 20	2.2
stable isotope latrine site analysis	10.0
duplication/computer fees	1.2
barge 2 trips @$2200	4.4
excess baggage/freight	1.2
publication	1.0
Alaska Railroad	0.5
lease 3 vehicles Fbx/Whitt/Fbx (1500mi@.50/mi)	2.3
freezer maintenance	0.8
boat motor/boat maintenance	1.5
weatherport maintenance	0.6
computer maintenance	0.7
binocular maintenance	0.1
blood panels (150PWS, 75KB @$43/panel)	9.7
blood panels (140otter @$43/panel)	1.7
boat safety training	0.2
telephone services	0.6
Contractual Total	$57.2

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Alaska, Fairbanks
Agency: USGS-BRD Contractor

FORM 4B
Contractual

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

Commodities Costs:	Proposed
Description	FY 1998
lab-haptoglobin (150PWS,+ 75KB_ 6 kits@$165/kit	1.0
lab-haptoglobin (40 river otters 2 kits@$165/kit	0.3
ELISA 4 kits @$300	1.2
2 interleukin kits@$550 each	1.1
food	7.4
sleeping bag(.2K)/ tent, 4 man dome(.6K)/therma rests 3@$89)	1.1
pesola scales 8 @ $50 ea	0.4
blind(.2K)/boat safety supplies (.4K)	0.6
whirl pacs	0.2
tripods 2 @ $149 ea	0.3
MSR waterworks filtration system (replace 2)	0.3
first aid kit (2@$132)	0.3
field camp supplies	1.0
rite-in-rain notebooks	0.3
rain gear	1.0
waders/extra tuffs (6@$52)	0.3
boat fule (60 gal/day @$1.50/gal, 110days)	9.9
propane tank 1001b. 4@$120 ea)	0.5
propane regular, lines	0.2
camp cooking supplies	0.3
blood samplling/storage supplies	3.5
Commodities Total	$31.2

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Alaska, Fairbanks
Agency: USGS-BRD Contractor

FORM 4B
Commodities

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

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Alaska, Fairbanks
Agency: USGS-BRD Contractor

FORM 4B
Equipment

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

Budget Category:	Authorized FY 1997	Proposed FY 1998	LONG RANGE FUNDING REQUIREMENTS					
				Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	
Personnel		$38.4						
Travel		$21.7						
Contractual		$15.5						
Commodities		$5.0						
Equipment		$0.0						
Subtotal	$0.0	$80.6						
Indirect		$12.1						
Project Total	$0.0	$92.7						
Full-time Equivalents (FTE)		17.5						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:
indirect cost is 15% total direct costs

1998
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Prepared:

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Washington
Agency: USGS-BRD Contractor

FORM 4A
Non-Trustee
SUMMARY

6/12/97

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

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 1998
		Project Leader- manuscript prep				2.5
		Research Assistant	12.0	1.6		19.2
		Research Assistant tuition				6.5
		Research Assistatant benefits				1.5
		Hourly person	5.5	1.4		7.7
		Hourly person benefits				1.0
						0.0
						0.0
						0.0
		Subtotal	17.5	3.0	0.0	
					Personnel Total	$38.4

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 1998
	Seattle/ANC/Seattle(field/planning)					14.7
	Seattle/ANC/Seattle(conferences)					2.0
	Int'l Marine Mammal Symposium					2.5
	International Otter Symposium					2.5
					Travel Total	$21.7

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Washington
Agency: USGS-BRD Contractor

FORM 4B
Personnel & Travel

6/12/97

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

Contractual Costs:	Proposed
Description	FY 1998
computer/statistical consulting	3.0
taxonomic consulting	3.0
computer repair	1.0
dive gear repair	0.5
clamshell isotope analysis	5.0
publications (page charges and VanBlaricom salary)	0.0
phone/fax/postage/photocopy/graphics/photoprocessing	3.0
Contractual Total	$15.5

Commodities Costs:	Proposed
Description	FY 1998
replacement dive gear	3.5
field sampling gear	1.0
office supplies	0.5
Commodities Total	$5.0

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Washington
Agency: USGS-BRD Contractor

FORM 4B
Contractual & Commodities

6/12/97

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

New Equipment Purchases:	Number of Units	Unit Price	Proposed FY 1998
Description			
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage:	Number of Units
Description	

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: University of Washington
Agency: USGS-BRD Contractor

FORM 4B
Equipment

pared:

6/12/97

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

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$156.4
Travel		$10.1
Contractual		$166.5
Commodities		$7.0
Equipment		$0.0
Subtotal	$336.0	$340.0
General Administration	$54.5	$47.1
Project Total	$390.5	$387.1
Full-time Equivalents (FTE)		2.1
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002

Dollar amounts are shown in thousands of dollars.

Comments:

Indirect costs are 25% Total Direct Cost, the rate negotiated by the EVOS Trustee Council with the University of Alaska

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: Alaska Department of Fish and Game Contractor UAF

FORM 4A
NON-TRUSTEE
AGENCY
SUMMARY

6/12/97

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

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
S. Jewett	Project Leader		10.0	7.7		77.0
H. Feder	Technician		0.5	12.7		6.4
A. Blanchard	Technician		2.0	5.0		10.0
M. Hoberg	Technician		10.0	4.8		48.0
	diver		1.5	5.0		7.5
	diver		1.5	5.0		7.5
	Subtotal		25.5	40.2	0.0	
					Personnel Total	$156.4

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Fbx/Anc/Fbx	0.2	4	15	0.2	3.8
Fbx/Cordova/Fbx	0.5	3	6	0.1	2.1
Fbx/San Diego/Fbx	0.8	3	18	0.1	4.2
				Travel Total	$10.1

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: Alaska Department of Fish and Game Contractor

FORM 4B
Personnel
& Travel
DETAIL 6/12/97

pared:

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

Contractual Costs:	Proposed
Description	FY 1998
communications	0.9
freight shipping field gear and samples	3.0
Contract with Coastal Resourcs Associates, Inc.	155.0
postage	0.1
compressor repair	5.0
repars on EVOS zodiacs borrowed from Highsmith Projects	2.5
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$166.5

Commodities Costs:	Proposed
Description	FY 1998
SCUBA supplies (misc. and 3 replacemnt suits at 1.5/suit)	5.0
project supplies	1.0
field supplies	1.0
Commodities Total	$7.0

Project Number:98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: Alaska Department of Fish and Game Contractor

FORM 4B
Contractual & Commodities DETAIL

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

Prepared:

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
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
13 ft. zodiac from Highsmith EVOS project		EVOS
14 ft. zodiac from Highsmith EVOS project		EVOS

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Agency: Alaska Department of Fish and Game Contractor

FORM 4B
Equipment
DETAIL 6/12/97

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

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$73.3
Travel		$5.9
Contractual		$0.0
Commodities		$4.1
Equipment		$0.0
Subtotal		$83.3
Indirect		$71.7
Project Total	$152.1	$155.0
Full-time Equivalents (FTE)		1.1
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	

Dollar amounts are shown in thousands of dollars.

Comments:

1998
31 of 34
Prepared:

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: Coastal Resources Associates, Inc,
Agency: Alaska Department of Fish and Game Contractor

FORM 4A
NON-TRUSTEE
AGENCY
SUMMARY 6/12/97

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

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FY 1998
Name	Position Description					
T. Dean	Project Leader		6.0	7.6		45.6
L.Deysher	Assistant		0.5	7.6		3.8
D. Jung	Assistant		6.0	3.4		20.4
	Diver 1		1.0	3.5		3.5
	Subtotal		13.5	22.1	0.0	
					Personnel Total	$73.3

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1998
Description					
SD/Anch/SD	0.5	7			3.5
per diem			24	0.1	2.4
				Travel Total	$5.9

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: Coastal Resources Associates, Inc.
Agency: Alaska Department of Fish and Game Contractor

FORM 4B
Personnel
& Travel
DETAIL

6/12/97

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

Contractual Costs:	Proposed
Description	FY 1998
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed
Description	FY 1998
office supplies	0.7
field supplies	1.1
computer supplies/software	1.3
copy costs	0.4
postage/freight	0.6
Commodities Total	$4.1

1998

Prepared:

Project Number:98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: Coastal Resources Associates, Inc.
Agency: Alaska Department of Fish and Game Contractor

FORM 4B
Contractual & Commodities DETAIL

6/12/97

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

New Equipment Purchases:	Number of Units	Unit Price	Proposed FY 1998
Description			
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage:	Number of Units	Inventory Agency
Description		
13 ft. zodiac from Highsmith EVOS project		EVOS
14 ft. zodiac from Highsmith EVOS project		EVOS

1998

Project Number: 98025
Project Title: Mechanisms of Impact & Potential Recovery of Nearshore Vertebrate Predators
Name: Coastal Resources Associates, Inc.
Agency: Alaska Department of Fish and Game Contractor

FORM 4B
Equipment
DETAIL

Approved TC 8-6-97

Monitoring of Cutthroat Trout and Dolly Varden Habitat Improvement Structures

Project Number:	98043B
Restoration Category:	Monitoring
Proposer:	USFS
Lead Trustee Agency:	USFS
Cooperative Agencies:	None
Alaska SeaLife Center:	
Duration:	3rd year, 5-year project
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. Preliminary data were collected in 1995 and 1996 could be interpreted to support this assumption, with regard to cutthroat trout. Additional monitoring seeks to address these questions, and provide solid results to base our conclusions on the effectiveness of these types of improvements to benefit Dolly Varden and cutthroat trout.

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 an oil spill related injuries to 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) study, 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 trouts 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 numbers 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 habitats in PWS. The distribution and abundance of cutthroat trout, Dolly Varden and coho salmon (*Onchorhynchus kisutch*) 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.
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 trouts, both juveniles. Instead, trapping was conducted in a nonrandom 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.

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. Sampling again in 1996 produced population estimates for the most part with a CV value of greater than 0.20 which is generally inadequate and indicates low precision of the estimates. This is due to the small sample size and the low numbers of recaptures of cutthroat trout.

The sampling design for 1996 had been modified to address this problem. The modification involved 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 was expected to increase the precision of the estimates. Table 1. in Appendix A. summarizes the mark recapture and CPUE datum collected in 1995 and 1996 for each of the project locations. Estimates of cutthroat trout populations did not appear to improve using this modified technique. However estimates of other species did improve. It appears that cutthroat trouts are "trap shy" making the likelihood of a recapture more difficult than anticipated. The additional trapping time is however providing useful CPUE information on habitat distribution and enhancement structure utilization, therefore I propose to continue using this method.

Sampling by Glacier Fisheries Crews in 1996 again suggested that cutthroat trout densities were greatest in the upper reaches of these inlet tributary streams. 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. A summary of the CPUE for Otter Creek, Gunboat Lakes and Red Creek by the three major habitat type and species for 1995 and 1996 data can be found in Appendix A. Chart 8. Preliminary data seems to indicate that cutthroat trout utilize all three habitat types nearly equally while coho and Dolly Varden seem to predominantly utilize slow water habitat types.

Preliminary catch per unit effort (CPUE) information is presented in Appendix A. Charts 2-7, this information is based on pre-project trapping in 1995 of enhancement sites and project area streams, and the data collected last season in these same locations. Since only a base line year and data from one season of post project exist, it is premature to draw conclusions on how the habitat improvements have affected the fish populations. Information collected in 1997 and subsequent years will help to refine these observations.

All sixty-three structures were inspected and minor repairs made, three cross-log structures required repositioning and anchoring. These structures were most probably dislodged during the fall 1995 Typhoon Oscar event. In general all the improvements were in good order and functioning as predicted.

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 AND TRADITIONAL ECOLOGICAL KNOWLEDGE

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 null hypotheses for this project is that the number of cutthroat trouts at the project locations will not increase due to the habitat improvements made in 1995. To test this and meet the projects objectives five working null hypotheses have been developed:

Hypotheses 1. The abundance of cutthroat trout at the project sites will not increase over the monitoring project duration.

Hypotheses 2. The current distribution of cutthroat trout within the project area will not change over the duration of the monitoring project.

Hypotheses 3. Cutthroat trout and Dolly Varden will not be the predominant species to utilize the newly created habitat structures.

Hypotheses 4. Aquatic microhabitats adjacent to areas of improvement will not be affected by the structures installed in 1995.

Hypotheses 5. The structures installed in 1995 will not have benefitted cutthroat trouts over the duration of the monitoring project.

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. Chart 1.

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. 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 98 (October 1, 1997 - September 30, 1998)

April 15 (1998): Report on preliminary findings of population and distribution estimations.
August (1998): 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 were 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 FY98 proposal does not differs from the FY97 proposal. The monitoring plan design remains the same as that proposed in 1997.

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

PRINCIPAL INVESTIGATOR

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

OTHER KEY PERSONNEL

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

Cliff Fox
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Dan Gillikin, Project Leader
U.S. Forest Service
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APPENDIX A

Table 1. Summary of mark recapture and CPUE data for project 95043B. for 1995 and 1996, shaded values indicate a CV less than or near 0.20.

Loc.	Spec.	Pop.Est		V (N)		CV		CPUE	
		95	96	95	96	95	96	95	96
Otter	CO	45	1220	324	10848	0.4	0.085	0.0019	0.0081
	CT	6	56	9	1344	0.5	0.654	0.0003	0.0002
	DV	128	1923	1536	7597	0.31	0.085	0.0039	0.0080
Red	CO	14	760	0	60805	0	0.324	0.0002	0.0024
	CT	105	72	1125	1344	0.32	0.509	0.0007	0.0003
	DV	427	374	8169	16456	0.21	0.343	0.0024	0.0012
Gun R 2	CO	504	426	6720	9975	3.25	0.23	0.0127	0.0027
	CT	50	36	300	1296	0.38	1	0.0009	0.0004
	DV	48	594	768	24293	0.21	0.262	0.0004	0.0034
Gun R 3	CO	N/A	30	N/A	244	N/A	0.51	N/A	N/A
	CT	N/A	54	N/A	1215	N/A	0.64	N/A	N/A
	DV	N/A	70	N/A	23	N/A	0.068	N/A	N/A
Billy	CO	N/A	N/A	N/A	N/A	N/A	N/A	0.0244	0.0282
	CT	N/A	N/A	N/A	N/A	N/A	N/A	0.0012	0.0001
	DV	N/A	N/A	N/A	N/A	N/A	N/A	0.0589	0.0124

Chart 1. Description of habitat classification technique.

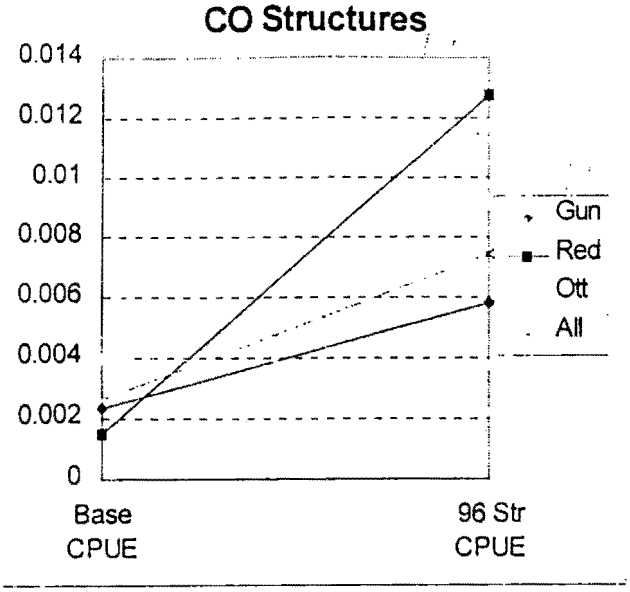
Fast Water Habitat Types

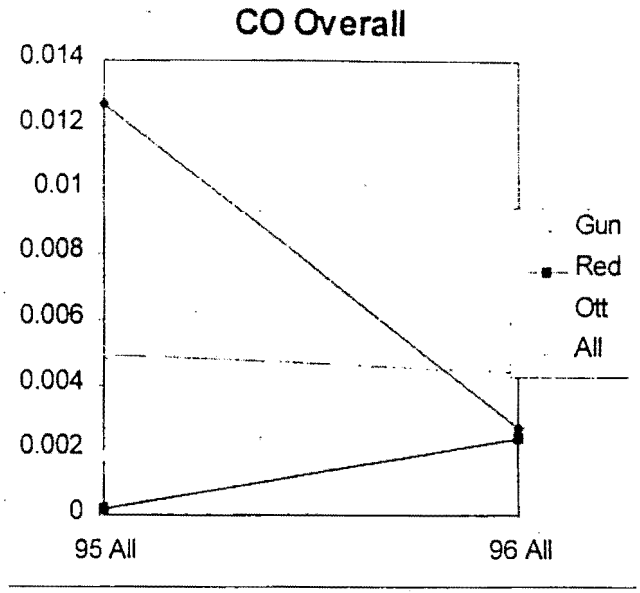
- Turbulent
  - Turbulent (Rapid)
  - High Gradient Riffle
  - Low Gradient Riffle
- Non-Turbulent
  - Runs
  - Glides

Slow Water Habitat Types

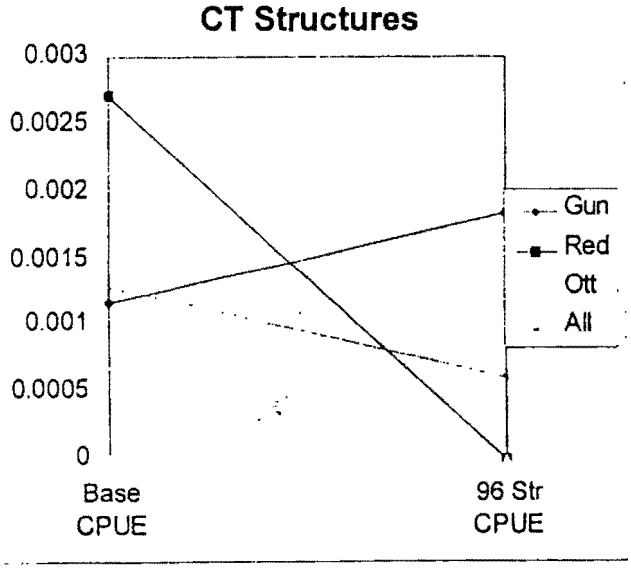
- Dammed
  - Main
  - Backwater
- Scoured
  - Lateral
  - Mid-Scour

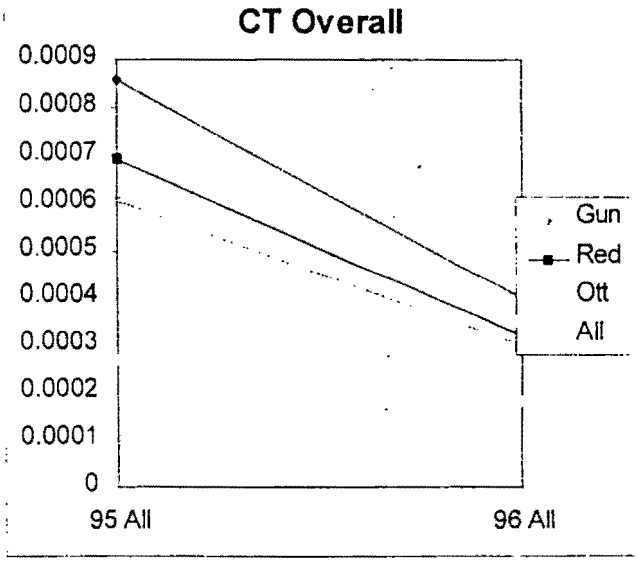
Charts 2,3. Catch Per Unit Effort (CPUE) data for juvenile coho salmon (CO) at the four project locations. Structures are at enhancement sites, Overall is for the entire stream reach within the project areas. Base CPUE is pre-project CPUE at enhancement sites.



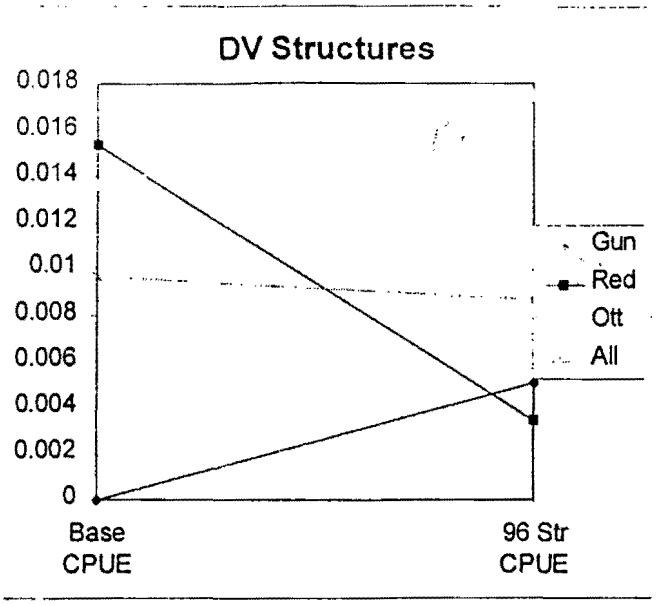


Charts 4,5. Catch Per Unit Effort (CPUE) data for juvenile cutthroat trout (CT) at the four project locations. Structures are at enhancement sites, Overall is for the entire stream reach within the project areas. Base CPUE is pre-project CPUE at enhancement sites.





Charts 6,7. Catch Per Unit Effort (CPUE) data for juvenile Dolly Varden (DV) at the four project locations. Structures are at enhancement sites, Overall is for the entire stream reach within the project areas. Base CPUE is pre-project CPUE at enhancement sites.



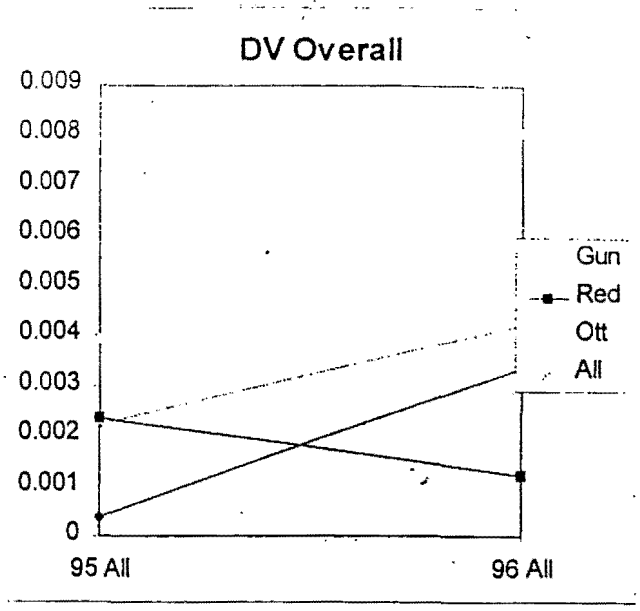
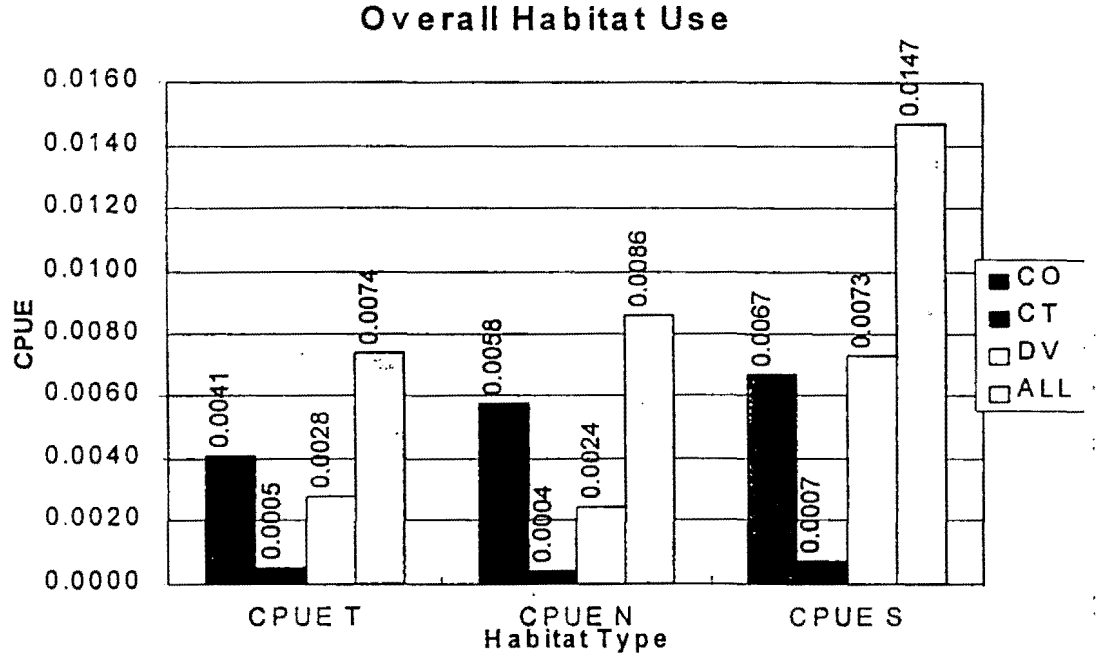


Chart 8. Summary of habitat utilization by species for Otter, Red Creek and Gunboat Lakes. T = Turbulent, N = Non-Turbulent, S = Slow Water habitat types.



1998 EXXON VALDEZ TRU[illegible]. COUNCIL PROJECT BUDGET

Approved TC 8-6-97

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel	$15.0	$15.0
Travel	$0.4	$0.0
Contractual	$3.0	$3.0
Commodities	$3.1	$3.5
Equipment	$0.0	$0.0
Subtotal	$21.5	$21.5
General Administration	$2.5	$2.5
Project Total	$24.0	$24.0
Full-time Equivalents (FTE)	0.3	0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002
$18.4	$8.0		

Dollar amounts are shown in thousands of dollars.

Comments: Continuation of 96043B, 97043B.

1998

Project Number: 98043B
Project Title: CT/DV Monitoring
Agency: US Forest Service

FORM 3A
TRUSTEE
AGENCY
SUMMARY

4/14/97

Prepared:4/4/97, K.Holbrook

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
Vacant	Fish Biologist	GS-9	0.8	5.2		4.2
D.Gillikin	Fish Biologist	GS-7	1.0	4.0		4.0
Seasonal	Fish Tech	GS-5	2.0	3.4		6.8
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.8	12.6	0.0	
					Personnel Total	$15.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

1998

Prepared:

Project Number: 98043B
Project Title: CT/DV Monitoring
Agency: US Forest Service

FORM 3B
Personnel
& Travel
DETAIL

4/14/97

1998 EXXON VALDEZ TRUS[illegible] COUNCIL PROJECT BUDGET
October 1, 1997 - September 30, 1998

Contractual Costs:		Proposed
Description		FY 1998
Air Charter	$250/hr for 12 hrs	3.0
When a non-trustee organization is used, the form 4A is required.	**Contractual Total**	$3.0

Commodities Costs:	Proposed
Description	FY 1998
boat fuel	1.4
truck fuel	0.2
camp supplies	0.4
camp food	0.5
supplies	0.5
Train tickets	0.5
Commodities Total	$3.5

1998

Prepared:

Project Number: 98043B
Project Title: CT/DV Monitoring
Agency: US Forest Service

FORM 3B
Contractual & Commodities DETAIL

4/14/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1998

Project Number: 98043B
Project Title: CT/DV Monitoring
Agency: US Forest Service

FORM 3B
Equipment
DETAIL

Prepared: 4/14/97

Approved TC 8-6-97

Community Involvement

Project Number:	98052A
Restoration Category:	General Restoration
Proposer:	P. Brown-Schwalenberg/CRRC
Lead Trustee Agency:	ADFG
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	Cont'd
Duration:	4th yr. 8 yr. project
Cost FY 98:	$232.1
Cost FY 99:	$230.0
Cost FY 2000:	$230.0
Cost FY 01:	$230.0
Cost FY 02:	$230.0
Geographic Area:	Spill-area wide
Injured Resource/Service:	Subsistence

ABSTRACT

This project will increase community involvement in the restoration process. The Spill Area-Wide Coordinator 's work will continue through a contract with the Chugach Regional Resources Commission (CRRC). Through direct communication with a network of local facilitators, the Spill Area-Wide Coordinator will continue to actively involve local residents in the restoration program. (Local facilitators are located in Tatitlek, Chenega Bay, Port Graham, Nanwalek, Cordova, Seward, Seldovia, Valdez, Kodiak, and Alaska Peninsula.)

INTRODUCTION

Nine local facilitators were hired in FY 96 through cooperative agreements with the village councils of Tatitlek, Chenega Bay, Port Graham, Nanwalek, Eyak (Cordova), Qutekcak (Seward), Valdez, and the native associations in Bristol Bay and Kodiak. Under 97052A, the number of community facilitators was expanded by one to include the community of Seldovia. No new communities will be added in 98052A. Martha Vlasoff, the full time Spill Area Wide Coordinator, will be hired by the Chugach Regional Resources Commission (CRRC) to continue her work out of the Restoration Office, to accomplish the following tasks:

1. Increase involvement of community members and organizations throughout the spill region in restoration projects. This community process will include a local representative (Community Facilitator), whose duties are described below.

2. Serve as the contact point for a Community Facilitator in each of ten participating communities (Tatitlek, Chenega Bay, Port Graham, Nanwalek, Cordova, Seward, Seldovia, Valdez, Kodiak region, and the Alaska Peninsula region -- the Community Facilitators will be subcontractors to CRRC.) The tasks for the Spill Area Wide Coordinator in relation to the Community Facilitators would be to:

    a. At least every two weeks, fax a brief one-page activities report to the Community Facilitator to keep them informed of Trustee Council actions, Restoration Office activities, upcoming events, new research findings, etc. The report could be in the form of "bullets" with who to contact for more information on each item.

    b. Update the local resources inventories for each community (lodging and meeting space available for rent, boats and people available for hire, etc.). This information will be consolidated and distributed to all PIs. The Spill Area-Wide Coordinator and Community Facilitators will then assist PIs in arranging use of these local resources.

    c. Coordinate the participation of the Community Facilitators in the annual Restoration Workshop and other workshops/meetings as appropriate.

    d. Working with the TEK Specialist (Project 87052B), coordinate an annual review by Community Facilitators and village councils of restoration project proposals involving indigenous knowledge, and develop recommendations for the Executive Director.

3. Annually review the community involvement component of all restoration project proposals. Inform the Community Facilitators of proposals that would involve their communities. Make recommendations to the Executive Director on the adequacy of, and ways to strengthen, the community involvement components. Once funding decisions are made by the Trustee

Council, initiate contact with PIs to offer assistance in implementing their community involvement components.

4. Assist in organizing Trustee Council/Restoration Office community meetings held in conjunction with the Invitation/Draft Work Plan. This may include arranging presentations in specific communities by PIs.

5. Participate in Restoration Work Force meetings.

6. Provide a "community report" to the Public Advisory Group at each of its meetings.

7. Attend (in person or by teleconference) all Trustee Council meetings and report to the Community Facilitators on actions taken.

8. Work with the EVOS Science Coordinator, the EVOS Communications Specialist, and the TEK Specialist (Project 98052B) to get research results to communities.

9. Coordinate the provision of technical assistance to the villages by the Trustee Council staff and agency personnel to develop project proposals.

10. Provide input to the Restoration Update newsletter.

11. Prepare quarterly project status updates for the Restoration Office and ensure all reports are submitted on a timely basis by the community facilitators.

The tasks of the local Community Facilitators include:

1. On the last day of each month, provide a brief written report to the Spill Area-Wide Coordinator identifying community issues, concerns or questions regarding restoration. These issues could be identified through community meetings conducted by the Community Facilitators or through other means, and should include relevant issues discussed at village council meetings. Ideas for new projects could also be included.

2. Assist the Spill Area-Wide Coordinator in increasing community involvement in restoration projects. This will include updating the local resources inventory manual which includes the names, telephone numbers, areas of expertise, and compensation requirements of specific community members who are interested and able to work on Trustee Council funded projects (areas of expertise may include skiff and other equipment availability, general laborers, interviewers, research assistants, guides, and traditional wisdom holders), facilities (lodging, meeting rooms, storage space) available for rent, etc.

3. Work with the Spill Area-Wide Coordinator in coordinating Trustee Council community meetings as well as community visits from project PIs. Under the TEK protocols adopted by the Trustee Council, the Community Facilitator will also serve as the initial contact in the village for any project involving indigenous knowledge. The Community Facilitators should be knowledgeable about the TEK protocols. All interested Community Facilitators will serve on the TEK Advisory Group (Project 98052B).

4. Disseminate to community members the twice-monthly update from the Spill Area-Wide Coordinator. This could be done by posting the update in a public location, making a presentation to the village council or other community organizations, etc.

5. All Community Facilitators shall attend the annual Restoration Workshop and associated meetings, including scientific review sessions when appropriate.

Duties to be undertaken by the ADF&G Subsistence Division include:

Eliminated 9/97

1. ~~Respond to calls to the Resource Abnormality Hotline, oversee transport of abnormal resources, communicate findings back to the communities, and resupply kit components.~~

2. Work with communities to develop restoration project proposals.

3. Provide technical expertise and general assistance to the Restoration Office, Trustee Council, Spill Area-Wide Coordinator, and PIs on subsistence restoration.

4. Administer the cooperative agreement with CRRC, which will include renewing the contract and amending the RAP, reviewing and processing invoices, reviewing quarterly reports, and monitoring contractor performance.

5. Contribute to the annual project report.

6. Respond to contacts from the general public in regard to EVOS subsistence projects.

NEED FOR THE PROJECT

A. Statement of Problem

The *Exxon Valdez* oil spill caused severe disruption of the lives of many people living in the spill impacted area. The spill also caused residents of the area to be concerned about the safety of their wild food sources, and the integrity of the surrounding natural environment. While scientific studies aimed at restoring the resources and services damaged by the oil spill have occurred throughout the spill area, most of the researchers work for agencies or institutions based

in Anchorage, Fairbanks, or outside Alaska. This project was created in response to concerns voiced by communities over a lack of involvement by spill area communities in the restoration effort, and incomplete communication to spill area inhabitants of study proposals and results.

B. Rationale

This project furthers the Trustee Council's goal of facilitating the involvement of spill area residents and resource users in the restoration process.

C. Location

The project will be undertaken throughout the oil spill region. Community Facilitators will be hired in the communities as mentioned above. However, all other communities in the oil spill impact area will also be included in outreach efforts, even though a local facilitator will not be hired in each community.

COMMUNITY INVOLVEMENT

The core of this project is community involvement.

FY 98 BUDGET

Budget Line Items	CRRC	ADF&G	In-Kind	Total
Personnel (incl. Fringe) $	48,000.00	$15,900.00	28,000.00	$91,900.00
Spill Area Wide Coordinator (Vlasoff)	*48,000.00*	*0.00*	*0.00*	*48,000.00*
Division Project Coordinator (Miraglia)	*0.00*	*15,900.00*	*0.00*	*15,900.00*
CRRC Executive Director	*0.00*	*0.00*	*9,500.00*	*9,500.00*
Natural Resource Specialists	*0.00*	*0.00*	*18,500.00*	*18,500.00*
Travel	30,000.00	3,000.00	2,500.00	35,500.00
Contractual	120,000.00	0.00	17,000.00	137,000.00
Community Facilitators	*120,000.00*	*0.00*	*0.00*	*120,000.00*
Alaska Inter-Tribal Council	*0.00*	*0.00*	*12,000.00*	*12,000.00*
Native American Fish & Wildlife Society	*0.00*	*0.00*	*5,000.00*	*5,000.00*
Commodities	500.00	500.00	2,500.00	3,500.00
Equipment	0.00	0.00	0.00	0.00
Capital Outlay	0.00	0.00	0.00	0.00
Subtotal	$198,500.00	$19,200.00	50,000.00	$267,700.00
General Administration	19,900.00	17,700.00	5,000.00	42,600.00
Project Total	$218,400.00	$36,900.00	$55,000.00	$310,300.00

PROJECT DESIGN

A. Objectives

1. To increase the involvement of spill area communities in the restoration efforts of the Trustee Council.

2. To improve the communication of findings and results of restoration efforts to spill area residents, including village and city councils, other community groups, and the appropriate regional organizations in a format that is meaningful and easy to understand.

B. Methods

The project will be implemented by a Spill Area-Wide Coordinator hired through a contract with the Chugach Regional Resources Commission, and the local Community Facilitators, with the assistance of the Alaska Department of Fish & Game's Division of Subsistence.

The objectives will be achieved using the following methods:

A contract will be renewed by ADF&G Subsistence Division to CRRC for overall coordination of the Community Facilitators and Spill Area-Wide Coordinator. CRRC will be expected to arrange for the hiring (where applicable) and coordination of local facilitators in the communities of Chenega Bay, Tatitlek, Port Graham, Nanwalek, Cordova, Seward, Valdez, Seldovia, and regional coordinators for the Kodiak Island and Alaska Peninsula regions. All other communities in the oil spill impacted area will be included in outreach efforts, even though a local facilitator will not be hired in each community.

Working with the Community Facilitators, the Spill Area-Wide Coordinator will work to increase meaningful public involvement in the restoration process. The goal will be to continue the partnership begun under 95052 between the people of the oil spill region and scientific researchers. Outreach will include communication of research proposals and study results.

The effectiveness of the project will be evaluated on an annual basis, by the Trustee Council staff working in cooperation with the Spill Area-Wide Coordinator, the communities in the oil spill region, and the Subsistence Division of the ADF&G.

C. Contracts and Other Agency Assistance

A contract will be let to CRRC for overall coordination of a facilitator network through a Spill Area-Wide Coordinator. These tasks are being contracted out for the following reasons:

1. The use of a regional organization as opposed to a state agency will better serve the needs of the local community members.

2. The Trustee Council has encouraged contracting tasks out to the private sector as much as possible, and as appropriate.

3. The state procurement system makes it difficult to contract directly with the communities in the oil spill region. It has proven to be simpler to contract out the coordination of the facilitator network on a sole source basis with CRRC, who has an established working relationship with the communities.

SCHEDULE

A. Measurable Project Tasks for FY98

October 1, 1997	Contract between CRRC and ADF&G renewed
October 1, 1997	Spill Area-Wide Coordinator hired
October 1, 1997	Subcontracts with communities for Community Facilitators renewed
November, 1997	Training workshop/orientation for Community Facilitators
December 1997	Update local resource inventories submitted to Spill Area-Wide Coordinator and compiled for distribution to PIs
January 1998	Participate in Annual Restoration Workshop, including session reviewing TEK program
April 1998	Communities' FY 98 project proposals submitted
May 1998	Submit recommendations to Executive Director on community involvement component of FY 98 restoration project proposals; inform Community Facilitators of proposals that would involve their communities
Each two weeks	Fax update to Community Facilitators
Each month	Report from Community Facilitators

B. Project Milestone and Endpoints

The project should be continued as long as there are significant restoration efforts underway. The project should be evaluated on a yearly basis to determine the most efficient way to continue to keep the communities involved in the Trustee Council Restoration Program.

C. Completion Date

Since the objective of this project is to integrate the local communities into the restoration program, this project will continue throughout the life of the restoration effort. The project will be evaluated on a yearly basis to determine how it can best serve the needs of the Trustee Council and the local communities.

PUBLICATIONS AND REPORTS

Annual reports will be compiled in coordination with ADF&G and submitted to the Chief Scientist on April 15th of each year by CRRC. The annual reports will describe and summarize the progress made toward increasing community involvement during the previous federal fiscal year. In addition, twice-monthly reports will be provided to the participating communities by the Spill Area-Wide Coordinator and monthly reports will be provided by the Community Facilitators to the Spill Area-Wide Coordinator.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project is an effort to coordinate the Restoration Program with the local residents and builds on the established relationship between CRRC and the communities in Prince William Sound. Under this project, CRRC will work to establish new relationships with Seldovia, Kodiak Island and Alaska Peninsula area residents.

CRRC is contributing in-kind services to the project through its other natural resource programs.

PROPOSED PRINCIPAL INVESTIGATOR

Patty Brown-Schwalenberg
Chugach Regional Resources Commission
4201 Tudor Centre Drive, Suite 300
Anchorage, Alaska 99508
phone number: 907/562-6647
fax number: 907/562-4939
e-mail: crrcomm@alaska.net

Revised 1/23/87
Approved TC 8-6-97

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1997	Proposed FFY 1998						
Personnel		$5.3						
Travel		$0.0						
Contractual		$211.2						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$216.5	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002		
General Administration		$15.6						
Project Total		$232.1	$230.0	$230.0	$230.0	$230.0		
Full-time Equivalents (FTE)								
			Dollar amounts are shown in thousands of dollars.					
Other Resources								

1998

Project Number: 98052A
Project Title: Community Involvement
Agency: Alaska Dept. Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

7/23/97

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

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 1998
Name	Position Description					
Miraglia	Subsistence Resource Specialist III	18C	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		1.0	5.3	0.0	
					Personnel Total	$5.3

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 1998
Description					
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

1998

Prepared: 2 of 4

Project Number: 98052A
Project Title: Community Involvement
Agency: ADFG

FORM 3B
Personnel
& Travel
DETAIL

7/23/97

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

Contractual Costs:	Proposed FFY 1998
Description	
Contract with Chugach Regional Resources Commission	211.2
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$211.2

Commodities Costs:	Proposed FFY 1998
Description	
Commodities Total	$0.0

1998

Prepared: 3 of 4

Project Number: 98052A
Project Title: Community Involvement
Agency: ADFG

FORM 3B
Contractual & Commodities DETAIL

7/23/97

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

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1998
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1998

Project Number: 98052A
Project Title: Community Involvement
Agency: ADFG

FORM 3B
Equipment
DETAIL

Prepared:

7/23/97

1997 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1996 - September 30, 1997

Budget Category:	Authorized FFY 1997	Proposed FFY 1998						
Personnel		$48.0						
Travel		$24.0						
Contractual		$120.0						
Commodities		$0.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal		$192.0	Estimated FFY 1999	Estimated FFY 2000	Estimated FFY 2001	Estimated FFY 2002		
Indirect		$19.2						
Project Total		$211.2	$211.0	$211.0	$211.0	$211.0		
Full-time Equivalents (FTE)								
			Dollar amounts are shown in thousands of dollars.					
Other Resources								

Comments:
Indirect rate is 10%.

1998

Project Number: 98052A
Project Title: Community Involvement
Name: Chugach Regional Resources Commission

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 1998
	Spill Areawide Coordinator		12.0	4,000		48.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		12.0	4000.0	0.0	
					Personnel Total	$48.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
Description		Price	Trips	Days	Per Diem	FFY 1998
Port Graham-Anchorage		400	3	8	150	2.4
Tatitlek-Anchorage		500	3	8	150	2.7
Chenega Bay-Anchorage		600	3	8	150	3.0
Seldovia-Anchorage		300	3	8	150	2.1
Nanwalek-Anchorage		400	3	8	150	2.4
Cordova-Anchorage		300	3	8	150	2.1
Valdez-Anchorage		300	3	8	150	2.1
Kodiak-Anchorage		500	3	8	150	2.7
Bristol Bay-Anchorage		500	3	8	150	2.7
Seward-Anchorage		200	3	8	150	1.8
						0.0
						0.0
					Travel Total	$24.0

1998

Prepared: 6 of 8

Project Number: 98052A
Project Title: Community Involvement
Name: CRRC

FORM 4B
Personnel
& Travel
DETAIL

7/23/97

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

Contractual Costs:	Proposed
Description	FFY 1998
CRRC will subcontract with 10 communities to hire facilitators for this project (budgeted at $12,000 per community)	120.0
Contractual Total	$120.0

Commodities Costs:	Proposed
Description	FFY 1998
Commodities Total	$0.0

1998

Project Number: 98052A
Project Title: Community Involvement
Name: CRRC

FORM 4B
Contractual & Commodities DETAIL

Prepared:

7/23/97

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

New Equipment Purchases:	Number of Units	Unit Price	Proposed FFY 1998
Description			
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage:	Number of Units	
Description		

1998

Project Number: 98052A
Project Title: Community Involvement
Name: CRRC

FORM 4B
Equipment
DETAIL

Prepared: 8 of 8

7/23/97

Revised 7/24/97
Approved TC 8-6-97

Traditional Ecological Knowledge

Project Number:	98052B
Restoration Category:	General Restoration
Proposer:	Chugach Regional Resources Commission
Lead Trustee Agency:	ADF&G, Division of Subsistence
Cooperating Agencies:	None
Alaska SeaLife Center:	
Duration:	1 year; may be continued
Cost FY 98:	$61,300
Cost FY 99:	
Cost FY 00:	
Cost FY 01:	
Geographic Area:	Spill-area wide
Injured Resource/Service	All Resources/Services

ABSTRACT

The project would fund a TEK (Traditional Ecological Knowledge) Specialist to (1) provide technical assistance to restoration project principal investigators (PIs) who plan to use, or for whom it would be appropriate to use, TEK, (2) serve as a contact point for spill area communities, the community facilitators and spill area wide coordinator hired under Project /052A, and principal investigators on issues related to TEK, and (3) organize and coordinate synthesis workshops between PIs and community experts. The TEK specialist would work under the guidance of an Advisory Group. Also, community workshops will be held to enhance understanding of the benefits and implications of working with TEK. These workshops may involve experts who have experience in applying TEK from an Alaska Native perspective. The Alaska Department of Fish and Game will provide staff support for the project.

INTRODUCTION

This project would continue work begun under the Community Involvement and Use of Traditional Knowledge Project (/052). Much progress has been made in making Principal Investigators (PIs) aware of the availability and value of traditional knowledge. This project would continue the EVOS Trustee Council's initiative to enhance community involvement in the restoration program through the application of traditional ecological knowledge (TEK) in Trustee Council-funded projects. In FY 98, there are three primary tasks, including:. (1) Provide technical assistance in data collection, analysis, and interpretation (continue working with PIs to develop appropriate ways to apply TEK in ongoing and potential projects); (2) Synthesis workshops (organizing focused discussions between PIs and community experts to develop substantive interactions about restoration research findings and TEK); and (3) Community assistance (building understanding of the benefits and implications of TEK research in local communities).

To meet these goals, this project would provide funds to contract with a TEK Specialist. The TEK Specialist would work under the guidance of an advisory group, composed of a diverse group of individuals familiar with both TEK and the restoration program. In FY 98 the TEK specialist would (1) serve as a contact point for spill area communities, the community facilitators and spill area wide coordinator hired under Project /052A, and principal investigators on issues related to TEK, (2) provide technical assistance to restoration project PIs who plan to use, or for whom it would be appropriate to use, TEK, such as assisting PIs in design and implementation of data gathering instruments and assisting in interpreting TEK; (3) review FY 99 work plan to identify restoration project that may benefit from a TEK component, (4) consult regularly with the Advisory Group, and (5) organize and coordinate synthesis workshops between PIs and community experts.

Also, community workshops will be held to enhance understanding of the benefits and implications of working with TEK. These workshops may involve experts who have experience in applying TEK from an Alaska Native perspective. Workshops will occur in the three communities in which synthesis workshops are planned, if desired by the communities. The Alaska Department of Fish and Game will provide staff support for the project, to provide assistance to the Advisory Group and TEK Specialist, and community facilitators and to assist with follow-up to community workshops.

NEED FOR THE PROJECT

A. Statement of Problem

Through the efforts of the Community Involvement project (/052), principal investigators

have been made aware of the value of traditional ecological knowledge for their projects. Traditional ecological knowledge was a major theme of the annual Restoration Science Workshop in January 1996. Principal investigators have requested technical assistance in the collection of traditional knowledge. This project would continue to provide that assistance.

B. Rationale/Link to Restoration

People living in the spill area have detailed knowledge about the condition of resources, which can add to data collected as part of scientific studies and may enhance the success of the restoration effort. This includes knowledge of the historic population sizes and ranges of many of the species injured by the spill, as well as observations concerning the diet, behavior and interrelationships of injured species. This information can help researchers evaluate the injury and recovery status of these species.

C. Location

Spill area wide, including Prince William Sound, the lower Kenai Peninsula, Kodiak and the Alaska Peninsula

COMMUNITY INVOLVEMENT

Community involvement is a major emphasis of this project. The project would foster communication between the principal investigators and residents of the communities impacted by the oil spill. The TEK Specialists would work closely with the Spill Area Wide Community Involvement Coordinator and the local facilitators hired under the Community Involvement project (/052A) and with the Youth Area Watch (Project /210) students.

PROJECT DESIGN

A. Objectives

1. Renew contract with the TEK Specialist to work with the TEK Advisory Group established in FY97 to provide guidance and direction for the Trustee Council's TEK effort.

2. Use the community facilitators and spill area wide coordinator hired under Project /052A when possible as contact points for spill area communities and principal investigators on issues related to TEK.

3. Provide technical assistance to restoration project PIs in the collection, interpretation, presentation (including presentation of study findings and results to participating communities), and archiving of TEK.

4. In cooperation with the Community Involvement Coordinator (-052A), identify community needs for training and planning workshops to develop community understanding of the benefits and implications of working with TEK. Where such needs are identified, most likely in the three communities in which synthesis workshops are planned, arrange appropriate workshops to be conducted by experts in the particular topic(s) of interest to the community.

5. Organize and coordinate at least five synthesis workshops, bringing together PIs and community experts to discuss topics of mutual interest and significance. These workshops will help in the application of TEK to restoration by engaging local experts in the analysis of research findings, and will help communicate the results of research project(s) by substantive dialogue between scientists and community members.

B. Methods

A TEK Specialist will be contracted to work under the guidance of an Advisory Group, the composition of which is described below. Experts in particular topics may be contracted with to conduct community-based workshops, as described below in "Community Assistance". ADF&G/Subsistence Division will also be involved in the project to provide staff expertise.

Interaction between the TEK Specialist and the Principal Investigators may occur in one of two ways. Either the PI will approach the TEK Specialist with a request for information, or the TEK Specialist will approach a PI to suggest the use of traditional knowledge. In either case, if both agree a TEK component would be of benefit to restoration, the TEK Specialist and the Principal Investigator will work together to formulate a research tool in order to elicit the desired information. The TEK Specialists will work closely with the Spill Area Wide Community Involvement Coordinator (Project /052A) to ensure appropriate community involvement in the TEK effort.

The TEK effort may be summarized as three primary tasks:

1) Data Collection, Analysis and Interpretation

If the information needed by a Principal Investigator on an existing project is not available through existing sources such as published literature and current databases, and if this information is likely to be held as TEK, the TEK Specialist will work with the Principal Investigator to develop an appropriate research tool to seek the desired

information. In doing so, the TEK Specialist will consult with the Advisory Group, and the relevant local facilitator(s) and village council(s). When such a project is underway, the TEK Specialist may also provide technical assistance to the PIs in the research and subsequent analysis and interpretation. In FY98 that this task will primarily consist of helping Project 98320T (Herring), which continues work done by the TEK Specialist in FY97.

2) Hold Synthesis Workshops

The TEK Specialist will identify PIs who are interested in utilizing TEK expertise through focused discussions, or synthesis workshops, with community experts. The TEK Specialist will work with the PIs and the communities to schedule, prepare for, facilitate, and report on the workshops. The workshops will last 2-3 days, and will be limited to the PIs, local experts identified by the community, and a facilitator (probably the TEK Specialist). The workshops will likely be held during late fall, winter, or early spring. Preparations for the workshop will include distributing relevant information, discussing the objectives of the workshop with the participants, and creating a list of topics to be covered. The workshops will be held in a setting chosen to encourage interactions between participants, both during formal discussions and informally at other times. Following the workshops, the participants will hold a community meeting to share the results of their discussions with community members. The TEK Specialist will oversee production of workshop reports that describe the background, participants, content and results of each workshop. Following all the workshops, the TEK Specialist will also prepare, with the assistance of the participants and the Advisory Group, a brief report for the Executive Director evaluating the utility of the workshops and making recommendations for future workshops.

The goal of the workshops is to promote substantive interactions between PIs and community members on topics related to spill area resources, restoration and stewardship. This will be achieved by focusing discussions on the PIs' research and findings, and local observations related to the subject of research. There are five nested objectives for the workshops:

a. to help the PIs and community members understand each other's perspectives;
b. to see whether and how the information each has can help the other understand better what is happening to the resources and the ecosystem;
c. to analyze together the various observations and findings, to see if a common understanding can be reached regarding the state of the resource and the need for further information;
d. to determine whether further collaboration between the PIs and the communities will help better understand or manage the resource; and
e. to plan future collaboration, if desired.

Not all objectives may be relevant to every workshop, and the overall success of each workshop will be evaluated less on the number of objectives achieved and more on the quality of interaction for each achieved objective.

In FY 98, it is expected that five synthesis workshops will take place in a total of three communities. The first will involve the Nearshore Vertebrate Predator (NVP) (Project 98025), in particular clams and sea otters. These workshops will be conducted in Chenega Bay, since that is the area NVP works in. Work is also expected in connection with Projects 98247 (Harlequin Ducks) and 98273 (Surf Scoters), with workshops in Tatitlek, Chenega Bay, and Port Graham. A total of five workshops is expected, and a time commitment for the TEK Specialist of 2.5 months to the planning, preparation , conduct and follow-up of these workshops.

3) Community Assistance

The Alaska Department of Fish and Game, Division of Subsistence, the TEK Specialist (to a limited degree depending upon work on other objectives), and Community Involvement Coordinator will work with community facilitators to identify specific training needs in the different communities. Based on the needs identified, the Community Involvement Coordinator, assisted by ADF&G, will schedule community-based workshops, to be conducted by experts in the topic(s) of interest to the community. These workshops will help build understanding of the benefits and implications of TEK research and use, and the capacity to develop, plan, and undertake TEK projects for the benefit of the community and others. ADF&G and the Community Involvement Coordinator will responsible for follow-up to these workshops, including identifying ways to implement ideas identified at the workshops in components of ongoing project, potential new projects, or synthesis workshops. It is most likely that community workshops will be held in Port Graham, Tatitlek, and Chenega Bay, prior to the synthesis workshops in those communities. Others will take place if existing project resources allow.

TEK Specialist: Duties and Responsibilities

Regarding Objectives 1, 2, and 3 (1.5 months)

1. Serve as a contact point for spill area communities, the community facilitators and spill area wide coordinator hired under Project /052A, and principal investigators on issues related to TEK.
2. Review the FY99 workplan to identify restoration projects that may benefit from a TEK component, initiate contact with the PI(s) to determine whether adding a TEK component is desired and feasible, and develop plans for such a component.
3. Provide technical assistance to PIs in the design and implementation of questionnaires and other research tools to be used in the collection of TEK, the development of data

collection methods, and the development of research agreements between the PI and village council as proposed in the draft TEK protocols.

4. Work with the Community Facilitators in identifying residents having specialized knowledge on a particular topic of interest to the principal investigators, and provide technical assistance in data collection as appropriate.
5. Assist the PIs in interpreting the TEK data collected as well as any data brought in from existing records, and in communicating study findings and results back to participating communities.
6. Consult regularly with the Advisory Group to obtain feedback, guidance, and direction on the TEK Program as it develops.

In FY98, the TEK Specialist will concentrate efforts in 3, 4, and 5, above, on one project: Herring 98320T.

Regarding Objective 5 the synthesis workshops (2.5 months)

7. Organize and coordinate synthesis workshops as described above.

Advisory Group: Composition and Duties

The Advisory Group is made up of a diverse group of individuals who are familiar with both TEK and the EVOS restoration program. Members were jointly selected by the Executive Director of CRRC and the Executive Director of the Trustee Council in FY97, and include:

1. Spill Area Wide Community Coordinator (Project /052A)
2. Three research scientists involved in the EVOS restoration process - Stan Senner, Bruce Wright, and Kate Wynne
3. All interested Community Facilitators (Project /052A)
4. Federal Trustee Council agency representative - Don Callaway
5. State Trustee Council representative - James Fall
6. Regional native organization representative - Carl Hild
7. Two persons with expertise in TEK - Maria Giminez and Patricia Cochran

The advisory group will meet regularly and where possible in conjunction with community facilitator meetings, to provide feedback to the TEK Specialist on the progress and development of the project and its various components. All relevant materials (draft reports, trip reports, proposals, etc.) will be circulated to the Advisory Group for comment. In addition to the meetings, the TEK Specialist may consult with any or all members of the Advisory Group at his/her discretion. The advisory group members will work on a volunteer basis. Travel costs, where required, will be provided out of this project.

Other TEK Experts

Regarding Objective 4, community workshops, one or more individuals who have experience in applying TEK from an Alaska Native perspective may be contracted to conduct community workshops. Follow-up to these workshops will be the responsibility of ADF&G and the Spill Area Wide Community Coordinator.

ADF&G/Subsistence Division: Duties and Responsibilities

Regarding Objectives 1, 2, and 3 (One month).

1. Provide assistance to the Advisory Group, the TEK Specialist, and community facilitators, including writing summaries of Advisory Group meetings, adding references to the reading list/bibliography, and helping to orient the Spill Are Wide Community Involvement Coordinator to issues involving TEK; provide general expertise on subsistence uses and oil spill impacts on these uses to assist in the design of research and data gathering instruments, and in the interpretation of study results.
2. Assist the TEK Specialist in providing technical assistance to PIs and potential PIs in application of TEK, including development of DPDs, and by reviewing data gathering instruments, field plans and project designs related to TEK components in EVOS projects.
3. Contribute to the annual project report.

Regarding Objective 4 (One month)

4. Provide input into the planning of community-based workshop/training sessions, and with the Spill Area Wide Community Coordinator develop follow-up to community workshops, including identifying ways to implement ideas identified at the workshops in components of on-going projects, potential new projects or synthesis workshops.

C. Cooperating Agencies & Organizations

National Park Service, other Trustee Council agencies

SCHEDULE

A. Measurable Project Tasks for FY98 (October 1, 1997-September 30, 1998)

October 1, 1997	Contract between ADF&G and CRRC renewed
October 1997	TEK Advisory Group in place
	TEK Specialist contract renewed

	Identify needs for community-based training workshops (will likely continue at least into December)
October 1997 - March 1998	Hold approximately three community training workshops
November 1997	TEK Specialist initiates contacts with PIs with TEK components in their FY 98 projects; and schedule synthesis workshops
November 1997 to April 1998	Hold five synthesis workshops
January 1998	TEK Specialist attends Annual Restoration Workshop and makes contacts with PIs re: including TEK component in FY 99 proposals
May 1998	TEK Specialist review all proposals submitted for FY 98 and develop recommendations for Executive Director re: TEK
June 1998	Prepare draft workshop reports Prepare draft reports on training workshops
July 1998	Review all projects recommended for funding in FFY '98 to determine which would benefit from a TEK component
September 1998	Prepare final workshop reports and distribute Prepare final reports on training workshops

B. Project Milestones and Endpoints

October 1997	TEK Specialist contract renewed
October 1997	Community workshop planning begins
November 1997	Synthesis workshops scheduled and initiated
March 1998	Approximately three community workshops completed
April 1998	Synthesis workshops completed
September 1998	Synthesis workshop reports completed Community workshop reports completed
Ongoing	Provide technical assistance to PIs regarding the collection, interpretation and presentation of TEK.

C. Completion Date

April 15, 2002

PUBLICATIONS AND REPORTS

An annual report on the development, progress, and accomplishments of this TEK project will be provided to the Trustee Council on April 15, 1998. Reports on the synthesis workshops will be prepared and completed by September, 1998. These reports will

summarize discussions held during the workshops, and identify what was gained by the participants.

Following the synthesis workshops and the community training workshops, the TEK Specialist, workshop experts, community participants, ADF&G, and PIs involved will review whether publication of results in a peer-reviewed journal is desirable and feasible. If so, manuscript(s) will be prepared for appropriate journals. Consideration will also be given to publishing a review of the TEK effort as a whole.

PROFESSIONAL CONFERENCES

Participation in professional conferences is not anticipated during this year of the project.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project is focused more than most on the coordination and integration of the restoration effort. The TEK Specialist will work with the Principal Investigators of other projects, providing a service that is expected to benefit those projects and the restoration effort as a whole. This project will also be closely coordinated with the Community Involvement Project (98052A), and the Youth Area Watch Project (98210).

BUDGET

	CRRC	ADF&G	TOTAL
TOTAL	**45,000**	**16,300**	**$61,300**
Project Personnel	**30,000**	**10,600**	**40,600**
TEK Specialist (Huntington, 4 mos.)	22,000		
ADF&G (Miraglia, 2 mos.)		10,600	
Training Workshop Experts	3,000		
Synthesis Workshop Participants (250 X 5 workshops X 4 participants)	5,000		
Travel	**10,400**	**1,000**	**11,400**
Community Assistance (Community Training Workshop Experts: 3 trips, 3 days each)	1,800		
Project Assistance (TEK Specialist, 2 trips, 3 days each)	1,700		
Synthesis Workshops (TEK Specialist, prep. Trips, workshop trips: 8 trips, 2.5 days each)	5,900		

PI travel to workshop	1,000		
(Some PIs would cover their own travel, this would help those without a budget for it: 3 PI trips, 3 days each)			
ADF&G		1,000	
(To attend community training workshops, and follow-up)			
Commodities	**500**	**0**	**500**
Maps, paper, notebooks, pens	500		
Overhead	**4,100**	**4,700**	**8,800**
CRRC indirect at 10%	4,100		
ADF&G		4,700	
(15% on line 100, 7% on line 300)			

PROPOSED PRINCIPAL INVESTIGATOR

Patty Brown-Schwalenberg, Executive Director
Chugach Regional Resources Commission
4201 Tudor Drive, Suite 300
Anchorage, Alaska 99508
Phone: (907) 562-6647
Fax: (907) 562-4939

Revision 7-23-97
approved TC 8-6-97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$10.6
Travel		$1.0
Contractual		$45.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$56.6
General Administration		$4.7
Project Total	$0.0	$61.3
Full-time Equivalents (FTE)		0.2
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	

Dollar amounts are shown in thousands of dollars.

Comments:

1998

Prepared: 1 of 8

Project Number: 98052B
Project Title: Traditional Ecological Knowledge
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

7/23/97

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

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 1998
Miraglia	Subsistence Resource Specialist III	18C	2.0	5.3	0.0	10.6
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		2.0	5.3	0.0	
					Personnel Total	$10.6

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 1998
Anchorage-Port Graham	0.2	1	2	0.1	0.4
Anchorage-Chenega Bay/Tatitlek	0.4	1	2	0.1	0.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.0

1998

Project Number: 98052B
Project Title: Traditional Ecological Knowledge
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed
Description	FY 1998
4A Linkage: Contract with Chugach Regional Resources Commission	45.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$45.0

Commodities Costs:	Proposed
Description	FY 1998
Commodities Total	$0.0

1998

Project Number: 98052B
Project Title: Traditional Ecological Knowledge

Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

Prepared:

7/23/97

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

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 1998
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

1998

Project Number: 98052B
Project Title: Traditional Ecological Knowledge
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

7/23/97

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FY 1997	Proposed FY 1998
Personnel		$0.0
Travel		$10.4
Contractual		$30.0
Commodities		$0.5
Equipment		$0.0
Subtotal	$0.0	$40.9
Indirect		$4.1
Project Total	$0.0	$45.0
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

	Estimated FY 1999	Estimated FY 2000	Estimated FY 2001	Estimated FY 2002	

Dollar amounts are shown in thousands of dollars.

Comments:

1998

Prepared: 5 of 8

Project Number: 98052B
Project Title: Tradition Ecological Knowledge
Name: Chugach Regional Resources Commission

FORM 4A
Non-Trustee
SUMMARY

7/23/97

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

Personnel Costs: Name	Position Description		Months Budgeted	Monthly Costs	Overtime	Proposed FY 1998
						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: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 1998
Community Assistance (Community Training Workshop Experts: 3 trips, 3 days each)					1.8
Project Assistance (TEK Specialist: 2 trips, 3 days each)					1.7
Synthesis Workshops (TEK Specialist, prep. & workshop trips: 8 trips, 2.5 days each)					5.9
PI Travel to Synthesis Workshops (Some PIs would cover their own travel; this would help those without a budget for it: 3 trips, 3 days each)					1.0
				Travel Total	$10.4

1998

Project Number: 98052B
Project Title: Traditional Ecological Knowledge
Name: Chugach Regional Resources Commission

FORM 4B
Personnel
& Travel
DETAIL

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

Contractual Costs:	Proposed
Description	FY 1998
Contract with Traditional Ecological Knowledge Specialist (Huntington, 4 months)	22.0
Contracts with experts to conduct community based training workshops as needed	3.0
Payments to synthesis workshop participants	5.0
Contractual Total	$30.0

Commodities Costs:	Proposed
Description	FY 1998
Supplies (pens, paper, notebooks, etc)	0.5
Commodities Total	$0.5

1998

Prepared:

Project Number: 98052B
Project Title: Traditional Ecological Knowledge
Name: Chugach Regional Resources Commission

FORM 4B
Contractual & Commodities DETAIL

7/23/97

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

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

1998

Project Number: 98052B
Project Title: Traditional Ecological Knowledge
Name: Chugach Regional Resources Commission

FORM 4B
Equipment
DETAIL

Prepared: 8 of 8

7/23/97

4/15 file
approved TC 8-6-97
and 12-18-97

Monitoring, Habitat Use, and Trophic Interactions of Harbor Seals in Prince William Sound

Project Number:	98064
Restoration Category:	Research
Proposer:	K. Frost/ADFG
Lead Trustee Agency:	ADFG
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	Cont'd
Duration:	4th yr. 5 yr. project
Cost FY 98:	$272.5
Cost FY 99:	$265.0
Cost FY 2000:	$130.0
Cost FY 01:	$0.0
Cost FY 02:	$0.0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Harbor seal

ABSTRACT

This project will monitor the status of harbor seals in Prince William Sound and investigate the hypothesis that food limitation to pups and juveniles is causing the ongoing decline. Aerial surveys will be conducted during molting to determine whether the population continues to decline, stabilizes, or increases. Seal pups will be satellite-tagged to describe and compare their movements, hauling out, and diving behavior to older seals and seals in other areas. Fatty acids analysis will be conducted on recent and archived blubber samples and mathematical models developed to estimate seal diets and whether they have changed since the 1970s. Special emphasis will be on pups and juveniles, the age groups most likely to be affected by food limitation.

INTRODUCTION

The *Exxon Valdez* oil spill (EVOS) occurred in Prince William Sound (PWS) in March 1989. Because harbor seals (*Phoca vitulina richardsi*) and their haulouts became oiled by the spill, harbor seal studies began almost immediately as part of the Natural Resources Damage Assessment (NRDA) program. These NRDA studies were conducted by the Alaska Department of Fish and Game (ADFG), and included aerial surveys to quantify mortality and necropsies to document levels of hydrocarbons and tissue damage in oiled seals. Based on these investigations, it was estimated that more than 300 harbor seals (36% of the seals in oiled areas) died in PWS following the EVOS. As NRDA studies progressed, it also became clear that the harbor seal population throughout PWS was declining and had been doing so since at least 1984. Therefore, beginning in 1991 as NRDA studies neared completion, the Trustee Council funded a harbor seal restoration study in which ADFG continued to monitor the trend of harbor seals in PWS and began to investigate the causes of the ongoing decline. These early restoration studies addressed a broad array of possible causes for the decline including disease, predation, human-caused mortality, reproduction, and food limitation.

Marine mammals and seabirds are apex predators in ecosystems in which fishes and cephalopods are important prey. As such, a strong relationship would be expected between predator populations and the abundance of fish stocks. This relationship is likely to be influenced by factors such as commercial fisheries and ecosystem changes (e.g., Beddington, et al. 1985; Springer 1993). In many parts of the world pinniped populations have increased as predicted after protection from over-exploitation (e.g., Olesiuk, et al. 1990; Shelton et al. 1995). However, large declines in populations of harbor seals and Steller sea lions (*Eumetopias jubatus*) have been documented in the Bering Sea and the GOA, including PWS (Pitcher 1990; Loughlin, et al. 1992). These declines occurred despite implementation of the 1972 Marine Mammal Protection Act (MMPA) which ended commercial hunting for pups and bounty payments for adults. Likewise, since the 1970's numerous species of seabirds have also declined in PWS. These unanticipated declines have prompted monitoring and assessment of marine mammal, seabird, and fish population trends, and perhaps most importantly, have furthered the idea of using predators as samplers of forage fish abundance (Duffy 1996; Roseneau and Byrd 1996). The latter aspect may provide the most useful information towards addressing the question of "Is it food?", since the mean abundance of prey at large spatial scales, as determined from fisheries surveys, may not be relevant to the scale at which seals and seabirds forage (e.g., Duffy 1996; NRC 1996).

In PWS, harbor seals are one of the most abundant and widely distributed marine mammals, hauling out and/or breeding at more than 50 sites. Since 1984 harbor seal numbers in PWS have declined by about 60%, with only part of this decline attributable to the 1989 *Exxon Valdez* oil spill (EVOS) (Frost and Lowry 1994a, Frost et al. 1994). The decline in harbor seals has not been limited to PWS, but has also occurred in adjacent parts of the GOA (Pitcher 1990). A change in the trophic structure of the ecosystem, and hence the availability of prey, is among the hypothesized causes for this observed decline, as well as that of other apex predators. Thus, understanding the diet of harbor seals and how they may depend on seasonal or area-specific concentrations of prey is not only needed in the management of harbor seals as a resource, but because harbor seals may also act as important indicators of other marine resources.

Recently, the use of fatty acid signature analysis (Iverson 1993) has been proposed to study marine food webs and pinniped diets (Iverson 1995). Fatty acids are the largest constituent of lipids and those of carbon chain length 14 or greater are often deposited in animal tissue with minimal modification from diet. Lipids in the marine food web are exceptionally complex and diverse. Owing to various restrictions and specificities in the biosynthesis and modification of fatty acids among different taxonomic groups (e.g., Paradis & Ackman 1976; Ackman 1980; Cook 1985; Fraser et al. 1989), many components appear which can be traced to a general or even specific ecological origin. Certain "indicator" fatty acids (Iverson 1993) exist which are particularly useful in food web studies since they can arise only or mostly from the diet. Although methods of fatty acid signature analysis are still being developed, the technique has been used both to identify general trophic level of diets and to detect major and minor shifts in diet within populations (Iverson, Arnould & Boyd 1997; Smith, Iverson & Bowen 1997).

Work in PWS conducted as part of this harbor seal restoration study in 1994-1996 is one of the two most comprehensive ecosystem studies ever conducted using fatty acids signature analysis (Iverson, Frost & Lowry, in press; Iverson, Bowen & Ackman, unpublished data), and has come the farthest in advancing the development of this method. In the first two years of study in PWS, fatty acid signatures have indicated that fine-scale structure of foraging distribution of harbor seals can be discerned, and that this is due not only to localized feeding patterns in seals, but also to specific differences in prey species with size and location or habitat within PWS (Iverson, Frost & Lowry, in press). From this initial work, it was also possible to make inferences about predominant prey species in the diet of individual seals. Since harbor seals are likely to adjust their foraging patterns to changes in abundance of local prey (Olesiuk 1993; Tollit & Thompson 1996), this suggests that determining diets or changes in diets of harbor seals over time using fatty acid signatures may provide clues not only to changes in foraging patterns, but also to differences in local prey availability, predominant species size classes, and species abundance at the spatial and temporal scales that are essential to the nutrition of individual animals. It has been proposed that one cause for the decline in some Alaskan pinniped populations may have been a change in community structure over time that resulted in an ecosystem dominated by large predatory pollock, thus making small forage fish less available to pinnipeds, especially juveniles (NRC 1996). Thus, the ability to detect relationships between and within predators and prey on a small spatial scale indicates that fatty acid signature analysis could begin to address such hypotheses.

During FY 96 and FY 97, the objectives of the harbor seal restoration study addressed seven hypotheses regarding the status and trends of harbor seals in PWS, possible causes for the ongoing population decline, and the genetic status of PWS harbor seals. The status of studies relative to these hypotheses is briefly summarized below.

Hypothesis 1: The PWS harbor seal population has stabilized and/or increased since the EVOS. Annual counts of seals at 25 standardized "trend count" haulout sites in PWS were made during August-September 1989-1996. Surveys showed a continued decline of 6% per year through 1996. Counts that had been adjusted for the effects of tide, date, and time of survey were 31% lower in 1996 than in 1989. The results of these analyses were prepared and submitted for publication to Marine Mammal Science and the manuscript is currently being revised (Frost et al. submitted).

Hypothesis 2: A disease agent is causing harbor seals to decline. All seals that were caught and handled in PWS during 1989-1996 were examined for external signs of disease and blood serum was collected for disease assays. Six potential disease-causing agents were included in the tests: phocid herpesvirus (n=102), phocine distemper virus (n=84), *Brucella* spp. (n=80), *Toxoplasma gondii* (n=80), influenza (n=91), and caliciviruses (n=5). Over 300 hundred harbor seals from PWS, southeast Alaska (SEAK), the northern Gulf of Alaska (GOA), and the Bering Sea were tested for various diseases. Sample collection in PWS was funded by this EVOS restoration study. Other sampling and all disease testing was conducted and paid for as part of a NOAA-funded ADFG harbor seal study focusing on SEAK and the northern GOA. Results to date were reported by Lowry et al. (1996) and have been prepared for publication in Zarnke et al. (in press) and Osterhaus et al. (in prep.).

Disease assays indicated that PWS harbor seals were exposed to phocid herpesvirus (58%), phocine distemper virus (1%), the bacteria *Brucella* spp. (30%), and the protozoan *Toxoplasma gondii* (10%). Rates of exposure for PWS seals were similar to those for seals from other parts of Alaska. Results of testing for influenza suggest that Alaskan harbor seals have not been exposed to influenza, which caused the deaths of hundreds of harbor seals along the New England coast in 1979-80 and again in 1991-1992. Furthermore, all tests for caliciviruses, which have been implicated in abortions of California sea lions, were negative for Alaska harbor seals.

The possible significance to PWS harbor seals of exposure to phocid herpesvirus, phocine distemper virus, *Brucella* spp., and *Toxoplasma gondii* is unclear. In most cases titers were low which could be indicative of mild exposure, weak immune reaction, or waning antibody response. Zarnke et al. (in press) concluded that exposure to phocid herpesvirus has been common, widespread, and long term in Alaska and that the lack of documented epizootics suggests that phocid herpesvirus has not been highly pathogenic. Osterhaus et al. (in prep.) suggest that phocine distemper virus has also been enzootic in Alaska for many years, although there have been no documented phocine distemper epizootics in Alaska. Possible effects of *Brucella* spp. on harbor seals are unknown. The most typical result of brucellosis in other species is abortion. *Brucella* has also been isolated from harbor seals in the North Atlantic and from ringed, ribbon and spotted seals and walruses in Alaska. Little is know about the effects of *Toxoplasma gondii* on harbor seals. Van Pelt and Dietrick (1973) described *T. gondii* infection of a harbor seal pup that was captured shortly after birth at Cold Bay and died three weeks later.

To summarize, although some of these agents are known to cause mortalities or have reproductive effects, symptoms of disease have not been documented in Alaska harbor seals. The data collected do not support the hypothesis that disease has been an important factor in the decline of seal numbers in PWS, or other parts of Alaska.

Hypothesis 3: Harbor seals in PWS belong to a separate management stock. Skin samples for genetics studies have been collected from all harbor seals handled in PWS since 1989. This EVOS harbor seal restoration study supported all sample collection in PWS and contributed funds for analytical supplies. Analysis of samples was funded primarily by ADFG's NOAA-funded harbor seal study. Genetics analyses were conducted at the NMFS Southwest Fisheries Science Center (SWFSC) as part of a Master of Science thesis project by Robin Westlake at San Diego State University. Genetics samples were also provided to investigators at other institutions.

Results that include PWS samples appear in Lehman et al (1993), Kappe et al. (1995 and submitted), and Burg et al. (1995).

Over 350 samples have been collected and are available to SWFSC for mtDNA analysis. As of December 1996, 164 Alaskan and 11 Japanese/Russian harbor seals had been sequenced, including samples from SEAK, PWS, the northern GOA, and the Bering Sea. Progress is reported in Westlake et al. (1996a, 1996b). To date, no significant differences have been found between harbor seals in PWS, SEAK, and the northern GOA based on mitochondrial DNA. Possible explanations are that: 1) there is no geographic population structuring; or 2) the population is structured but the power of statistical tests for detecting differences was low due to relatively small sample sizes. SWFSC researchers caution against drawing conclusions about management units for Alaska harbor seals until all sample analysis is complete. This thesis project is expected to reach completion in 1997.

Hypothesis 4: Low pup production may be causing harbor seals to decline. Annual counts were made of pups and non-pups during June 1989-1995. Surveys showed a normal rate of pupping in PWS, compared to other locations around the world, but a continued decline in overall numbers (Frost et al. 1996). This suggested that poor pup production was not responsible for the decline. For this reason, and because surveys in PWS during pupping had less statistical power to detect a trend, pupping-period surveys were discontinued in 1996.

Hypothesis 5: Predation by killer whales is causing the decline or preventing the recovery. A harbor seal population model was developed as part of this project in 1995-1996 (Frost et al. 1996). The final report for the modeling project, including the model itself and a User's Manual, has been completed and is being submitted to the EVOS restoration office under separate cover (Small 1996a & b). As part of this modeling exercise, it was possible to examine the effects of different levels of mortality (such as killer whale predation) on the growth rate of the population. Based on the population model, killer whale predation in PWS (estimated at the equivalent of 377 adult harbor seals annually; C. Matkin, personal communication) could not have caused the initial harbor seal population decline. It is possible, however, that predation could be affecting the recovery of the much-reduced harbor seal population.

Hypothesis 6: Mortality caused by subsistence hunting and/or fisheries-related take is preventing harbor seals from recovering. The model described under Hypothesis 5 was also used to estimate the impact of human-caused mortality (e.g. subsistence hunting, incidental fisheries take, etc.) on the PWS harbor seal population. It is clear from the model that reported levels of harvest and/or incidental take could not have caused the decline that occurred prior to the EVOS (Frost et al. 1996).

The model does predict, however, that if the carrying capacity of PWS to support harbor seals is lower now than it was in the 1980s (e.g. food availability is limiting), and remains at this reduced level, then human-caused mortality of 300 seals per year could cause the population decline to continue. By the year 2005, an annual removal of 300 seals could result in an additional 20% decline in the PWS harbor seal population. In contrast, the annual removal of 100 seals would result in little or no decline.

If carrying capacity increases in the future (food becomes more available and reproduction and survival increase), then the model predicts that the population will begin to grow with annual removals of 100-300 seals. The model predicts that an increase in carrying capacity from 5,281 (the 1995 population estimate) to 8,662 (the 1988 population estimate), with annual removals of 100 seals, could result in a population increase of 2,000-3,000 seals by 2005. With removals of 300 seals/year, the model predicts a smaller increase of 600-2,000 seals by 2005.

In the future, investigators for this project will continue to incorporate updated harvest and incidental take statistics into the harbor seal population model and will continue to inform and work with PWS subsistence hunters through the Alaska Native Harbor Seal Commission.

Hypothesis 7: A change in food availability has caused harbor seals to decline. During 1994-1996, samples for stable isotope, blubber energy, blood chemistry, and fatty acids analyses were obtained from all seals handled during tagging. Morphometric measurements, ultrasound, and measurements of bioimpedence were also obtained from these seals. This included 36 seals in 1994, 42 in 1995, and 39 in 1996. In addition, some blubber samples were obtained from subsistence hunters as part of an EVOS-funded biosampling program. These samples have been analyzed by a variety of investigators in a multi-disciplinary approach to the question of whether food is limiting the recovery of harbor seals. Stable isotope results will be reported by Schell and Hirons as part of EVOS Restoration Project 170 and blood chemistry and blubber energy results by Castellini et al. as part of EVOS Restoration Project 001. Two major components of this harbor seal restoration study have addressed the food limitation hypothesis: satellite-tagging and fatty acids analysis. Methodology for both of these approaches was developed by this restoration project.

Satellite-tags have provided information about locations, movements, and diving of seals, which is helping us to identify feeding areas and understand feeding behavior (Frost et al. 1996). To date, 51 harbor seals have been successfully instrumented with satellite-linked depth recorders (SDRs), including 26 adults (11 males, 15 females), 23 subadults (12 males, 11 females), and 2 female pups (Table 1). Twenty-two of these were tagged in April- May and 29 in September.

Satellite-tagging data clearly indicate substantial individual variation in the way seals make their livings (Frost and Lowry 1994b; Frost et al. 1995 and 1996). Some tagged seals used only a few haulouts and made only short trips away from them to feed. Others made longer trips of several days to almost two weeks. Some of these feeding trips were apparently entirely within PWS and others were in the GOA. Movements between terrestrial haulouts in central PWS and glaciers in northern PWS were not uncommon. Some seals made consistently shallow dives, while others fed in deeper waters and dove to greater depths. The deepest dive by a tagged seal was 404 m, but most dives were to less than 200 m. In general, seals dove more and hauled out less in the winter. They spent a greater proportion of days hauled out in summer, and used more haulout sites during this period. This is the period when pupping, breeding, and molting occur.

Over the four years of this study, there appears to have been a change in the feeding behavior of seals during winter. None of 6 seals tagged in September 1993 and only 2 of 8 tagged in September 1994 left PWS. All three adult females tagged in fall 1994.spent the entire winter in PWS. In contrast, 12 of 15 seals tagged in September 1995-1996 made winter-spring feeding trips outside PWS. Of the 5 adult females, 4 moved to the Copper River Delta in March,

suggesting that food resources found there in spring may be important to pregnant females. These feeding trips outside PWS occurred primarily during winter and spring. Only 3 of 22 seals tagged in April/May left PWS. Two of these were adults that went to the GOA in May and returned to PWS by June. One small subadult spent parts of May-July in the Copper River Delta.

The SDR data set for 51 harbor seals from PWS is one of the largest of its kind. It is especially valuable because ADFG has similar SDR data from an additional 64 harbor seals instrumented in SEAK and near Kodiak as part of the NOAA-funded harbor seal study (Swain et al. 1996). When the information from these two data sets are synthesized, it will represent the most complete body of information about harbor seal movements and diving/feeding behavior anywhere in the world.

The sample size of satellite-tagged adult and subadult males and females in PWS should now be sufficient to generally characterize the movements and diving behavior of these age groups of seals. However, we have tagged only two seal pups. This is because the SDRs available in the past have been too large to use on pups. Recently small 0.25-watt SDRs were developed and tested. We now have the capability to safely instrument small pups. Consequently, our emphasis in the future will shift to the tagging of newly-weaned pups.

Fatty acids analysis in PWS harbor seals and their prey was initially funded by the EVOS Trustee Council starting in 1994 as a pilot project. The results of the first two years of this study have been written up and accepted for publication in Marine Ecology Progress Series (Iverson et al. in press). In that initial study, fatty acid signatures were used to investigate the diet and spatial scales of foraging in harbor seals and selected prey in PWS and the GOA (Iverson, et al. in press). Blubber samples collected in 1994 and 1995 from 104 harbor seals from PWS, Kodiak Island, and SEAK were analyzed for fatty acid composition. A total of 163 potential prey samples representing 10 taxa were collected and individually analyzed for total fat content and fatty acid composition. Classification and regression tree analysis was used to classify seals and prey according to their fatty acid signatures. Large differences were found in the fatty acid composition of blubber from seals sampled at Kodiak, SEAK and PWS. Additionally, fatty acid signatures distinguished seals from different regions within PWS, as well as from haulout sites only a few kilometers apart. These findings suggested that seals forage very site-specifically.

Prey fatty acid patterns also differed on similarly small spatial scales within PWS. Not only could prey species such as herring and pollock be differentiated from one another using fatty acid signatures, but they could also be distinguished by size-class and location within PWS, reflecting differences in diet with age and as well as with fine-scale habitat. Results from this study were consistent with both satellite data from tagged harbor seals and stomach content analyses of forage fish species in PWS. Although preliminary, analyses suggest that large herring and pollock, as well as flatfish, may have dominated the diet of seals in southern PWS, whereas diets of seals in northern and eastern PWS may have been comprised more of small size classes of herring and pollock, and perhaps other items such as cephalopods, sandlance, cod, and shrimp. Although a more comprehensive data base on the fatty acid composition of all potential prey species is required, along with development of a modeling program, it is clear that fatty acid signature analysis will be an important contribution to understanding marine food webs in PWS and other marine environments.

Proposed work in 1997. During the 1997 field season, satellite tagging, sampling, and monitoring will continue. Research will focus on the hypothesis that the availability of food, particularly to pups and subadults, is limiting the harbor seal population. Aerial surveys will be flown to monitor trends during the molting period in 1997.

During late June and early July 1997, small 0.25-watt satellite tags will be attached to 12 newly-weaned harbor seal pups. We hope to obtain 4-6 months of data from each of these pups. ADFG, as part of the NOAA-funded harbor seal study, will also tag 10 newly-weaned harbor seal pups on Tugidak Island in the northern GOA in summer 1997. This will provide a valuable comparison to the pups we tag in PWS.

Blood, blubber, skin, and measurements will be taken from all seals that are caught during tagging operations regardless of age. Similar samples are being collected by ADFG in SEAK, where harbor seals are not declining, and in the Kodiak region where they have declined more than 90% since the mid-1970s as part of the NOAA-funded harbor seal project. Data will be compared to better understand why seals are doing well in some areas and declining in others.

Work proposed in 1998 and beyond. The research being proposed for 1998-2000 is a more tightly focused extension of harbor seal restoration studies funded by the Trustee Council in 1995-1997. It will build upon previous research findings and incorporate new components to address high-priority issues regarding harbor seal recovery.

We will continue aerial surveys to monitor the trend of harbor seals in PWS during 1998 and 1999. These surveys are relatively inexpensive to conduct, and since PWS harbor seals continued to decline through 1996, we think it is important to continue to monitor their trend. The analysis of trend data is complicated by within- and between-year variability in the number of seals hauled out during survey flights. Because the timing of surveys is constrained by environmental factors such as weather and tides, and also by the biology of the seals (peak periods for hauling out occur for only several weeks per year), it is not possible to eliminate many of the variables that affect seal counts, even with standardized methodology. For this reason, we propose to conduct additional analysis of historical and recent survey data an attempt to overcome some of these inherent difficulties with the variability of aerial survey data. We plan to reanalyze survey data using a hierarchical Bayes (HB) model, develop Bayesian statistical models that relate observed seal count to a number of covariates (including location), and develop a Bayesian approach to trend monitoring.

We propose to attach satellite transmitters to 10 additional harbor seal pups in 1998 to assist with the interpretation of dietary information provided by fatty acid analysis, and to identify areas used by newly weaned pups for feeding. Satellite-tagging will also provide information about dispersal of pups after weaning, and whether or not they leave PWS. Unless something unusual or unexpected develops from pup tagging in 1997 and 1998, we do not propose to attach additional satellite tags in 1999. Data collected from the 51 seals satellite tagged during 1992-1996, as well as the pups that will be instrumented in 1997 and 1998, will be thoroughly.

We will continue to use the harbor seal population model to evaluate ongoing population trends, and will incorporate recent harvest data and estimates of predation, incidental fisheries take, etc. as they are collected. We will also use the model to estimate the impacts of changes in carrying

capacity on harbor seals in PWS. We now intend to make the basic model more "user friendly" by adding a button-driven menu and illustrations. We will make it available to the Alaska Native Harbor Seal Commission and to the Youth Area Watch program directors for use in local communities.

Fatty acid studies will be continued and extended. Additional samples of a few select prey species will be analyzed to fill in missing locations or age classes and to enable an examination of annual variability in fatty acid signatures. We will obtain and analyze blubber samples from seals that we catch, as well as from subsistence caught seals. We will place particular emphasis on pup and young subadult seals, since this is the age class thought to be most sensitive to food limitation. Information on diet will be integrated with data from forage fish studies to understand how harbor seals utilize prey and how they may depend on seasonal or area-specific concentrations of prey.

NEED FOR THE PROJECT

A. Statement of Problem

From 1984-1988, harbor seal counts at 25 trend sites in PWS declined by 43% due to unknown causes. The decline continued in 1989, aggravated in oiled areas by the EVOS. Counts of seals at oiled trend count sites declined by 45%, compared to 11% at unoiled sites. More than 300 harbor seals (36% of those in oiled areas) were estimated to have died in PWS due to the spill.

Since 1989, numbers have continued to decline at about 6% per year. There were 31% fewer seals in 1996 than in 1989, and over 60% fewer than in 1984. The reasons for the continuing decline remain unknown, but are thought to relate to food limitation.

B. Rationale

Harbor seals are important to residents of PWS for subsistence. In 1985-1989, harbor seals made up 13%-27% of the subsistence foods harvested in Tatitlek and Chenega Bay. During 1992-1995, these two villages harvested less than half the number harvested annually before the spill. Native residents have noted the scarcity of seals and the impact this has had on subsistence hunting. Harbor seals are also watched and photographed by tourists and recreational users of PWS, and they interact with and are incidentally killed by commercial fisheries.

Like all marine mammals, harbor seals have special federal protection under the Marine Mammal Protection Act. Because of the ongoing decline, it is essential that current population data be available so that inappropriate restrictions on human activities are not implemented. It is important to understand what factors are limiting the population. We cannot assume, given the ongoing decline, that the number of seals in oiled areas will return naturally to pre-spill levels. It is necessary to continue monitoring trends, identify and appropriately manage areas of particular biological significance, and communicate information on population status to subsistence hunters and fishermen in order to minimize mortality and augment recovery in any way possible. Commercial fisheries in PWS may face greater restrictions designed to reduce incidental take of harbor seals unless something can be done to understand and reverse the population decline.

The ongoing decline of harbor seals began over two decades ago in the Kodiak area, and was detected at least a decade ago in PWS. Although periodic surveys have documented the downward trends and are useful for determining whether the recovery objective of "stable or increasing population trends" has been met, they are not adequate for determining what is causing the seal population to decline, or for designing conservation and management measures to facilitate recovery and ensure the future health of the population. Unless research is specifically designed and conducted to investigate the factors limiting harbor seals, it is likely that little progress will be made in understanding and mitigating the decline. This is a difficult but important topic to investigate. It will require a multidisciplinary approach that incorporates an understanding of harbor seal behavior, habitat use, and energetics, with data about the distribution, abundance, and biology of prey species and predators.

C. Location

This project will be conducted in PWS. Aerial surveys will be flown over the 25 established trend count sites listed in Table 1. Seal tagging and sampling will take place at a variety of locations throughout PWS. Pup tagging locations will be chosen based on our ability to catch seals, to represent different habitats, and the existence of previous tagging data for adult and subadult seals, to facilitate comparisons. Comparative data will be obtained by other ADFG harbor seal studies near Kodiak and in SEAK.

Communities that harvest harbor seals or engage in commercial fishing activities, and may be affected by or utilize results of this study, include Cordova, Chenega Bay, Tatitlek, and Valdez.

COMMUNITY INVOLVEMENT

Investigators for the harbor seal restoration project attended March and November 1996 meetings of the Alaska Native Harbor Seal Commission (ANHSC) and the harbor seal breakout session during the January 1997 EVOS workshop to discuss PWS harbor seal research and population trend. "Harbor Seal Updates" were produced and distributed to PWS subsistence hunters and other interested persons in PWS communities in February and September 1996. . During 1996, this project supported the travel of two PWS Youth Area Watch students from Cordova to Anchorage to attend ANHSC meetings and/or the EVOS workshop, and to facilitate communication between hunters and youth.

Information from this study will be presented at oil spill symposia, planning workshops, conferences, and in the published literature. Information will be provided to the University of Alaska Sea Grant program and ADFG Division of Subsistence for use in meetings and discussions with PWS subsistence hunters regarding the biosampling program. ADFG marine mammals staff regularly attend meetings with various public groups (tourism industry, fisheries, conservation groups, subsistence communities) to inform them about status, important conservation issues, and key research needs for harbor seals.

Project investigators will cooperate with personnel from the ADFG Division of Subsistence in their efforts to inform residents of Chenega Bay, Tatitlek, Valdez, and Cordova about the findings of this study and to incorporate the suggestions of PWS residents in study design. Such an

exchange of information will allow biologists to benefit from residents' observations about abundance and behavior of harbor seals in PWS, and will help residents to make informed decisions about their annual harvest of harbor seals.

Investigators will continue to attend 1-2 meetings of the ANHSC each year to discuss study results and proposed research. Investigators will assist as requested in developing community-based sampling programs. Biosampling is a cooperative effort of the ANHSC, NMFS, the University of Alaska Sea Grant program, and the ADFG Division of Subsistence. Personnel from this harbor seal project will facilitate sample analysis and communication of results to community residents. The principal investigator will continue to prepare newsletter-type reports of project findings (Harbor Seal Updates) for distribution to community residents and to the Public Advisory Group.

PROJECT DESIGN

A. Objectives

1. Monitor the abundance and trends of harbor seals at trend count sites in oiled and unoiled areas of PWS to determine whether the PWS harbor seal population has declined, stabilized, or increased since the EVOS.

2. Recommend a schedule for continued aerial survey monitoring based on observed trend and statistical characteristics of survey data.

3. Identify important prey species in the diets of harbor seals in PWS, with a particular emphasis on pups and yearlings, and determine whether there are dietary differences among different components of the population.

4. In conjunction with reserach efforts being done on the Scotian Shelf, develop mathematical models and associated software programs to quantitatively estimate species composition of individual harbor seal diets.

5. Determine whether there are differences in diets and important prey species among populations of harbor seals in areas of the Gulf of Alaska where they are continuing to decline (e.g., PWS and northern GOA) and areas where the population is stable or increasing (SEAK).

6. Determine whether changes in harbor seal diets and important prey species have occurred over the past two decades.

7. Compare estimates of abundance and importance of harbor seal prey to trawl survey data and data obtained from seabird diet studies being conducted concurrently under the APEX program.

8. Determine foraging range and diving behavior of harbor seal pups and juveniles and compare to similar information for other age groups.

9. Provide information to subsistence hunters so they can make informed decisions about the appropriate level of harvest for harbor seals.

B. Methods

The following hypotheses were developed for FY 98 - FY 00 for this harbor seal study to meet the above objectives.

Hypothesis 1: The PWS harbor seal population has stabilized and/or increased since the EVOS.

1. Conduct aerial surveys at PWS trend sites during molting in 1998 and 1999;
2. Re-analyze survey data using a hierarchical Bayes (HB) model and develop HB estimates of the annual number of observed seals.
3. Develop Bayesian statistical models that relate observed seal count to a number of covariates, including location, calendar day, time, height of low tide, time of low tide, and qualitative assessments of wind and sky conditions.
4. Develop a Bayesian approach to trend monitoring, taking into account the covariates.
5. Reevaluate survey data collected since 1989 using HB methods to evaluate whether seal numbers are continuing to decline, have stabilized, or are recovering to pre-spill levels.

Hypothesis 2: Juvenile harbor seals are particularly sensitive to characteristics of prey abundance such as depth, prey size, and prey type. Prey changes in PWS have resulted in food limitation, poorer body condition, and therefore reduced survival of juvenile seals.

1. Obtain blood and blubber samples from pups, subadult and adult harbor seals in PWS during two time periods: a) in late June/early July, representing the diets of pups about 2 weeks post-weaning (and therefore of their mothers) and the first over-winter diets for yearling harbor seals, and b) in August/September, a time when pups have lost blubber stores obtained from milk fat consumed during suckling and have begun to forage on their own, and also a time representing the summer diets of other age groups.
2. Analyze blubber samples for fatty acid signatures of individuals and age groups.
3. Measure total body composition (fat, protein, and lean body mass) of pups and juveniles using D20 equilibration as an indicator of individual nutritional status.
4. Use fatty acids signature analysis to determine whether individual, age-related, and interannual differences in diets occur in harbor seals; use this information to examine whether seals from different areas appear to have different diets because of differing prey intake with location or because of different age-group composition.
5. Continue to assess variation in the fat content and fatty acid composition of prey species in PWS, but with a particular emphasis on characterizing size-class and regional differences in the four prey species that are likely of most importance to harbor seals and especially juveniles: herring (*Clupea pallasi*), pollock (*Theragra chalcogramma*), capelin (*Mallotus villosus*), and sandlance (*Ammodytes hexapterus*).
6. Assemble the entire database being gathered in PWS on the fatty acid signatures of predators and prey and, together with a cooperating Scotian Shelf research program, develop mathematical models and associated software programs to quantitatively estimate species and size-class composition of individual harbor seal diets.
7. Estimate the most important prey items (and size classes) in diets of different demographic groups of harbor seals and determine whether diets of pups and small subadults differ

significantly from diets of large subadults and adults and relate this to data obtained previously on characteristics and limits of dive depths in pups, subadults, and adults.

Hypothesis 3: The diets of PWS and other declining populations of harbor seals differ from diets of harbor seals in areas where populations are stable, reflecting differences in the distribution and abundance of important forage fishes at relevant scales.

1. Obtain blood and blubber samples at similar time periods as in Hypothesis 2.1 from similar demographic groups of harbor seal populations, in another area of decline (Kodiak) and an area of stability (SEAK).
2. Analyze blubber samples for fatty acid signatures of individuals and age groups.
3. Determine whether diets of pups, subadults and adult harbor seals differ between PWS, Kodiak, and SEAK using fatty acid signatures.
5. Assess variation in the fat content and fatty acid composition of prey species that are likely to be of importance to harbor seals in Kodiak and SEAK, in cooperation with other ADFG harbor seal studies.
6. Using mathematical models developed (Hypothesis 2.7), estimate the diet of the differing demographic groups among the differing regions and determine whether juveniles appear to be less constrained by prey availability in SEAK versus Kodiak and PWS.

Hypothesis 4: The diets of harbor seals have changed over the past few decades, reflecting a change in the distribution and abundance of important forage fishes.

1. Archived blubber samples collected in the 1970s from Kodiak and in the late 1980s from PWS are available for analysis and have been successfully tested for their ability to be cleanly analyzed for fatty acid signatures. These samples will be analyzed for fatty acid signatures of individuals and age groups.
2. Using data on prey species fatty acid signatures (and accounting for any annual variability in these signatures), the species composition of diets of archived samples will be estimated using the developed mathematical models.
3. Compare estimated diets of seals collected in the 1970s with diets in the 1990s.

Hypothesis 5: The diet composition of harbor seals in areas of population decline reflect differences or changes in the relative distribution and abundance of prey important to various demographic groups.

1. Target PWS prey collection to areas both where seals are sampled and to where other work is being done on prey and/or seabirds under the APEX program.
2. Compare size-class and regional differences within prey species, especially herring and pollock, to data from stomach content analysis of these prey (APEX).
3. Compare and combine estimates of abundance and importance of harbor seal prey to trawl survey data (APEX).
4. Assess whether fish species important to juvenile seals, such as capelin and sandlance, are limited in areas where harbor seals are declining, as determined through data obtained from seabird diet studies being conducted concurrently under the APEX program.

Hypothesis 6. Harbor seal pups and juveniles spend more of their time foraging to obtain adequate nutrition than do adults; pups in PWS spend more time foraging than pups in other areas where the population is not declining.

1. Compare dive data from seal pups satellite tagged in PWS with data from subadult and adult seals tagged in the PWS.
2. Compare dive data from seal pups satellite tagged in PWS with data from pups tagged in other areas of Alaska (northern GOA and/or SEAK).
3. Assess the annual variability in the foraging behavior of satellite-tagged seal pups.

We are proposing two additional years of field study (1998 and 1999) with final data analysis and reporting to take place in 2000. Findings from this study will be evaluated after each field season. Any modifications to the study approach will be recommended based on findings during the previous field season from this and other PWS studies. In addition to the components outlined in this project description, questions about harbor seal health and condition, stable isotope analyses, and prey availability will be addressed by other Restoration studies.

Aerial Surveys and Analysis

Harbor seal abundance will be monitored by flying aerial surveys during the molting period in mid to late August. A fixed-wing aircraft will be used to survey 25 trend count sites at an altitude of 700-1000 ft. These haulout sites have been used by ADFG for PWS harbor seal trend counts since 1983, including NRDA and Restoration studies in 1989-1996 (Calkins and Pitcher 1984; Pitcher 1986, 1989; Frost and Lowry 1994a; Frost et al. 1994a; Frost et. al 1995; Frost et. al 1996). The trend count route includes 7 sites that were impacted by the EVOS (Agnes, Storey, Little Smith, Big Smith, Seal, and Green islands, and Applegate Rocks) and 18 unoiled sites (Table 2). The survey methodology and observers will be the same as those used in PWS harbor seal studies conducted in 1989-1996 (Frost et. al. 1996), and as summarized below.

Maximum numbers of harbor seals are known to haul out during pupping and molting (Pitcher and Calkins 1979; Calambokidis et al. 1987). Within these periods, more animals are usually hauled out at lower stages of the tide, since availability of many haulout sites is limited by tidal stage. Our surveys will be conducted during mid to late August (molting), and will begin within two hours before daylight low tides and finish within two hours after low tide. Multiple counts will be made at each site to allow statistical analysis of trend.

Power analysis of data from 1989-1994 indicated that in order to detect a 5% increase per year over a five year period ($p=0.05$) with a greater than 80% probability of being right (using initial population = 767, the number of seals at trend count sites in 1994), it is necessary to fly annual surveys during the molting period, with at least 7 replicates per year, and to adjust them for the effects of time of day, date, and tide. This analysis was based on data collected by ADFG during 1984-1994, and took advantage of one of the most extensive data sets of its kind. The recommendation of 7 or more replicates is similar to the number of replicates recommended by Pitcher based on analysis of other harbor seal surveys in Alaska (Pitcher 1986, 1989). The number of replicates also may be influenced by weather, which can limit the number of days suitable for flying within a survey period.

Aerial surveys do not estimate the total number of seals present since they do not account for seals that are in the water or seals hauled out at locations not on the trend count route. Surveys provide indices of abundance based on the number of hauled out seals. Interpretation of trend count surveys relies on the assumption that counts of harbor seals on select haulout sites are valid

linear indices of local abundance. We assume that within a given biological window, such as the molting period, hauling out behavior remains the same from one year to the next, and counts can thus be compared (e.g., Harvey 1987, Pitcher 1989). Standardization of procedures minimizes, but cannot eliminate, the effects of variables such as tide and weather that could influence the number of seals hauled out on a given day. Consequently, there may be considerable variation in daily counts, despite our attempts to standardize conditions. As part of this project during 1994-1996, we developed multivariate analyses to correct counts for weather, tide, and date (Ver Hoef et al. submitted). However, even this approach may not adequately estimate the variance associated with corrected counts.

The current models for trend-monitoring use Poisson regression and linear regression in a two-stage analysis. For the Poisson regression, a separate effect is fit for each site and year. With 10 years of data, and 25 sites, that makes 216 parameter estimates (9x24=216). We have also considered separate covariate effects for time of day (6 levels) and plan to include site-specific effects (but not separately for each year), so that adds more parameters (=5+24=29). In addition, site-specific effects for time relative to low tide (8 levels) (7+24=31), date (1+24=25), and other parameters related to weather are used. If we average 6 replicate flights per year, we have 6x25x10=1500 observations. That makes approximately 300 estimated parameters, and the fraction of parameters estimated to number of data is 1/5. A problem with such an approach is that we are estimating hundreds of parameters, and we may be getting large variances and poor estimation properties under these conditions. For the second stage analysis, the mean effect for year and location are calculated from the Poisson regression parameter estimates for standardized states of the covariates, and then the sites are summed for each year. This sum is then used in linear regression to determine trend across years. This second stage does not formally include estimation variance from the Poisson regression, which is an additional concern.

We have considered variations to our model to get rid of the 2nd stage regression analysis, but they also cause difficulties. For example, we could put the overall trend parameter in Poisson regression. However, this would cause all sites to have a common yearly mean. Another approach would be to allow each site to have a separate intercept with a common trend in the Poisson regression. However, it is clear that not all sites have a common trend. A final approach is to allow each site to have a separate trend slope and intercept in the Poisson regression model, but then it is unclear how to combine all 25 slope estimates into a single estimate of overall trend. Ideally, we would like to weight each slope estimate by the abundance at each site, but computing the variance of such a method may not be possible.

The Poisson regression model has served its purpose as a simple model that, 1) incorporated covariates that allowed us to examine different effects on seal counts, 2) allowed us to adjust our counts to get better trend estimates, and 3) allowed us to do power analysis. However, as we acquire more data, we feel that it is important to model effects separately for each site, and this makes the model much more complicated. For example, how do we summarize an effect for time of day, with 6 categories, for 25 sites? A natural approach is to combine parameters by giving them a distribution; this is called a hierarchical modeling approach.

Given the problems listed above, one solution is to put more structure on the model. This can be done using a hierarchical model, where all the "parameters" above can be considered "variables" in their own right, coming from one or a few "prior" distributions. For example, rather than

having 25 separate trend slope parameters (one for each site), we might consider all 25 slopes as coming from a common prior distribution. These prior distributions have only a few parameters that control their behavior. Thus, we have reduced a large set of hundreds of parameters to a set that contains relatively few. Also, because the 25 slope parameters will have a "distribution," it is conceptually easy to take a weighted sum and obtain the proper variance for an overall trend.

With a hierarchical modeling approach, we will develop a Bayesian statistical model that relates observed seal counts to a number of covariates. Covariates recorded at each observation include year, spatial coordinates, calendar day, time, height of low tide, time of low tide, and qualitative assessments of wind and sky conditions. Using modern Monte Carlo Markov Chain methods, we will assess the usefulness of any or all of these covariates in explaining and/or predicting the number of seals observed. An integral part of this modeling will be the development of a hierarchical Bayesian approach to trend monitoring. Ultimately, a separate trend may be occurring at each of the 25 haul-out sites in the Prince William Sound. One can consider a trend parameter, such as the slope of a regression through time, for each site. Bayesian hierarchical methods are ideally suited for combining these 25 trend parameters to get an overall trend indicator for all sites.

Catching and Sampling Seals

Seals will be caught by entanglement in nets placed near the haulouts. Nets will be approximately 100 m long and either 3.7 or 7.4 m deep with standard floats or float line and light lead lines. Mesh openings will be about 30 cm stretched measure. Nets will be deployed from a 6 m boat assisted by one or two other small boats to assist in maneuvering the net and tending it to ensure that all captured seals are quickly detected and removed (see Frost and Lowry 1994b). Some seal pups may be caught using long-handled dipnets.

When seals become entangled, they will be brought into the boats or to shore, cut free from the tangle net, and placed into hoop nets (large stockings made of 1 cm mesh soft nylon webbing). As necessary, seals will be sedated with a mixture of ketamine and diazepam administered intramuscularly at standard doses (Geraci et al. 1981). Each seal will be weighed, measured, and tagged in both hindflippers with individually numbered plastic tags. Field personnel will collect approximately 50 cc of blood from the extradural intervertebral vein. Ultrasound measurements of blubber thickness will be made whenever possible. Standard blood chemistry panels and virology screens (phocine distemper virus, herpes, and others as indicated) will be run on these samples. The following samples will also be taken: a 0.5 cm x 2.5 cm blubber biopsy for fatty acid analysis and analysis of energy content, whiskers for stable isotope analysis, and a small piece of skin for genetics studies. Ultrasound and blood chemistry panels will be analyzed by Project 001. Virology screens will be coordinated and paid for by the ADFG's NOAA-funded harbor seal study, as will all genetics analyses. Seal pups and small juveniles will be selected for instrumentation with satellite tags, as described below.

Total body composition (fat content, protein content, lean body mass) will be measured on a subset of the pups and juveniles that we sample using isotope dilution with deuterium oxide (D20). D20 is a stable isotope of water, which is widely used as a non-invasive method to measure body water pool size and the rate of water turnover in mammals and other vertebrates (Nagy & Costa 1980; Oftedal & Iverson 1987; Oftedal, Iverson & Boness 1987; Iverson et al.

1993). After administration of a known amount of D2O, the isotope completely equilibrates with all body water of the animal. Measurement of the final dilution of D2O in the body water (dilution space) can then be used to accurately measure total body water content (Oftedal, Bowen & Boness 1993). Body water content is then used to calculate total body fat, protein, and energy stores of the seal, based on the fact that the water and protein contents of lean body mass (fat-free mass) are approximately constant among mammals, particularly among individuals of a given species and age (Pace & Rathbun 1945; Reilly & Fedak 1990; Iverson et al. 1993).

Prior to the onset of the D20 procedure, seals will be weighed to the nearest 0.1 kg, and a blood sample. Any stomach contents of the animal will be evacuated by gastric intubation using a 3/8 inch veterinary stomach tube. A pre-weighed amount (approximately 1g/kg body mass) of deuterium oxide (99.9% purity), contained in a syringe with a three-way stopcock, will be delivered by gastric intubation using a small 12 French stomach tube (to reduce total surface area during delivery). The syringe and stomach tube will then be rinsed with 2 x 5 ml quantities of water, and air blown through the tube as it is withdrawn to ensure complete delivery. The animal will then be held for approximately two hours to permit isotope equilibration. After that, two sequential blood samples, separated by about 20 minutes, will be taken to ensure that equilibration has occurred. Bloods will be centrifuged and sera collected and frozen in airtight cryovials until the time of analysis. Laboratory analyses will be done at Dalhousie University. Total free water will be collected from blood sera by heat distillation, and D2O concentration will be determined by quantitative infrared spectrophotometry according to Oftedal & Iverson (1987) and Oftedal, Iverson & Boness (1987) on a Perkin-Elmer Fourier Transfor Infrared Spectrophotometer with integrated data station (Paragon 1000).

Seals will be caught in three regions of PWS to coincide with sampling areas being used by other studies (APEX, herring studies, etc.). These will be Port Gravina; southern PWS near Montague, Green, and Little Green islands; and central PWS near Agnes, Smith, and Seal islands. This will facilitate comparison of data obtained by fish, seabird, and harbor seal researchers about important prey species and responses to changing availability of prey. Hydroacoustic and trawl data will be available from these areas. We will try to catch and sample approximately 40-50 seals total per year, during April-May and August-September. If sample analyses indicate that other areas or seasons should be sampled, we will extend or modify our sampling schedule.

Seals will be caught from other areas (Kodiak and SEAK) at similar time periods, to the extent possible, as part of the NOAA-funded harbor seal study. We hope to obtain about 20 blubber biopsy samples per year from each area. Additionally, wherever possible, blubber samples from harvested seals will be obtained from subsistence hunters in SEAK and Kodiak. Archived samples are available from both of these areas (10-20 per year since 1995).

Fatty Acids Analysis

Recently, a method has been developed for understanding marine food webs through the use of fatty acid signatures (Iverson 1993). Fatty acids are essentially the building blocks of lipid. Organisms are able to biosynthesize and modify fatty acids, but there are biochemical limitations and differences in these processes depending on the organism. Specific fatty acids cannot be synthesized by animals and therefore can only originate from diet. Because of this, some fatty acids in the food chain can be attributed to specific origins (Cook 1985). Lipids from marine

organisms are characterized by a very complex array of fatty acids. There are substantial differences in fatty acid composition among species and prey types, as well as within species by geographic region (e.g., Ackman et al. 1975, Iverson 1993). In marine mammals, dietary fatty acids are often deposited in body tissue without modification (Iverson and Oftedal 1992, Iverson et al. submitted). Consequently, it is possible to trace fatty acids obtained from the diet and to compare arrays in the tissues of the predator to those in the prey consumed.

The use of specific lipids as biological markers has been demonstrated in a number of studies on fish and copepods (Lee, Nevenzel & Paffenhofer 1971; Sargent et al. 1988; Fraser et al. 1989; Klungsoyr et al. 1989; Graeve, Kattner & Hagen 1994; St. John & Lund 1996). Relative proportions of dietary fatty acids have also been shown to be reflected in the fatty acid composition of storage lipids in both captive and free-ranging carnivores (e.g., Reidinger et al. 1985; Rouvinen & Kiiskinen 1989; Colby, Mattacks & Pond 1993; Pond et al. 1995). In seals, ingested fatty acids can be deposited directly into adipose tissue, such that blubber may be a mirror of current diet when a seal is rapidly fattening on a high fat diet (Iverson et al. 1995), or may reflect a longer-term integration of dietary fatty acids and possibly biosynthesized fatty acids at times of reduced intake (Kirsch, Iverson & Bowen 1995).

This concept of fatty acids as trophodynamic indicators can be applied to harbor seals. In general, lipid transfer from prey to deposition in tissue is extremely efficient (Iverson 1988, Iverson et al. 1995). Because certain fatty acids cannot be biosynthesized by seals, these can be identified as being of dietary origin. Since most seals undergo seasonal periods of fasting and depletion of fat stores (e.g., during the breeding season or the molt) followed by intensive blubber deposition (prior to the subsequent breeding season), blubber fatty acids usually reflect the integration of diet over a period of several months. Thus, fatty acids in blubber provide information on dietary history of the animal. Since many seals tend to feed on only a single or few selected prey species at a given time or season (e.g., Bowen 1990), this facilitates the use of fatty acid signatures.

In the initial study funded by the EVOS Trustee Council, we used fatty acid signatures to investigate the diet and spatial scales of foraging in harbor seals and selected prey in PWS and the Gulf of Alaska (Iverson, Frost and Lowry, in press). We found large differences in the fatty acid composition of blubber from seals sampled in geographic regions several hundred kilometers apart. Within PWS, fatty acid signatures distinguished seals from haulouts only a few kilometers apart, suggesting that seals forage very site-specifically. Prey fatty acid patterns also differed on similarly small spatial scales within PWS.

The next step is to advance fatty acid signature analysis so that we can use it to quantitatively estimate the composition of the diet. This means not only determining the species composition, but also the size classes of species eaten and possible area from which the prey were fed upon. Then, it will be critical to apply this technique to evaluating possible problems in recruitment of the population by better understanding the foraging ecology of juvenile harbor seals and perhaps pregnant females. It will be important to document diet differences among age-groups in the declining PWS harbor seal population, as well as differences which occur in the same age-groups but in areas where the population is stable. It will also be important to compare this information with data available from time periods of lesser declines (1970's and 1980's). Juveniles in particular are thought to be significantly affected by reduced prey availability at scales relevant to the nutrition of individuals (NRC 1996). Thus, there could be several indications about stresses

on juveniles through understanding diets. Small forage fish species such as capelin and sandlance have long been an important part of pinniped diets and a decline in these prey species may have affected the seal populations which depend upon them. If reductions in these prey are apparent in the diets of adult seals in areas of decline, this would suggest a lower abundance of these prey in general. If indeed juveniles are found to be dependent on and limited to smaller size prey, this would coincide with the above finding. If juveniles are feeding on smaller but different prey than the small prey in adult diets, this might indicate competition with large animals for available food and further indication of low abundance of important forage fish species.

Blubber samples will be taken from seals of the various demographic groups using routine biopsies (sterile 6 mm biopsy punches). Samples will initially be collected in late spring and late summer to coincide with the overwintering period and the initial summer foraging period of pups, respectively. Samples will be placed in chloroform and methanol with BHT as an antioxidant, and kept frozen until analyzed. Samples will be collected from all seals that are caught during tagging operations. Blood will be collected from the same animals and centrifuged in the field. In addition, some samples may be available through the biosampling program being conducted by the Alaska Native Harbor Seal Commission.

Blubber samples archived by ADFG from harbor seals collected in the 1970s will be subsampled, placed in BHT and sent to Dalhousie University for anlaysis. Several of these archived samples were analyzed on a test basis during 1996-1997 to determine whether the blubber was still in suitable condition. The analyses were successful, indicating that some or all of the remaining archived specimens will be useful for this study. There are 365 total archived specimens from 1976-1978, of which approximately 200 are from areas where recent samples have also been collected (southeast Alaska, n = 16; Kodiak, n = 193; Middleton Island, n = 5; and miscellaneous others from the northern GOA). Samples will be prioritized based on age and specific location, to facilitate comparisons with samples from the 1990s. These same samples will be analyzed for lipid and water content, as well as total caloric density, by Castellini et al. (EVOS project 001) thus enabling the two projects to jointly examine and compare the energy content of the blubber and diet in recent and 20-yr-old samples from areas that have and have not declined.

Prey species will be obtained through APEX and other sampling cruises and analyzed at Dalhousie University. We will target our prey collection, where possible, to areas where seals are being sampled and to where other work is being done on prey and seabirds under the APEX program and where trawl survey data are available on abundance and distribution of prey species. We plan to continue to assess variation in the fat content and fatty acid composition of prey species in PWS, but with a particular emphasis on characterizing size-class and regional differences in the four prey species that are likely of most importance to harbor seals and especially juveniles: herring, pollock, capelin, and sandlance. Prey species from the other areas of harbor seal sampling (Kodiak and SEAK) will be obtained as possible through other studies and sources of funding, including in cooperation with the National Marine Mammal Laboratory as part of sea lion studies. Prey species to be analyzed will be chosen based on their collective importance to harbor seals and other apex predators and this project will work with other projects being conducted under APEX to avoid duplicative analyses and to share data and information.

Laboratory analysis and evaluation of data will be conducted by Dr. Sara Iverson at Dalhousie University, Nova Scotia. Fatty acids will be extracted from seal blubber and prey according to

content of each prey and size class, and finally, weighting on individual fatty acids as a function of their ability to be biosynthesized by the predator. We expect to start out from a basis of an optimization problem with a simple least square error assumption (R. Myers, pers. comm.). Given the constraints listed above, standard optimization methods cannot be used. The inequality (of fatty acids) is more difficult to deal with analytically and hence also the estimation of standard errors. However, software can be written and developed to handle these. This work will be done in the laboratory of Dr. S. Iverson as a cooperative effort between Alaska and Scotian Shelf research and with partial support from NSERC.

Fatty acid signature analysis has not to date been a stand-alone method, but neither has any other currently available method for examining marine mammal diets. Stomach contents analysis is limited by our ability to obtain large enough samples, the digestive state of contents, and by the fact that food in a stomach represents a single meal. In PWS, large tidal fluctuations every 6 hours make it virtually impossible to collect scats from areas where seals haul out. Stable isotopes indicate the trophic level at which seals feed and temporal variations in prey type, but provide little information on specific prey. Studies of prey availability (e.g. from trawl surveys) are necessary to establish the "menu" from which seals may choose, but they do not reflect the availability of prey to seals on relevant scales or the energetic costs of capturing different prey. Progress towards answering the question of "Is food limiting harbor seals?" will most likely come through the combination and integration of a variety of approaches, but it is clear from our previous work that fatty acids may be a particularly valuable tool in achieving a better understanding of trophic dynamics, dietary differences and demography of harbor seal populations in PWS and the Gulf of Alaska.

Satellite-tagging

Satellite-linked telemetry can be used to gather information about habitat use, including site fidelity, movements between haulouts and in and out of PWS, seasonal changes in hauling out patterns, feeding habitats, and feeding and diving behavior. Satellite-linked time-depth recorders (SDRs) have provided researchers with the ability to monitor location and diving behavior of marine mammals (Mate 1986, 1989, Hill et al. 1987, Stewart et al. 1989, Lowry et al. 1994, Frost and Lowry 1994b). The SDRs transmit to a satellite-based Doppler positioning system that calculates locations and tracks movements of animals with considerable accuracy. When combined with appropriate environmental sensors and microprocessor hardware and software, other information about an animal's environment and behavior can be transmitted to the satellite.

This study has demonstrated that SDRs are an effective means of monitoring the movements and haulout locations of harbor seals in PWS. During 1992-1996, significant data were received from SDRs attached to 51 harbor seals in PWS, including 23 males and 28 females (Table 1). Twenty-six were adults, 23 were subadults, and 2 were pups. SDRs were attached to 18 seals from areas in central PWS that were oiled by the EVOS (Seal Island, Herring Bay, Bay of Isles, Applegate Rocks); four from eastern PWS (Olsen Bay, Gravina Island); one from northwestern PWS (the Dutch Group); and 28 from unoiled sites in southcentral PWS (Port Chalmers, Stockdale Harbor, Little Green Island, and Channel Island). SDRs were operational for up to 10 months, and provided locations for about 80% of those days.

During 1998, SDRs will be attached to 10 harbor seal pups at locations chosen to complement data from 12 pups tagged in 1997 and from adults and subadults tagged during 1992-1996. These will include Olsen Bay (important pupping area and also herring area), southern PWS near Montague, Green, and Little Green islands (herring and fish data from here, and a large number of seals); and central PWS near Applegate Rocks and Seal Island (APEX fish data available, and significant seal haulouts with pups). Actual tagging locations will depend on where seals are present and can be caught.

Emphasis will be placed on instrumenting pups and 1-yr-olds. Depending on the performance of tags in 1997, it is likely that in 1998 seal pups will be instrumented in late July or August.

One-quarter-watt transmitters (10 cm x 5 cm x 3 cm and weighing 170 g) will be attached to the mid-dorsal surface of seal pups by gluing with epoxy resin (Fedak et al. 1984; Stewart et al. 1989). SDRs attached after weaning should remain attached until the next molt, but will not operate that long. A prototype 0.25-watt SDR attached to a harbor seal pup in September 1996 operated until the end of December and sent approximately 12,000 transmissions. Through duty cycling and by limiting the number of daily transmissions, we hope to double the data collection period for 0.25-watt SDRs deployed in 1997 and beyond.

Data will be acquired from the ARGOS satellite receiving system and formatted using software provided by the manufacturer of the transmitters. Each SDR will transmit signals to polar-orbiting satellites whenever the seal is hauled out or when it surfaces sufficiently long for a transmission to occur. An uplink occurs when a satellite is positioned to receive the signal. Information transmitted by the SDR is used by Service ARGOS to calculate the geographic location of the seal. Units will be equipped with built-in programmable microprocessors to collect and summarize data for periods when animals are diving and store it for later transmission, as has been done for crabeater seals, Steller sea lions, and spotted seals (Hill et al. 1987; R. Merrick, personal communication; Lowry et al. 1994a). These data will be stored in six hour blocks and transmitted to the satellite once the six hour data collection period is complete. Sensor information from a pressure transducer and a conductivity switch will be used to indicate when the animal is hauled out. Data from four periods will be stored in memory, providing at least a 24 hour window for transmission before the data are lost. Dive data will be summarized as histograms in depth bins of 4-20 m, 21-50 m, 51-100 m, 101-150 m, 151-200 m, 201-250 m, 251-300 m, 301-350 m, and over 350 m, and duration bins of 0-120 seconds, 121-240 seconds, 241-360 seconds, 361-480 seconds, 481-600 seconds, 601-720 seconds, 721-840 seconds, 841-960 seconds, 961-1080 seconds, and over 1080 seconds. In addition, SDRs will store and transmit the amount of time spent in each depth bin and the total time spent at the surface.

Each SDR broadcasts a unique identification code so that data can be assigned to a particular seal. Position accuracy for all geographical location information is rated by Service ARGOS to reflect the predicted accuracy of the calculated locations (Fancy et al. 1988, Stewart et al. 1989). Locations calculated by ARGOS will be screened for accuracy and plotted on charts of PWS.

Data on the haulout patterns of tagged seal pups will be examined for indications of daily or seasonal variations, for example to determine whether there is a change in the frequency of haulout by season, or whether the amount of time spent hauled out changes. Plots of locations where continuous signals are received will be used to determine the degree and regularity of use

of particular haulout sites. We expect to receive fewer locations of seals while at sea, because the transmitter antenna will frequently be submerged. At-sea locations will be plotted as an indication of areas used for feeding. Information on depth and pattern of diving will be compiled, and will provide additional information on the general areas used for feeding.

Dive data will be presented as graphs and histograms which indicate the range in individual behavior as well as summary data for all seals combined. Dive data histograms will present the number of dives at different depth increments and by duration of dive. Means and standard deviations for dive depth and duration will be calculated and compared for seals in different locations or habitats and at different times of day and year. Compilation of data on time and location of feeding dives will be used to identify feeding areas near different haulouts, if possible. If sensors indicating whether the seal is on land or at sea become more reliable and the necessary SDR software is developed to provide a continuous record of this information, then diving and hauling out cycles will be examined relative to time of day, tide, and season. Summaries of the number and quality of uplink data and at-sea position data will be presented in tabular form.

Tabular summaries will also be prepared for use of different haulouts by individual seal pups, and frequency of haulout and amount of time spent feeding by season. These data will be used to evaluate site fidelity of seal pups, to quantify the amount of interchange among haulouts within and outside of the area impacted by the EVOS and within and outside of PWS, to determine seasonal importance of particular haulouts, to identify areas used for feeding, and to examine differences in movements and feeding behavior of pups, subadult and adult seals.

C. Contracts and Other Agency Assistance

Survey aircraft will be chartered from the private sector. Charter aircraft for surveys will not require contracts. ADFG maintains a list of qualified air charter operators. Aircraft for surveys will be chosen from this list according to state procedures. Vessels will also be chartered from the private sector. Vessel support for tagging work will use small vessels contracts that will be completed by the Principal Investigator according the state SOP manual.

Costs of acquiring SDR data from Service ARGOS are paid for through a contract with the National Oceanic and Atmospheric Administration (NOAA). This contract covers all ADFG Division of Wildlife Conservation satellite tagging projects (harbor and spotted seals, and caribou), not just this harbor seal restoration project, and is processed by the Division of Wildlife Conservation. Funds for data acquisition must be encumbered and guaranteed to NOAA in early February. Actual contract processing occurs later in the spring.

Satellite SDRs will be purchased under contract award from Wildlife Computers, a private company in Seattle, Washington. The contract award is currently. Wildlife Computers is the only company in the United States which manufacturers SDRs with the capabilities necessary to acquire the data we require about diving behavior of seals.

Fatty acid analyses and interpretation will be done by Dr. Sara Iverson at Dalhousie University through a Cooperative Agreement between ADFG and Dalhousie. Dr. Iverson is the only person in North America with specific experience in analysis of fatty acids in seal blubber, and

particularly with the sophisticated statistical analyses necessary to infer diet from the relative abundance of these fatty acids.

A Reimbursable Services Agreement will be negotiated with the University of Alaska Anchorage to cover the costs for Master of Science student Tracey Gotthardt. In her graduate thesis, Ms. Gotthardt will correlate the distribution of forage fishes in PWS, as indicated by trawl data collected by APEX, with the movements and diving behavior of satellite-tagged harbor seals.

Bayesian statistical analysis will be conducted as a cooperative effort between Jay Ver Hoef, ADFG, and Edwin J. Green and William E. Strawderman of Rutgers - The State University of New Jersey. This work will be undertaken through a Cooperative Agreement between ADFG and Rutgers. Drs. Green and Strawderman are acknowledged experts in this particular area of statistics (e.g. Green and Strawderman 1991, 1992). Their experience with hierarchical Bayes model will speed the process of obtaining results.

SCHEDULE

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

Field work for this project will continue during 1998 and 1999, with final data analysis and submission of a final report in 2000. A schedule of field activities, data analysis, and report preparation is shown in Table 3 and below.

FY 98: October 1, 1997- September 30, 1998 (98064)

October:	Analyze 97 aerial survey data (preliminary)
October/November (1 day):	Meet with hunter representatives at annual ANHSC meeting
October-September:	Analyze SDR tag data
October-December:	Analyze fish distribution/seal diving
October-December:	Finish "user friendly" population model
October-March:	Analyze 97 seal/prey fatty acids samples
December:	Prepare and distribute Harbor Seal Update
January:	* Order SDRs for 1998 field season; reserve Argos channels
January-September:	* Fatty acids model development
January-March:	Arrange logistics (vessel, plane, contracts, equipment)
January (3-4 days)	Attend Annual Restoration Workshop
February (2-3 days)	Coordination meeting for ADFG and NOAA harbor seal studies
April 15:	Submit "user-friendly" population model
April 15:	Submit annual report (FY 97 findings)
April 15:	Submit renewal proposal
June 1, 1998	Submit final report (masters thesis) on fish distribution/seal diving
June-August:	* Bayesian reanalysis of survey data
June 20-July 7 (8 days):	* Sample seals in PWS
August 1 -15:	* Satellite tag and sample seals in PWS
August-March:	* Retrieve Argos SDR data
August 15-30:	Aerial surveys in PWS during molting
September 15-30:	Prepare and distribute Harbor Seal Update

* defered to December

FY 99: October 1, 1998- September 30, 1999 (99064)

October:	Analyze 98 aerial survey data (preliminary)
October/November (1 day):	Meet with hunter representatives at annual ANHSC meeting
October-March:	Retrieve 1998 Argos SDR data
October-September:	Analyze SDR tag data
October-March:	Analyze 98 seal/prey fatty acids samples
October-March:	Fatty acids model development
December:	Prepare and distribute Harbor Seal Update
January-March:	Arrange logistics (vessel, plane, contracts, equipment)
January (3-4 days)	Attend Annual Restoration Workshop
February (2-3 days)	Coordination meeting for ADFG and NOAA harbor seal studies
April 15:	Submit annual report (FY 98 findings)
April 15:	Submit renewal proposal
June 1	Submit final report (masters thesis) on fish distribution/seal diving
June 20-July 7 (8 days):	Sample seals in PWS
August 1 -15 (8 days):	Sample seals in PWS
August 15-30:	Aerial surveys in PWS during molting
September 15-30:	Prepare and distribute Harbor Seal Update

FY 00: October 1, 1999- September 30, 2000 (00064)

October:	Analyze 99 aerial survey data (preliminary)
October/November (1 day):	Meet with hunter representatives at annual ANHSC meeting
October-March:	Analyze 98 seal/prey fatty acids samples
December:	Prepare and distribute Harbor Seal Update
January (3-4 days)	Attend Annual Restoration Workshop
January-June:	Final SDR tag data analysis
January-June:	Final trend analysis 1989-1999
January-June:	Final fatty acid analysis and interpretation
April-September	Final report and manuscript preparation
31 September:	Submit final report

B. Project Milestones and Endpoints

Objective 1

August 15-30, 1998-1999:	Conduct aerial surveys at 25 sites in PWS
September 1998-2000:	Prepare Harbor Seal Updates for hunters to describe trend
September 1998:	Submit manuscript describing Bayesian trend analysis
April 15, 1998-2000:	Submit population trend analysis as part of annual reports
June 2000:	Submit manuscript describing 1989-99 PWS harbor seal trend

Objective 2

June 2000:	Submit ms describing 1989-99 PWS trend analysis and methods
September 30, 2000:	Submit final report with recommended monitoring scheme

Objectives 3 -7

January 1998:	Paper on fatty acids work at 12th Biennial Marine Mammal Conf.

June-August, 1998-1999:	Sample 30-50 harbor seals for blubber fatty acids
June-August, 1998-1999:	Sample 20 seal pups and juveniles using D20 for body composition
October-September,1998-99:	Analyze 80-100 recent harbor seal blubber samples for fatty acids
October-September,1998-99:	Analyze 100-200 archived harbor seal samples for fatty acids
October-September,1998-99:	Analyze 200-300 prey samples for fatty acids
July 1998:	Submit manuscript describing fatty acids work
October 1998:	Submit manuscript describing D20 studies of seal pups
November 1999:	Paper on fatty acids work at 13th Biennial Marine Mammal Conf.
September 2000:	Submit manuscript describing fatty acids work

Objective 8

January 1998:	Paper at 12th Biennial Marine Mammal Conf on seal movements
February 1998:	Submit manuscript on PWS seal movements
August 1998:	Attach SDRs to 10 seal pups in PWS
November 1999:	Paper at 13th Biennial Marine Mammal Conf on PWS seal diving
May 2000:	Submit manuscript on diving and movements of seal pups in PWS

Objective 9

April 15, 1998:	Distribute population model to ANHSC, Youth Area Watch
September 1998-2000:	Prepare and distribute Harbor Seal Update describing study results
November? 1998-1999:	Attend ANHSC meetings to discuss status and studies with hunters
December 1998-1999:	Prepare and distribute Harbor Seal Update describing study results

D. Completion Date

This project will continue for three fiscal years, FY 98-FY 00. Field work and laboratory analyses will be conducted during FY 98 and FY 99. Final data analyses will be conducted and a final report prepared in FY 00.

PUBLICATIONS AND REPORTS IN FY 98

1. Oral/poster presentations at EVOS Restoration Annual Workshop (January 1998)
2. Oral/poster presentation(s) at Twelfth Biennial Conference on the Biology of Marine Mammals, Monaco - fatty acids, tagging (January 1998)
3. Submit manuscript on PWS seal movements (February-June 1998)
4. Annual report for FY 1997 studies; will include results of molting surveys including progress of Bayesian covariate and trend analyses; analysis of data for SDRs deployed on pups in June-July 1997; status report on 1997 fatty acid analyses (April 1998)
5. User friendly population model (April 1998)
6. Manuscript describing fatty acids work (July 1998)
7. Report of field activities for August surveys and pup/juvenile tagging and sampling (September 1998)
8. Manuscript describing Bayesian trend analysis (September-December 1998)

Manuscript titles and journals to which they will be submitted have not been determined. Topics include: 1) results of Bayesian statistical modeling of the harbor seal trend count data (Ver Hoef et al.); 2) age, sex, and location related differences in harbor seal diets in Prince William Sound and the Gulf of Alaska using fatty acid signature analysis (Iverson, Frost, et al); and 3) seasonal movements and distribution of satellite-tagged seals in PWS (Lowry and Frost). It is possible that a fourth manuscript will be prepared describing the use of population modeling to evaluate the role of carrying capacity in the ongoing harbor seal decline (Small, Frost, et al.).

PROFESSIONAL CONFERENCES

Project investigators plan to attend the 12th Biennial Conference on the Biology of Marine Mammals in Monaco in January 1998. This conference is sponsored by the Society for Marine Mammalogy and is the largest marine mammals conference in the world. Abstracts will be submitted and it is anticipated that oral or poster presentations will describe the results of fatty acids (Iverson) and satellite-tagging studies (Frost or Lowry). Results of other studies using samples from PWS provided by this restoration study are also likely to be reported but travel will not be funded by this grant.

NORMAL AGENCY MANAGEMENT

This project is funded entirely by the Trustee Council as a restoration project. ADFG conducts no other studies of harbor seals in PWS that are not a part of the restoration program. ADFG has no management responsibility for harbor seals. ADFG biologists are conducting this research as principal investigators because of their many years of experience investigating the biology of seals and other marine mammals in Alaska. The Subsistence Division of ADFG has been funded by the Trustee Council to monitor the harvest of harbor seals in PWS (Project 244) and to conduct food safety testing (Project 279). Subsistence Division also collects and reports harbor seal harvest data for other parts of the State with funding from NOAA.

ADFG is conducting studies of harbor seals in SEAK and near Kodiak with funding from NOAA/NMFS. Those studies contain similar components to the PWS study and are closely coordinated to ensure that data are collected and analyzed in a similar manner. This will facilitate comparisons of data from declining populations (PWS and Kodiak) and a stable population (SEA) of harbor seals. Equipment is shared by the two projects. Consequently, it has not been necessary for the PWS project to purchase many equipment items and supplies solely for the use of this study. Because of these other ongoing projects, the PWS harbor seal project has had access to a GIS system with which to analyze tagging data.

Without this project, information on the status and trend of harbor seals in PWS will not be regularly available. There will be no systematic documentation of trend, and whether or not the decline continues will be unknown for a much longer time than if regular monitoring continues. Power analysis of data collected through this study has indicated that a minimum of five consecutive surveys is required to reliably detect a trend. If surveys do not occur on a regular basis, it will be a very long time before a trend can be correctly identified.

Because of Trustee Council-funded projects, progress is being made on communicating information about the decline to the public, in particular to fishermen who may incidentally take harbor seals while fishing and to subsistence hunters from PWS villages. This transfer of information is making local residents more aware of the factors that may affect the decline, and has resulted in the initiation of a village-based biosampling program that may provide important samples to researchers. One of the significant long-term benefits of this and other harbor seal studies will be the involvement of local hunters in the research and management of harbor seals and the formation of the Alaska Native Harbor Seal Commission.

The statistical methods developed to analyze survey data from PWS will have great application to harbor seal surveys in other regions of Alaska and elsewhere. Other investigators should be able to design more reliable and cost-effective surveys using methodology developed through this Trustee Council-funded project. Similarly, the application of fatty acids analysis to investigations of diet and changes in diet is likely to have significant and far-reaching effects on our ability to investigate the trophic dependencies and interactions of many species. Already, techniques developed as part of this project appear to have application for studies of fish movements and stock identity.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Other EVOS-funded marine mammal studies include: Recovery of Harbor Seals from EVOS: Condition and Health Status (Project 001); Harbor Seals and EVOS: Blubber and Lipids as Indices of Food Limitation (Project 117-BAA, UAF); and Isotope Tracers - Food Web Dependencies in PWS (Project 170, UAF). Investigators from the three projects regularly communicate and discuss these projects.

Project 064 is a multidisciplinary, inter-agency undertaking. Surveys and satellite tagging will be conducted by ADFG; lipid analyses and interpretation by Dalhousie University; blood chemistry analyses at UAF (as part of 001); and Bayesian statistical analysis by ADFG and Rutgers University. Inclusion of interdisciplinary components within the same project will ensure that data are shared and interpreted in an interdisciplinary manner.

Project 064 (this project) will provide logistics, the MMPA permit to conduct sampling, and access to seals and samples for this study and the study conducted by Dr. Michael Castellini entitled "Condition and Health of Harbor Seals" (Project 001, UAF). Archived harbor seal data and blubber samples have been and will in the future be provided to Castellini/UAF for use in analyses of body condition and blubber. Subsamples of these same archived ADFG harbor seal blubber samples will be sent to Dalhousie University for fatty acids analysis. It will be very useful to have historical fatty acids and blubber quality results from the same individuals. Harbor seal investigators at ADFG and UAF have been working successfully together for the last five years on harbor seals in PWS and elsewhere, and future collaborations should be equally productive. Regular meetings and seminars are held by marine mammal investigators at UAF and ADFG Fairbanks to exchange information and ideas.

This study will continue to directly interface with the study entitled "Isotope Ratio Studies of Marine Mammals" (Project 170, UAF) as long as it continues to be funded. Samples of seal

whiskers and seal prey have been and will continue to be provided to that study. Investigators of the two projects (Frost and Schell/Hirons) discuss stable isotope results at regular intervals and are pursuing preparation and publication of a joint manuscript describing preliminary findings of this study.

Prey samples for fatty acid analysis have been and will continue to be obtained through PWS System Investigation studies and the APEX study. Species to be analyzed have been chosen based on their collective importance to harbor seals, seabirds, and killer whales Information on distribution and movements of harbor seals, and diving behavior, will be shared with PWS Sound Investigation modeling studies to look at energy flow within PWS, and with forage fish investigators who may examine the effects of predation on fish population dynamics.

Statistical modeling to assign quantitative values to seal diets based on fatty acids signatures will be done as a cooperative effort between this restoration study and Scotian Shelf research project, with partial support from NSERC.

This harbor seal study will obtain samples of prey and incorporate results from Herring (ADFG) and SEA studies being submitted under the PWS System Investigation, and from the study Apex Predator Ecosystem Experiment. Prey samples from the GOA and SEAK will be obtained on an opportunistic basis, in cooperation with other ADFG harbor seal studies and with National Marine Mammal Laboratory (NMML) sea lion projects. These samples will be analyzed with non-EVOS funding, but analyses will be included in the results of the project. Fatty acids analysis in the future will emphasize pollock, herring, capelin, and sand lance. These species are important to seabirds and to harbor seals. The NMFS Auke Bay laboratory is submitting a proposal for FY 98 that will investigate fatty acid profiles and lipid class analysis of herring and other forage fishes. That study plans to conduct detailed sampling and fatty acids analysis of herring (and perhaps others) in northeastern (Port Fidalgo) and southwestern PWS. Investigators of that project and this harbor seal study will coordinate to eliminate overlap in sample analysis. The intent is for the projects to concentrate in different areas/sites and therefore to augment the sample base for each project. For example project 064 will also emphasize samples from southcentral PWS, adding to the proposed Auke Bay work in the southwestern sound. We will analyze samples from Port Gravina in the northeastern sound, thereby extending Auke Bay's work in Port Fidalgo. Project 064 will also share some harbor samples with Auke Bay personnel for duplicate analysis. This will provide a basis through which to ensure that results of analyses conducted by different laboratories are the same and can therefore be compared and combined. This is especially important as fatty acids studies become more prevalent and are conducted by a variety of laboratories.

Harbor seal investigators are currently and will continue to participate in interactive discussions with subsistence hunters in PWS and the GOA the Alaska Native Harbor Seal Commission. These discussions include the ongoing harbor seal decline, communication of results of Restoration-funded studies, and suggestions for future research.

ADFG receives funding from NOAA to conduct complementary studies of harbor seals in the northern GOA and SEAK. This funding provides an "economy of scale" for many aspects of both studies. For example, disease and genetics analyses of PWS seals have been done at minimal or no cost to this study, but are instead provided through the NOAA-funded harbor seal study.

Equipment is shared and analytical techniques and software developed by one project can be used by the other.

EVALUATION OF CHANGES IN CONTINUING PROJECTS

Major changes proposed for this project in FY 98 and beyond include cessation of satellite-tagging of adult and older subadult seals and elimination of disease, genetics, and modeling components of the study (these types of investigations may be incorporated in the NOAA-funded harbor seal study). The major focus in FY 98 will be on addressing hypotheses related to food limitation and population trend. This focus will continue in the form of fatty acid analysis, analysis of historical fatty acid samples from Kodiak and SEAK, and satellite tagging of pups, with a considerable increase in effort devoted to data analysis. Annual molt-period surveys will continue. Survey analysis will include a Bayesian approach that should eliminate some problems with variance associated with so many count locations and the variety of covariates. There will be continued emphasis on working with subsistence hunters to evaluate the impact of subsistence hunting on the harbor seal population, and on sharing the harbor seal population model with the users.

PROPOSED PRINCIPAL INVESTIGATOR

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Table 1. Harbor seals instrumented with SDRs and sampled during 1992-1996.

Location	Date	SDRs AdM	SubM	AdF	SubF	DNA	Blood	Fat	Whiskers
Northern PWS									
Dutch Group/Lone I	May 95		1			5	5	5	5
Northeastern PWS									
Gravina Island	Sep 94		1			3	3	3	3
	Sep 95				2 (1 p)	2	2	2	2
Olsen Bay	May 95				1	2	2	2	2
	May 96					4	4	4	4
Central PWS									
Applegate Rocks	May 92		3	1			5		
	May 93	2				5	5		
	Sep 93					1	1		1
	Sep 95					2	2	2	2
	May 96				1	2	2	2	2
	Sep 96				1	3	3	3	3
Bay of Isles	Sep 93	1				1	1		1
Seal Island	May 92					1	3		
	May 93	3		1		7	7		
	Sep 93	2	1	1		10	10		10
	May 96		1			3	3	3	3
	Sep 96					4	4	4	4
Southcentral PWS									
Channel Island	Sep 93	1				3	3		3
	Sep 94	1	1		1	13	11	13	12
	May 95					6	6	6	6
	Sep 95					1	1	1	1
	May 96					1	1	1	1
	Sep 96		2	1	1	5	5	5	5
Green Island	Apr 94					1	1		1
Little Green Isl.	Apr 94					1	1	1	1
	Sep 95		1	1		9	9	9	9
	May 96				2	6	6	6	6
Chalmers/Stockdale	Apr 94					8	8	7	8
	Sep 94			3	1	10	10	10	10
	May 95	1		2	1	9	9	9	9
	Sep 95			2	1	6	6	6	6
	May 96			2		6	6	6	6
	Sep 96		1	1	1 (p)	5	5	5	5
	TOTAL	**11**	**12**	**15**	**13**	**145**	**150**	**115**	**131**

Table 2. Prince William Sound harbor seal trend count route.

Site #	Description	Status relative to EVOS
1	Sheep Bay	unoiled
2	Gravina Island	unoiled
3	Gravina Rocks	unoiled
4	Olsen Bay	unoiled
5	Porcupine Point	unoiled
6	Fairmount Island	unoiled
7	Payday	unoiled
8	Olsen Island	unoiled
9	Point Pellew	unoiled
10	Little Axel Lind Island	unoiled
11	Storey Island	oiled
12	Agnes Island	oiled
13	Little Smith Island	oiled
14	Big Smith Island	oiled
15	Seal Island	oiled
16	Applegate Rocks	oiled
17	Green Island	oiled
18	Channel Island	unoiled
19	Little Green Island	unoiled
20	Port Chalmers	unoiled
21	Stockdale Harbor	unoiled
22	Montague Point	unoiled
23	Rocky Bay	unoiled
24	Schooner Point	unoiled
25	Canoe Passage	unoiled

Table 3. Table of project activities for EVOS restoration project 064 by quarter, 1997-2000. Activities are designated as follows: F = field; L = lab; A = analysis; R = Report; X = other.

	Oct-Dec 96	Jan-Mar 97	Apr-Jun 97	Jul-Sep 97
FY 97: 1996-97 (97064)				
Satellite/VHF tag pups			F	F
Sample seals, pups and others (FAs)			F	F
Work on "user friendly" pop model			F	F
Aerial surveys during the molt period				F
Retrieve ARGOS SDR data				X X
	Oct-Dec 97	**Jan-Mar 98**	**Apr-Jun 98**	**Jul-Sep 98**
FY 98: 1997-98 (98064)				
Analyze 97 survey data	A			
Meet with HS Commission	X			
Distribute HS Update	X			X
Retrieve ARGOS SDR data	X X X			X X
Analyze fish distribution/seal diving	A A R			
Finish "user friendly" pop model	X X R			
Order SDRs for 1998 field season		X		
Attend Restoration Workshop		X		
Coordination ADFG NOAA	X			
Reserve ARGOS satellite channels		X		
Arrange logistics		X X X		
Analyze 97 seal/prey FA samples	L L L	L L L		
Fatty acids model development		A A A	A A A	A A A
Analyze SDR tag data	A A A	A A A	A A A	A A A
Prepare annual report and proposal		R R R		
Bayesian reanalysis of survey data			A	A A
Sample seals - pups and others(FAs)			F	F
Satellite tag pups				F
Aerial surveys during molt period				F
	Oct-Dec 98	**Jan-Mar 99**	**Apr-Jun 99**	**Jul-Sep 99**
FY 99: 1998-99 (99064)				
Analyze 98 survey data	A			
Meet with HS Commission	X			
Distribute HS Update	X			X
Retrieve ARGOS SDR data	X X X	X X X		
Attend EVOS workshop		X		
Arrange logistics		X X X		
Analyze 98 seal/prey FA samples	L L L	L L L		
FA model development	A A A	A A A		
Prepare annual report and proposal		R R R		
Analyze 98 SDR tag pup data			A A A	A A A
Sample seals - pups and others (FAs)			F	F F
Aerial surveys during molt period				F

Table 3. Continued.

	Oct-Dec 99			Jan-Mar 00			Apr-Jun 00			Jul-Sep 01		
FY 00: 1999-2000 (00064)												
Analyze 99 survey data	A											
Meet with HS Commission		X										
Distribute HS Update			X									X
Attend EVOS workshop				X								
Analyze 99 seal/prey FA samples	L	L	L	L	L	L						
Final trend analysis 1989-1999				A	A	A	A	A	A			
Final SDR tag data analysis				A	A	A	A	A	A			
Final fatty acid analysis and interpretation				A	A	A	A	A	A	A	A	A
Final report and manuscript preparation							R	R	R	R	R	R

Revised 12-9-97
Approved 12-18-97
(This adds to 150.0 interim funding.)

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Budget Category:	Authorized FFY 1997	Proposed FFY 1998
Personnel	$139.4	$24.2
Travel	$8.2	$5.1
Contractual	$83.9	$58.0
Commodities	$59.5	$27.5
Equipment	$0.0	$0.0
Subtotal	$291.0	$114.8
General Administration	$26.8	$7.7
Project Total	$317.8	$122.5
Full-time Equivalents (FTE)	1.8	0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FFY 1999	Estimated FFY2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003	
$265.0	$130.0				

Dollar amounts are shown in thousands of dollars.

Comments: This project is a more tightly refocused extension of harbor seal restoration studies funded by the Trustee Council in 1995-1997 as project 064. It will build upon previous research findings and incorporate new components to address high-priority issues regarding harbor seal recovery. The amount budgeted for FFY 98 (307.5) exceeds the amount originally projected for this study (150.0). This is because, per invitation by the Trustee Council, it includes expanded work on fatty acids in harbor seals and their prey.

None of the project funds are required for NEPA compliance. Permits to conduct this work are obtained from NOAA under terms of the Marine Mammal Protection Act at no extra cost to the project. Costs for workshop and conference attendance are identified under travel costs.

This project achieves major cost savings by collaborating with other studies and agencies to conduct this work. For example, ADF&G receives funds to conduct harbor seal studies in other parts of Alaska. This enables investigators to share costs for equipment, computers and software, as well as for developing new methodologies and approaches to data analysis. Costs for fatty acid model development will be shared by this and Scotian Shelf research projects. Fatty acid samples to be used by this study for comparisons between PWS and other geographic areas will be provided by other ADF&G harbor seal studies, and also by National Marine Mammal Lab/NOAA personnel. Analysis of samples for disease and genetics are funded by other contracts, but results are made available to this project.

Approved August 150.0
Approved December 122.5
FY98 TOTAL: 272.5

1998

Project Number: 98064
Project Title: Monitoring Habitat Use and Trophic Interactions of Harbor Seals in Prince William Sound
Agency: AK Dept. of Fish & Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

1998 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 1997 - September 30, 1998

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1998
11-2115	WBIII, Program Coordinator and Mngt	18K	1.5	6.5		9.8
11-2113	WBIII,Permits, Data Analysis&Interpretati	18L	1.5	6.9		10.4
Vacant	WBI, data analysis and graphics	14A	1.0	4.0		4.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		4.0	17.4	0.0	
					Personnel Total	$24.2

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1998
Fbks-Anchorage, tagging, 2 persons x 1 field trip	0.2	2	2	0.1	0.6
PWS-Anchorage 1-way charter, crew rotation	0.1	1	0	0.0	0.1
Portage-Whittier by train (2 vehicles per trip)	0.8	2	0	0.0	1.6
Fbks-Portage, personal vehicles	0.3	2	2	0.1	0.8
Halifax-Fairbanks, 1 person	1.5	1	5	0.1	2.0
				Travel Total	$5.1

1998

Project Number: 98064
Project Title: Monitoring Habitat Use and Trophic Interactions of Harbor Seals in Prince William Sound
Agency: AK Dept. of Fish & Game

FORM 3B
Personnel
& Travel
DETAIL

Prepared: 9-Dec-97 Add-on to base budget of $150,000

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

Contractual Costs:	Proposed
Description	FFY 1998
NOAA contract and ARGOS expenses for ARGOS satellite data, new FY 98 tags	4.0
Trailer parking & launch fees, Whittier	0.2
Aircraft charter 5 hrs @ $.23/hr (track VHF tags)	1.2
Vessel charter for tagging/sampling @ 1.7/day x 14 days	23.8
Lipid analysis contract with Dalhousie University	18.8
Rutgers RSA for Bayesian survey analysis	10.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$58.0

Commodities Costs:	Proposed
Description	FFY 1998
Fuel for boats and skiffs	1.0
VHF flipper tags, 10 @ $200	2.0
Biopsy punches, flipper tags, epoxy. tag supplies, film, net	1.0
Small boat supplies (propellers, oars, oil, etc.)	1.0
Laboratory supplies (D2O, cryovials, vacutainers, etc.)	1.0
Repair supplies for skiffs, net, etc.	1.0
5 satellite tags @ $4.1/unit (from Wildlife Computers)	20.5
Commodities Total	$27.5

1998

Project Number: 98064
Project Title: Monitoring Habitat Use and Trophic Interactions of Harbor Seals in Prince William Sound
Agency: AK Dept. of Fish & Game

FORM 3B
Contractual & Commodities
DETAIL

Prepared: 9-Dec-97 Add-on to base budget of $150,000

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

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1998
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
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
Equipment used by project, purchased with oil spill funds		
Leitz binoculars	1	ADF&G
HP LIID Printer	1	ADF&G
Compaq 286 Computer	1	ADF&G
Zodiac Raft	1	ADF&G
Equipment used by project, but purchased with non-oil spill funds		
20 ft Boston whaler	1	ADF&G
17 ft Boston whaler	1	ADF&G
Seal nets	1	ADF&G
2 486 computers + Plotter	1	ADF&G
Printer	2	ADF&G
Color printer	1	ADF&G

1998

Project Number: 98064
Project Title: Monitoring Habitat Use and Trophic Interactions of Harbor Seals in Prince William Sound
Agency: AK Dept. of Fish & Game

FORM 3B
Equipment
DETAIL

Prepared: 9-Dec-97 Add-on to base budget of $150,000

Revised 6[illegible]-97
Continuing objectives only
Approved TC 8-6-97

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

Budget Category:	Authorized FFY 1997	Proposed FFY 1998
Personnel	$139.4	$92.2
Travel	$8.2	$4.7
Contractual	$83.9	$34.9
Commodities	$59.5	$1.9
Equipment	$0.0	$0.0
Subtotal	$291.0	$133.7
General Administration	$26.8	$16.3
Project Total	$317.8	$150.0
Full-time Equivalents (FTE)	1.8	1.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FFY 1999	Estimated FFY2000	Estimated FFY 2001	Estimated FFY 2002	Estimated FFY 2003	
$60.0					

Dollar amounts are shown in thousands of dollars.

Comments: This project is a continuation of harbor seal restoration studies funded by the Trustee Council in 1995-1997 as project 064. It will build upon previous research findings and focus on data analysis to address high-priority issues regarding harbor seal recovery.

None of the project funds are required for NEPA compliance. Permits to conduct this work are obtained from NOAA under terms of the Marine Mammal Protection Act at no extra cost to the project. Costs for workshop and conference attendance are identified under travel costs.

This project achieves major cost savings by collaborating with other studies and agencies to conduct this work. For example, ADF&G receives funds to conduct harbor seal studies in other parts of Alaska. This enables investigators to share costs for equipment, computers and software, as well as for developing new methodologies and approaches to data analysis. Costs for fatty acid model development will be shared by this and Scotian Shelf research projects. Fatty acid samples to be used by this study for comparisons between PWS and other geographic areas will be provided by other ADF&G harbor seal studies, and also by National Marine Mammal Lab/NOAA personnel. Analysis of samples for disease and genetics are funded by other contracts, but results are made available to this project.

1998

Project Number: 98064
Project Title: Monitoring Habitat Use and Trophic Interactions of Harbor Seals in Prince William Sound
Agency: AK Dept. of Fish & Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared: 20-Jun-97

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

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FFY 1998
11-2115	WBIII, Program Coordinator and Mngt	18K	7.0	6.5		45.5
11-2113	WBIII,Permits, Data Analysis&Interpretati	18L	2.5	6.9		17.3
11-2137	Analyst Programmer III - GIS programmin	17E	1.0	5.7		5.7
11-2206	Biometrician II - survey statistical analysis	19E	1.0	6.4		6.4
Vacant	WBI, data analysis and graphics	14A	3.0	4.0		12.0
11-2229	Biometrician II - sat tag statistical analysis	19A	1.0	5.3		5.3
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		15.5	34.8	0.0	
					Personnel Total	$92.2

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FFY 1998
Fbks-Anchorage, Harbor Seal Commission, 1 person	0.2	2	2	0.1	0.6
Fbks-Anchorage, annual workshop, 1 person	0.2	1	5	0.1	0.7
Fbks-Anchorage, workshop no advance, 1 person	0.3	1	3	0.1	0.6
Fbks-Anchorage, coordination committee, 1 person	0.2	2	2	0.1	0.6
Fbks-Cordova for Aug surveys, 1 person	0.5	1	12	0.1	1.7
Rental car, Cordova					0.5
				Travel Total	$4.7

1998

Project Number: 98064
Project Title: Monitoring Habitat Use and Trophic Interactions of Harbor Seals in Prince William Sound
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FORM 3B
Personnel
& Travel
DETAIL

Prepared: 20-Jun-97

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

Contractual Costs:	Proposed
Description	FFY 1998
NOAA contract and ARGOS expenses for ARGOS satellite data, old FY 97 tags	4.0
Print/graphics (slides for workshops, report production)	0.3
Long distance phone calls	0.4
Postage (DHL, courier, etc.)	0.3
Aircraft charter 30 hrs @ $.23/hr (1 survey during fall molt)	6.9
Freight and shipping of samples	1.0
Lipid analysis contract with Dalhousie University	22.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$34.9

Commodities Costs:	Proposed
Description	FFY 1998
Misc. field and office supplies (film, notebooks, bindings, etc.)	0.3
Computer supplies and software for graphics, GIS, and other analyses	1.6
Commodities Total	$1.9

1998

Project Number: 98064
Project Title: Monitoring Habitat Use and Trophic Interactions of Harbor Seals in Prince William Sound
Agency: AK Dept. of Fish & Game

FORM 3B
Contractual & Commodities DETAIL

Prepared: 20-Jun-97

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 1998
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.	**New Equipment Total**		$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Equipment used by project, purchased with oil spill funds		
Leitz binoculars	1	ADF&G
HP LIID Printer	1	ADF&G
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1998

Project Number: 98064
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FORM 3B
Equipment
DETAIL

Prepared: 20-Jun-97