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Exxon Valdez Oil Spill Trustee Council

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MEMORANDUM

TO: Restoration Work Force

FROM: Sandra ~~S.~~ Schubert

RE: Binders of FY 01 DPDs and Budgets

DATE: January 22, 2001

Attached are Detailed Project Descriptions and budgets for deferred projects approved by the Trustee Council in December 2000 and January 2001. These should be added to the FY 01 binders that you were provided back in August. Please note that the attached DPD and budget for Project 01630 supersede those distributed in August.

FOR OFFICAL RECORD

FY 01 WORK PLAN: Index of DPDs & Budgets Approved 8/3/00, 12/5/00 & 1/16/01

Proj.No.	Project Title
01012-BAA	Photographic and Acoustic Monitoring of Killer Whales in Prince William Sound and Kenai Fjords
01052	Community Involvement Planning for GEM
01064-CLO	Monitoring, Habitat Use, and Trophic Interactions of Harbor Seals in Prince William Sound
01100	Public Information, Science Management, and Administration
01126	Habitat Protection and Acquisition Support
01131	Chugach Native Region Clam Restoration
01144	Common Murre Population Monitoring
01154	Archaeological Repository, Display Facilities, and Exhibits for Prince William Sound and Lower Cook Inlet
01159	Surveys to Monitor Marine Bird Abundance in Prince William Sound During Winter and Summer
01163-CLO	Alaska Predator Ecosystem Experiment in Prince William Sound and the Gulf of Alaska (APEX)
01190	Construction of a Linkage Map for the Pink Salmon Genome
01195	Pristane Monitoring in Mussels
01210	Youth Area Watch
01245	Community-Based Harbor Seal Management and Biological Sampling
01247	Kametolook River Coho Salmon Subsistence Project
01250	Project Management
01256B	Sockeye Salmon Stocking at Solf Lake
01273-CLO	Scoter Life History and Ecology: Linking Satellite Technology with Traditional Knowledge to Conserve the Resource
01290	Hydrocarbon Database and Interpretation Service
01327-CLO	Pigeon Guillemot Restoration Research at the Alaska SeaLife Center
01338	Survival of Adult Murres and Kittiwakes in Relation to Forage Fish Abundance
01340	Toward Long-Term Oceanographic Monitoring of the Gulf of Alaska Ecosystem
01341-CLO	Harbor Seal Recovery: Controlled Studies of Health and Diet
01360-BAA	The *Exxon Valdez* Oil Spill: Guidance for Future Research Activities
01366-CLO	Improved Salmon Escapement Enumeration Using Remote Video and Time-Lapse Recording Technology
01371-CLO	Effects of Harbor Seal Metabolism on Stable Isotope Ratio Tracers
01385	Partnering with NOAA to Quantify and Monitor Environmental Attributes of Kachemak Bay
01389	3-D Ocean State Simulations for Ecosystem Applications from 1995-98 in Prince William Sound
01391	Cook Inlet Information Management/Monitoring System (CIIMMS)
01393-BAA	Prince William Sound Food Webs: Structure and Change
01396	Alaska Salmon Shark Assessment
01401	Assessment of Spot Shrimp Abundance in Prince William Sound

FY 01 WORK PLAN: Index of DPDs & Budgets Approved 8/3/00, 12/5/00 & 1/16/01

Proj.No.	Project Title
01404	Testing Archival Tag Technology in Alaska Salmon
01407	Harlequin Duck Population Dynamics
01423	Patterns and Processes of Population Change in Selected Nearshore Vertebrate Predators
01424	Restoration Reserve
01441-CLO	Harbor Seal Recovery: Effects of Diet on Lipid Metabolism and Health
01452-BAA	Assessing Prey and Competitor/ Predators of Pink Salmon Fry
01454-CLO	Evidence and Consequences of Persistent Oil Contamination in Pink Salmon Natal Habitats
01455	Gulf Ecosystem Monitoring and Research Program Data System
01462-CLO	Effect of Disease on Pacific Herring Population Recovery in Prince William Sound
01468-CLO	FEATS: Fundamental Estimations of Acoustic Target Strength
01476	Effects of Oiled Incubation Substrate on Pink Salmon Reproduction
01478	Testing Satellite Tags as a Tool for Identifying Critical Habitat
01479	Effects of Food Stress on Survival and Reproductive Performance of Seabirds
01481	Documentary Film on the Oil Spill Impacts on Subsistence Use of Intertidal Resources
01492	Were Pink Salmon Embryo Studies in Prince William Sound Biased?
01513	*Exxon Valdez* Oil Spill Exhibit: The Continuing Legacy
01534	Comparison of Cytochrome P4501A Induction in Blood and Liver Cells of Sea Otters
01535	EVOS Trustee Council Restoration Program Final Report
01538	Evaluation of Two Methods to Discriminate Pacific Herring Stocks along the Northern Gulf of Alaska
01543	Evaluation of Oil Remaining in the Intertidal from the *Exxon Valdez* Oil Spill
01550	Alaska Resources Library and Information Services
01551-BAA	Checklist and Distributional Analysis of Marine Algal Species Collected as Vouchers Under Project CH1A
01552-BAA	Exchange Between Prince William Sound and the Gulf of Alaska
01555	Can Stress Hormones be Used as an Indication of Food Availability and Reproductive Performance? An Experimental Approach
01558	Harbor Seal Recovery: Application of New Technologies for Monitoring Health
01599-CLO	Evaluation of Yakataga Oil Seeps as Regional Background Hydrocarbon Sources in Benthic Sediments of the Spill Area
01610	Kodiak Archipelago Youth Area Watch
01630	Planning for Long-Term Monitoring and Research Program

approved TC 12-5-0

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

Project Number:	01064-CLO
Restoration Category:	Monitoring
Proposer:	K. Frost, ADFG
Lead Trustee Agency:	ADFG
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	Cont'd
Duration:	7th yr. 7 yr. project
Cost FY 01:	$22.6
Cost FY 02:	$0.0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Harbor seals

ABSTRACT

This project will fund an additional year of data analysis and manuscript preparation for this multi-year study of harbor seals in Prince William Sound. FY 00 was to be the closeout year for this project. However, at the end of FY 00 some data will remain unanalyzed and unpublished. FY 01 funding will cover analysis and final write-up of (a) August 2000 harbor seal aerial surveys, (b) a comparison of 2000 counts with previous years (i.e., an updated analysis of population trend), (c) 1999 seal pup tagging data, and (d) integration of 1999 pup tagging data with other years and a synoptic analysis of movements and diving behavior of harbor seal pups in Prince William Sound.

INTRODUCTION

Harbor seals (*Phoca vitulina richardsi*) were one of the wildlife resources damaged by the March 1989 Exxon Valdez oil spill (EVOS) (Frost et al. 1994, Lowry et al. 1994, Spraker et al. 1994). The number of harbor seals in central and eastern Prince William Sound (PWS) was declining before the spill (Frost et al. 1994) and has continued to decline ever since, with an overall reduction in population size of 57% during 1984-1998 (Frost et al. 1999a).

Harbor seal studies began almost immediately after the spill as part of the Natural Resources Damage Assessment (NRDA) program. NRDA studies were conducted by the Alaska Department of Fish and Game (ADF&G), and included aerial surveys to quantify mortality and necropsies to document levels of hydrocarbons and tissue damage in oiled seals. Beginning in 1991 as NRDA studies neared completion, the EVOS Trustee Council funded a harbor seal Restoration Science Study in which ADF&G continued to monitor the trend of harbor seals in PWS and began a research program to investigate the causes of the ongoing population decline. Initially the harbor seal restoration study addressed a broad array of possible causes for the decline including disease, predation, human-caused mortality, reproduction, and food limitation (Frost et al. 1995, 1996).

Investigations conducted in PWS as part of Restoration Study 064 indicate that disease, poor pup production, or emigration are unlikely as causes for the decline. Population modeling studies have suggested that poor survival of juvenile seals was a likely factor, and that the carrying capacity for harbor seals in PWS may have declined (Frost et al. 1996). Consequently, the focus of investigations shifted to studies of harbor seal feeding ecology (Frost et al. 1997, 1998, 1999a). During 1994-1996 we addressed this question relative to adult and subadult segments of the population, and in 1997-1999 for pups and yearlings. Major components of this study have included tagging with satellite-linked depth recorders to study movements and diving behavior, and the determination of diets based on analysis of fatty acid signatures in harbor seal blubber and in their potential prey. Most recently studies have included use of isotope dilution to measure the body fat composition of animals. These analyses indicate substantial geographic, interannual, age, and gender related differences in harbor seal movement patterns, diversity and species composition of diets, and body composition.

FY 2000 has been a close-out year for project 064. The final field season for tagging and sampling harbor seal pups and yearlings was conducted in June-July 1999. Satellite transmitters were attached to seven harbor seal pups at that time. Aerial surveys were conducted in August 1999. Final analysis of blubber and prey fatty acids was completed, as well as deuterium oxide equilibration experiments to determine body composition of PWS harbor seals pups and yearlings. Major effort has been expended on final analysis of movements and diving data for harbor seal adults and subadults tagged in 1992-1996. However, not all of the final analysis will be complete by project termination in September 2000.

We anticipate that the following papers and manuscripts will have been published or submitted for publication by the end of the current FY 00 fiscal year:

1) Frost, K. F, Lowry, L. F., and Ver Hoef, J. M. 1999. Monitoring trends of harbor seals in Prince William Sound, Alaska, after the *Exxon Valdez* oil spill. Marine Mammal Science 15(2): 494-506.

2) Frost, K. J., Simpkins, M. A., and Lowry L. F. Diving behavior of harbor seals in Prince William Sound, Alaska, 1992-1996. *Marine Mammal Science.* (to be submitted early May 2000)
3) Iverson, S. J., Field, C., Bowen, W. D., and Blanchard, W. Quantitative fatty acid signature analysis: statistical modeling of marine mammal diets from fat stores. *Ecology.*
4) Iverson, S. J., Frost, K. J., and Lang, S. Fat and fatty acid composition of fish species in Prince William Sound, Alaska: variation with species, habitat and diet. *Canadian Journal of Fisheries and Aquatic Sciences.*
5) Iverson, S. J., Frost, K. J., and Burns, J. M. Links between diet and energy storage in juvenile harbor seals in Prince William Sound, Alaska. *Journal of Animal Ecology.*
6) Lowry, L. F., Frost, K. J., Ver Hoef, J. M., and DeLong, R. Movements of satellite-tagged harbor seals in Prince William Sound, Alaska, 1992-1997. *Marine Mammal Science.* (to be submitted early May 2000)
7) Ver Hoef, J. M., and Frost, K. J. Bayesian hierarchical models for estimating harbor seal trends in Prince William Sound, Alaska. *(Journal to be determined)*

Proposed work in 2001. During FY 2001 we propose to conclude final write-up and manuscript preparation for aspects of study 064 that could not be completed prior to September 2000. This will include the following: analysis and write-up of aerial surveys conducted in August 2000; an updated trend analysis for PWS harbor seals for 1989-2000; analysis of 1999 seal pup tagging data (some tags are still transmitting as of April 2000); integration of 1999 pup tagging data with other years for a synoptic analysis of movements and diving behavior of harbor seal pups in PWS.

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 the estimated total population in oiled areas) were estimated to have died in PWS due to the spill (Frost et al 1994).

During 1990-1998, harbor seal numbers in the trend count area of PWS continued to decline at an average rate of about 2.4% per year. There were 18% fewer seals in 1998 than in 1990, and 57% fewer than in 1984 (Frost et al. 1999a). It appears that the decline has slowed in recent years and the PWS harbor seal population may be starting to stabilize, but future surveys will be required to confirm that.

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, the annual harvest at those two villages was less than half of what it was before the spill. Native residents have noted the scarcity of seals and the impact that 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. The National Marine Fisheries Service is currently conducting a Population Viability Analysis for harbor seals in Alaska. This analysis will be used to determine whether harbor seals have declined to such a degree that they should be listed as depleted under the MMPA, or threatened/endangered under the Endangered Species Act.

Aerial surveys have documented the downward trend in PWS harbor seal abundance and have provided the information needed to determine whether the recovery objective of "stable or increasing population trend" has been met in the spill area. However, they are not adequate for determining what is causing the seal population to decline, or whether it is realistic to expect the population to increase given existing carrying capacity in PWS.

The Restoration Program has funded a strong field research program to test hypotheses about the health, condition, and foraging behavior of harbor seal adults and sub-adults within PWS. In recent years, attention has been focused more on the youngest age classes within the population, pups and yearlings. This attention is warranted because survival rates of juveniles are significantly lower than for older animals, and recruitment of juveniles is critical for population recovery. It is essential that these data are completely analyzed and published in the peer-reviewed literature.

C. Location

This project entails no field work. It will be conducted out of the ADF&G office in Fairbanks.

COMMUNITY INVOLVEMENT

Information will be presented at the 2001 oil spill symposia, where the general public may learn about results of this study.

PROJECT DESIGN

A. Objectives

1. Analyze data from August 2000 aerial surveys of the PWS trend count route, prepare a final analysis of PWS trend count data since 1989, and prepare a manuscript for publication.

2. Conduct final analysis of data from seven harbor seal pups that were satellite tagged in June-July 1999, integrate tagging data from 1999 seal pups with data from previous years, and prepare data for publication in the peer-reviewed literature.

3. Prepare manuscript on spatial and temporal scales of diet and foraging patterns of PWS harbor seals based on fatty acids signature analysis.

B. Methods

Data will be analyzed and manuscripts prepared by the investigators who were primarily responsible for the research. Responsibilities will be as follows: a) aerial surveys – Frost and Ver Hoef; b) movements and hauling out behavior – Lowry; c) diving behavior – Frost; d) fatty acids analysis – Iverson and Frost.

C. Contracts and Other Agency Assistance

Fatty acid and D_2O analyses, interpretation and manuscript preparation will be done by Dr. Sara Iverson at Dalhousie University under an existing Cooperative Agreement between ADF&G and Dalhousie. Dr. Iverson has conducted all previous fatty acid signature analyses and body composition work for PWS harbor seal studies.

Lloyd Lowry at the University of Alaska Fairbanks will conduct final analysis and manuscript preparation for data regarding movements and hauling out behavior of harbor seal pups through a Reimbursable Services Agreement with UAF. Mr. Lowry has analyzed all previous PWS tagging data and has been involved in the project since its inception..

SCHEDULE

A. Measurable Project Tasks for FY 00 (October 1, 2000 - September 30, 2001)

FY 01: October 1, 2000- September 30, 2001

October – December:	Analysis of aerial survey data
October – December	Preparation of manuscript on spatial and temporal scales of foraging of PWS harbor seals
October-December	Analysis of 1999 satellite tag data for PWS harbor seal pups, and preparation of manuscript on movements and hauling out behavior.
January (3-4 days)	Attend Annual Restoration Workshop
January – March	Preparation of manuscript about harbor seal trends in PWS
January – March	Preparation of manuscript on diving behavior of PWS harbor seal pups.

B. Project Milestones and Endpoints

December 2000:	Submit manuscript on spatial and temporal scaled of foraging of PWS harbor seals
December 2000:	Submit manuscript on movements and hauling out behavior of PWS harbor seal pups
March 2001:	Submit manuscript on recent harbor seals trends in PWS
March 2001:	Submit manuscript on diving behavior of PWS harbor seal pups.

C. Completion Date

This project will include one fiscal year, FY 01, and will be completed by September 30, 2001.

PUBLICATIONS AND REPORTS

1) Iverson, S. J., Frost, K. J. and Lowry, L. F. Spatial and temporal scales of diet and foraging patterns of harbor seals in Prince William Sound, Alaska. *Ecological Applications.* (This may be split into two manuscripts.)

2) Frost, K. F, Lowry, L. F., and Ver Hoef, J. M. Trends in harbor seal abundance in Prince William Sound, Alaska, based on molting-period counts during 1984-2000. *Marine Mammal Science.*

3) Lowry, L. F., Frost, K. J., and Ver Hoef, J. M. Movements of satellite-tagged harbor seal pups in Prince William Sound, Alaska, 1997-2000. *Marine Mammal Science.*

4) Frost, K. J., Simpkins, M. A., and Lowry L. F. Diving behavior of harbor seal pups in Prince William Sound, Alaska, 1997-2000. *Marine Mammal Science.*

PROFESSIONAL CONFERENCES

None anticipated in 2000-2001

NORMAL AGENCY MANAGEMENT

This project is funded entirely by the Trustee Council as a restoration project. ADF&G has no management responsibility for harbor seals. ADF&G 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.

ADF&G is conducting studies of harbor seals in southeast Alaska 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. It is anticipated that joint publications will be prepared comparing various aspects of harbor seal behavior in PWS and other parts of Alaska.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

ADF&G receives funding from NOAA to conduct complementary studies of harbor seals in the northern GOA and southeast AK. Results of those studies and PWS studies are compared, and in the future will be included in joint, comparative publications.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

This project is a follow-up to Project 064, which will allow final analysis and reporting of data collected too late in the year to be completed by September 30, 2000. This includes data from

August 2000 aerial surveys and from satellite tags attached to pups in June/July 1999 that were still transmitting in late spring 2000.

PROPOSED PRINCIPAL INVESTIGATOR

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PERSONNEL QUALIFICATIONS

Kathryn Frost (the principal investigator) has conducted research on marine mammals in Alaska since 1975. She has undertaken extensive research on natural history and ecology of seals, including aerial surveys; studies of food habits and trophic interactions; and studies of habitat use using satellite tags. She has conducted extensive aerial surveys of harbor seals in PWS and boat-based observations and sampling of harbor seals as part of NRDA studies following the EVOS. She has conducted satellite tagging studies of harbor seals in PWS from 1991 through 1999.

Lloyd Lowry is an Affiliate Associate Professor of Marine Science at the School of Fisheries and Ocean Sciences, University of Alaska Fairbanks. He has conducted research on marine mammals in Alaska since 1975, including studies of the natural history, ecology, distribution, abundance, and food habits of seals. He has participated in all NRDA and Restoration studies on harbor seals, including the development of methods to catch and attach satellite tags to harbor seals. He has been responsible for project coordination and management of state and federally funded research projects, and is familiar with the federal marine mammal permit system.

Dr. Sara Iverson is an Assistant Professor at the University of Dalhousie. She is currently conducting research at Sable Island, Nova Scotia, on the lipid metabolism of seals and the use of fatty acids to determine marine food webs. She received her Ph.D. in nutritional sciences, conducting studies of the energetics of reproduction and fatty acid metabolism in seals. She developed procedures for analysis of lipids in milk, blubber and tissues of pinnipeds. Dr. Iverson has published extensively on those subjects.

Dr. Jay Ver Hoef is a Biometrician for ADF&G. He has been responsible for statistical analysis of all harbor seal data during NRDA and Restoration studies. He has participated in field work in PWS and is familiar with seal catching and tagging techniques.

KEY PERSONNEL

Kathryn Frost:	Project management and coordination, data analysis, reporting
Lloyd Lowry:	Data analysis and reporting
Jay Ver Hoef:	Statistical analysis of data, reporting
Sara Iverson:	Fatty acid and body composition analysis, interpretation and reporting

LITERATURE CITED

Frost, K. J., L. F. Lowry, E. Sinclair, J. Ver Hoef, and D. C. McAllister. 1994. Impacts on distribution, abundance, and productivity of harbor seals. Pages 97-118 *in*: T. R. Loughlin (ed.). Marine Mammals and the *Exxon Valdez*. Academic Press, San Diego, CA.

Frost, K. F., L. F. Lowry, and J. Ver Hoef. 1995. Habitat use, behavior, and monitoring of harbor seals in Prince William Sound, Alaska. Ann. Rep. to the EVOS Trustee Council. Restoration Study No. 94064 and 94320-F. 88 pp.

Frost, K. F., L. F. Lowry, R. J. Small, and S. J. Iverson. 1996. Monitoring, habitat use, and trophic interactions of harbor seals in Prince William Sound, Alaska. Ann. Rep. to the EVOS Trustee Council. Restoration Study No. 95064. 133 pp.

Frost, K. F., L. F. Lowry, J. M. Ver Hoef, and S. J. Iverson. 1997. Monitoring, habitat use, and trophic interactions of harbor seals in Prince William Sound, Alaska. Ann. Rep. to the EVOS Trustee Council. Restoration Study No. 96064. 115 pp.

Frost, K. F., L. F. Lowry, J. M. Ver Hoef, S. J. Iverson, and T. Gotthardt. 1998. Monitoring, habitat use, and trophic interactions of harbor seals in Prince William Sound, Alaska. Ann. Rep. to the EVOS Trustee Council. Restoration Study No. 97064. 148 pp.

Frost, K. F., L. F. Lowry, J. M. Ver Hoef, and S. J. Iverson. 1999a. Monitoring, habitat use, and trophic interactions of harbor seals in Prince William Sound, Alaska. Ann. Rep. to the EVOS Trustee Council. Restoration Study No. 98064. 145 pp.

Frost, K. J., L. F. Lowry, and J. Ver Hoef. 1999b. Monitoring the trend of harbor seals in Prince William Sound, Alaska after the *Exxon Valdez* oil spill. Marine Mammal Science 15(2): 494-506.

Iverson, S. J., K. J. Frost, and L. F. Lowry. 1997. Fatty acids signatures reveal fine scale structure of foraging distribution of harbor seals and their prey in Prince William Sound, Alaska. Mar. Ecol. Prog. Series 151:255-271.

Lowry, L. F., K. J. Frost, and K. W. Pitcher. 1994b. Observations of oiling of harbor seals in Prince William Sound. Pages 209-225 *in*: T. R. Loughlin (ed.). Marine Mammals and the *Exxon Valdez*. Academic Press, San Diego, CA.

Spraker, T. R., L. F. Lowry, and K. J. Frost. 1994. Gross necropsy and histopathological lesions found in harbor seals. Pages 281-311 *in*: T. R. Loughlin (ed.). Marine Mammals and the *Exxon Valdez*. Academic Press, San Diego, CA.

Ver Hoef, J. M., and K. J. Frost. 1999. Bayesian hierarchical models for estimating harbor seal trends in Prince William Sound, Alaska. Pages 104-125 *in*: Monitoring, habitat use, and trophic interactions of harbor seals in Prince William Sound, Alaska. Ann. Rep. to the EVOS Trustee Council. Restoration Study No. 98064. ADF&G, Fairbanks, AK.

Revision 9-11-00
Approved TC 12-5-00

APEX: Alaska Predator Ecosystem Experiment in Prince William Sound and the Gulf of Alaska

Project Number:	01163 A-T
Restoration Category:	Research
Proposer:	David Cameron Duffy, Project Leader, Paumanok Solutions.
Cooperating Agencies:	DOI, ADF&G, NOAA
Alaska SeaLife Center:	no
Duration:	Penultimate year of writing up of five-year project
Cost FY 01:	$199.6 K
Cost FY 02:	$ 100.0 K
Cost FY 03:	$ 20.0 K
Geographic Area:	Prince William Sound, Cook Inlet, Northern Gulf of Alaska
Injured Resource/Service:	Common Murre, Marbled Murrelet, Pacific Herring, Pigeon Guillemot.

ABSTRACT

This study uses seabirds as probes of the trophic (foraging) environment of Prince William Sound and Cook Inlet, comparing their reproductive and foraging biologies, including diet. These measurements are compared with hydroacoustic, aerial, and net sampling of fish to calibrate seabird performance with fish distribution and abundance. This will allow us to determine the extent to which food limits the recover of seabirds from the *Exxon Valdez* oil spill. We use historical data from a variety of sources to detect shifts in forage fish abundance and to test hypotheses explaining such shifts. This year represents production and publication of APEX results as scientific papers.

INTRODUCTION

The spill from the oil tanker *Exxon Valdez* resulted in significant mortality of several seabirds and in massive acute damage to Prince William Sound (PWS) and the Gulf of Alaska (GOA) (Piatt *et al.* 1990). A decade following the spill, several species have not recovered . This may be the result of lingering effects of the oil spill (toxicity of prey or sublethal effects of oil exposure to organisms). Other non-oil factors may also be involved, such as predation, climate-driven ecosystem changes, or even 'random' perturbations.

Both to aid in the recovery of injured resources and to safeguard the long-term health of Prince William Sound and the upper Gulf of Alaska, we need to understand the ecological processes that control the ecosystem. This project focuses on the trophic interactions of seabirds and the forage species they feed on. We chose food as the focus because: 1) much of seabird population theory and several empirical field tests have identified food as an important limiting factor (Ashmole 1963; Cairns 1989; Birt *et al.* 1987; Furness and Birkhead 1984); 2) seabird/fish researchers in the PWS/GOA complex have concluded that major changes in food have occurred during the period (Springer 1993; Anderson *et al.* 1994; Piatt and Anderson 1995); 3) other factors such as oil toxicity and climate change might express themselves through the food supply; and 4) knowledge of the forage prey base is critical for other apex predators, such as marine mammals and predatory fish (Pitcher 1980, 1981; Lowry *et al.* 1989), as well as for any larger effort to manage the marine resources of Prince William Sound, Cook Inlet and the Gulf of Alaska in a sustainable manner.

We studied the distribution and abundance of prey species through acoustic, aerial, and net sampling in relation to environmental conditions. Combined with historical analyses, this helped test hypotheses concerning the physical, behavioral and competitive factors that limit access to these forage species for seabirds. We examined the reproductive consequences of such limitations for pigeon guillemots (*Cepphus columba*), black-legged kittiwakes (*Rissa tridactyla*), tufted puffins (*Fratercula cirrhata*), common murres (*Uria aalge*) and cormorants (*Phalacrocorax* spp.).

By examining the diet and reproductive consequences for a surface-feeder (kittiwake), a benthic diver (pigeon guillemot), and two pelagic divers (puffin and murre), we built up a picture of the forage base for the entire seabird community, setting the stage for a long-term, low-cost monitoring program.

NEED FOR THE PROJECT

A. Statement of Problem

Numerous seabird species have declined between surveys in the 1970s and the 1990s in Prince William Sound: cormorants, kittiwake, glaucous-winged gull (*Larus glaucescens*), Arctic tern (*Sterna paradisaea*), Kittlitz's and marbled murrelets (*Brachyramphus brevirostris* and *B. marmoratus*), tufted and horned (*F. corniculata*) puffins, and pigeon guillemot (Agler *et al.* 1994 a,b; Klosiewski and Laing 1994). Colony trends for kittiwakes in Prince William Sound have been inconsistent, with colonies decreasing in the south and increasing in the north (Irons unpubl. data). The population of pigeon guillemots in PWS has decreased from about 15,000 in the 1970's to about 3,000 in 1993 (Isleib and Kessel 1973; Oakley and Kuletz 1996). Based on censuses taken around the Naked Island complex, pre-spill counts were roughly twice as high as post-spill counts (Oakley and Kuletz 1993). Pigeon guillemots are listed as "Not recovering" in the *Exxon Valdez* Oil Spill Restoration Plan.

Common murres were among the species most damaged by the oil spill (Piatt et al. 1990), but most of the oiled birds nested outside PWS. Murres were also listed as "Not recovering" in the 1994 Exxon Valdez Oil Spill Restoration Plan, but have since been upgraded to "recovering" because productivity has been normal since 1993 (Roseneau *et al.* 1995, 1996). Marbled Murrelets are also listed as Recovering.

The best evidence for a shift in trophic resources for seabirds within Prince William Sound comes from pigeon guillemots. No long-term diet data sets exist for other species or, like black-legged kittiwakes, diet exhibits great year to year variability. In 1994, sand lance (*Ammodytes hexapterus*) accounted for only about 1% of prey items fed to guillemot chicks at Jackpot Island and about 8% at Naked Island ; in contrast, in 1979 the sand lance component at Naked Island was about 55% (Kuletz 1983; Oakley and Kuletz 1993). Gadids were much more prevalent in the diet of guillemot chicks on Naked Island in 1994 (ca. 30%) than they were in 1979-1981 (< 7%) (Kuletz 1983).

Pre-spill studies of pigeon guillemots breeding at Naked Island suggest that sand lance were preferred prey during chick-rearing (Kuletz 1983). Breeding pairs that specialize on sand lance tended to initiate nesting attempts earlier and produce chicks that grew faster and fledged at higher weights than did breeding pairs that preyed mostly upon blennies and sculpins, at least in years when sand lance were readily available. Consequently, the overall productivity of the guillemot population was higher when sand lance were available.

The decline in the prevalence of sand lance in the diet of guillemots breeding at Naked Island might be a key element in the failure of this species to recover from the oil spill. The schooling behavior of sand lance, coupled with their high lipid content relative to that of gadids and nearshore bottom fish, might make this species a particularly high-quality forage resource for PWS pigeon guillemots. This is consistent with the observation that other seabird species (e.g., puffins, murres, kittiwakes) experience enhanced reproductive success when sand lance are available (Pearson 1968; Harris and Hislop 1978; Vermeer 1979, 1980; Monaghan et al. 1993).

Major oceanographic shifts seen in the northern Gulf of Alaska and North Pacific (Springer 1993; Piatt and Anderson 1995) may have favored pollock (*Theragra chalcogramma*), also an important seabird food (Springer and Byrd 1989) which has become one of the most abundant forage fish species currently available to seabirds (Parks and Zenger 1979; Brodeur and Merati 1993). Pollock may be an important competitor or predator of other forage fish species and may have suppressed populations of these species. Similarly, other species pairs may overlap in diet, such as herring and sand lance (McGurk and Warburton 1992) or pink salmon (*Oncorhynchus gorbuscha*) and sand lance (Sturtevant 1995), raising the possibility that reductions in the trophic role of one species may "release" others from competition for food.

B. Rationale/Link to Restoration

Both scientific theory and common sense suggest that ecosystems change over time and that changes to one species or other component of the ecosystem may reverberate through the entire ecosystem (Pimm 1984; Wolfe and Kjerfve 1986). Such changes have occurred in the North Pacific and Gulf of Alaska (Hatch et al. 1993; Springer 1993; Piatt and Anderson 1995). Climate variations, fishing, or an oil spill may trigger changes that can take years to become apparent (Duffy 1993). Similarly, restoration efforts following the *Exxon Valdez* oil spill might increase injured species that are predators or competitors of other injured species, preventing their recovery several years after oil was removed as an immediate cause. By studying only the species level, we may miss such effects. An ecosystem approach, such as the APEX study of the upper-trophic level predators of Prince William Sound, is designed to look for such indirect links and to improve our understanding of the ecological context lacking from single-species work (Wheelwright 1994).

In conjunction with the former Sound Ecology Assessment and Nearshore Vertebrate Predators projects, ecosystem projects funded by the Exxon Valdez Oil Spill Trustee Council, APEX attempted to give us a basic understanding of the ecological processes that may affect future changes in upper trophic levels that may in turn affect restoration efforts and also helps us to determine when we have finally restored a sustainable and healthy marine environment in the oil spill area.

C. Location

The project will use office-based locations for writing.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

None in this phase which draws only upon existing data and reports.

PROJECT DESIGN

A. Objectives

This fiscal year (FY 01) will be spent producing basic summary review papers on the results of APEX projects. FY 02 will see the production of a synthesis, based on the analysis from FY 00 – 01. FY 03 will see the production of a semipopular account of the APEX project.

B. Methods

FY 01
After discussions with project leaders, we selected certain projects for further funding, to produce terminal scientific publications, based on their annual reports and further analysis in FY 01. Different subprojects took very different approaches to producing these summary scientific papers. Some involve single projects, others involve multiple project "coalitions". Some projects are producing single, major papers containing their main results; others have broken their efforts into smaller units or have chosen to publish about separate aspects of their projects as individual papers. While there is some overlap, such cases involve a different focus or point of view. We will try to ensure that separate papers do not converge during preparation. In some cases, we may encourage copublication of complementary efforts, but there will be no sign common publication for the papers here.

The following papers are expected to result from FY 01 support. Subprojects are indicated below the list.

FISH
Long-term changes in Northern Gulf of Alaska forage fish. Anderson, Blackburn, Piatt *et al.* (Subproject L)

Dynamic structure and composition of marine fish communities in a large estuarine ecosystem. Robards, Abookire, Speckman *et al.* (nonparametric examination of fish community structure in relation to spatial and interannual variability in environment) (Subproject M)

Predation effects of scyphomedusae on zooplankton in Prince William Sound. Purcell (Subproject S)

Seasonal and interannual variability in forage fish distribution, abundance, availability as prey for seabirds, and environmental factors affecting that distribution in Prince William Sound, Alaska, 1995-1999. Brown, Coyle, Thedinga, Hurlbert *et al.* (This is a fish-based view of bird/fish interactions (Subprojects A, T)

Seabirds and forage fish of Prince William Sound: dynamics, selection and implications for recovery following the Exxon Valdez oil spill. Ostrand, Irons, Kuletz, Suryan and Thedinga (This is a bird's eye view of bird/fish interactions) (Subproject B, E, A, R)

BIRDS

Activity time-budgets of Common Murres at three colonies with differing food regimes. Shultz, Kettle, et al. (synthesis and summary of five years of study on chick-feeding rates). (Subproject M)

Individual strategies and local habitat characteristics dictate foraging site selection in Pigeon Guillemots. (pelagic vs benthic fish foraging) Golet, Litzow, Fischer, Howlin, Irons and Piatt. (Subprojects F, M)

Prey availability and other environmental controls of foraging and reproduction in the Black-legged Kittiwake: a multiyear, ecosystem study. Suryan, Irons *et al.* (Subproject E)

Breeding chronology and productivity of a non-colonial seabird in response to spatial and temporal variability in prey. Kuletz *et al.* (Subprojects R, A)

MODELS

Effects of diet quality on reproductive success of piscivorous seabirds in Alaska: testing the junk food hypothesis. Jodice, Roby, Irons, Golet, Suryan, Litzow, Piatt and Duffy (examining lipid content of forage fish vs. availability as affecting prey selection by kittiwakes and guillemots; lipid content vs. availability as factors influencing reproductive success; evidence of regime shifts influencing the relative availability of low and high lipid forage fishes) (Subprojects G, E, F, M, I)

The numerical response of seabirds to variation in food density. Piatt, Irons, Duffy, *et al.* (non-linear response of murres and kittiwakes to variations in food density) (Sub project M, E, I)

An integrated model of foraging behavior and demography for Black-legged Kittiwakes in Prince William Sound. Ainley and Ford (Subproject Q)

Marine and terrestrial factors that determine the distribution and productivity of marbled murrelets in Prince William Sound: Implications to monitoring and conservation efforts. Kuletz, DeVelice, *et al.* (GIS) (Subproject R)

LESSONS

Management implications for a large ecosystem project: Why was APEX started? Spill, litigation; settlement cleared way for science. What did we know and assume at the start? Evidence of change in prey in North Pacific. Roles of El Nino and decadal change. Evolution of the project. Scientific and administrative constraints on a large science project. Links to restoration. Duffy (Subproject I)

FY 02

SYNTHESIS

This synthesis will be based on the final reports of FY 00 and the papers of FY 01. This is intended to be a book or special journal number. To have a successful synthesis, there has to be a common currency that

extends across topics and taxa; otherwise, there is a great risk of a topic-by-topic or taxon-by-taxon recapitulation of what has been learned. Possible common currencies include carbon, energy flux, variance, and scale. We have tentatively decided to use scale: how do organisms respond to different scales? Here, macroscale is roughly at the decadal and gulf level, mesoscale is at the month/year and sound/inlet scale (10 – 100 km) and microscale at the meter to kilometer and hour/day scale.

We hope to also include an element of complexity theory, examining how responses at one scale may be understandable biologically, but they produce effects at other scales that appear chaotic/random. Kittiwake foraging might be a good example of this: smart decisions at a decadal scale as to where to forage appear maladaptive at the scale of a particular year. Each chapter would hopefully address implications for the other scales.

Authors are tentative, as we would be offering only at most honoraria, so some participants of FY00 and FY01 may have taken other positions that do not allow them to participate.

1. Introduction.

Scale and Understanding of a Changing Marine Ecosystem—DUFFY & SCHNEIDER

2. Macroscale

A. Macroscale Changes in Prey Species and their Ecosystems in the Northern Gulf of Alaska-- ANDERSON, PIATT

B. Macroscale Changes in Seabird Species and their Ecologies in the Northern Gulf of Alaska--IRONS

3. Mesoscale

A. Mesoscale Distributions and Their Causes for Prey Species in the Northern Gulf of Alaska-- BROWN, SPECKMAN, & THEDINGA

B. Interactions of Prey and Seabird Colonies at the Mesoscale Level in the Northern Gulf of Alaska--PIATT

C. Mesoscale Foraging Decisions by Seabirds--SURYAN, GOLET, & LITZOW

4. Microscale

A. Microscale Distributions and Interactions of Prey Species. ROBARD, PURCELL, OSTRAND, BROWN, & STURTEVANT

B. Microscale Selection of Foraging Sites--KULETZ, GOLET, & LITZOW

C. Foraging at Microsites: Flocking, Conflict and Facilitation--OSTRAND

5. Understanding the System: Alternative Approaches

A. Patterns of Variability and Coherence between Prey and Bird Populations--FORD, AINLEY, & SCHNEIDER

B. It's Energetics and Nutrition: JODICE, ROBY, PIATT, & IRONS

C. Response Curves and Population Functions--PIATT

6. **Afterword and Afterward:**

Linking Birds to Prey and Monitoring and Managing the Northern Gulf of Alaska: Lessons from APEX—DUFFY AND WRIGHT

FY03
The project leader (Duffy) will be responsible for a semipopular synthesis and will solicit collaborations, but will if necessary proceed without them.

List of Subprojects

Project PI		Short Title
a.	Thelinga/Hurlbert	Fish population sampling
b.	Ostrand	Seabird foraging
e.	Irons/Suryan	Kittiwake foraging and reproduction
f.	Golet	Guillemot foraging and reproduction
g.	Roby	Seabird reproduction and energetics
i.	Duffy	Project leader
j.	Roseneau	Barrens nesting study
k.	Roseneau	Predatory Fish Diets
l.	Piatt, Anderson & Blackburn	Historical analysis
m.	Piatt	Cook Inlet studies
o.	McDonald	Statistical support
q.	Ainley, Ford & Schneider	Modeling
r.	Kuletz	Marbled Murrelet
s.	Purcell	Jellyfish
t.	Brown/Norcross	Aerial Survey

Methods by Objective

All activities will involve analysis of data and samples and writing up of the material. Details of the original subprojects may be found in the previously-published, individual FY 00 Detailed Project Descriptions.

C. Cooperating Agencies, Contracts, and other Agency Assistance

Details of the responsibility of each agency and contracts with the private sector and with other government agencies can be found in the appendices describing individual subprojects in the FY 00 Detailed Project Descriptions.

SCHEDULE

A. Measurable Project Tasks for FY 01

2001
Sept. Final Manuscripts Due for papers

B. Project Milestones and Endpoints
2001 Final manuscripts completed.
2002 Synthesis manuscripts completed
2003 Popular account completed

C. Completion Date
December 31, 2002

PUBLICATIONS AND REPORTS

See methods and schedule above for publications.

PROFESSIONAL CONFERENCES

None budgeted

NORMAL AGENCY MANAGEMENT

99163 A
Not applicable

99163 B
See explanation under 99163 E

99163 E
The need for the APEX synthesis would not exist if the oil spill and resulting research had not occurred.

99163 F
See explanation under 99163 E

99163 G
Not applicable

99163 I
Not applicable

99163 J
The need for the APEX synthesis would not exist if the oil spill and resulting research had not occurred.

99163 K
Not applicable

99163 L
The need for the APEX synthesis would not exist if the oil spill and resulting research had not occurred.

99163 M
See explanation under 99163 L.

99163 O
Not applicable

99163 Q
Not applicable

99163 R
See explanation under 99163 E.

99163 S
Not applicable

99163 T
Not applicable

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project is an integration of the APEX project, designed to provide an accessible synthesis of its results for the public and managers.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

NA

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approved TC 12-5-00

Prince William Sound Food Webs: Structure and Change

Project Number:	01393-BAA
Restoration Category:	Research
Proposer:	T. Kline/PWSSC
Lead Trustee Agency:	NOAA
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	Cont'd
Duration:	3rd yr. 3 yr. project
Cost FY 01:	$119.0
Cost FY 02:	$0.0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Pink salmon, Pacific herring

ABSTRACT

Recent research has shown that the oceanographic conditions connecting the northern Gulf of Alaska with Prince William Sound may affect recruitment and nutritional processes in fishes. Accordingly, food webs are subject to changes in carbon flow occurring between the Gulf of Alaska and Prince William Sound. This project seeks to conduct retrospective analyses of Gulf of Alaska production shifts since the oil spill. These analyses will enable a better understanding of the ecological role of regime shift processes conjectured to be impeding the natural restoration of populations in Prince William Sound affected by the oil spill.

INTRODUCTION

Stable isotope ratios of carbon and nitrogen have been shown to serve as effective tracers of energy supply in the Prince William Sound study area (Kline 1997a, 1997b, 1998, 1999b) This is due to (1) the conservative transfer of carbon isotope ratios between the lower tropic levels (phytoplankton to zooplankton to forage fishes, etc.) of Prince William Sound (PWS) and adjacent Gulf of Alaska (GOA) waters up to the top consumers and (2) the naturally occurring gradient in $^{13}C/^{12}C$ productivity generated in the Gulf compared with the Sound. Organisms acquire these isotope ratios in response to the importance of the food in bulk body tissues. Isotope ratio analysis of tissues thus provide insight into both habitat usage and assist in quantifying amounts derived from various areas. Nitrogen isotope ratios, in turn, provide excellent definition of relative trophic level. The heavy isotope of nitrogen is enriched by about 0.3 % with each trophic level and thus can accurately indicate the relative trophic status of species within an ecosystem (Minagawa and Wada 1984, Fry 1988) and is useful for food web model validation (Kline and Pauly 1998, Kline 1999b).

Results from prior work

Juvenile herring and pollock are the dominant pelagic fishes in PWS and both consume zooplankton. Juvenile herring and pollock from PWS shifted in $^{13}C/^{12}C$ content between 1994 and 1995 from which a change in carbon source dependency was inferred (Kline 1999b). Although both species shifted in concert to greater GOA dependency in 1995 than 1994, pollock were consistently less dependent on GOA carbon. Juvenile pollock and herring occupy different levels in the water column, have different schooling behavior, and recruit from the larval stage at different times, effecting access to a different forage-base as confirmed by the data. This difference may not be reflected in the species composition of diet but instead the where and when of the production cycle as integrated into the isotopic signature (Kline 1998), which reflects the assimilated carbon pool of the fish. The greater reliance on GOA-derived carbon in herring may reflect their dependence on carbon generated later in the season during the time when advection of GOA production was nearly the sole carbon source in 1995 as suggested by the data. The concordant shift to greater GOA dependency by both species in 1995, Sound-wide, implied that system-wide bottom-up effects permeated the whole ecosystem due oceanographic processes.

The isotopic gradient between PWS and GOA had a consistent relationship in the 1994-1996 period except for May 1996 when the gradient reversed owing to a large magnitude change in the GOA signature (Kline 1999b). Whereas PWS mean $^{13}C/^{12}C$ values ranged within 1 delta unit, and the difference between PWS and GOA averaged 3 delta units, the GOA mean value shifted in Spring 1996 by 5 delta units. This large shift reflected a change in phytoplankon fractionation during uptake

of CO_2 which varies as a function of growth rate (Laws et al. 1995, Bidigare et al. 1997). Thus the productivity pattern during the spring bloom of 1996 was markedly different from other times. Large fluctuations in productivity in the GOA suggests large inconsistencies in food availability for consumers from year to year if these fluctuations are typical. Thus the question arises : Are fluctuations in GOA spring bloom productivity, as evidenced by changes in $^{13}C/^{12}C$, typical?

The Ecopath modeling group (Pauly and Pimm et al.) Trustee Council sponsored synthesis of known ecological relationships of many of the organisms inhabiting PWS will be used to conduct perturbation experiments to examine EVOS and restoration effects. The utility of this effort will in part be dependent on how realistic their models are. One way to determine if the model is realistic is to compare model predictions with those made using an independent method. Ecopath generates as part of the output, the fractional trophic level for each functional group defined in the model input that can be validated with $^{15}N/^{14}N$ data (Kline and Pauly 1998). Kline and Pauly (1998) validated a preliminary PWS Ecopath model using this novel approach. They used a limited number of functional groups which contrasts with the full Ecopath model which will have ~ 50. In comparison to the preliminary model, the artifact of functional group over-aggregation will be significantly reduced in the full model, enabling a more robust Ecopath validation if $^{15}N/^{14}N$ data for a large proportion of the functional groups were available. See Kline (2000) for the preliminary results of this project.

NEED FOR THE PROJECT

A. Statement of Problem

The Problem: Recovery of EVOS damaged species is uncertain in light of regime shifts

Decadal-scale changes in the production cycles of the subarctic Pacific Ocean have been conjectured to effect population changes in fishes and their zooplankton forage base (Brodeur and Ware 1992, Francis and Hare 1994). A "ring of zooplankton" occurring near the Gulf of Alaska (GOA) continental shelf break appears to undergo dramatic oscillations in abundance over decadal time scales (Brodeur and Ware 1992). This "ring of zooplankton" is driven onto the shelf providing the ecosystem with an important forage base (Cooney 1988, 1993). Natural stable isotope (NSI) data suggested that the transport of zooplankton from the GOA into Prince William Sound (PWS) may provide significant quantities of forage for food webs and may be a good method for detecting changes in biophysical coupling in the PWS region (Kline 1999b).

A recent "regime shift" similar to that seen in the past (Brodeur and Ware 1992, Francis and Hare 1994) is conjectured to be presently occurring in

the North Pacific (Anderson et al. 1996). Post-EVOS recoveries are uncertain since the regime shift may impede population increases. Recently, using NSI, it has been possible to ascertain that GOA primary productivity patterns vary at inter-annual time scales and that GAO production is important to PWS (Kline 1999b). Using retrospective NSI analysis, it may be possible to assess whether fluctuations in primary production took place since EVOS. If so, this could explain the poor recovery of some injured species. Furthermore, fluctuations in the mass balance of carbon postulated to be taking place can be incorporated into applications of the Ecopath model being developed by Trustee Council funding which can also be validated using NSI data (Kline and Pauly 1998).

Need #1: Gulf of Alaska productivity fluctuations - retrospective analysis since EVOS

There is a discontinuity between the start of PWS ecosystem studies in 1994 and the timing of EVOS in 1979. Ecosystem shifts occurring in the GOA since 1989 were thus not incorporated in present studies. To overcome this perspective, retrospective NSI analyses may enable a reconstruction systematic ecological changes occurring since 1989.A retrospective approach is being used by GLOBEC in several projects in the N.E. Pacific as a means of overcoming temporal limitations in our database (U.S. GLOBEC 1996). Fixed tissues such as the protein layer on the exterior of mussels provide a recent record of changes in the isotopic composition of their phytoplankton diet. An opportunistic collection of *Mytilus californianus* from Middleton Island made in September 1997 provides an inexpensive approach to retrospective analysis. Middleton Island's location in the Alaska Current provides an "upstream perspective" on the EVOS area since samples from there will reflect changes in plankton upstream before interaction with PWS-origin carbon is possible.

Need #2: Mass-balance modeling validation data gaps

Kline and Pauly (1998) established the utility of using NSI data to validate the Ecopath mass-balance model (Project 330). This was done with a small number of highly aggregated functional groups. The final model has about 46 functional groups. Of the functional groups listed good isotopic representation was available for about 7 prior to this project. Thus confident model validation could only be performed for a limited selection of the functional groups. therefore this project will analyze additional samples to increase the number of functional groups validated. These and preliminary results are listed in Kline (2000).

B. Rationale/Link to Restoration

Shifts in carbon flow occurring as a result in variations in the physical environment represent fundamental changes in the way the PWS

ecosystem supports commercially important species. The availability of macrozooplankton forage for fishes varies in space and time because of changes in physical processes in PWS. The NSI approach is unique in its ability to integrate time and spatial scales at mesoscale levels. No other technique currently available can generate such results. The natural tracer aspects of the approach emulates artificial tracer experiments without the burden of needing to generate signals or experimental artifacts. Tracking the effect of Gulf carbon inflow on pelagic production that appears to vary between years will be used to resolve the question of how oceanographic process affect fisheries recruitment. Finally, the value of the Ecopath modeling effort funded as restoration tool would be greatly enhanced through a incorporation of a proven model validation concept.

C. Location

Prince William Sound

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The participation of the community and incorporation of local knowledge into regional science efforts was the raison d'être for the PWSSC. The Center has a web page and distributes brochures and newsletters to all PWS communities. Our 1999 building addition includes an area where public presentations are given. Our education program provides a unique community involvement. To further our invovement in the entire community and external governing board is being implemented in 2000. The following are some of the individuals and groups that have been invited to participate: President, Valdez Chamber of Commerce Valdez; Marine Safety Office Cmdr. US Coast Guard Valdez; Mayor, City of Whittier Whittier; President, Chugach Alaska Corporation Anchorage, SeaRiver; President, The Eyak Corporation Cordova; Alaska Dept. of Environmental Conservation, Valdez; U.S. Coast Guard Cmdr., Sweetbrier, Cordova; Herb and Barb Jensen, Cordova; Dave and Kim Erbey, Cordova Air Service, Cordova; Jim and Patty Kallander, Cordova; Sue Aspelund, Executive Director, Cordova District Fishermen United Cordova; Jack Babic, Jr., Cordova; Cal Baker, Cordova District Ranger, Cordova; Bob Baldwin. BP Exploration Shipping; Bob Berceli, Alaska Dept.& of Fish & Game, Cordova; Trish Berg, ARCO Alaska Shipping; Russ Bradley, President, Cordova Chamber of Commerce, Cordova; Pat Carney, BP Exploration Shipping; Dave Cobb, Mayor, City of Valdez, Valdez; Tom Colby, Alaska Tanker Company, Valdez; John Devens, Executive Director, PWS Regional Citizens' Advisory Council, Valdez, Gail Evanoff, President, Chenega Bay Village Council, Chenega Bay; Senator Georgianna Lincoln, State Senate, Alaska State Legislature, Juneau; Bob Henrichs, President, Native Village of Eyak, Cordova; David Janka, Auklet Charter Services, Cordova; Representative John Harris, House District 35, Alaska State Legislature, Juneau; Margy Johnson, Former

Mayor, City of Cordova, Cordova; Tim Joyce, Alaska Dept. of Fish & Game, Cordova; Gary Kompkoff, President, Tatitlek Village Corporation Tatitlek; Carroll Kompkoff, President, The Tatitlek Corporation Cordova; Dune Lankard, Eyak Preservation Council, Cordova; Gerald McCune, President, Cordova District Fishermen United, Cordova; Jody McDowell, President, Prince William Sound Community College, Valdez; Vince Mitchell, SERVS Valdez; Riki Ott, Ph.D.. Copper River Watershed Project, Cordova; Brad Phillips, Phillips Cruises, Anchorage; Steve Ranney, Fishing and Flying, Cordova; Gayle Ranney, Fishing and Flying, Cordova; Ken Roemhildt, Superintendent, North Pacific Processors, Cordova; Jerry Sanger, Charter operator, Whittier; Dan Sharp, Alaska Dept. of Fish & Game, Valdez; Dorothy Shepard, Cordova Coordinator, PWS Community College, Cordova; Stan Stephens, Stan Stephens Charters, Valdez; Paul Swartzbart, Cordova; Chuck Totemoff, President, Chenega Bay Corporation, Anchorage; Bill Webber, Jr., Cordova; Mark Willette, Alaska Dept. of Fish & Game, Cordova; Ed Zeine, Mayor, City of Cordova, Cordova.

Additionally, community involvement and traditional ecological knowledge were incorporated into the sampling. For example, local fishermen provided the T. Kline with the knowledge and opportunity to acquire the *Mytilus californianus* samples.

PROJECT DESIGN

Natural stable isotope abundances reflect (1) trophic level and (2) source of assimilated matter and are thus a proxy for the change in diet. Stable isotope ratios will thus be used as a indicator of production and shifts in predation as tests of hypotheses which are stated below in relation to the stated needs.

A. Hypothesis-based Objectives

The needs described above suggest several hypotheses, listed below, that form the basis for the project objectives.

<u>For Need #1 -- thus Objective #1</u>
$Ho_{1.1}$: The isotopic shift seen in 1995 was a singular anomaly, therefore the GOA $^{13}C/^{12}C$ values in earlier years will be consistent.
$Ha_{1.1}$: If they are different, what is the pattern (if there is one)?
$Ho_{1.2}$: The $^{13}C/^{12}C$ of *Mytilus californianus* = $^{13}C/^{12}C$ of *Neocalanus*. This is expected since both are herbivores.
$Ha_{1.2}$: If they are not equal is the there a systematic difference?

There are three goals to be fulfilled for Objective #2:

1. Reconstruct a $^{13}C/^{12}C$ time-series covering at least the 1989 - 1997 period.

2. Compare the time-series with observed $^{13}C/^{12}C$ changes in 1994-1997 (Fig. 2 plus the additional data-year (1997) currently being generated in project 311).

3. Publication of the results in the open literature.

For Need #2 -- thus Objective #2
$Ho_{2.1}$: Trophic level of each functional group predicted by Ecopath = the trophic level of each functional group predicted by their mean $^{15}N/^{14}N$.
$Ho_{2.2}$: Omnivory index of each functional group predicted by Ecopath = the standard deviation of trophic level of each functional group predicted by individual $^{15}N/^{14}N$ values.

There are three goals to be fulfilled for Objective #2:

1. Provide a better representation of the Ecopath functional groups so as to enhance model validation. Note that only a limited number of functional groups were used in the preliminary model validation (Fig. 3). The goal is to make a substantial improvement.

2. Provide validation data for the more model-sensitive higher trophic levels (D. Pauly, pers. comm.). Much of the predictive power of the Ecopath model is for trophic level 4 and 5 functional groups, therefore validation of these functional groups would provide a robust test of the model.

3. Publication of the PWS Ecopath model validation in the open literature, this would have to be a significant leap over Kline and Pauly (1998) to pass the reviewers, hence goals 1 and 2.

See Kline and Pauly 1998 for a description of the validation method.

Data Gaps

The proposed study will build upon the existing data base; adding new data will fill data gaps and further the construction and tests of conceptual food webs supporting productivity in the greater Prince William Sound area. The goal is to determine the trophic positions and to define the natural history parameters accessible from NSI data in light of the observed declines in their populations. These include changes in trophic level over the lives of pelagic organisms, habitat dependencies, seasonal energetics and trophic dynamics relative to other community organisms. As part of this goal, we will integrate our analytical work with the field and laboratory studies of other investigators looking at food web structure, productivity of lower trophic levels, and provide validation data for assessment of conceptual and quantitative models.

Sampling objectives are listed in relation to needs and their hypotheses. The emphasis will shift among the objectives by fiscal year (these are given proceeding each objective).

B. Objective-based Methods

For Objective 1, Retrospective Analysis Of GOA Production Shifts Since EVOS

FY99-00: Stable isotopic analysis of the outer protein layer (periostracum) on the shells and body tissues of Sea-mussels (*Mytilus californianus*) of varying ages collected at Middleton Island (N= 50 mussels) in September 1997. The periostracum will be analyzed by cutting sections (of 2.0 mg for each analysis) along annular growth rings. Mussels of different age will be used to extract data from various years (as annuli are wider and more distinct at earlier ages) to reconstruct an isotopic time series retracing conditions from 1997 backwards in time to EVOS and earlier. For example a 5 to 10 - year old mussel will resolve well recent years whereas a 10 to-20 year old will resolve years when the mussel was younger. Overlapping years (of periostracum samples) of good age resolution will be used to inter-calibrate mussels while younger mussels will be calibrated against our zooplankton database (Fig. 2). An estimated 250 isotopic analyses (~ n = 10/ mussel) will be required for this task in FY99 (*reduced from 500 in original DPD*). The expected results would consist of an isotopic characterization in GOA isotopic signature from 1989 (possibly earlier) to 1997. The following question will be asked: Did changes of the magnitude seen in 1996 occur in other years? If so, how often. If not, then the 1996 will be considered an anomaly rather than a common occurrence.

For Objective 2, Addressing Ecopath Model Validation Data Gaps

A) Analysis of available samples from the P.I.'s archives and samples from other P.I.'s.

The purpose of this objective is to acquire data most cost-effectively - without additional field sampling. Functional groups identified for additional analyses are noted by the underlined. Since the Ecopath model is centered on data collected from 1994-6 and for which years these samples are from, they are optimal for this purpose.

The methods for calculating trophic level and omnivory index are given in Kline and Pauly 1998 (duplicated in Kline 1999b). The data generated will used in a similar way.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

N/A

SCHEDULE

This schedule reflects project \393 commencement date of 1 April 1999.

A. Measurable Project Tasks for FY01 (October 1, 2000 - September 30, 2001)

Oct. 00 - Jun. 01:	Preparation of last samples (for Objectives 1 & 2) for mass spectrometry
Oct. 00 - Sep. 01:	Mass spectrometry at UAF (~ 6-9 month processing time)
Oct. 00 - Sep. 01:	Process new isotope data

B. Project Milestones and Endpoints

Jun. 2001:	Preparation of samples for mass spectrometry completed
Jan. 2001, 2002:	Attend Annual Restoration Workshop
Dec. 2001:	All data received from mass spec. lab.
Apr. 2002:	Isotope data processed
Apr. 2002:	Data integration and synthesis complete
Oct. 1999 - Sep. 2002:	Preparation for and dissemination of results at EVOS and other symposia
Jan. - Apr. 2001, 2002:	Preparation of reports
Apr. 15, 2002:	Draft final report
Sept. 30, 2002:	Final report

C. Completion Date

September 30, 2002 (Final Report)

PUBLICATIONS AND REPORTS

Kline and Pauly - a greatly augmented sequel to Kline and Pauly (1998) incorporating validation of the model developed in project 330) is planned for 2001-02.

Kline - A paper based on the retrospective analysis is planned for 2001-02.

PROFESSIONAL CONFERENCES

Travel is requested for the P.I. to present results at a national (or when appropriate, international) meeting such as ASLO or AGU and to attend workshops with collaborators. Travel to present project results at national meetings and to participate in collaborative workshops are essential to the project's success.

NORMAL AGENCY MANAGEMENT

N/A

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

Collaboration with other EVOS investigators will continue and facilitate relating carbon-source dependency with e.g., somatic energy content (A.J. Paul) and trophic level (D. Pauly and S. Pimm). Other P.I.'s in possession of NSI data for certain functional groups, noted in Table 1 (their names proceeded by "see") will be asked to provide appropriate portions of pertinent data for incorporation into objective #2. Results of analyses will be exchanged at workshops and by telecommunications. Preliminary analysis from the integrated effort will be used to direct retrospective analysis of archived samples. Sampling will be coordinated with other P.I.'s and within the auspices of other biota sampling programs. Pertinent data of each sample (i.e. data on each individual fish will be shared among components). Coordination in relation to specific objectives listed in project design section.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

Since approval of funding for this project was delayed until December 1998 and the contract was not completed until 1 April 1999, the project schedule has been reset in time accordingly. It is still planned as a three-year project. The contract for the proposed final year of the project, FY2001, will thus start on 1 April, 2001 and end on 30 March, 2002. A no-cost extension will enable funding to the final report submission on the Trustee Council's 15 April scheduled due date in 2002 and revision by 30 September, 2002.

PROPOSED PRINCIPAL INVESTIGATOR

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Revision 1-19-01
Approved TC 12-5-00

Alaska Salmon Shark Assessment Project

Project Number:	01396
Restoration Category:	Research
Proposer:	Jeep Rice NMFS, Auke Bay Laboratory
Lead Trustee Agency:	NOAA
Cooperating Agencies:	Alaska Department of Fish and Game
Alaska Sea Life Center:	no
Duration:	Year 2 of 2 year project
Cost FY 01:	$85.0K
Geographic Area:	Prince William Sound
Injured Resource/Service:	Pacific salmon, Pacific herring, rockfish

ABSTRACT

Throughout the 1990's salmon shark observations and bycatch in Prince William Sound (PWS) and the northeastern Gulf of Alaska (GOA) increased dramatically. The second year of the Alaska Salmon Shark Assessment Project is designed to investigate seasonal salmon shark movements and diet in PWS and GOA to determine seasonal fidelity to diet and region. Utilization of state-of-the-art satellite telemetry transmitters will augment successful applications of the technology demonstrated in FY00. Data transmitted by satellite tags deployed on salmon sharks in July 2000 are providing much needed information about spatial and temporal movements beyond the summer sampling period, but more tags need to be deployed. Seasonal variations in salmon shark diet composition will be described from stomach sample analyses. The project will also synthesize historical salmon shark distribution and abundance in the north Pacific from literature and analysis of bycatch databases. This work will be performed to investigate whether evidence of salmon shark population trends are revealed. These inquiries are needed to assess the ecological role of a predominant shark species in the Gulf of Alaska, and the potential impact they could have on other important species; forage fish, sablefish (*Anoplopoma fimbria*), salmon (Oncorhynchus spp.), and marine mammals.

INTRODUCTION

The salmon shark, *Lamna ditropis,* is one of the predominant shark species in coastal Gulf of Alaska (GOA), yet very little is known of their seasonal movements, regional fidelity, or diet composition. Large surface aggregations, often numbering in the thousands, have been observed in PWS bays and passages associated with returning adult chum salmon (*Onchorhynchus keta*) and pink salmon (*Onchorhynchus gorbuscha*) since the mid 1990's. Previously, salmon shark sightings and bycatch in commercial fishing gear were rare. Preliminary results of diet analyses indicate that the sharks consume a variety of prey, even during summer months when adult salmon are abundant (Table 1). As Fall approaches and salmon abundance declines, the sharks disperse and are rarely observed at the surface. However, satellite telemetry data and bycatch in the walleye pollock (*Theragra chalcogramma*) fishery in PWS confirm salmon sharks occur in PWS and the northeastern GOA during winter months. Salmon shark diet composition during times of the year when adult salmon are not abundant has not been documented. In regions of high abundance, salmon sharks have the potential to affect the recovery of oil spill damaged species including wild salmon, herring, and rockfish.

Lamna ditropis Prey Taxa	Frequency (%)	Biomass (%)
Salmonids (*Oncorhynchus*)	26	40
Sablefish (*Anoplopoma*)	26	36
Pollock, Cod (*Gadidae*)	5	4
Rockfish (*Sebastes*)	5	1
Herring (*Clupeidae*)	11	0.4
Spiny dogfish (*Squalus acanthias*)	5	7
Squid (*Teuthoidea*)	16	1
Halibut (*Pleuronectidae*)	5	11

Table 1. Summary of stomach contents from 18 salmon sharks caught in the PWS region during July and early August.

Data transmitted from satellite tags deployed in FY00 are yielding previously inaccessible information that are necessary to study salmon shark movements and ecology. Conventional tag-and-recapture programs studying sharks are dependent on fisheries for tag recoveries, and as indicators of movement and behavior have limited resolution. To date, of the 223 salmon sharks tagged with spaghetti tags in 1999 and 2000, only one has been recaptured. There is no directed commercial salmon shark fishing in Alaska and tag recoveries are low, either due to low incidental bycatch or low recovery as large sharks are rarely brought aboard. Utilization of satellite telemetry technologies provide state-of-the-art methods to acquire otherwise unattainable data on the movements, seasonal residency, regional fidelity, and ecology of these apex fish predators in PWS and GOA ecosystems. The data returned to date is intriguing, but the

sample size is small and more tag deployments are needed.

Increases in salmon shark abundance in the northeastern GOA follows 10-15 years after an ocean climate regime shift and changes in trophic community structure. Is the trend in shark abundance due to population increase or range extension? Are the sharks more affected by climate regime shift or trophic regime shift? Synthesis of historical salmon shark distribution and abundance data in the north Pacific from literature and bycatch databases will be performed to investigate whether evidence of salmon shark population trends are revealed.

Seasonally diverse salmon shark diet data are needed to assess the ecological role of salmon sharks in PWS and GOA ecosystems. One of the more cost-effective methods of assessing complex interactions of a food web is diet analysis from stomach contents. Cooperation has been established with commercial and sport fishermen and various agencies to acquire seasonally and regionally diverse salmon shark stomach samples in the GOA.

Understanding the ecology and impact of sharks on the predator/prey dynamics of PWS requires research on TWO shark species; salmon sharks (*Lamna ditropis*) and Pacific sleeper sharks (*Somniosus pacificus*). The evidence of increasing numbers occurs for both species. These species have different biologies, although little is known about the diet and migration of either species. Salmon sharks are caught in salmon fisheries; sleeper sharks are not. Sleeper sharks are caught often in long line gear; salmon sharks are not. Parallel but independent will be sleeper shark studies conducted by the NMFS, using emerging Stellar Sea Lion funds. Although the present evidence is meager, there is growing evidence of predation by sleeper sharks on marine mammals. This EVOS study will focus on salmon sharks, and at this time, is projected to be the last and only directed study on salmon sharks.

NEED FOR THE PROJECT

A. Statement of the Problem

The ecological role of sharks in PWS and their affects on the recovery of spill-injured resources in the region will vary with temporal and spatial patterns of movement. Salmon shark seasonal residency patterns, movements, and diet in PWS and the GOA have not been described. Large numbers of sharks coupled with high food consumption to support above ambient body temperatures indicates that shark predation may be dominant and directly limit other key species (salmon, herring, rockfish, sablefish). Salmon shark body temperature averages 26.5^{0}C (80^{0}F) (Goldman 1999 unpublished data) and may be the highest of any shark. Because of this and the cold waters they inhabit in the GOA, salmon sharks likely possess a high metabolism and high daily ration. Eighteen salmon shark stomachs collected in late July and early August, during peak pink salmon returns, contained as many sablefish as salmon and also contained herring and rockfish (Hulbert 1999 unpublished data). In regions of high abundance, salmon sharks have the potential to affect the recovery of oil spill injured species, including Pacific herring, Pacific salmon, and rockfish.

Salmon sharks inhabiting Alaskan waters have low fecundity, long life, and slow maturation.

Once sharks reach a dominance level in the community they are likely to continue that dominance for a long time. Observations suggest salmon sharks may be a dominant predator in PWS now and for some time into the future, but we do not understand the significance of this role to other species and the ecosystem.

B. Rationale

This research will provide a valuable contribution to the understanding of shark ecology in the GOA and PWS and will document predator/prey interactions in the region. This information is needed to further the understanding of the ecological role of sharks in PWS and their effects on the recovery of spill injured resources in the region.

Pop-up archival transmitting (PAT) tags, and smart position-only transmitting (SPOT) tags were successfully demonstrated by the project in FY00 for monitoring the movements and diving behavior of salmon sharks. Data from satellite tags and opportunistic aerial observations will continue to be collected and analyzed in FY01 to describe salmon shark movements, migrations, regional fidelity, and critical feeding areas.

Shark stomachs will be collected during directed sampling efforts, opportunistically from commercial and sport fishermen, and from NMFS and ADF&G biologists. Efforts to collect and analyze seasonally diverse diet samples will be emphasized in an effort to describe prey switching when spawning aggregations of Pacific salmon are not present.

The project will also synthesize historical salmon shark distribution and abundance in the north Pacific from published literature and analysis of bycatch databases. This work is needed to investigate whether evidence of salmon shark population trends are revealed.

C. Location

Prince William Sound and Gulf of Alaska

COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

A traditional and local knowledge component has been incorporated in this study. People from Cordova, Chenega, and Tatitlik have been and will continue to be asked to contribute their knowledge of shark temporal abundance and distribution. Community members may also be hired to recover PAT tags if they "pop-up" in PWS.

PROJECT DESIGN

A. Objectives and Hypotheses

The overall objectives of the project are to document salmon shark seasonal movements and fidelity to Prince William Sound, and to document seasonal variation in salmon shark diet. This information will be an important contribution to assessing the role of salmon sharks in the Prince William Sound ecosystem. All permits necessary for this work are in place.

Primary Hypotheses

H1: Salmon sharks inhabit Prince William Sound and the Gulf of Alaska during winter months

H2: Salmon sharks are highly migratory and exhibit seasonal fidelity to Prince William Sound

H3: Salmon shark diet composition changes from summer to winter months

Project Objectives

1. Determine seasonal migration patterns by deploying SPOT and PAT tags on summer caught salmon sharks.

2. Determine seasonal diet from stomach analyses of salmon sharks collected in the summer (at time of tagging deployment), and in stomachs acquired from non-salmon fisheries at other times of the year.

3. Determine if there is evidence of historical trends in distribution and abundance by synthesizing literature and bycatch data bases.

B. Methods

1. Methods for determination of seasonal migration.
Migration movement will be tracked by the use of two types of tags: SPOT and PAT. Data from both types of tags use the ARGOS satellites to retrieve data; hence the initial costs of the tags are considerable, but data retrieval is cheap (no charters to track sharks for example). Why two types of tags? SPOT tags will continuously report position when the tagged shark fin breaks the surface. This tag will give high resolution tracking, particularly during the summer months when animals are at the surface more often. Knowing location of sharks in the winter is problematic, as the fin does not break the surface often. In contrast, the PAT tag is an archival tag yielding more biological information, recording time at depth and temperature data, but accurate position data is only given once- when the tag releases from the shark at a pre-programed date and time, floats to the surface, and begins transmitting. By having multiple tags programmed for different release dates, migration and fidelity can be determined. A combination of tags has the highest probability of success.

Collection of animals: Summer charter of a purse seiner will be used. This technique has been highly successful in the past.

Tag deployments.

- SPOT tags (Smart Position Only Tags) are bolted to the sharks dorsal fin and transmit high resolution movement data to ARGOS satellites when the tag breaks the waters surface. The tags are providing information on salmon shark regional fidelity, seasonal PWS residency, and large and small scale spatial and temporal movements.

  Three SPOT tags will be deployed in FY01 to supplement the 3 active tags which were deployed in FY00.

- PAT (Pop-up Archival Transmitting) tags are attached to the base of the sharks dorsal fin with a stainless steel dart. The tag releases from the animal on a predetermined date and time, and transmits archived data and position. The tags provide large-scale geographic movement data, time spent at depth, and seasonal PWS and GOA residency information.

  Nine PAT tags will be deployed. Three tags will be programmed to pop-up on each of three dates: October 1, 2001; February 1, 2002; and July 1, 2002. Note: The shorter the time period, the greater the chance of success; the longer the time period, less chance of success, but more meaningful information. We plan a scan of dates to give us the best chance of success and return of information.

  Note: Satellite tag data is transmitted to Argos system satellites which collect and retransmit the data to Argos centers for processing. The processed data is then sent via e-mail to the NMFS Auke Bay Laboratory for analysis.

Miscellaneous field sampling objectives:

Captured sharks will be sexed and measured for length, and weight (or estimated from length/girth measurements). After measurement, if a shark is to be released, tissue samples will be collected for stable isotope tracers, fatty acids, and genetic analyses. The shark will then be double tagged with numbered spaghetti tags and released. If a shark is killed, vertebrae and stomach will be collected and frozen for subsequent laboratory analysis. Maturity state will be recorded and urogenital tract collected and preserved in 10% formalin solution or frozen: presence or absence of eggs or embryos in females, and male clasper length will be recorded. Permits allowing this are in place.

2. Methods for determining seasonal variation in salmon shark diet.

Stomachs will be collected during the shark tagging charter during July 2001. Our goal is to collect 20 specimens representing a range of size during the charter. Another key objective is to collect another 20 voluntary and opportunistic stomachs samples during other times of the year from commercial and sport fishermen, and from researchers conducting surveys in Alaska waters. Salmon shark stomach collection efforts will emphasize a diverse seasonal range whenever possible. Stomach contents analyses methods will follow "Standardized diet compositions and trophic levels of sharks" (Cortes 1999).

3. Methods for determining whether there are historical trends in distribution and abundance. Evidence of historical salmon shark distribution and abundance in the north Pacific will be investigated by reviewing published salmon shark bycatch records in the literature and from analysis of bycatch databases. Special attention will be given to historical high seas gillnet fishery data. NorPac and RaceBase databases will be analyzed as well.

C. Cooperating Agencies and Volunteers

Alaska Department of Fish and Game port samplers will collect salmon shark stomachs and tissue samples.

University of Alaska Fairbanks (Evelyn Brown) will provide opportunistic PWS aerial salmon shark observations.

Cordova Air will provide opportunistic PWS aerial salmon shark observations.

Virginia Institute of Marine Science (Ken Goldman) will provide salmon shark stomachs.

SCHEDULE

A. Measurable Project Tasks (Milestones) for FY 01 (October 1, 2001-September 30, 2002)

April 15, 2001:	Complete FY00 Annual report
July 2001:	Conduct field research, deploy tags.
August 2001-September 2001	Organize and analyze data from FY01 field season. Analyze stomachs collected during summer
May 2001-July 2002	Retrieve and analyze satellite data as available. (3 SPOT tags deployed last year should reappear by May
August-September 2002	Analyze satellite tag data, complete reports/manuscripts

C. Completion Date

October, 2002	Final Report (Date of final report allows for analysis of satellite tag data transmissions from SPOT tags which are likely to transmit during summer months when the sharks are active in surface waters. and the last PAT tags, set for summer 2002 release.)

D. Budget Summary

Budget Category:	**FY01**
Personnel	$28.2
Travel	$ 2.2
Contractual	$22.2
Commodities	$26.6
Equipment	$ 0.0
Subtotal	$79.2
General Administration	$ 5.8
Project Total	$85.0

PUBLICATIONS AND REPORTS

An EVOS annual report in April 2001 will describe the results and accomplishments of the research to date.

A final report detailing results and accomplishments of the research will be accompanied by: A draft salmon shark seasonal diet manuscript; a draft salmon shark spatial and temporal movement manuscript; and report detailing the results of salmon shark historical distribution and abundance synthesis.

NORMAL AGENCY MANAGEMENT

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

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

The information gathered in this study may be useful to understanding the lack of recovery of some non-recovering species (harbor seals, Pacific herring).

PRINCIPAL INVESTIGATOR

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Scott Meyer, ADF&G, Homer AK

Submitted 7-6-00
Approved TC 12-5-00

Testing Archival Tag Technology in Alaska Salmon

+ see amendment, final page

Project Number:	01404
Restoration Category:	Research
Proposer:	J. Nielsen/USGS-BRD
Lead Trustee Agency:	DOI
Cooperating Agencies:	None
Alaska SeaLife Center:	Yes
New or Continued:	New
Duration:	1st yr. 2 yr. project
Cost FY 01:	$75.0
Cost FY 02:	
Geographic Area:	Prince William Sound, Gulf of Alaska
Injured Resource/Service:	King salmon

ABSTRACT

Archive tags with temperature and light-geolocation sensors will be monitored for post-smolt coho salmon in Cook Inlet. Light/location relationships specific to the Gulf of Alaska developed under Project 00478 will be applied in this study of movement and migration paths for coho salmon during maturation in ocean environments in Cook Inlet. Salmon for this study will be reared in captivity (at the Alaska Department of Fish and Game hatchery at Fort Richardson) to 1+ year of age (150-250mm) and released in Cook Inlet as part of the department's Ship Creek sport-fishing hatchery release. FY 01 will include pilot studies of tag retention, behavior, and growth for coho in captivity. A spring release experiment in the first year will be contingent on the success of the retention study and incorporate timed releases of smolts, 1+, and surveys for early jack recoveries at the Ship Creek weir. Archive tagged fish will be used to document coho salmon use of marine habitats, migration routes, contribution to the sport fishery, and hatchery/wild interactions for salmon in Cook Inlet.

INTRODUCTION

Our previous EVOS study (#00478) tested light-based geoposition estimates for archive tags in the Gulf of Alaska. Light sensors attached to the smaller archive tags used in this study will be designed to collect identical data for geoposition estimates. Part of this study will continue these efforts to gain accuracy of geoposition estimates on the local scale within the Gulf of Alaska and to monitor local geography, climatic, and water quality conditions leading to errors in these estimates. To that end we will complete one year's collection of *in situ* data from tag arrays mounted on a stationary buoy at the entrance of Resurrection Bay (2001) and develop a new stationary array under this study at a different latitude in Prince William Sound (2002). Analytical analyses of light-based data for geoposition estimates will be honed and adjusted based on comparisons made between the two latitudes and between years. Tags recovered from salmonids with different ocean movement patterns will allow us to develop accurate correction factors to adjust for light attenuation at depth and special conditions for Prince William Sound.

The application of archive tag technology in ocean-going fish species has been underway for several years and is an effective tool for estimates of open-ocean migration pathways and to ascertain basin-scale movements along parts of the continental shelf (Welch and Eveson 1999; R. W. Brill, personal communications). Recent developments in the architecture and size of these tags have made them appropriate for use in maturing salmon such as steelhead, sea trout, Atlantic salmon, and Arctic charr (Welch and Eveson 1999; M.A. Svenning, and F. A. Voegeli pers. comm.) Life history investigations of oceanic behavior by salmonids will be greatly enhanced by using archive tags to trace migratory patterns of individual fish during their development at sea. Crepuscular diving behavior has been demonstrated in many pelagic marine species using

archive tags, but the mechanisms driving this behavior remain unknown, i.e. reaction to light scatter at dawn and dusk and/or a search for uniquely available prey items at depth during these intervals (B. Block et al. 1998; Lutcavage et al. 1999). It is interesting that this behavior has been documented in both the Atlantic and Pacific Oceans for multiple species, including Atlantic salmon (J. Sturlaugsson, pers. comm.) It is unknown if Pacific salmon in open seawater exhibit this behavior, and if they do how they react to long crepuscular conditions in the Gulf of Alaska.

King salmon (*Oncorhynchus tshawytscha*) from the Copper River support significant commercial, sport and subsistance fisheries in the Gulf of Alaska. The distribution of chinook post-smolts and sub-adults from the Copper River throughout saltwater habitats in the Gulf of Alaska is unknown. The development of new tagging technologies can be used to document the distribution and migration patterns of important salmonid populations in saltwater habitats. The development of effective application and protocols for these technologies under local conditions, however, require initial studies in non-critical populations. Alaska Department of Fish and Game (ADFG) assumes no natural production of chinook within Prince William Sound. A new hatchery program is being developed by ADFG for the release for king salmon into Prince William Sound where a dramatic increase in sport fishery is anticipated as a result of the new road opening auto traffic to Wittier (L. Peltz, ADFG, pers. comm.) We propose to use this chinook stock for initial tagging studies using archive tags. We will be able to raise hatchery salmon post-smolts in captivity to the threshold size (150 - 300 mm) necessary for successful surgically application of archive tag recorders. This study will test tag retention, behavior and growth in tagged salmon for on year prior to any live releases. Contingent of these tests, we will acclimate and release tagged chinook from the Esther Island facility and monitor initial movements away from the release location, migrations between near-shore and open ocean habitats, and critical marine habitats for hatchery king salmon from post-smolt to maturation (1-2 years).

Finding where and when king salmon go at sea and their temporal and spatial use of specific marine locations critical to oil spill management and recovery are important steps to identifying factors potentially contributing to survival and fitness under different environmental conditions. Data developed from archive tags on hatchery chinook will provide inference on hatchery vs. wild fish interactions, "hot-spots" of chinook production within Prince William Sound, migration paths and critical ocean habitat, and spawning fidelity of hatchery fish within the basin. All of these data will set baseline structure and sampling protocols for future implementation of archive tags on wild salmonid stocks within the Gulf of Alaska, including potential studies of endemic cutthroat trout (*O. clarki clarki*), Dolly Varden (*Salvelinus malma*), and Cooper River chinook and coho (*O. kisutch*) salmon. Our studies of these hatchery stocks will provide valuable information to ADFG on the management and stability of hatchery production in this area and its contribution to the local fishery.

The definition of "critical habitat" in the marine environment for anadromous and pelagic fishes is essential to the development of reserves or protected areas (Anonymous, NOAA, 1999). In Alaska, the relationship of aquatic protected areas to subsistence, commercial, or sport fisheries is a critical factor in considerations of design and implementation of reserves. Resource protection and strategic use are not incompatible concepts when a sound foundation of scientific knowledge on the distribution and abundance of key species is incorporated into reserve planning and resource use, and if local community-based natural resource management is included in the analyses of such data (Getz et al. 1999). This proposal continues to test the application and deployment of a new technology, archive tags, in investigations into the temporal and spatial distribution of key anadromous and marine fish species in the Gulf of Alaska. Many aquatic

species that fall under the jurisdiction of the Trustee Council in their efforts to restore the resources and services injured by the spill may benefit from the development and local adaptation of this technology. Monitoring of critical habitat use by Gulf of Alaska fish species will allow the organisms to speak directly to the managers of the resource during the development, implementation and applications of recovery or enhancement activities.

For many commercially important anadromous and marine fish species ocean-use and critical habitat remain uninvestigated with little or no scientific evidence to support distribution on temporal or spatial scales. The use of radio telemetry and satellite-linked tracking for studying fishes has experienced a recent exponential growth in the development of technologies and applications (Lucas et al. 1993; Eiler 1995; Sibert 2000). In addition to critical habitat designation, physiological telemetry can now be used to monitor energy expenditure, life history migrations, stage of life cycle, and environmental conditions critical to improving and validating habitat-use models for pelagic fishes (B. Block et al. 1998). Archival technologies offer the fisheries research community a new tool that is required to resolve movement patterns, spatial and temporal habitat use, and stock structure of many migratory marine species found in the Gulf of Alaska. The critical advantage to this new technology is that it allows documentation of habitat use that is independent of harvest or fishing effort. Conventional identification tags have been used on fish since the early 1900s. Hydroacoustic tags can provide multi-day records of location, depth, temperature and swimming speed in marine fishes, but their temporal and spatial scale is limited by the range of signal recovery and transmission duration in salt water. In the late 1980's the first generation of archive tags was developed and deployed on marine fish.

Recovery rates for archive tags in the open ocean are typically low (~30%). It is unclear, however, if these poor recoveries are due to differences in survivorship of the fish, differences in tagging technique, tags location, or tag failure. In studies with an active fishery and where fish carrying an external identification tag can be collected at terminal spawning locations, archive tag recoveries can be quite successful (60-80%, D. Welch, pers. comm.) Testing tag recovery rates and efficiencies in a hatchery stock released into Prince William Sound provides the best possible conditions for initial archive tag studies using this technology in the Gulf of Alaska.

Data archived by these tags include records of ambient and internal body temperature, pressure, and light. It is possible to estimate latitude (geoposition) for tag location at any given time from light intensity, temperature, and accurate temporal measurements of dawn and dusk (Hill 1994). The longitude determination is equally accurate throughout the year and at all locations except those where no dawn and dusk events are recorded. Latitude determinations are most accurate at the solstices and useless at the equinoxes. This is clearly a problem in Alaska waters where long crepuscular periods (winter) are followed by intense solar periods (summer). The accuracy of light-level measurements, duration of crepuscular events, atmospheric aberrations, and individual fish behavior can all impact the accuracy of geoposition estimates. A current error rate of 50-60 miles is not uncommon in the analyses of these data from temperate waters. We expect a much lower error rate in Alaskan waters based on current studies of light sensors and data analyses adapted to local light conditions (EVOS #00478).

Data from archive tags can be made available at the time of recovery to any user group after developed algorithms translate sequence data stored on tags into temperature, pressure, and light information. Successful integration of archive tag data into the EVOS Trustee Council's Gulf Ecosystem Monitoring (GEM) program will allow the development of a unique and continuous information base on natural use of critical marine habitat by king salmon caught in the Whittier sport fishery and during spawning migrations. These data will allow estimates of ocean use, migrations, development rates, and movement of hatchery fish into natural salt and

freshwater habitats in Prince William Sound. This proposal suggests that data collected from archive tags deployed in the Gulf of Alaska be made available to local communities and interest groups through internet web links with a USGS/BRD web site dedicated to this study. This proposal is intended to test the accuracy and efficiency of archive tags for estimates of geoposition and ocean use by king salmon in the Gulf of Alaska. If successful these data can provide an effective database for sampling protocols and analyses of critical habitat use by post-smolt and maturing wild king salmon in Alaska waters.

Additional research on cost-effective tagging regimes for this area need to follow our development of efficient light-based geoposition estimates using archive tags. To this end the PI (JLN) has been invited to participate in a development cosortium devoted to scientific advances in the application of electronic tagging tools in marine ecosystems. This informal consortium is made up of several research scientists, resource managers, and manufacturers devoted to tagging technology in ocean environments. The rationale of the consortium is to provide open communications on the existing technology (supply and demand, recent developments, application problems and successes) and to push for the appropriate level of investment and product specifications (e.g. size, transmission potential, data storage, validated data) for ongoing needs and the manufacturability (including quality, reliability, satellite platforms, price, and development times) for future research. This consortium provides an active dialogue among key researchers and institutions that are willing and able to invest resources to aid and abet the development and application of this technology in a transparent process that will share the risks and the rewards. Our satellite pop-up tag study (EVOS project 00478) designed to test geolocation technology under local application is considered one of the few "well structured technical assessments of this technology" currently in progress (D. Welch's study of steelhead ocean migration in British Columbia is another).

Our new proposal will investigate species-specific tagging protocols, size and location of tags as they affect survival rates (for both fish and tags), effects of coastal geology on tag recovery and data collection, and the effects of fish mortality and tag mortality on the interpretation of results in king salmon. These objectives will require integration of archive tag data with other significant geological, oceanographic, and climatic databases for this area. Alaska Department of Fish and Game will benefit from this study by an analysis of hatchery fish adaptation to and use of critical marine habitats in Prince William Sound. These data will allow interpretation of hatchery fish interactions with local fish stocks (both predators and prey) and other aquatic resources such as marine mammals at different locations or habitats. These data will provide information important to the development of hatchery supplementation programs and conservation strategies in this area.

This proposal requests funding to undertake archive telemetry studies on Prince William Sound king salmon incorporating five program elements:

1) Initiate an *in situ* array of archive tags on a stationary buoy in Prince William Sound and monitor light data reflecting natural solar conditions at various depths for one year. These data will be incorporated with light sensor information developed in Resurrection Bay (EVOS#00478) to provide data from two latitudes for different years. These data will serve as the baseline data against which we will develop geoposition algorithms specific to local conditions in the Gulf of Alaska.

2) Rear chinook salmon from the Willow Creek stock maintained by ADFG for live releases into PWS at ADFG's hatchery facilities (Elmendorf) and at the SeaLife Center until they reach critical size for surgical implants of archive tags (150 - 300 mm). Implant tags in 60 salmon smolts/post-smolts and retain 60 fish of equal size as non-tagged controls (2001). Monitor tag retention, behavior, and growth for one year in captivity prior to any live releases.

3) Year 2 (2002) we plan live releases at ADFG's Ester Island facility on Prince William Sound. Tagged fish will be acclimated to PWS waters at the hatchery release location for imprinting and then released into marine waters. Size structured live releases will be made based on results from our first year's pilot study of tag retention and behavior. Since king salmon typically spend 1-2 years at sea and have a three-year life cycle, recoveries from the sport fishery and in spawning habitats will be monitored in 2002 - 2004. Yearly progress reports will be made with a final report submitted by September 15, 2004.

4) Monitor tag recoveries in the fishery, at the hatchery release site, and adjacent streams. Analyze data on individual fish behavior for two years post-release using geoposition estimates developed specifically for Gulf of Alaska.

5) Plot estimates of geoposition, movement, critical habitat use, and maturation cycles from archive tags collected from king salmon in Prince William Sound. Draw inference from these data for chinook use of ocean conditions, migration paths, stray rates, and critical habitat needs for king salmon in Prince William Sound. These data will be incorporated into the GEM database and provide information on sport fishery effects in marine systems, hatchery enhancement effects on other marine organisms, and critical marine habitat needs of chinook salmon in the Gulf of Alaska.

NEED FOR THE PROJECT

A. Statement of Problem

Knowledge of the marine distribution of individual fish over time and space within the Gulf of Alaska ecosystem is needed to make sound management decisions for recovery, management of the resource, and for the development of reserves and/or protected areas in marine ecosystems. Without sound scientific support, recovery and conservation activities in marine systems will remain controversial among diverse user groups, especially in species governed by such diverse interests as chinook salmon. Including local community based information in the deployment and recovery of these scientific data will be an effective tool in resource management. Documentation of individual fish behavior in economically and ecologically important species within the Gulf of Alaska will aid in the development of a common-ground database on fish distributions over time and space during the development and implementation of management units within the marine systems where frequent conflict-of-interest problems are expected to arise.

The marine environment imposes severe constraints on the type of tags that can be used to monitor the behavior of fish in their natural environment. Seawater is highly conductive and radio waves do not propagate well in this medium. Recently marine biologists have developed new technologies in an effort to address this problem. Archive tags are internally positioned in the fish's abdomen with light and temperature sensors extending outside the fish on a thin

antenna. Sensors are programmed to collect data at set intervals for up to three years. To date this technology has been applied to many important marine species including cod and anadromous salmonids (primarily in Atlantic waters) and in Canadian steelhead populations (D. Welch, pers. comm.) The developmental approach used in the acquisition and analyses of light data generated by archive tags is the same as that used for pop-up tags (EVOS #00478) with the same need for adaptation to local climatic and solar conditions.

Additional research needs to be undertaken on cost-effective and efficient tagging regimes for this new technology, especially in salmon species. The implications of the successful application of archive tags in salmon for documentation of ocean use are enormous. Documentation of changes in salmonid ocean migrations, marine habitat use, and their reaction to critical production variables in the marine environment are necessary for our understanding of salmonid response to decadal shifts in ocean conditions and larger climatic cycles of ocean productivity. This study would facilitate investigations of species-specific tagging protocols, size and location of tags as they affect survival rates (for both fish and tags), effects of coastal geology and local climate on light data, recovery probability for different terminal captures and tag types (i.e. sport fishery and weirs with archive tags vs. satellite pop-up tags), and the effects of fish mortality and tag mortality on the interpretation of results. We will also develop a platform for data exchange, crossover studies, and data archive capacity for ecosystem scale marine habitat analyses in the Gulf of Alaska. This latter objective will require integration of archive tag data with other significant geological, oceanographic, and climatic databases for this area.

Potential future applications directed at discovery and monitoring of ocean habitat use by king salmon are broad. A clear understanding of marine life history and ocean forage migrations in salmonids will only become available with the development and appropriate application of this technology. Understanding temporal and spatial use of marine habitats by critical marine species will contribute significant information to fisheries resource management decisions in the Gulf of Alaska.

B. Rationale/Link to Restoration

Information collected during this study will contribute to our ability to use new technology to assess recovery and impediments to recovery (critical habitat) for an economically and ecologically important fish species found in Prince William Sound and the Gulf of Alaska, king salmon. The proposed work represents an initial scientific approach to increase our technological capacity to investigate the factors that affect population dynamics on multiple temporal and spatial scales. If successful, this technology will help in the definition of critical habitat for proposed marine reserves in the Gulf of Alaska. Without an understanding of the general underlying patterns of habitat use that dictate population change and species interaction within marine units or areas, we can not prescribe or limit specific activities within the reserve based on species distribution. Analysis of critical habitat use, hatchery/wild interactions, and interspecific competition for different life history stages of key species will allow integration of sustainable use or limited harvest in the conservation and management of these species within critical marine areas sensitive to anthropomorphic changes over time. The development of archive tag technology offers a promising window on this type of information.

Archival tag technologies offer the fisheries research community a new tool that is required to resolve movement patterns, spatial and temporal habitat use, and stock structure of many migratory marine species found in the Gulf of Alaska. The critical advantage to this new

technology is that it allows documentation of habitat use based on actual fish movement and behavior in areas and at times where human observations are impossible. Conventional identification tags have been used since the early 1900s, but individuals must be recaptured before information is obtained. Hydroacoustic tags can provide multi-day records of location, depth, temperature and swimming speed in marine fishes, but their temporal and spatial scale is limited by the range of signal recovery and transmission duration. In 1996 the first generation of archive satellite "pop-up" tags were developed and deployed on pelagic fish, but these tags are currently limited to very large fish (~70 lbs). Implant archive tags allow recovery of data from much smaller individuals including salmon post-smolts. The data archived by these tags can include records of ambient and internal body temperature, pressure, and light. It is possible to estimate latitude and longitude for tag location at any given time from changes in light intensity (see proposal #00478). Approaches developed from studies of satellite pop-up tags in the previous proposal are transferable to analyses of data collected from implant archive tags in salmon post-smolts and young adults from the Gulf of Alaska.

C. Location

Data to be compiled will come from tags deployed in Prince William Sound. Initial physiological data concerning tagging effects and efficiencies of light intensity data will be assessed using a limited number of fish in captivity at ADFG hatchery facilities. Tagging of 40 post-smolts with archive tags will take place in collaboration with ADFG and the local sport fishing community. Tag array disposition on a stationary buoy in the Prince William Sound will parallel our previous efforts in Resurrection Bay (proposal #00478). Tag recoveries will employ local sport fishers (yr 1 & 2), collection of spawning adults at the release site (yr 1 & 2), and incidental recoveries in other sport, commercial and research fisheries in and around Prince William Sound.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

All efforts will be made throughout the project to incorporate participation in and provide local involvement in the implementation and development of this project in relation to target populations and tagging localities. Project staff will be available to present information to local communities, internet access to real-time data from satellite tags will be made available at the local level as it becomes available to the PI. All articles, video, or photographs of the tagging study will be made available to the Trustee Council. The nature of the tagging study and the charismatic character of the fish subject make this a potentially high profile public relations project for the recovery and Trustee Council.

PROJECT DESIGN

A. Objectives

1) Initiate an *in situ* array of archive tags on a stationary buoy in Prince William Sound and monitor light-data reflecting natural solar conditions at various depths in this area.
    A. These data will be incorporated with light sensor information developed in Resurrection Bay (EVOS#00478) to provide data from two latitudes over two

years. These data will serve as the baseline data against which we will develop geoposition algorithms specific to local conditions in the Gulf of Alaska.

2) Rear chinook salmon from the Willow Creek stock maintained by ADFG for live releases into PWS at two independent facilities: ADFG's hatchery facilities (Elmendorf) and the SeaLife Center. Fish will be reared until they reach critical size for surgical implants of archive tags (150 - 300 mm). Implant tags in 60 salmon smolts/post-smolts and retain 60 fish of equal size as non-tagged controls under the same reading conditions. Monitor tag retention, behavior, and growth for one year in captivity prior to any live releases.

   A. Cooperation and contribution of resources by ADFG has been promised by Larry Peltz, Hatchery Manager ADFG. The hatchery stock used in this program is the same Willow Creek stock used for release by ADFG in Resurrection Bay.

3) Second year (2002) we plan 60 live releases at ADFG's Ester Island facility on Prince William Sound (an additional 60 tagged chinook will be released if external funds become available for the implementation of the tag study from sources outside of EVOS). Tagged fish will be acclimated to PWS waters in holding pens at the hatchery release location for imprinting and then released into marine waters. Size structured live releases will be made based on results from our first year's pilot study of tag retention and behavior.

4) Monitor tag recoveries in the sport fishery, at the hatchery release site, and at adjacent spawning locations (strays) and analyze data on individual fish behavior for time post-release using geoposition estimates developed specifically for Gulf of Alaska and Prince William Sound. Since king salmon typically spend 1-2 years at sea and have a three-year life cycle, recoveries from the sport fishery and in spawning habitats will be monitored in 2002 - 2004. Yearly progress reports will be made to EVOS.

5) Plot estimates of geoposition, movement, critical habitat use, and maturation cycles from archive tags collected from Prince William Sound king salmon.

   A. Draw inference from these data for chinook use of ocean conditions, migration paths, stray rates, and critical habitat needs for king salmon in Prince William Sound. These data will be incorporated into the GEM database and provide information on sport fishery effects in marine systems, hatchery enhancement effects on other marine organisms, and critical marine habitat needs of chinook salmon in the Gulf of Alaska.

B. Methods

A total of 120 archive tags will be deployed under various conditions to gather and analyze data on estimates of geolocation for free ranging king salmon in the Gulf of Alaska. The PI will monitor surgical tag implantation effects on a test population (N=60) with at least two veterinary scientists at two independent rearing location to avoid potentially complicating environmental effects. Tests will include anesthetic effects, physiological stress during and after

tagging, stability of implantation over time, fish mortality, fish growth and fish behavior. Live releases of 60 – 120 tagged chinook will be made in year 2002 from ADFG's chinook hatchery facility of Esther Island. Recovery of tags from the fishery and from natural returns to the hatchery and in geographically proximate spawning locations will be monitored for two years post release.

Several features of the archive tags will be tested from an array of tags deployed from a stationary buoy located in Prince William Sound. This tag array will be used to test efficiency of light sensors at different latitudes within the Gulf of Alaska, temperature cycles at depth, stability of pressure sensors at depth, and effective recovery of data over time. Estimates of actual fish location will be obtained from data collected from fish captured in the fishery and recovered at the site of release. These data will then be compared and analyzed for rigor of geoposition estimates based of our findings from previous captivity light studies and the stationary tag array in the Gulf of Alaska.

Conversion of archive data to position and movement cycles for individual fish will be made using adaptations of existing conversion algorithms available from the vendor and our initial field trials of tags in the Gulf of Alaska. New approaches to estimating geoposition from light data using time series analyses will be used in this study (R. Hill, Wildlife Computers, pers. comm.) Data for location and position for individual tags collected in the wild will be plotted on digitized maps of the Gulf of Alaska (two dimensional) incorporating any bathymetric data (three dimensional) available for this area using standard telemetry and GIS mapping methods (Baltz 1990; Cressie 1991; Thompson et al. 1992).

This study will continue the development and implementation of the internet link to Gulf of Alaska tagging studies and results will run parallel to the ongoing field studies and tagging data development. The web site will be posted on the USGS/BRD Alaska Biological Science Center's home page.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

This proposal relies on a number of significant research collaborators including ADFG's Larry Peltz and Bob Clark. Many unnamed collaborations will develop during the implementation of this project (i.e. commercial or sport boat captains, fishing volunteers, and community internet links). Known collaborators include: Dan Mulcahy, DVM, USGS/BRD fish and wildlife veterinarian; Riley Wilson, DVM Anchorage Zoo; Roger Hill, Wildlife Computers; Dr. Paul Howey, Microwave Telemetry, Inc., Jim Lotimer and Keith Stoodley, LOTEC Marine Technologies, Inc. Lee Hulbert of the National Marine Fisheries has volunteered collaboration on the analysis of light data collected from their shark pop-up tag study. All technical and clerical staff will be employees of USDGS/BRD Alaska Biological Science Center or qualified individuals contracted directly for this project.

SCHEDULE

A. Measurable Project Tasks for 2001 - 2004

Funding 2001 (EVOS)

Oct. 00 – Mar. 01: Purchase of archive tags, dummy tags and tags for buoy array. Establish holding facilities for king salmon from FY00 broodstock from Willow

	Creek for use in implant studies (site determined by ADFG) and at the Alaska Sea Life Center.
April 2001	Control tests for surgical implants of tags for estimates of survival, handling stress and delayed mortality in king salmon.
May – June:	Surgical implants of archive tags in size-structured study groups (N = 60) and establishment of monitoring protocols for tag retention, growth, behavior and survival.
June - July:	Deploy light sensor tag array on stationary buoy in Prince William Sound.
May 01–Apr 02:	Monitor and evaluate fish performance, survival, behavior and tag retention at two rearing locations.
April 15, 02	Annual report due EVOS.

Funding 2002 - 2003 (EVOS/BRD)

May – June:	Surgical implants of archive tags in size-structured release groups (N = 60). Acclimation to PWS waters at hatchery site on Esther Island. Tag releases into marine waters.
June - Sept	Monitor fish recoveries from sport fishery out of Wittier (implement reward program) and from streams near release site for possible early returns of spawning fish (jacks) with tags in natural stream environments.
July 2003:	Recover light sensor tag array on stationary buoy
Sept – Dec:	Collect and analyze first data sets from sport fishery. Develop Web Page for study results and plot initial data. Consult on tagging applications and data interpretation. Develop oceanic temperature and bathymetry database for Prince William Sound.
Aug. - Nov.:	Collect tags from king salmon spawning recoveries in streams in vicinity of release site using nets, hook-and-line, and carcass recoveries.
Nov. – Dec.	Analyze yearly data sets from sport fishery, spawning recoveries, and buoy array.
Dec. – Jan.:	Integrate light data sets from all recoveries and plot fish movements over time using geolocation estimates.

Funding 2004 (BRD)

Jan. 2003: Prepare final data presentation and attend restoration meeting.

Feb – Apr. 2003: Integrate analyses from parallel studies of pop-up tags in Gulf of Alaska.

April 15: Submit final report to EVOS on study results.

B. Project Milestones and Endpoints

All EVOS costs for this project will be billed in 2001-02, with primary tagging costs in 2001.

Due to timing of salmonid life cycle (up to two years at sea) data analyses will continue into FY2004.

Project will be completed upon submission of the final report prior to Sept. 15, 2004.

C. Completion Date

All project objectives billed to EVOS will be met before the end of Sept. 2003.

PUBLICATIONS AND REPORTS

Preliminary report submitted to EVOS April 15, 2002. A final report of activities will be submitted to the Restoration Office on or before 15 Sept. 2004.

Manuscript containing final results and recommendations will be submitted to a peer-reviewed scientific journal for publication in FY03-4.

Website development and maintenance of our tagging database will be available FY01-03. At the end of the project we will transfer the internet site to a webmaster designated by the Trustee Council.

PROFESSIONAL CONFERENCES

International workshop on tracking salmon at sea FY01 (British Columbia, CA)
Fourth Conference on Fish Telemetry - June 2001 (Trondheim, Norway)
American Fisheries Society - Aug 2001 (Phoenix, AZ)

NORMAL AGENCY MANAGEMENT

The work proposed here is not part of normal agency management and is related specifically to research addressing oil spill restoration concerns. No similar work has been conducted, is currently being conducted, or is planned using agency funds.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This research provides fundamental information needed for the implementation and development a new technology dedicated to the identification of critical marine reserve areas in Prince William Sound and the Gulf of Alaska. The definition of critical marine habitat for economically and ecologically important fish species will serve as a cornerstone for future Trustee sponsored conservation and use management proposals under the GEM program. The major objectives of this work require interaction with several other investigators and integration of all available data that are relevant to the question of critical marine habitat in the Gulf of Alaska.

PROPOSED PRINCIPAL INVESTIGATOR

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PERSONNEL QUALIFICATIONS

Jennifer Nielsen is Fisheries Supervisor and Research Biologist (GS14) with the Alaska Biological Science Center, USGS Biological Resources Division. She has conducted salmonid and fisheries research throughout the western Pacific for the past 22 years. Dr. Nielsen is an Associate Professor at the University of Alaska, Fairbanks in the School of Fisheries and Ocean Sciences. From 1995 - 1999 she was a visiting scientist at Hopkins Marine Station, Stanford University, where the first experiments on satellite pop-up tags were conducted on blue fin tuna. From 1995 - 1999, she was an Adjunct Professor in Ichthyology and Fisheries at the University of California, Berkeley and Moss Landing Marine Laboratory, and served on the Scientific Review Board for the Monterey Bay Aquarium. Dr. Nielsen has published over 30 peer-reviewed journal publications and book chapters, numerous technical reports, and gives frequent national and international presentations at scientific meetings addressing research issues in fish conservation, behavior, evolution, and genetics. Her work on salmonid fishes is recognized internationally for its contribution and focus in fisheries conservation and management.

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LITERATURE CITED

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United States Department of the Interior

U.S. GEOLOGICAL SURVEY
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IN REPLY REFER TO:

TC approve 1-4-01

Memorandum

To: *Exxon Valdez* Oil Spill Trustee Council

From: Dede Bohn, USGS liaison

Subj: Revisions requested for Project 01404

Date: January 2, 2001

At your December 5 meeting, you approved $75,000 in funding for Dr. Jennifer Nielsen to proceed with project 01404, "Archival Tags for Tracking King Salmon at Sea Reveal Migrations, Biology, and Oceanographic Preferences in Prince William Sound". We appreciate and thank you for your support.

At this time, we would like to request two revisions to the project that will not affect the scientific intent of the study, which is to test the tag technology. The revisions were raised by ADFG hatchery officials as Dr. Nielsen met with them in late December to get this project underway; Dr. Nielsen concurs with the recommendations. The requested revisions are: 1) Test the tags on Coho instead of Chinook salmon, and 2) Release the fish at Ship Creek in Cook Inlet rather than the Ester Island hatchery in Prince William Sound.

Coho salmon are being requested for the first year of the project because Chinook currently available at the hatchery come from the year 2000 brood stock, and are too small to support tags, even by accelerating growth conditions. Coho salmon, however, can be obtained from 1999 brood stock, and can be raised by March to the size necessary for tagging (150 - 300 mm) through accelerated growth conditions (warmer water and more food). In addition, ADFG data from Ship Creek show both significantly higher returns for Coho (10%) than Chinook (2%), and faster return rates for Coho (18 months) than Chinook (3 years), improving the success of the project. Note that by accelerating early growth, as proposed in this project, these returns are predicted sooner.

Release at Ship Creek instead of Ester Island is proposed to increase the chance of fish recovery. Ship Creek is favored because there is a weir that can be monitored, its close proximity to the hatchery reduces transport distance and handling of the fish, and advantage can be made of existing ADFG reporting programs, which include volunteers at Ship Creek and a sport fishery program.

We appreciate your consideration of this request.

APPLIED
Marine
SCIENCES

Memo

January 4, 2001

To: Exxon Valdez Trustee Council

From: Robert Spies, Chief Scientist

Re: Testing archival tag technology in Alaskan salmon (Project 01404)

At your December 5 meeting you approved $75K for Dr. Nielsen to proceed with this project, but requested that some further consideration be given to the species, Coho vs. Chinook salmon, and site of release for the fish. As a result of your request, Dr. Nielsen has met with representatives of the Alaska Department of Fish and Game and has proposed the following changes:
1. Testing the tag technology on Coho instead of Chinook salmon, and
2. Releasing the tagged fish at Ship Creek in Cook Inlet instead of Easter Island hatchery in Prince William Sound.

I find that the requested changes are consistent with the overall goal of testing tag technology. In fact, they may allow a greater rate of tag recovery, which will make the project more cost effective. I am therefore recommending that the revisions be accepted and that the project proceed as now planned.

Cc: M. McCamon
P. Mundy
S. Schubert

4749 Bennett Drive Suite L Livermore CA 94550 925.373 7142 Fax 925.373.7834

Revision 11-8-00
approved TC 12-5-00

EXXON VALDEZ OIL SPILL DETAILED PROJECT DESCRIPTION

Project Title: Harlequin duck population dynamics

Project Number:	01407
Restoration Category:	Monitoring
Proposer:	Alaska Department of Fish and Game
Lead Trustee Agency:	Alaska Department of Fish and Game
Cooperating Agencies:	USFWS, USGS-BRD
Alaska SeaLife Center:	No
Duration:	2nd year of 3 year project
Cost FY01:	$67,600
Cost FY02:	$70,000
Cost FY03:	$43,000 (Report Writing, Close-Out)
Geographic Area:	Prince William Sound
Injured Resource:	Harlequin ducks

ABSTRACT

Harlequin duck (*Histrionicus histrionicus*) populations in Prince William Sound (PWS) have not recovered from the effects of the *Exxon Valdez* Oil Spill. Populations are declining in oiled areas while increasing in unoiled areas. Proposed late-winter boat surveys have been designed to assess the recovery of ducks inhabiting oiled areas. Population structure, abundance, and recruitment will be compared between oiled and unoiled areas in PWS to assess trends, population dynamics, and the progress of recovery. As part of the Gulf Ecosystem Monitoring program this survey will help identify changes to the Gulf of Alaska ecosystem and improve our ability to differentiate between natural and man-caused population changes. This will be the second year of this project.

INTRODUCTION

Harlequin duck (*Histrionicus histrionicus*) populations in Prince William Sound (PWS) have not recovered from the effects of the *Exxon Valdez* Oil Spill. Populations are declining in oiled areas while increasing in unoiled areas (Rosenberg and Petrula 1998). This lack of recovery may be a result of continued oil exposure. Ducks in oiled areas exhibit elevated levels of cytochrome P450 induction, indicating continued oil exposure and adult female winter survival was lower on oiled than unoiled areas (Holland -Bartels et al. 1999). These two studies provide strong evidence that harlequin ducks have not recovered from the effects of the *Exxon Valdez* oil spill (*Exxon Valdez* Oil Spill Trustee Council 1999).

Harlequin ducks occur year-round in intertidal zones of PWS (Isleib and Kessel 1973). At least 1,298 harlequin ducks were estimated to have died as a direct result of oil exposure following the Exxon Valdez oil spill (J. Piatt pers. comm.). Oil spill studies of harlequin ducks in western Prince William Sound (PWS) from 1990-93 found consistently low numbers of birds during the breeding season, little breeding, low productivity, and an apparent decline in post-breeding molting birds (Patten et al. 1998a, Patten et al. 1998b). In 1995, six years after the Exxon Valdez oil spill there was no sign of recovery (Exxon Valdez Oil Spill Trustee Council 1996).

As a result of the 1990-1993 findings and the lack of recovery, ADF&G initiated population monitoring in 1994 (Rosenberg and Petrula 1998). These studies, conducted from 1994 through 1997, found no difference in population structure between oiled and unoiled areas; no brood production in the spill area; and a decline in molting populations. Similar population structures, a positive finding, indicated that the population was in a position to recover. However, the declining trend in numbers during autumn surveys for the oiled areas of western PWS remained a concern, especially since populations in unoiled eastern PWS increased. This indicated that recovery has not occurred.

Other studies have collaborated our findings. Winter survival of adult female harlequin ducks was lower on oiled areas than unoiled areas in PWS (Holland-Bartels et al. 1999). Modeling efforts based on this data predicted a declining population in the oiled area and a stable population in the unoiled area. Lower survival rates may be related to continued oil exposure (Holland-Bartels et al. 1999). Results of USFWS marine bird surveys were more ambiguous. These surveys show no evidence of population recovery based on summer surveys. However their March surveys show an increase in densities in both oiled and unoiled areas, although the comparative increase between the oiled and unoiled area does not meet their criteria for recovery (Lance et al. 1999).

Sea duck populations, in general, are composed of relatively long-lived birds with delayed sexual maturity. Productivity may be limited to a few favorable years and population levels may change slowly. Long-term population stability depends on high adult survival coupled with a few years of successful reproduction. Initial high losses of adults, especially females, may result in a long and slow recovery period, especially if initial causes of mortality are still influential.

We propose to continue our winter survey that is comparing population trends and structure in the same oiled and unoiled areas surveyed in project \427 (Rosenberg and Petrula 1998) and

expanded in this project. By expanding geographic coverage we will improve our ability to compare regional differences in population trends within oiled and unoiled areas, increase statistical power, and detect long-term changes in the marine ecosystem.

Harlequin ducks occur year-round in the nearshore environment, feed on benthic invertebrates, exhibit site-fidelity, are relatively long-lived, and are widely dispersed in the Gulf of Alaska. These characteristics make them unique among nearshore avian predators and ideal candidates for monitoring ecosystem change.

With modifications, this is a continuation of Project /427 Harlequin Duck Recovery Monitoring conducted from 1995-1997. A March survey was conducted in 1997. No fieldwork was conducted on project /427 in FY98 or FY99. This project will continue to monitor harlequin duck populations in oiled and unoiled areas of PWS. Surveys will be conducted in March. March is a period when pair bonds are well formed, and there is relative stability in both numbers and movements of harlequin ducks.

NEED FOR THE PROJECT

A. Statement of Problem

Harlequin ducks have not recovered from the effects of the *Exxon Valdez* oil spill. Populations in oiled areas are continuing to decline (Rosenberg and Petrula 1998). Declining molting populations, coupled with low female survival, and exposure to hydrocarbons in oiled areas are all indicative of a lack of recovery and continued oil spill effects. Residual oil is still present in the nearshore environment (Pat Harris, NMFS, pers. comm.) and it has the potential to interfere with physiological processes (Holland -Bartels et al. 1999). Two main hypotheses have been presented to explain population declines: (1) ingested oil is continuing to cause either mortality and/or sublethal impairment of reproduction; and/or (2) initial mortality caused significant losses to the western PWS population which may result in a protracted recovery period.

The greatest biological problem in identifying the effects of the EVOS was our lack of basic knowledge on harlequin duck life history, ecology, distribution, and abundance. Poor knowledge of harlequin duck life history at the time of the spill made it difficult to design effective damage assessment and monitoring programs. Scant baseline data on population size made assigning injury and recovery based on pre-and post-spill comparisons tenuous because of a low sample size, high variability, and data that was collected many years before the spill. Poor understanding of regional differences within PWS confounded interpretations of differences between oiled and unoiled areas. This clearly pointed out the need to have good baseline information and time-series data on numbers, distribution, population structure, and a variety of life history events.

Identifying and establishing the cause of population declines depends on knowledge of the status of the resource immediately prior to environmental perturbations and an understanding of the inter-annual variability or the normal variation between years in periods of little perturbations in the larger physical system. Thus, our ability to detect departures from natural variation is necessary if we are to accurately evaluate the effects of major environmental perturbations whether natural or

man-caused. This requires numerous samples, distributed through time, preferably focusing on long-lived species that tend to show less natural variability. Without time-series data on harlequin duck abundance and abiotic and biotic ecosystem changes we lack the ability to interpret the affects of natural or man-induced processes.

B. Rationale/Link to Restoration

This proposed work represents a relatively simple, workable approach to the long-term monitoring of harlequin duck populations that will allow us to assess recovery from the spill, detect long-term ecosystem changes, gather basic life history information, and improve management.

We propose a survey that will have the power to detect trends in populations in oiled and unoiled areas, provide information on population demographics, and give insight into geographic differences within PWS. This study is directly linked to the recovery objectives for harlequin ducks in the EVOS Restoration Plan (Exxon Valdez Oil Spill Trustee Council 1999). This project will provide winter population trends; compare population structure, and provide an index of recruitment between oiled and unoiled areas.

Harlequin ducks are highly philopatric to breeding, molting, and wintering sites. This is an adaptive strategy in natural situations and predictable environments. It is not favorable in the face of dramatic environmental perturbations or rapidly changing land-use practices. It does not favor rapid recovery and colonization of new undisturbed sites. This strong philopatry may result in continued exposure to residual oil or delays in pioneering new nest sites once populations stabilize. Monitoring provides a direct approach to assess recovery.

Information from this project will aid in the development of a population model. A population model is central to monitoring harlequin duck recovery. The model must include demographic parameters and identification of critical periods of the annual cycle that may limit recovery from the *Exxon Valdez* oil spill. This will allow researchers to predict population trends and rate of recovery. While some of this information has been collected for PWS populations (Rosenberg and Petrula 1998, Holland-Bartels et al.1999) and harlequin ducks in North America (Goudie et al. 1994, Robertson and Goudie 1999), many specifics are still lacking, including data on productivity, recruitment, dispersal, and subadult survival.

Detecting trends in abundance and productivity from natural year-to-year variation will be met sooner with increased sampling. Results of this work will have a direct bearing on assessing the status and outlook for this resource and help guide agency programs and policies related to public uses, especially subsistence and recreational hunting, land-use practices, and wildlife viewing.

C. Location

The proposed project will be conducted in the oil spill area of western Prince William Sound and unoiled eastern PWS between Valdez and Cordova and northern Montague Island. March surveys

will repeat areas surveyed in /427 Harlequin Duck Recovery Monitoring (Rosenberg and Petrula 1998). Additional survey sites in PWS will be located on Montague Island, following the sampling scheme of project \025 Nearshore Vertebrate Predator Project (Holland-Bartels et al. 1999), and southwestern PWS.

Surveys in the spill area will focus on Knight Island, Applegate Island, Foul Bay, Main Bay, Eshamy Bay, Crafton Island, Chenega Island, Green Island, Naked Island, and Bainbridge, Evans, and LaTouche islands in southwestern PWS. Surveys in non-oiled areas will include portions of Hinchinbrook Island, Simpson Bay, Sheep Bay, Port Gravina, Landlocked Bay, Bligh and Busby islands, Galena Bay and Valdez Arm, and Montague Island.

Communities affected by the project include Chenega Bay, Tatitlek, Whittier, Valdez, and Cordova.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The project will continue to inform and coordinate our community involvement activities. This effort began with project /427 (Harlequin duck recovery monitoring) and a TEK report is included in Rosenberg and Petrula (1998). This effort was continued with project /273 (Scoter life history and ecology: linking satellite telemetry with traditional ecological knowledge).

Efforts have and will continue to be made throughout the restoration process to participate in and provide public involvement in the design and implementation of this project. Information gathered from this project will be shared with local communities. Study plans and results of project /427 and project /273 have been presented in the oil spill communities of Tatitlek, Chenega Bay, Cordova, Port Graham, Nanwalek, and Seldovia and at meetings of community facilitators. We will continue to present information to local communities and prepare articles or photographs for Trustee Council publications.

Boat and air charter contracts, and other services will continue to be contracted from local sources when possible.

PROJECT DESIGN

1. Surveys

A. Objectives

1. Compare population structure (number of breeding pairs, subadult males, adult males, and females) between oiled and unoiled areas during March.

2. Estimate density for oiled and unoiled survey sites in March.

3. Compare annual changes in density and population structure for oiled and unoiled survey sites.

4. Compare annual changes in density and population structure *within* oiled and unoiled survey sites during March.

5. Compare results with EVOS project /427 Harlequin Duck Recovery Monitoring.

6. Add to our knowledge of harlequin duck life history

7. Integrate data with other long-term monitoring surveys to detect long-term changes in marine ecosystems

B. Methods

This study will test the following hypotheses:

1. Objective 1.
   H_o: The ratio of males to females; total ducks to subadult males; and breeding pairs to total ducks is the same for oiled and unoiled populations during March.

   H_1: The ratio of males to females; total ducks to subadult males; and breeding pairs to total ducks is different for oiled and unoiled populations during March.

A generalized logit model (Agresti, 1990) will be used to test differences in population structure for oiled versus unoiled survey sites for winter and late-summer for objectives 1 and 2. Male:female ratios for individual survey periods will be compared by estimating proportions using cluster sampling (flocks) (Cochran, 1977).

2. Objective 2. No hypothesis is being tested.

3. Objective 3.
   Ho: The rate and direction of population change between years is the same for oiled and unoiled survey sites.

   H_1: The rate and direction of population change between years is different for oiled and unoiled survey sites.

Density changes will be tested by regression and population structure will be tested with logistic regression (Agresti, 1990).

4. Objective 4.
   H_o: The rate and direction of population change between years is the same within oiled and unoiled survey sites.

   H_1: The rate and direction of population change between years is different within oiled and unoiled survey sites.

Density changes will be tested by regression and population structure will be tested with logistic regression (Agresti, 1990).

5. Objective 5. No hypothesis is being tested.

6. Objective 6. No hypothesis is being tested.

7. Objective 7. No hypothesis is being tested.

March surveys. Surveys will be conducted in representative portions of oiled areas in western PWS and unoiled areas in eastern PWS. FY 95-97 transects will be repeated (Rosenberg and Petrula 1998) and new transects will be established in areas of northern Montague Island and southwestern PWS. Surveys will be conducted from approximately March 20 through 30. Repeat surveys will not be conducted and surveys in oiled and unoiled areas will not be conducted simultaneously because population flux is expected to be minimal at this time of year.

All harlequin ducks will be recorded along each survey route. Observations will be recorded as pairs or by sex, and males will be divided into two age groups using predetermined criteria (Rosenberg and Petrula 1998). Surveys will be conducted from open skiffs up to 20 feet long. Each skiff will have two observers. Surveys will be conducted from within 30 meters of shore along predetermined routes. A pace and course will be chosen that will assure complete coverage of the survey area and maximize the opportunity to see ducks. All transects will be mapped and all observations will be recorded by date and location and mapped by flock. Exxon Valdez oil spill beach segment modifiers (oiled areas), habitat associations, time, and weather will be noted.

Population composition and annual changes in density will be compared to test whether harlequin duck populations are exhibiting similar growth trends or the oiled (injured) population is exhibiting a different direction or rate of change. We will continue to test whether low reproductive success in oiled areas has resulted in changes in population age and sex structure. The proportion of first-year males to total males will be used as a measure of past reproductive success. Proportions of paired birds and male:female ratios will be compared for oiled and unoiled sites to indicate breeding propensity. Surveys will be used to detect changes in abundance and compare the direction and rate of change between years for the two survey areas. Surveys within oiled and unoiled areas will be compared to determine if geographic differences are detectable. Data from FY95-FY97 surveys will be incorporated into the analysis when applicable.

Power Analysis. We compared similar surveys conducted in March 1997 and March 2000. In EPWS (unoiled), 24 transects from 5 geographically similar regions were surveyed covering 244 km of shoreline. In WPWS (oiled), 18 transects from 7 geographically similar regions were surveyed covering 310 km of shoreline. For each transect we fit a simple linear regression model (y = density, x = year) to obtain an estimate of the rate of change in duck densities (birds/km). A hierarchical ANOVA was used to test for differences in the rate of change between locations. The model used was:

Rate of Change = overall mean + location + region (location) + transect (region location)

The power of the test was then calculated for several differences in slope between EPWS and WPWS and is presented below.

Difference in slope	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3
power (α= 0.10)	0.52	0.67	0.81	0.90	0.95	0.98	0.99	1.00	1.00
power (α= 0.05)	0.30	0.46	0.62	0.76	0.87	0.94	0.97	0.99	1.00

We observed a significant difference in the rate of change in density between EPWS and WPWS (difference in mean slopes = 0.76, p-value = 0.016). We would correctly reject the null hypothesis that there is no difference in the rate of change between EPWS and WPWS 81% of the time when the slopes differed by at least 0.7 (α=0.10). Because the slope is based upon density (birds/km), we can convert this change in slope to the change in the number of ducks we observe on our surveys.

By adding transects in oiled portions of southwest PWS (SWPWS) and unoiled Montague Island (Montague) we should be able to increase the power of our test, thus improving our ability to assess recovery. However, at present we cannot calculate a variance or slope for SWPWS or Montague because we only have one year of survey data. Thus, we cannot determine the power to detect a change in slopes between SWPWS and WPWS (i.e. within oiled areas) or between Montague and EPWS (within unoiled areas) until we have at least one more year of surveys. Regardless, the difference in slopes and how they compare to WPWS and EPWS will give us an estimate of geographic differences and of the contribution of these additional areas to any changes we observe.

Winter transects will give us greater power to detect a change than did our fall surveys (Rosenberg and Petrula 1998). Once we have 3 years of survey data we will be able to calculate the true slope and variance. Beyond that, frequency of sampling will depend upon biological and economic factors, and recovery objectives. Comparing the annual variation and rate and direction of slopes relative to each other will help determine sampling frequency.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

ADF&G personnel will conduct all data collection and analysis. Winter surveys and contracts for vessel support for winter surveys will be coordinated with related EVOS projects. Private sector contracts for winter vessel support will be solicited.

SCHEDULE

A. Measurable Project Tasks for FY 2001

October 2000	Project start-up. Interagency coordination. Plan logistics and personnel for winter surveys. Contract for vessel support.
Jan. –Feb. 2001	Hire seasonal technicians for March survey. Prepare field equipment. Finalize field logistics.
March 2001	Conduct winter surveys in PWS.
April – May 2001	Create databases, GIS. Analyze field data and begin report preparation. Maintain equipment.
June - July 2001	Analyze data
July-Aug-Sept 2001	Analyze data and begin report preparation
April 2002	Annual Report submitted

B. Project Milestones and Endpoints

FY01

October-February:	Coordinate and plan surveys, prepare equipment, contract for vessel support, hire personnel.
March:	Conduct population surveys.
April-September:	Data analysis and report preparation, maintain equipment.
April 15:	Submit annual report.

FY02

October-February:	Coordinate and plan surveys, prepare equipment, contract for vessel support, hire personnel.
March:	Conduct population surveys.
April-September:	Data analysis and report preparation, maintain equipment.
April 15:	Submit annual report.

FY03

October-February:	Coordinate and plan surveys, order transmitters, prepare equipment, contract for vessel support, hire personnel.
March:	Conduct population surveys.
April-September:	Data analysis and report preparation, maintain equipment.
April 15:	Submit annual report.

This is a minimum three-year monitoring program designed to assess the recovery of an injured species. Each project objective will be assessed annually for oiled and unoiled areas then compared with each other and with data collected in subsequent years. Year to year trends will first be compared in 2000 and then each year after. At the end of each year results will be compared with the restoration goals to assess whether recovery has occurred.

C. Completion Date

Under present guidelines, harlequin ducks will have recovered when breeding- and nonbreeding-season densities return to prespill levels. An increasing population and decreasing exposure to hydrocarbons in oiled parts of PWS will indicate that recovery is underway (Exxon Valdez Oil Spill Trustee Council, 1999).

This project will compare harlequin duck population structure and abundance between oiled and unoiled areas and within geographic areas. Until further information is gathered it will not be possible to predict when densities will return to prespill levels and oiled populations exhibit a positive trend, indicative of a population increase comparable to unoiled areas. This project may also discover new information that will suggest changes to the Recovery Objectives and it meets the objectives of the Gulf Ecosystem Monitoring program. If continued for the long-term, this survey will help identify changes to the Gulf of Alaska ecosystem and improve our ability to differentiate between natural population changes and those induced by human intervention.

PUBLICATIONS AND REPORTS

Annual reports will be presented to the Chief Scientist by April 15. Reports will include survey areas, population structure and abundance and movements and timing of marked birds. A final report will be prepared at the end of the proposed monitoring schedule unless continued monitoring is warranted or when recovery objectives are met. Special reports (publications) will be prepared during the course of the monitoring effort if warranted. Publications will be prepared for peer-review journals when sufficient data has been collected to warrant manuscript preparation.

PROFESSIONAL CONFERENCES

None

NORMAL AGENCY MANAGEMENT

There are no other agency or non-agency contributions to this project. ADF&G is not required to conduct these surveys by statute or regulation. Limited staffing and funding precludes ADF&G from undertaking these surveys as part of normal operations and in the past ADF&G has not conducted marine bird surveys in PWS as part of its normal waterfowl management functions.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This research relies on incorporation of methods and information from other EVOS Trustee sponsored research, including projects /427, and /025. Equipment purchased by /427 and /273 will be used to conduct this research. Location of research sites, and data collection and analysis will follow previously established protocols. All efforts will be made to coordinate surveys and

share vessel support and equipment with other EVOS projects. Personnel with ADF&G and USGS-BRD will assist each other when possible.

This project will be integrated with ongoing studies or findings of past studies including project \052B Traditional Ecological Knowledge; project \025 Nearshore Vertebrate Predator Project; project \427 Harlequin Duck Recovery Monitoring; and project \159 Prince William Sound Marine Bird and Mammal Surveys.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

No major changes from FY2000. This is the second-year of this proposed 3-year project.

PROPOSED PRINCIPAL INVESTIGATORS

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Revision 10-10-00
Approved TC 12-5-00

Assessing Prey and Competitor/ Predators of Pink Salmon Fry

Project Number:	01452-BAA
Restoration Category:	Research
Proposer:	R. Thorne, G. Thomas/PWSSC
Lead Trustee Agency:	NOAA
Cooperating Agencies:	None
Alaska SeaLife Center:	No
New or Continued:	New
Duration:	1st yr. 1 yr. project
Cost FY 01:	$57.6
Cost FY 02:	$0.0
Geographic Area:	Prince William Sound
Injured Resource/Service:	Walleye pollock, pink salmon fry, Pacific herring

ABSTRACT

Research suggests that macro zooplankton and adult walleye pollock densities are the primary biological forcing variables affecting pink salmon fry survival. A program to make these estimates was initiated in spring 2000 by a partnership of organizations including the Oil Spill Recovery Institute, Sound Emergency Response Vehicle System, and the Alaska Department of Fish and Game. This project will expand this effort to provide data on annual and seasonal variation of both predators and food availability for juvenile pink salmon and to interact with Project 01195/Pristane Monitoring, which is studying the use of pristane concentrations in mussels to estimate pink salmon fry survival.

INTRODUCTION

In 1989, the National Science Foundation GLOBEC program defined the limitations of observing and predicting animal population change in marine ecosystems (GLOBEC 1990a,b.c). One of the primary failures in past marine research was identified as the use of sparse, discrete measurements with nets to estimate abundance. GLOBEC recommended the combination of acoustical and optical quasi-continuous measurement technologies with discrete net sampling to resolve confounding temporal and spatial variation. Thomas (1992a) concluded that implementation of such methods were the single most important improvement that could be made to improve fisheries science and management. With the publication of new two-stage, acoustic-discrete sampling methods, the use of traditional discrete-only sampling methods to estimate fish and plankton abundance has become obsolete (Thomas and Kirsch 2000a,b; Kirsch et al. 2000).

The absence of quantitative information on prey and predator densities has long been recognized as a limiting factor to describing the mechanisms that affect juvenile fish survival (Cushing 1974; Jones 1973). Cooney (1993) and Willette et al. (1999a,b) have shown this to be true for pink salmon fry in Prince William Sound (PWS). Thomas et al. (1998) and Kirsch et al. (2000) developed acoustic-plankton net techniques to synoptically measure zooplankton prey and fry predator densities along the outmigration route of pink salmon fry in PWS. These data are prerequisites to run the models that predict pink salmon fry survival in the Sound (Cooney 1993; Mason and Patrick unpublished), and to empirically estimate survival until such models are developed and applied.

The annual run of pink salmon, which is composed of up to 90% hatchery fish, is a valued resource to the residents of the Sound (Thomas et al. 1991; Thomas and Mathisen 1993). The timing of release of pink salmon fry from the hatcheries in PWS is determined by measuring an abundance of macrozooplankton prey with a plankton net. However, Cooney et al. (1995) noted that the data from this plankton-watch program was not always consistent with other measures of productivity. Our observations show gradients between nearshore and offshore zooplankton could easily confound the data obtained from discrete sampling with a 0.5 m plankton net from 20 m to the surface. We have calculated that the sampling volume of an acoustic survey is a minimum of 20,000 times that of the 0.5 m plankton net survey of similar effort, and that the resolution is at least a 50 times greater. Furthermore, we have shown that hundreds of 0.5 m plankton-net samples are needed to estimate zooplankton densities with acceptable precision along any given transect. Thus, we conclude that it is impractical to accurately monitor zooplankton abundance with plankton nets.

Since acoustic surveys of macrozooplankton provide the distribution of the population that is being measured, and they require plankton net sampling to ground-truth the targets (McClatchey and Thorne 2000), proportional allocation of the plankton-net subsample is possible to increase sampling efficiency (Cochran 1967). Another advantage of acoustic surveys of macrozooplankton is the capability to threshold or use multi-frequency

techniques to synoptically estimate nekton predators. In PWS, researchers have shown that adult walleye pollock are the primary competitor with juvenile fishes for macrozooplankton prey in the spring (Thomas et. al 1997, 1998; Willette et al. 1999a,b). This compounds their importance to the survival of juvenile fishes since they also represent the dominant pelagic predator in the Sound. Thus, spring monitoring of zooplankton prey and fry predators is the critical first step needed to assess marine survival of the pink salmon fry.

Assessment of changing the ocean survival of North Pacific pink salmon is also a primary objective of the Global Ocean Ecosystem Dynamics program (GLOBEC). Thus the monitoring that we advocate in this proposal is both timely and relevant. It is highly unlikely that GLOBEC can accomplish its "overarching" goal, to understand the basis of interannual variation in juvenile salmon mortality, without the information this program will obtain. Pink salmon from PWS hatcheries are the primary component of GOA salmon, and the major source of mortality occurs in the early marine stages, i.e., in Prince William Sound. Recognizing this weakness of the ongoing GlOBEC program, we have initiated contact with several GLOBEC projects and plan collaborative work.

In FY00, the Oil Spill Recovery Institute (OSRI), in cooperation with the Prince William Sound Aquaculture Corporation (PWSAC), the Ship Escort Response Vessel System (SERVS) and the Alaska Department of Fish and Game (ADF&G) initiated a program to observe fry predator and zooplankton prey densities along the spring outmigration corridor of pink salmon fry in PWS. This proposal requests the funds to expand this program to include greater survey coverage in time and space, more in-depth data analysis and further development of the technique, as well as provide a linkage to an ongoing EVOS Trustee Council project (#01195) that is using pristane concentrations in mussels to predict pink salmon survival.

In summary, we have developed new methods and understanding of the Sound's complex ecosystem. We know that pollock dominates as a pelagic predator of pink salmon fry in the spring, and that it filter feeds on the same zooplankton the fry depend on for growth and survival. We have developed new acoustic-net sampling techniques that give us synoptic and representative estimates of these prey and predators. An application of this new methodology and information is to apply it to make annual estimates of fry survival and use this information to improve the forecasts of adult returns. Recognizing the importance of pink salmon to the Sound ecosystem, we have developed a collaborative program between OSRI, PWSAC, ADF&G and industry to monitor annual changes in the zooplankton prey and fry predator densities. Expanding this partnership to include the EVOS Trustee Council is a natural step because pink salmon are a large part of the restoration program, and the Council has made significant investments in the development of new methods and information.

Our objectives are to:

- Measure macrozooplankton density, distribution and abundance in PWS several times during the spring using echointegration-plankton net techniques,
- Make synoptic measurements of dominant fry predators, relying on the thousands of

past net samples and the simple composition of the pelagic fish assemblage for ground-truthing purposes,

- Use the predator-prey information along with physical oceanography information from the OSRI nowcast-forecast program to predict pink salmon fry survival,
- Exchange information on zooplankton and fish distribution and density with the pristane project to test assumptions, underlying mechanisms and compare results.

NEED FOR THE PROJECT

A. Statement of the problem

One of the original questions sought by the SEA program was to explain why the survival of juvenile salmon fluctuated dramatically after the oil spill. Pink salmon suffered major declines in 1992 and 1993. Declines in abundance may have resulted from changes to habitat, food supply, predator and competitor populations, genetic degradation, the commercial fishery and management, or unknown natural events. In 1990, GLOBEC scientists concluded that only with the development of the new population measurement techniques and survival models, would it be possible to hind-cast, now-cast and forecast accurately enough to separate the effects of natural from anthropogenic forcing on animal populations (Cullen 1989). The proposed monitoring program resulted from the development of new predictive tools for pink salmon survival. Specifically, the abundance of spring prey and predators is critical input for assessment of pink salmon marine survival. Improving predictive capability is the path for designing restoration activities that promote the conservation and sustainable use of the pink salmon stocks of Prince William Sound.

The EXXON VALDEZ oil spill occurred n 1989. In this same time period, the GLOBEC program was defining the limitations of predicting animal population change in marine ecosystems,. Armed with the only tools available, Alaska and federal agencies, and industry, began a massive, expensive and controversial damage assessment program. In 1994, the EVOS Trustee Council made a commitment to invest some resources into improving observation and prediction capabilities in the region.

The development and testing of new predictive models requires accurate and precise observational data. The new measurement tools that we developed in the past eight years are useful to both research and management because they are accurate and precise, which helps in the verification of predictions. In addition, they are cost-effective. This proposal requests EVOS Trustee Council provide a 25% match to the existing monitoring program and become a partner in the continued observation of spring predators and prey of juvenile pink salmon.

B. Rationale/Link to Restoration

This project provides the observational data that is necessary to explain annual changes in

the marine survival of pink salmon. It also provides "best-available" technology and information to agencies and industry for management purposes. The goal of these observations is to increase the capability to predict natural changes that are occurring in the pink salmon populations. This capability is a prerequisite for assessing anthropogenic impacts, such as those caused by an oil, assessment of restoration, and prediction of run size. The relevance of this research will be measured in its contribution to establishing a healthy salmon population that provides sufficient production to support abundant fish, seabirds and marine mammal predators and human use.

We are looking for a two-year partnership with EVOS Trustee Council to complete the transition from the research program to a fully operational model-based monitoring program. Concurrent with this project is the development of the physical nowcast-forecasting efforts (an OSRI, EVOSTC, RCAC, ADF&G and Industry partnership). The nowcast-forecast program provides important information on the spatially and temporally variable physical conditions that force changes in the predator-prey assemblage and affect population bioenergetics of all the species. Implementation of both biological and physical monitoring to determine juvenile fish survival was the original goal of the GLOBEC and SEA programs.

C. Location

Research will be conducted in Prince William Sound where the fishing industry in the communities of Cordova, Valdez, Tatitlek, Chenega Bay, Whittier and Seward will benefit. Transfer of this technology to outlining areas could result in benefits throughout Alaskan coastal communities.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Traditional and scientific knowledge has led to the development of regional applications of new acoustic methods. Local and Native fishermen were responsible for first applications of new quantitative acoustic technologies for fish stock assessment and research 1) after the herring collapse in 1993 (Gerald McCune, Cordova District Fishermen United, personal communication), 2) after the pink salmon collapse in 1993 (R.J. Kopchak and Jim Gray, Cordova fishermen, personal communication) and 3) at the beginning of the walleye pollock commercial fishery in 1995 (Jay Stinson, Alaska Draggers Assoc., pers. comm.) After repeated applications over the last seven years, management is slowly integrating this technology into its harvest management practices in the Sound. Full implementation of the information from these stock assessments and transfer of this technology to other areas such as Kodiak and Cook Inlet is dependent upon continued community involvement to generate the grass-roots support to obtain funding.

The following procedures have worked well for the SEA program and the Prince William Sound Science Center and will be followed for this project: 1) discusing problems with

the Board of Directors of the Science Center and the Oil Spill Recovery Institute, who collectively have four fishermen and four Alaska Natives as local representatives, 2) consulting with community representatives during the conception and design of the project to seek input, 3) advertising all vessel charters and employment opportunities in communities near where the work is to be performed, 4) visiting local communities during the course of the field work with our educational outreach program, and where appropriate, base field work out of the villages using local lodging and/or vessels, 5) providing information to the community through the publication and distribution of newsletters that use non-technical language on project results, 6) the posting of non-technical information on our web page, 7) the presentation of research results as seminars during the year in the community, 8) acknowledging all contributions appropriately, 9) applying the results of the research in ways designed to benefit local communities, people, and cultural practices and 10) living in and becoming part of the community we serve.

PROJECT DESIGN

A. Objectives

- Measure macrozooplankton density, distribution and abundance in PWS during the spring using echointegration-plankton net techniques,
- Make synoptic measurements of dominant fry predators, relying on the thousands of past net samples and the simple composition of the pelagic fish assemblage for ground-truthing purposes,
- Use the predator-prey information along with physical oceanography information from the OSRI nowcast-forecast program to predict pink salmon fry survival,
- Exchange information on zooplankton and fish distribution and density with the pristane project to test assumptions, underlying mechanisms and compare results.

B. Methods

Acoustic and ground-truthing procedures: Acoustic methodology for zooplankton assessment is well developed. Major publications include: Holliday and Peiper 1980; Greenlaw and Pearcy 1985; Peiper et al. 1990; GLOBEC 1990a,c; Stanton et al. 1994, 1996; Wiebe et al. 1997; Thomas and Kirsch 2000a,b. Specific application in Prince William Sound is described in Kirsch et al. (2000). The draft final report of the OSRI monitoring program for FY00 is attached as Appendix 1.

The application of multiple frequencies allows use of scattering models (Holliday and Piper 1980; Greenlaw and Pearcy 1985; Peiper et al. 1990; Stanton et al. 1994, 1996) to improve assessment accuracy. Although a variety of acoustic frequencies have been used in Prince William Sound, from 38 kHz to 1 mHz, comparable applications (acoustic/net sampling applications on *Neocalamus* spps. copepods) were previously limited to single frequency studies, either 120 kHz or 420 kHz (Thomas et al. 1998; Kirsch et al. 2000; Thorne and Thomas 2000a,b). The OSRI monitoring program (Appendix 1) uses three

frequencies simultaneously, 38 kHz, 120 kHz and 420 kHz. The 38-kHz frequency is primarily meant for fish, although the surveys in May 2000 found that 38 kHz also detected zooplankton with larger target strengths. The 120 kHz frequency is known to detect *Neocalanus* size zooplankton very effectively, while 420 kHz can detect most calanoid copepod zooplankton. We have found that frequencies higher than 420 kHz (720 kHz and 1 mHz) are impractical in PWS during the spring because the high sound attenuation in plankton layers severely limits the range and volume of the sampling.

In FY00, we used a BioSonics 38 kHz DT4000 with a 6-degree transducer, a 120 kHz BioSonics Model 101 with a 7-degree transducer and a BioSonics 420 kHz Model 102 with a 6-degree transducer. The systems were calibrated with standard targets following procedures of Foote and MacLennan (1982). All three systems were mounted on a single towing vehicle. Triggering for all three was synoptic at one per second, driven by the DT system. The DT4000 stores raw digital echo information directly on computer hard-drive. The data were analyzed using BioSonics Echo Integration Analyzer Program Version 4.0. The 420 kHz data were analyzed in real-time using a BioSonics Model 221 Echo Signal Processor. The 120 kHz data were recorded on DAT and later processed using the BioSonics ESP. Future plans call for using DT (Digital Transducer) technology for all three frequencies. DT systems are available for this purpose, but require some modifications that were not possible for the 2000 surveys because of limited time and funding. The conversion to an all-digital system is one of the improvements that is contingent upon EVOS funding.

The basic echo integration analysis produces estimates of volume backscattering. Estimation of absolute density from volume backscattering measurement requires estimates of species composition and average backscattering cross-section. Species composition information is obtained from the net sampling. Backscattering models for zooplankton are described in several publications (Holliday and Peiper 1980, Greenlaw and Pearcy 1985, Peiper et al. 1990, Stanton et al. 1994, 1996). Kirsch et al. (2000) specifically estimated the reflection characteristics of copepods, pteropods and euphausids in PWS at 420 kHz and details the absolute density estimation procedure. Results from the May 2000 surveys show that the three-frequency volume backscatter combined with the plankton nets readily allows estimation of the absolute densities of the various zooplankton components (Appendix 1).

Backscatter from fish is readily detected and separated from zooplankton backscatter in most cases. Backscatter from schooled or layered fish aggregations is far higher than for zooplankton. When individual fish targets are present within a zooplankton scattering layer, the fish signals appear as high, narrow spikes above the more homogenous zooplankton backscatter. In most cases, it is relatively easy to estimate fish densities in the presence of zooplankton by simple thresholding. The separation is greatly facilitated with digital transducer technology. With this technology, raw signal data can be rapidly examined at various thresholds and the echo integration component from different signal levels can be measured. This procedure can also be done with recorded analog data, as was the case for the FY00 surveys, but the procedure is more time consuming. For data that is analyzed in real-time, the best procedure is to echo integrate over small space/time

scales and carefully edit out returns from fish. This procedure works except where fish densities are too low to make an obvious contribution to the backscatter, but in those case the error from misappropriation is minor.

No direct sampling for fish targets is envisioned in this program, at least for the near future. Sufficient pattern classification information is available from historic observations to separate components into adult pollock, juvenile pollock and forage fish categories with reasonable accuracy. In five years of intensive midwater trawling during April and May, we found that 95% or more of the large fish targets in the plankton layers to be walleye pollock (Thomas et al. 1997; 1998). Acoustic backscattering cross-section information is available for these categories for biomass estimation (Thorne 1983a) of schools and layers. Echo counting techniques can provide numerical abundance estimates with high accuracy (Thorne 1983b). Trends in observed fish abundance will be compared with annual biomass estimates of adult herring and adult pollock conducted by OSRI monitoring programs for those species (Thorne and Thomas 2000a,b). The May 2000 surveys showed high densities of both adult and juvenile pollock in central PWS early in May (Appendix 1). Fish densities in the Knight Island/Perry Passage area were very low until the end of the month when the abundance increased dramatically. The increase corresponded with a decrease in abundance in the central basin.

Past sampling of the zooplankton in the Sound during April and May has shown that *Neocalanus* spps. copepods dominate the assemblage (Cooney 1993; Cooney et al. 1995). They are the primary large zooplankton scatter in the surface layers until late May (Thomas et al. 1998; Kirsch et al. 2000). Our plankton net sampling is conducted primarily to verify that the composition of the early spring zooplankton assemblage is dominated by *Neocalanus* spps. copepods. During the FY00 surveys, three to five zooplankton samples were taken within each 4-transect cluster. The zooplankton sampling was a 50 m vertical tow using a 0.335-mm 0.5 m-ring net, following procedures of Cooney et al. (1995). Samples are preserved in the field in 10% seawater formalin. Zooplankton analysis follows standard procedures (Coyle et al. 1990). Samples are processed for to identify and quantify the species composition and dominant zooplankters. The FY00 sampling verified the predominance of *Neocalanus*. Changes in the zooplankton composition were clearly reflected in changes the backscattering ratios among the three frequencies and corresponded to changes predicted from existing scattering models (Appendix 1). In 2001 we will add the use of a closing net and flow meter to improve our capability to sample specific depth layers.

Physical data acquisition: Temperature and salinity data were acquired using a SeaBird Electronics Model 19.03 CTD. Typically, 6-7 CTD stations were taken each cruise and were arrayed to provide inshore/offshore and north/south trends. This information is incorporated into the seasonal physical Oceanographic sampling database funded by the OSRI nowcast-forecast program. A Princeton Ocean Model (POM) is used to assimilate the physical monitoring data and produce nowcast-forecasts of physical structure (current velocities, direction, temperature, salinity, and density) in the Sound. By superimposing the distribution of predators and prey populations on this physical data, the actual physical conditions experienced by these animal populations are estimated accurately

enough to incorporate as parameters into the bioenergetics growth models. Simulations with the POM are also being conducted to reconstruct the distributions we observe on the surveys. These simulations and observations should help us determine if the *Neocalanus* spps. copepods are originating from the Sound or the Gulf (Kline 1999).

Survey design: The methods follow those developed and applied on the OSRI, SERVS, PWSAC and ADF&G program in spring 2000. Effort centers on the early marine life history period of the pink salmon, since the overwhelming consensus of evidence is that this stage is crucial to total survival. This follows the rationale of the PWSAC Plankton-Watch program, which is designed to guide pink salmon fry releases by monitoring food availability. The *Neocalanus* spps. copepod life history strategy anticipates the timing of the spring bloom by placing the earliest life stages in the water column before plant production is initiated each spring (Cooney et al. 1995), providing an ideal food source for pink salmon fry. Peak abundance of *Neocalanus* spps. copepods in the upper 50 m occur during the month of May. In June, *Neocalanus* spps. copepods migrate to deeper waters. The proposed monitoring program is designed to cover this critical period. Three surveys were conducted during May 2000. EVOS funding will allow temporal expansion of this project to five surveys between mid-April and mid-June in 2001.

The FY00 zooplankton survey design was six groups or clusters of four transects (Figure 1). Three clusters (twelve transects) extended along central PWS from Bligh Island to the Hinchinbrook Entrance and three more clusters along the primary pink salmon out-migration corridor west and north of Knight Island, extending to Perry Island. This initial design was based on several criteria: (1) coverage of the historic area of juvenile pink salmon out-migration and hatchery locations, (2) contrast between the traditional western outmigration route and the eastern side or main basin of Prince William Sound, and (3) an area that could be covered within a two-day survey. Transects were designed to be able to contrast near-shore and offshore areas as well as north/south trends. Strong gradients in abundance were observed, with highest densities in the southern portions of Knight Island (Appendix 1). The lowest abundance of zooplankton was consistently observed along the west shore. EVOS funding will support a spatial expansion of this project to nine groups or clusters of four transects that will achieve a better understanding of the over-winter areas/sources of zooplankton, incorporate sampling near more hatcheries and sample adjacent to the mussel-bed areas where pristane is being measured (Jeff Short, NMFS, pers. comm.).

The tactical procedure used in spring 2000 acoustic survey was to complete the acoustic data collection along a four-transect cluster, then backtrack to collect net and sensor samples at selected locations for zooplankton and salinity/temperature measurements. Usually these station locations are where the higher zooplankton densities were observed, but low-density locations were also selected for contrast. This general pattern approximates proportional sampling and will be refined in future surveys. Our analysis of two-stage, proportional sampling shows that we achieve between 600 to 20,000 fold increases in efficiency over traditional discrete-only sampling designs. Zooplankton data collection is limited to daytime hours due to the long daylight hours and the presence of benthic nekton species at the surface during the night.

Pristane links: The initial studies of pristane concentrations in mussels have indicated a positive correlation with marine survival of hatchery pink salmon (Jeff Short, NMFS, pers. comm.). The hypothetical mechanism for this is:

- the pink salmon fry feed on pristane-rich *Neocalanus* spps. copepods;
- the pink salmon fry are the dominant zooplantivores in mussel bed habitats;
- the pink salmon fry defecate pristane-rich feces near the mussel beds,
- the pristane-rich feces are ingested by mussels,
- the pristane accumulates in the mussel tissues in proportion to the amount of feeding by the fry on the copepods.

The acoustic survey will not measure pink salmon fry directly, but it will document the inshore-offshore gradients of *Neocalanus* spps. copepods, herring and other fishes, which should provide supporting data for interpretation of the pristane data. First, high occurrences of juvenile herring and sand lance in the nearshore during the summer is well documented (Stokesbury et al. 2000) and could possibly swamp the effects of pink salmon fry on the mussel beds. Acoustic surveys can determine if these fishes are in the mussel bed habitats where pristane concentrations are measured. It is possible that other fishes may only be inshore at night when the come to the surface and spread out so some nocturnal sampling will be required (Thomas et al. 1995). Second, we will be able to compare the distribution of zooplankton and fish to pristane levels in the mussels. This information should help to resolve questions on zooplankton and pristane origin.

In addition, there are also some assumptions that the pristane index makes that will require new information. Willette et al. (1999a,b) also suggested that the availability of *Neocalanus* spps. copepods inshore were a critical factor in pink salmon survival. However, in our FY00 surveys we frequently observed pink salmon fry feeding on patches of copepods in the middle of the Perry Island and Knight Island passages. It is obvious that the pink fry must cross these passages to migrate so we are not sure at this time what portion of the population resides offshore. Also most of the historical sampling of the pink salmon fry has been based upon visually locating the fry at the surface along the shoreline and then seining them (Willette, pers. comm.).

Estimating fry survival: Historically, fisheries models have not used predator-prey information to predict returns (Ricker 1975). However, with the development of the bioenergetics model (Hewitt and Johnson 1992) and it's application at the population level (Beauchamp et al. 1995), modeling of population bioenergetics became a numerical process driven by temperature and food, which are measured environmental parameters. With predation being a function of size and size a function of growth, survival is a function of growth. Thus the linking of predator numbers in the environment with the population bioenergetics is the accepted numerical approach to solving for survival.

SEA research has shown that calanoid copepods and adult walleye pollock are the primary prey and predator, respectively of the pink salmon fry in the Sound (Willette et al. 1999a,b; Thomas et al. 1997). Thus, making synoptic measures of the temperature, density of calanoid copepods and adult walleye pollock in the marine rearing areas of the

Sound offers the best approach to solving population survival questions for the PWS pink salmon.

Assimilation of the measurement data can be into spreadsheet formats that are common in fisheries management or into more complex numerical solutions such as the pink salmon fry model developed during the SEA program (Mason and Patrick, unpublished). Since neither of the Principal Investigators in this proposal are modelers, we will outsource modeling work to collaborators in ADF&G, UW and NOAA. First, we have had discussions with Steve Moffit, who has assumed Mark Willette's responsibilities for forecasting pink salmon returns. Steve will be using Mark's spreadsheet to forecast pink survival, and we will be providing Steve with prey and predator numbers to assimilate and compare results with the traditional method.

Second, we will collaborate with the numerical modelers in the GLOBEC program to encourage use of data to estimate the nearshore survival of fry. Since estimation of nearshore marine mortality is a prerequisite for separating ocean mortality from total mortality as measured by marked fish returns, this monitoring program in the Sound provides critical measurement data for estimating nearshore marine mortality. We have had discussions with David Beauchamp, University of Washington, to develop a graduate student program for this effort. David Beauchamp is the modeler working as co-PI with Jake Helle and Lew Halderson on the GLOBEC ocean survival modeling of juvenile pink salmon.

Finally, Jeff Short has developed a Pristane index model as a surrogate to the magnitude of pink salmon feeding on calanoid copepods, which is a surrogate to survival. As stated earlier, this model has several assumptions that we can evaluate with direct measures of copepod and fish abundance. Given that total mortality will be determined the following year by adult pink salmon returning to the Sound, the data we collect will be useful to three independent modeling groups to compare expected survival estimates.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

OSRI, PWSAC, SERVS and ADF&G provided approximately 110K to conduct the FY00 surveys. This level is expected to increase to 150K in FY01. This program makes extensive use of the measurement and computing equipment purchased and used on past EVOS TC research at minimal costs to upgrade and maintain.

SCHEDULE

A. Measurable Project Tasks for FY 01 (October 1, 2000 - September 30, 2001)

Oct 10-12: Attend EVOS workshop in Anchorage

Jan 1 - Mar 31: Review of databases and models for program and survey design;

design and begin refinements of measurement systems, design and begin assembling processing system for making near-real time estimates of abundance, obtain NEPA categorical exclusion

Apr 1 - Jun 30: Implementation of field surveys; continue data analysis.

July 1 - Sep 30: Report, evaluate and refine survey design, make initial predictions of recruitment, and modify sampling for second year implementation, develop manuscript for publication in a peer reviewed journal

B. Project Milestones and Endpoints

FY01 Report on the spring 2001 predator-prey surveys with prediction of future pink salmon survival.
FY02 Report on the spring 2002 predator-prey surveys with estimates of future pink Survival.

C. Completion Date

FY02 (September 2002) with annual report on April 15, 2002.

PUBLICATIONS AND REPORTS

An annual report will be prepared to meet the Council's requirements for work done in 2001. Several peer-reviewed articles are anticipated from past work and some may incorporate this first year's work as well. In the second year, we will prepare manuscripts presenting results of the first two years of work for publication in professional journals.

PROFESSIONAL CONFERENCES

Presentations are planned for the International Council for Exploration of the Seas: Fisheries Acoustics Symposium, PICES, the American Fisheries Society Meetings and the World Fisheries Congress.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project is directly interacting with EVOS Trustee Council projects on physical oceanography modeling and observations, pristane measurement, and stable isotope analysis. We will also make use of preceding Council research through the designation of common field sites and sampling design. This project will also make use of data generated in the SEA, APEX and NSP projects as well as seek the input of researchers involved in other projects within the region.

PRINCIPAL INVESTIGATORS

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Responsibilities: Dr. Thorne will be responsible for project administration and acoustic sampling, analysis and writing. He has been working as a PI on research projects for over 25 years while at the University of Washington and at BioSonics Inc. He participated as a subcontractor to the University of Alaska Fairbanks on the APEX research program.

Dr. Thomas will be responsible for project coordination, field logistics, data analysis and writing running and refinement of the Nekton model. He has worked as a PI on past EVOS TC research programs.

C.V.s for both investigators are attached. Please address all correspondence related to this proposal to Richard E. Thorne.

KEY PERSONNEL

Field assistants (staff):	Assists with all aspects of fieldwork and sampling.

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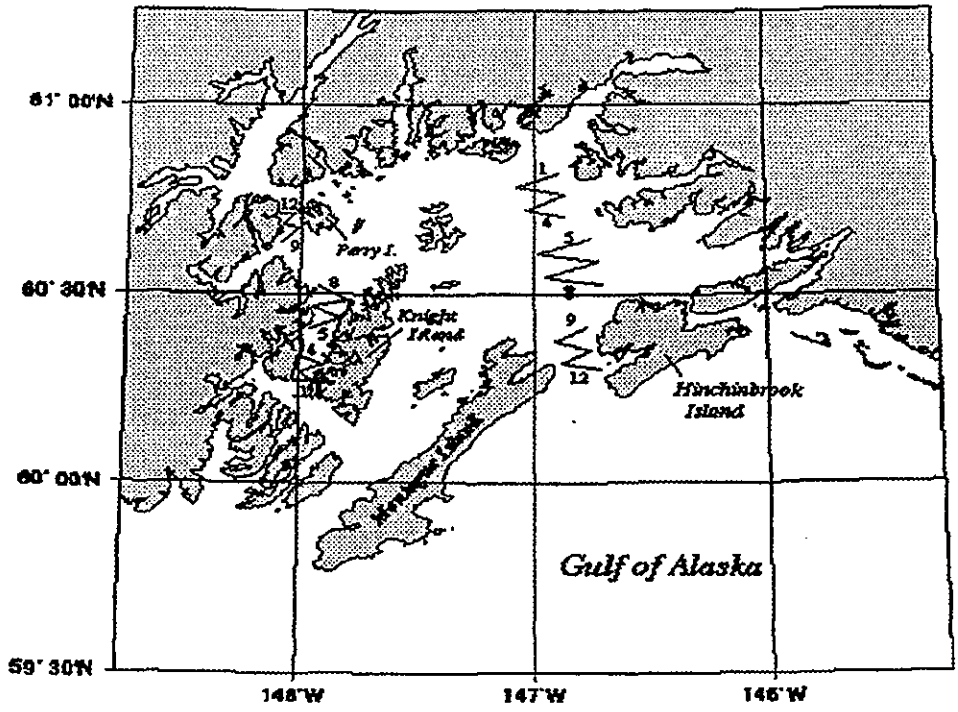

Figure 1. Schematic of approximate transect locations for the May 2000 surveys in Prince William Sound.

Approved TC 12-5-00

Gulf Ecosystem Monitoring and Research Program Data System

Project Number:	01455
Restoration Category:	Monitoring and research
Proposer:	Restoration Office, *Exxon Valdez* Oil Spill Trustee Council
Lead Trustee Agency:	Restoration Office (ADFG)
Cooperating Agencies:	None
Alaska SeaLife Center:	No
Duration:	1st year, on going project
Cost FY 01:	$35,700
Cost FY 02:	TBD
Geographic Area:	All
Injured Resource:	All

ABSTRACT

This project will initiate an ongoing data system for GEM (Gulf Ecosystem Monitoring, the Trustee Council's long-term monitoring and research program currently under development). GEM is being designed to monitor the ecosystems of the northern Gulf of Alaska and the adjacent coastal regions for a very long time period. Data collection, archiving, transfer, delivery, and presentation are critical components of GEM. FY 01 funding will be used to hire a data system manager to provide the leadership necessary for developing this essential part of the GEM program.

INTRODUCTION

In March of 1999 the Trustee Council decided to devote a large portion of the remaining settlement funds to a long-term monitoring and research program as part of the legacy of the *Exxon Valdez* oil spill. Although the details of the monitoring and research program are still evolving, it will include ensuring that the data collected with Trustee Council funds are handled and stored in ways that ensure easy and efficient access by all users both now and in the future. Access to data by the widest range of users requires a data system that is capable of providing a variety of formats, such as tables, maps, and graphs.

During FY 00, Project 00455, An Evaluation of the Data System for the EVOS Long-term Monitoring Program, identified a data manager as being one of the most important success factors in developing a data system. The system's success depends on a manager who understands the fundamental goal and vision of the system, the users of the system, the types of data products that will be needed and that can be produced, and the data policies that determine how, when and in what format the data will be provided to the GEM program.

Need for the Project

A. Statement of Problem

The Trustee Council established goals for the GEM program (April 2000) that make data management a top priority. The "Inform" goal states that the GEM program will provide integrated and synthesized information to the public, resource managers, industry and policy makers in order for them to respond to changing conditions. The "Solve" goal requires developing tools, technologies, and information that can help resource managers and regulators improve management of marine resources and address problems that may arise from human activities. The "Detect" goal also has a data management and communication aspect, as GEM is asked to serve as a sentinel (early warning) system by detecting annual and long-term changes in the marine ecosystem, from coastal watersheds to the central Gulf of Alaska. Advice received from EVOS peer reviewers and members of the public over the past 18 months urges GEM to address data management needs early in the program's development.

Many issues need resolving during the planning and development stages of any data system. The GEM data system will be a complex and involved process that requires a professional data system manager, who will provide guidance and direction in developing a successful system. Planning for data management requires a data manager to assist existing staff in responding to input from the public, scientists and the National Research Council review (expected in February 2001) to implement the Trustee Council's goals.

B. Rationale/Link to Restoration

In order to accomplish the Trustee Council's goals for the GEM program, management of monitoring and research data is a top priority. The purpose of this project is to begin the development of a data system by hiring a GEM program data system manager and implementing the recommendations from Project 00455, as well as from peer reviewers and October 2000 EVOS Annual Workshop participants.

C. Location

The data system manager will work in the *Exxon Valdez* Oil Spill Restoration Office in Anchorage. The data manager will work under the supervision of the Science Coordinator.

Project Design

A. Objectives

The EVOS Executive Director, Science Coordinator, and Chief Scientist will review the report being prepared by Charles Falkenberg under Project 00455 (Evaluation of the Data System for the EVOS Long-term Monitoring Program), the October 2000 EVOS Annual Workshop input, and the National Research Council's recommendations. They will develop a job description, advertise the data system manager position, and screen, interview, and hire the most qualified candidate. The intent is to have the data manager on board by June 1, 2001.

Once hired, the data system manager's immediate concerns will be to: 1) identify, with the assistance of the data advisory committee established under Project 00455, the data goals of the GEM program; 2) review existing data and data sets and determine how to best incorporate these into the system; 3) serve as liaison between agency technical and scientific personnel; and 4) identify the technology available to create a useable, affordable GEM program data system.

B. Methods

A comprehensive search for a data system manager will be conducted both within and outside of the state of Alaska. The person hired will likely become an employee of the Alaska Department of Fish and Game, although arrangements can be made for federal employment if the candidate is already in the federal system.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

As part of Project 00455, each Trustee agency was asked to identify a technical data person from their agency to serve on a data system advisory committee. The committee will assist in setting goals and policies for the GEM data system. The data advisory

committee members will be familiar with their agencies' databases; when and what new data will be added; data formats and requirements; and plans for future agency databases. The data committee will also assist in the development of the data system and help make critical decisions about the target user community and the scope of the system.

SCHEDULE

A. Measurable Project Tasks for FY 01 (October 1, 2000 – September 30, 2001)

February 1 – February 28:	Develop Data System Manager job description
March 1 – April 30:	Advertise Data System Manager position; screen applicants and conduct interviews of selected applicants; make job offer to most qualified applicant
June 1-September 30:	Data System Manager begins work and development of data system

B. Completion Date

The data system will be an ongoing component of the GEM program.

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PRINCIPAL INVESTIGATOR

Ms. McCammon has 25 years of experience in Alaska in recreation and tourism, journalism, communications, and public policy, emphasizing natural resource issues. She has been Executive Director of the Trustee Council since 1994.

Dr. Phil Mundy holds a Ph.D. in Fishery Science and has been Science Coordinator for the *Exxon Valdez* Oil Spill Restoration Office since 1999. He brings 28 years of experience in computer science to the Data System project . As Science Coordinator, he works closely with the Chief Scientist on the Restoration Program and in development of the Gulf Ecosystem Monitoring (GEM) program .

Revision 11-27-00
approved TC 12-5-00

FEATS: Fundamental Estimations of Acoustic Target Strength

Project Number:	01468-CLO
Restoration Category:	
Proposer:	G. Thomas/PWSSC
Lead Trustee Agency:	NOAA
Cooperating Agencies:	
Alaska SeaLife Center:	
New or Continued:	Cont'd
Duration:	3rd yr. 3 yr. project
Cost FY 01:	$5.8
Cost FY 02:	$0.0
Geographic Area:	
Injured Resource/Service:	

ABSTRACT

This small amount of funding in FY 01 will allow for completion of the final report begun under Project 99468. In 1999, this project conducted cage experiments to determine the acoustic strength of herring and sand lance. Obtaining better definitions of target strength was essential to completion of work on two of the Trustee Council's major ecosystem projects, the Sound Ecosystem Assessment (SEA, Project /320) and the Alaska Predator Ecosystem Experiment (APEX, Project /163).

INTRODUCTION

Pacific herring is a valued resource to the residents of the Sound. Furthermore, herring and sand lance are recognized as critical forage fishes for piscivores birds and mammals. Recognizing the importance of herring to the Sound ecosystem, we have developed a collaborative program between OSRI, ADF&G, local fishers and industry to monitor changes in the herring stock with acoustics. This requires accurate estimates of target strength. Our objective is to revise target strength reports that were submitted in 2000 with subsequent peer reviews, combine the two reports into a single report in journal publication format, resubmit this revised report to EVOS Trustee Council and submit the manuscript for journal publication.

NEED FOR THE PROJECT

A. Statement of the problem

There is considerable variability in the reported target strengths of herring and sand lance in the literature. This project will attempt to resolve some of this discrepancy.

B. Rationale/Link to Restoration

This project provides critical information to support annual tracking of changes in the herring population and will reduce some of the uncertainty in measuring sand lance with acoustic techniques.

C. Location

This research is being conducted in Prince William Sound. Communities in the sound that depend upon a healthy herring population will be the long-term benefactors of this research.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Local, traditional and scientific knowledge have led to the development of the herring research.

PROJECT DESIGN

A. Objectives

Revise herring and sand lance target strength reports into a single journal-format report, resubmit this report to EVOS TC and to a journal for publication.

B. Methods

Incorporate peer review comments into report and manuscript and submit. The Canadian Journal of Fisheries and Aquatic Sciences is the target journal because it has frequently published papers on Pacific herring and acoustic applications.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

OSRI and ADF&G are cooperating on herring research in the Sound.

SCHEDULE

Revise and resubmit EVOS TC report by December 31, 2000. Submit manuscript for journal publication by March 31, 2001.

B. Project Milestones and Endpoints

Revised final report to EVOSTC. Submission of manuscript to journal.

C. Completion Date

End of FY01 (September 2001).

PUBLICATIONS AND REPORTS

Above

PROFESSIONAL CONFERENCES

Presentations are planned for the International Council for Exploration of the Seas: Fisheries Acoustics Symposium

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will be used by ADF&G and OSRI in future acoustic surveys of herring biomass in the Sound.

PRINCIPAL INVESTIGATORS

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Responsibilities: Dr. Thorne will be responsible for revision of the report and manuscript. He has been working as a PI on research projects for over 25 years while at the University of Washington and at BioSonics Inc. He participated as a subcontractor to the University of Alaska Fairbanks on the APEX research program.

Dr. Thomas will be responsible for revision of the report and manuscript. He has worked as a PI on past EVOSTC research programs.

C.V.s for both investigators are attached. Please address all correspondence related to this proposal to Richard E. Thorne.

KEY PERSONNEL

Above

Revision 1-8-01
Approved TC 1-16-01

EXXON VALDEZ Oil Spill Trustee Council
FY 01 Detailed Project Description

Evaluation of two methods to discriminate Pacific herring (*Clupea pallasi*) stocks along the northern Gulf of Alaska

Project Number:	01538
Restoration Category:	Research
Proposer:	Ted Otis (ADF&G) Ron Heintz (NMFS-Auke Bay)
Lead Agency:	ADF&G
Cooperating Agencies:	ADF&G, NMFS-Auke Bay
Alaska SeaLife Center:	No
Duration:	Closeout in FY02
Cost FY 2001:	$ 10.1K
Cost FY 2002:	$ 47.1K
Cost FY 2003:	$ 0.0K
Cost FY 2004:	$ 0.0K
Geographic Area:	PWS, Kodiak, Lower Cook Inlet
Injured Resource/Service:	Pacific herring/commercial fishing

ABSTRACT

Pacific herring within the spill area, and particularly within Prince William Sound, were injured by the 1989 *Exxon Valdez* oil spill and have not yet fully recovered. Because herring are important prey for many marine species, as well as humans, their stock health is relevant to the recovery of other injured resources and services. To increase our understanding of the distribution and mixing of Northwest Gulf of Alaska (NWGA) herring stocks and to help identify important habitats and rearing areas for individual populations, it is relevant to be able to determine the stock of origin for herring sampled during field investigations. This 1-year pilot study will perform a comparative investigation of two promising stock identification techniques (elemental analysis of otoliths and fatty acid profile analysis of select soft tissues). Limited samples from Sitka Sound, PWS, Kamishak Bay, Kodiak Island, and Togiak will be collected and analyzed to determine if stock differences are detectable by each procedure, and at what scale. Successful results from this pilot study should be followed up with future evaluations of the temporal and structural (i.e., sex, age, maturity) stability of these biomarkers.

INTRODUCTION

Pacific herring *Clupea pallasi* within the spill area, and particularly within Prince William Sound (PWS), were injured by the 1989 *Exxon Valdez* oil spill (Brown 1995) and have not yet fully recovered (EVOS Restoration Plan 1998). Elevated levels of physical and genetic abnormalities in newly hatched larvae and reduced hatching success of embryos were documented in 1989 (Brown 1995). Significant histopathological damage was measured in adults collected in oiled areas in both 1989 and 1990 confirming exposure of the fish to toxins (Brown 1995). In 1993, the herring population in PWS collapsed. The total observed spawning population was less than one third of preseason predictions and the average sizes of herring in each age class were some of the smallest on record. The total commercial harvest for that year was also one of the lowest on record. In 1994, the total observed spawning population was below the threshold biomass required to conduct a commercial harvest and no fishing occurred. Pathology studies indicated that viral hemorrhagic septicemia (VHS) and the fungus *Ichthyophonus hoferi* probably contributed most to the population decline (Meyers 1994, Marty et al. 1996, 1998). After rebounding from the 1993 decline, the PWS herring population collapsed again in the winter of 1998-99. Viral hemorrhagic septicemia and *Ichthyophonus hoferi* were found in many herring sampled in 1998 and 1999, respectively, and appear to have once again contributed to their decline (pers. comm. Steve Moffitt, PWS Area Research Project Leader, ADF&G-Cordova).

Herring are an important component of the marine ecosystem providing a trophic pathway for energy flowing from secondary producers to apex predators. Throughout their life, herring are prey to birds (Logerwell and Hargreaves 1997), marine mammals (Iverson et al. 1997), invertebrates (e.g. hydromedusae: Wespestad and Moksness 1989), other fish (Tanasichuk et al. 1991), and humans (Fischer et al. 1997). Understanding the role herring occupy in the food web of marine ecosystems is relevant to sustaining viable populations of herring and the species that prey on them (Schweigert 1997). The ability to define the stock of origin for herring sampled during ecosystem level investigations (e.g., Gulf Ecosystem Monitoring [GEM]) would dramatically improve our understanding of the distribution and ecology of this organism. Researchers would be better able to evaluate cause and effect relationships associated with the population dynamics of NWGA herring stocks and thereby improve the management and recovery of herring, as well as other marine species that feed on them.

Many diverse techniques have been investigated to facilitate discriminating between fish populations including: nuclear and mtDNA analysis (Seeb 1995), enzyme electrophoresis (Schweigert and Withler 1990), parasite markers (Moles et al. 1990), scale pattern (Rowell 1981, Ross and Packard 1990, Barros and Holst 1995), mass marking of otoliths using temperature manipulation (Joyce et al. 1996) and fluorescent markers (Beckman et al 1990), and meristic and morphometric characteristics (Schweigert 1990). While many of these techniques have proven successful for certain applications, each has its own set of limitations that may reduce its effectiveness for specific stock identification situations. For instance, DNA analysis and enzyme electrophoresis are often able to discriminate stocks on a broad geographic scale, however, these techniques can falter when even a small amount of genetic drift occurs between closely distributed populations.

We propose to conduct a pilot study of two promising techniques for herring stock identification. Herring from Prince William Sound, Kamishak Bay, Kodiak Island, Togiak, and Sitka Sound will be collected. Otoliths and heart tissue will be extracted from each specimen to facilitate elemental analysis (EA) and fatty acid analysis (FAA), respectively. To minimize sample sizes (i.e., costs) for this pilot study, we propose to focus our investigation on age-4 and age-5, pre-spawning female herring. If these procedures prove capable of identifying significant differences between similar cohorts from different stocks, further investigation would be warranted to evaluate the temporal, spatial, and structural (i.e., sex, age, gonad maturity) variability associated with each stock's unique biomarkers. Our principal objective is to determine which of these two stock identification tools is most robust.

NEED FOR THE PROJECT

A. Statement of Problem

Herring populations in PWS and Kamishak Bay are depressed. To better understand factors affecting the dynamics of these populations, and therefore effect their recoveries through potential improvements in management, we propose to evaluate two tools that may facilitate determining the scale at which discrete stocks exist within PWS and the greater NWGA. Herring researchers have long pondered the degree to which herring return to natal areas to spawn and the scale at which population structure exists within large geographic areas (Hourston 1982, Wheeler and Winters 1984, Hay and McCarter 1997, McQuinn 1997). Answers to these fundamental questions are directly relevant to the manner in which herring are assessed and managed. One of the underlying principles of sustainable fisheries management is the ability to monitor the dynamics (environmental, biological, and human induced) of individual populations (Mundy 1996). The inability to accurately apportion the catch from mixed stock fisheries, for example, is a common problem that undermines fishery managers' abilities to manage populations discretely.

Many diverse techniques have been investigated to discriminate between fish populations including: nuclear and mtDNA analysis (Seeb 1995), enzyme electrophoresis (Schweigert and Withler 1990), parasite markers (Moles et al. 1990), scale pattern analysis (Rowell 1981, Ross and Packard 1990, Barros and Holst 1995), otoliths thermal marking (Joyce et al. 1996), fluorescent markers (Beckman et al 1990), and meristic and morphometric characteristics (Schweigert 1990). While many of these techniques have proven successful for specific applications, each has its own set of limitations that may reduce its effectiveness in certain situations. For instance, DNA analysis and enzyme electrophoresis are often able to discriminate stocks on a broad geographic scale, however, these techniques can falter when even a small amount of genetic drift occurs between closely distributed populations.

This pilot study proposes to evaluate the potential for elemental analysis (EA), and fatty acid analysis (FAA) to discriminate NWGA herring stocks residing within and between PWS, Kodiak Island, and Kamishak Bay. Our principal objective will be to determine which of these two stock identification tools is most robust. The stock identification technique developed through this project could eventually be applied to identify the stock of origin for juvenile and adult herring collections made during long term monitoring (e.g., GEM) and also to apportion mixed stock

harvests during commercial fisheries (e.g., Shelikof Strait food/bait fishery). Finding discernable differences between Kodiak and Kamishak herring is of particular interest to managers of these respective stocks (Otis and Bechtol 1997, Otis et al. 1998). Herring harvested from northwest Kodiak Island (e.g., Shuyak, Afognak, and Raspberry Is.) during the Shelikof Strait fall food/bait fishery are presumed to include both Kodiak and Kamishak stocks (Johnson et al. 1987). The Department's Kamishak Bay District Herring Management Plan addresses this presumed mixed-stock fishery through allocation of the Kamishak Bay harvestable surplus (5 AAC 27.465). The success of this pilot project may result in the ability of managers to more accurately allocate the harvest of herring taken during the Shelikof fall food/bait fishery.

Fatty acid compositions of fish lipids have been investigated for decades (Ackman et al. 1963). Much of the early lipid research was directed at determining the commercial value of fish oils (e.g. Ackman 1966) and understanding how fat content relates to various life history functions (e.g. Rajasilta 1992). Because the composition of certain lipids can be closely related to the types of food recently ingested (Navarro et al. 1995, Kirsch et al. 1998), recent investigations have been directed at diet analysis and foraging distribution (e.g. Iverson et al 1997). The composition of phospholipid fatty acids prominent in some body tissues (e.g., heart tissue, gills, eggs) have been shown to have a more stable genetic or environmental basis that makes analysis of these tissues appropriate for stock identification studies. As early as the 1930's it was demonstrated that different stocks of fin whale *Balaenoptera physalus* could be distinguished by the degree of unsaturation of their oils (measured as iodine value: Lund 1934, as cited in Grahl-Nielsen et al. 1993). Recently, fatty acid analysis of eggs has been used to discriminate between American lobster *Homarus americanus* populations (Castell et al. 1995), Baltic cod *Gadus morhua* stocks (Pickova et al. 1997), and even the wild/domestic origin of sturgeon ova (Czesny et al. 2000).

Chemometry of fatty acids from heart tissue has been used to discriminate stocks of striped bass *Morone saxatilis* (Grahl-Nielsen and Mjaavatten 1992), Atlantic herring *Clupea harengus harengus* (Grahl-Nielsen and Ulvund 1990), and Atlantic cod *Gadus morhua* (Joensen et. al. 2000). This technique has also been used to distinguish between closely related species of the genus *Sebastes* from the Faroe Islands (Joensen and Grahl-Nielsen 2000). It is often the fatty acid profile (i.e., unique composition of an array of fatty acid levels; also referred to as a 'signature' by Iverson et al. 1997 and Smith et al. 1998) that distinguishes individual stocks, and not a single distinct fatty acid. Considerable variability can naturally occur in the fatty acid profiles (especially lipid profiles) between individual fish (Viga and Grahl-Nielsen 1990). This variability can be influenced by changes in diet, water temperature, salinity, growth, reproductive cycle, and pollution (Viga and Grahl-Nielsen 1990). The fatty acid profiles of certain tissues (e.g., heart) and specific lipids (e.g., phospholipids) are considered more stable, but still exhibit some variability. Recently published research found significant differences in the fatty acid profiles of heart tissue extracted from representatives of 2 cod stocks that had been reared under identical conditions since hatching (Joensen et. al. 2000). This key study demonstrates the potential for fatty acid compositions to discriminate fish stocks, even when they may occupy similar environments during later stages of their life histories (e.g., Kamishak Bay and Northwest Kodiak stocks).

Trace elemental analysis of otoliths has been used to identify stocks of pink snapper, (Edmonds et al. 1989), orange roughy (Edmonds et al. 1991), yellow-eye mullet (Edmonds et al. 1992), Atlantic cod (Campana and Gagne 1995, Campana et al. 1995), and salmonids (Kalish 1990).

Thresher (1999) provides a comprehensive review of the use of otolith elemental composition as stock discriminators and offers some cautionary suggestions for researchers interested in employing this promising technique. Of particular concern is the potential for non-standardized lab equipment and procedures to contribute to differences in otolith elemental composition reported among published studies (Campana et al. 1997).

Otoliths are acellular, so once accreted, the material is not resorbed or reworked (Campana and Nielson 1985). As a result, otolith microchemistry can be used to identify the environments inhabited by fish during their life (Gunn et al. 1992, Radtke and Shafer 1992, Secor et al. 1992). The use of otoliths as records of environmental exposure is based on the premise that otolith microchemistry reflects differences in water chemistry in the environment (Radtke and Shafer 1992, Campana and Gagne 1995). The trace elemental composition of fish otoliths is determined by the elemental composition of the endolymph (Kalish 1989, 1991). The concentration of various trace elements in the environment and the physiology of the fish largely determine the composition of the endolymph. Physiological processes may be modified by temperature (Kalish 1991), or subtle differences in the genetics of the fish affecting the uptake of various elements and their inclusion in the endolymph (Thresher et al. 1994). Controlled laboratory studies have shown that otolith microchemistry is strongly affected by temperature, salinity and ontogeny (Fowler et al. 1995a, 1995b).

Successful application of trace otolith elemental analysis for stock discrimination is likely dependent on the extent of the differences in water chemistry between the environments inhabited by each stock. But, the need to identify stocks often arises when they are exploited in mixed-stock fisheries in the same environment. Three methods are commonly employed for otolith elemental analysis. Solution-based inductively coupled plasma mass spectrometry (ICPMS) is typically used to measure elemental concentrations in whole otolith samples or portions of whole otoliths (Date 1991). Laser-ablation ICPMS is a technique that can be used to analyze trace elements (ppm) at specific loci (30 μm) on the otolith (Gray 1985, Denoyer et al. 1991). Electron microprobes (EM) also allow analysis of specific loci (5-7 μm), albeit at a reduced resolution in the parts per thousand (ppt) range (pers. comm. K. Severin, UAF Dept. of Geology and Geophysics). Solution-based ICPMS may successfully discriminate stocks that inhabit different environments exhibiting different water chemistries during the majority of their life history (Campana et al. 1995). However, techniques that target specific loci, such as EM and LA-ICPMS, may be more appropriate for identifying stocks that spawn in different environments but later reside in similar environments (Coutant and Chen 1993, pers. comm. K. Severin). In this case, the microchemistry of the otolith accreted during the embryo or larval stage may indicate differences between stocks. It is unknown to what extent herring spawning around Kodiak Island, in Kamishak Bay or PWS may inhabit similar environments throughout their life history. Therefore, the proposed project will examine the efficacy of either EA or LA-ICPMS of the primordium of the otolith for discriminating between herring stocks.

B. Rationale/Link to Restoration (Why should work be done)

Pacific herring is a key species in the marine ecosystem affected by the 1989 Exxon Valdez oil spill. Herring is also a primary forage species for other marine fishes, birds and mammals, and is

used extensively by subsistence and commercial fishers.

C. Location

Herring will be collected from Sitka Sound, PWS (Montague and NE PWS), Lower Cook Inlet (Kamishak Bay), Kodiak Island (west side), and Bristol Bay (Togiak) waters.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

Lab Study/Not Applicable

PROJECT DESIGN

A. Objectives

To accommodate funding limitations, we propose to restrict our FY01 activities to sample collection and preservation. The bulk of our lab analyses will take place in FY02.

FY01:

1. Collect herring samples from Sitka, PWS, Kodiak, Kamishak, and Togiak; extract lipids for fatty acid analysis to be performed in FY02.

FY02:

1. Determine whether EA or FAA will allow discrimination among Alaska's 3 major herring stocks, and if so;

2. Determine whether EA or FAA can detect finer scale structuring of putative herring stocks inside PWS and elsewhere in the NWGA.

B. Methods

This pilot study has one main objective broken down into two parts: to determine if EA or FAA can distinguish between Pacific herring stocks, and if so, on what scale. To accomplish the first part of this objective we plan to compare the biomarker profiles of herring collected from Alaska's three major stocks- PWS, Sitka Sound and Togiak. Togiak and PWS have already been shown to have disparate genetic profiles (O'Connel et. al. 1998), so they make ideal initial test groups. If EA and FAA are not able to distinguish between these stocks, then they probably have little value as stock discrimination tools for Pacific herring. However, if PWS, Sitka and Togiak samples are distinguishable, we will process our remaining samples to investigate smaller scale population structuring within the NWGA, and PWS specifically.

To minimize the inherent natural variability that may reside within each population, only age-4 and age-5 prespawning female herring will be collected. This will also allow us to minimize our sample sizes (i.e., cost) for this pilot study while still retaining the ability to look for variability in chemical markers across adjacent year classes. Herring will be collected from the north end of Montague Island (e.g., Zaikof Bay) and the northeast corner of PWS (e.g., Galena Bay), locations believed to represent the focal spawning areas for two putative PWS herring stocks (Pers. Comm., Evelyn Brown, UAF, IMS). We will also collect herring from NWGA spawning aggregations centered on the west side of Kodiak Island (e.g., Uganik Bay) and in Lower Cook Inlet (Kamishak Bay). Processing samples from these collection sites will allow us to resolve the scale at which EA and FAA techniques are able to discriminate between herring stocks in the NWGA.

Collections will be made where significant numbers of herring spawn in areas judged to be the focal spawning area for each respective stock and will target the first groups of returning fish (Table 1). For each specimen, length, wet weight, sex, and gonad maturity will be determined. When pre-spawning female herring between 190-250 mm SL are encountered, a scale will be removed to determine the age of the fish. If determined to be age-4 or age-5, their heads will be removed, individually labeled, and stored frozen in plastic bags for later laboratory processing of the otoliths. Whole hearts will be removed, transferred to labeled vials, placed in liquid nitrogen, and stored at –70° C until analyzed (Ackman et al. 1969, Grahl-Nielsen and Mjaavatten 1992). The remaining body of the fish will be labeled, bagged, and frozen whole for possible whole body fatty acid analysis. EA and FAA will only be conducted on specimens from the same two adjacent age classes from each area (e.g. age 4 and 5). This approach will control for biomarker variability that may occur across cohorts. To reduce project costs, only 30 samples from each area will be processed (180 total samples). However, 50 additional fish of similar age/sex will be collected in case the sample variance dictates more individuals are needed to facilitate robust statistical comparisons (Johnson and Wichern 1992).

Table 1: Dates, locations, and sample sizes for FY01 collections to evaluate the feasibility of EA and FAA to discriminate between northern Gulf of Alaska herring stocks.

		Sample sizes	
Location	Date	EA	FAA
Sitka Sound	3/10-4/10	30	30
PWS, N. Montague	4/10-4/20	30	30
PWS, NE (e.g., Galena Bay)	4/10-4/30	30	30
LCI, Chenik/Amakdedori	4/20-5/5	30	30
KDK, Paramanof/Foul Bay	4/15-4/30	30	30
Togiak	5/1-5/20	30	30
Totals Samples		180	180

Direct methanolysis of the thawed heart tissue and gas chromatography of the resulting fatty acid methyl esters will follow procedures described by Viga and Grahl-Nielsen (1990) and Grahl-Nielsen and Mjaavatten (1992). Representative peaks (i.e. fatty acid levels) from the resulting chromatograms will be selected and quantified. Multivariate techniques such as principal

components analysis (PCA), soft independent modeling of class analogy (SIMCA), linear discriminant analysis (LDA), and classification and regression trees (CART) have typically been used to compare fatty acid compositions (Grahl-Nielsen and Mjaavatten 1992, Navarro et al 1995, Castell et al. 1995, Smith et al. 1997). However, there remains some debate over which multivariate techniques are most robust for this application (Grahl-Nielsen 1999, Smith et al. 1999).

Otoliths will be removed from heads and processed as described by Fowler et al. (1995a). Left and right sagittal otoliths will be dissected from each specimen using glass probes on a glass surface, insuring that the otolith and dissection equipment do not touch metal. Tissue adhering to the otoliths will be removed with glass probes and the sample washed in Super Q water. Otoliths will be air dried in a positive flow flume hood and weighed to the nearest 0.01 mg. Those used for laser-ablation ICPMS will be mounted on glass slides using thermal plastic cement, then ground and polished in the sagittal plane until the otolith primordium is visible. Polished otoliths will be rinsed in super Q water (deionized, purified through reverse osmosis, and millipore filtered) and stored in paper envelopes for later analysis (Fowler et al. 1995b). Methods described by Fowler et al. (1995a) and Fowler et al. (1995b) will be used for the laser-ablation ICPMS analyses of the primordium of each otolith.

Discriminant function analysis (DFA) and principle component analysis (PCA) will be applied to the calibration samples collected from all areas to determine which analytical technique (EA or FAA) is the best stock discriminator (Johnson and Wichern 1992). Each technique produces a biomarker signature (trace elements or fatty acid profiles) that will be evaluated for the level of discrimination (e.g. number of stocks identified) and the accuracy of discrimination. Each multivariate statistical technique will first be applied to the data sets derived from each analytical technique (EA or FAA), separately. The misclassification probabilities associated with each technique will be compared to evaluate the accuracy of each method. DFA and PCA could then be conducted on the data set derived from all analytical techniques combined. This approach would enable us to determine whether a combination of variables from the two analytical techniques provides greater classification accuracy than any of the individual techniques.

A stepwise discriminant analysis will first be applied to the variables derived from each analytical technique to identify any biomarker signatures associated with herring stocks or age classes. All variables found to be poor discriminators will be discarded. DFA will then be applied to the reduced set of variables. DFA produces a probability density function (pdf) for each group identified. If DFA can not discriminate between stocks it will combine all stocks into one pdf. The number of unique stocks identified will indicate the level of discrimination achieved. If DFA can discriminate between stocks, misclassification probabilities (accuracies) will be determined by the number of specimens that incorrectly fall outside the pdf for their respective stock in the calibration sample. Groups may be pooled if misclassification is high. This will reduce detail but increase overall accuracy.

PCA will be used to express the biomarker signatures as a set of principal component variables. Skree plots will be used to determine how many principal components are needed to accurately describe the variation in the biomarker signatures. To reveal relationships that exist within the signatures a varimax rotation of the principle components will be completed and the components will be graphed against each other. If PCA appears to distinguish among stocks, additional PCAs

will be conducted for each individual stock and perhaps age-classes within stocks. Cross-validation analysis will be used to determine the number of principal components that best describe the data (Wold 1978). Varimax rotation plots will be used to evaluate misclassification (accuracies).

C. Cooperating Agencies, Contracts, and other Agency Assistance

This project is jointly proposed by the Alaska Department of Fish and Game (ADF&G) and the National Marine Fisheries Service (NMFS), Auke Bay Lab. ADF&G will collect all the necessary samples and Auke Bay Lab will perform the fatty acid analysis of soft tissues. If this project is funded, the department will draft specifications for EA and solicit bids from at least three qualified vendors. This process will follow standard State of Alaska bidding and contract award procedures. The successful bidder will be offered a co-authorship option if publishable findings result from the analyses.

SCHEDULE

A. Measurable Project Tasks for FY01

Feb-Mar:	Contract laboratory for elemental analysis of otoliths.
Apr-May:	Collect otolith and heart samples from spring spawning herring from Sitka Sound, PWS, Kodiak, Kamishak, and Togiak.
Jun-Sep:	Extract lipids from soft tissue, store samples until they can be processed in FY02.

B. Measurable Project Tasks for FY02

Oct-Jan:	Perform fatty acid and elemental analyses of soft tissue and otoliths, respectively.
Feb-Mar:	Analyze results, write project final report.
April:	Submit project final report

C. Project Milestones and Endpoints

Sep 2001	Complete FY01 objective 1
Jan 2002	Complete FY02 objectives 1 and 2
April 2002	Complete project final report.

C. Completion Date

This project will be completed in FY02. A final report will be submitted by April 15, 2002.

PUBLICATIONS AND REPORTS

A project final report will be submitted by April 15, 2002. Selected results from the project may be published in referred journals in FY02 or 03 as appropriate.

PROFESSIONAL CONFERENCES

Travel funds have been requested to present selected project results at one professional conference in FY02, as appropriate (e.g. Lowell Wakefield Symposium).

NORMAL AGENCY MANAGEMENT

The ability to distinguish between and manage stocks discretely is a principal component of sustainable fisheries management. However, this principle cannot be implemented effectively in many cases due to inherent difficulties in distinguishing discrete stocks using methods commonly available to fishery managers. New advances in fisheries stock identification are necessary to fill these gaps. The techniques we propose to evaluate may have broad application towards better understanding the structuring of many marine mammal and fish populations, including those not managed by the proposing agencies. Successfully applying these techniques as stock discriminators could also illuminate pathways for more effective long term monitoring through GEM.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project proposes to develop stock discrimination tools that may help resolve questions concerning the scale at which discrete herring stocks exist in PWS and the greater Gulf of Alaska. Information gained by this project could help put the results of other EVOS projects into context and illuminate new pathways for long term monitoring under GEM.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

This is a new project.

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Professional Experience: April 1996-present: Asst. Area Research Biologist for Lower Cook Inlet, Alaska Department of Fish and Game, DCF, Homer, AK. Supervised by William R. Bechtol. Responsible for assessment and forecasting of Kamishak Bay herring stock, direct salmon and herring catch and escapement sampling programs, forecast Lower Cook Inlet salmon returns. April 1994-March 1996: Fishery Technician, Kenai Fishery Resources Office, U.S. Fish and Wildlife Service, Kenai, AK. Supervised by Gary Sonnevil. Project leader for Andreafsky River (Yukon) adult salmon enumeration project: constructed and deployed resistance board/floating weir to count adult salmon; project leader for Kenai River rainbow trout radio-telemetry project: surgically implanted radio transmitters and tracked fish using mobile receivers and remote data loggers. June 1991-March 1994: Graduate Research Asst., Univ. of Arizona, Dept. of Renewable Natural Resources, Tucson, AZ. Supervised by Dr. O. Eugene Maughan. Designed and implemented field studies to assess the composition, abundance, and distribution of fishes in streams tributary to the Colorado River in Grand Canyon. Designed and implemented field study to inventory aquatic habitat available to stream fishes in Grand Canyon. August 1987-June 1991 (intermittent): Fisheries technician, Kenai Fishery Resources Office, U.S. Fish and Wildlife Service, Kenai, AK. Supervised by Gary Sonnevil. Project Leader or team member on various field projects including: assessing adult salmon returns using weirs (Uganik R, Kodiak); developing new approaches to aging dolly varden and lake trout otoliths; enumerating emergent salmon fry (Tustumena Lake); evaluating angler effort (Kenai River); investigating run-timing and migration rates of chinook salmon (Kuskokwim River); and inventorying salmon spawning habitat (Ayakulik R., Kodiak).

Selected Publications:

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Currently enrolled as PhD candidate at University of Alaska
Master of Science, Fisheries Biology, University of Alaska, Fairbanks. 1987.
Bachelor of Science, Ecology Ethology and Evolution, University of Illinois, Champaign. 1979.

Principle Findings involving chemometric techniques:

1. Oil weathers by first-order loss-rate kinetics (Short and Heintz 1997).
2. Most toxic PAHs spilled by *Exxon Valdez* persisted in spawning habitats for at least six years after the spill (Murphy et al. 1999).
3. Marine derived fatty acids provided by returning salmon are an important source of nutrition to fish residing in the natal streams (Wipfli et al. in press).

Current Research:

1. Evaluation of the potential use of fatty acid and lipid class analysis for discriminating diet and diet quality in marine species.
2. Use of lipid class and fatty acid analysis for discriminating populations of northern fur seals.
3. Characterization of the quality of salmon rearing habitats by evaluation of the lipid class and fatty acid composition of overwintering parr.

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Revision 1-10-01
Approved TC 12-5-00

Evaluation of Oil Remaining in the Intertidal from the *Exxon Valdez* Oil Spill

Project Number:	01543
Restoration Category:	Monitoring
Proposer:	J. Short/NOAA
Lead Trustee Agency:	NOAA
Cooperating Agencies:	ALL
Alaska SeaLife Center:	No
New or Continued:	New
Duration:	1st yr. 2 yr. project
Cost FY 01:	$477.2 — includes { $ 22.6 Phase I (approved 8-3-00); $ 454.6 Phase II (approved 12-5-00) }
Cost FY 02:	$95.0
Geographic Area:	Prince William Sound, Gulf of Alaska
Injured Resource/Service:	Intertidal communities, sediments

ABSTRACT

This project will assess the amount of oil remaining from the oil spill on shorelines within Prince William Sound. FY 01 funding will be requested in two phases. Phase 1 (Oct.-Nov.) produced a sampling design. Phase 2 (Dec.-Sept.) will intensively sample a stratified random sample of shoreline for surface and subsurface oil to estimate length of oiled shoreline, area and volume of oiled sediment, and volume of oil. Approximately 8 kilometers will be sampled by digging more than 8,000 pits to discover and quantify subsurface oil.

ABSTRACT

This project will assess the amount of oil remaining from the *Exxon Valdez* oil spill on shorelines within Prince William Sound. A stratified random sample of shoreline will be intensively sampled for surface and subsurface oil to estimate length of oiled shoreline, area and volume of oiled sediment, and volume of oil. Approximately 8 km will be sampled by digging more than 8,000 pits to discover and quantify subsurface oil.

INTRODUCTION

Oil from the March 1989 Exxon Valdez oil spill (EVOS) has been surprisingly persistent on some beaches. At the end of the 1992 cleanup season, natural processes were expected to disperse most of the oil remaining on shorelines. However, relatively unweathered oil remains today at a number of locations that were heavily oiled initially, and protected from dispersion by storm-generated waves. The extent of the remaining oil is unknown, and this uncertainty engenders public and scientific concerns about the effects the oil may continue to have on humans and on fauna that may become exposed to the oil either directly or indirectly. The project proposed here seeks to address these concerns by providing a quantitative estimate of the amount of shoreline (length, area, sediment and volume) that remains contaminated. This estimate will inform any assessment of the significance of the amount of oil remaining, and be the basis for further management (e.g., do nothing, restrict access or harvest; etc.).

Estimating the oil remaining on beaches affected by the EVOS in a cost-effective manner presents a considerable challenge. Previous attempts to address this problem have mainly relied on Shoreline Contamination Assessment Teams (SCAT), consisting of field teams performing comprehensive foot-surveys of impacted beaches. Although this approach may be useful for directing cleanup efforts immediately after a spill, it is less appropriate for producing a quantitative estimate of remaining oil contamination, especially long after a spill when most remaining oil is obscured from casual view. Instead, a stratified random/adaptive sampling design will be used to focus sampling effort in areas where oil most likely persists, while allocating some effort to discovering oil in areas where persistence is uncertain. This approach will guarantee a credible minimum estimate of remaining oiled area, and will provide a confidence interval for the most likely amount remaining throughout the affected region. This information is needed to predict oil persistence into the future and to determine associated risks to vulnerable biota.

This project will focus on oil remaining on beaches inside Prince William Sound (PWS). At this time, areas outside of PWS are not part of the proposed assessment. Previous Trustee-funded projects have examined oil persistence along the Kenai-Alaska Peninsula shoreline in 1999 (Project 99495) and in the vicinity of Kodiak Island in 1995 (Project 95027). These studies confirmed the persistence of localized oil. The value of a shoreline assessment outside PWS will be reevaluated after reviewing results from the current study.

This project will be divided into three phases: Phase 1 is development of the sampling design to be applied to the study area. Phase 1 was funded, and the study design described here is the product. Design alternatives were developed during summer 2000 and presented at a workshop in November 2000 for consideration by peer-reviewers, trustee agency representatives, and other

stakeholders. Phase 2 is execution of the adopted sampling design inside Prince William Sound during spring/summer 2001. Phase 3 will be the closeout in FY02 involving analysis and report writing. This detailed project description presents the specific objectives, sampling design, and methodology for phase 2.

NEED FOR THE PROJECT

A. Statement of Problem

Although the persistence of relatively unweathered oil is clearly established on some beaches 10 years after the EVOS, the cumulative extent of remaining oiled beach is controversial. One estimate places the area of beach that remains contaminated by oil at less than 450 m^2 (Page 1999), but the basis for this claim has not been presented. Other studies suggest more extensive contamination (Brodersen et al. 1999; Hayes and Michel 1999; Irvine et al. 1999). These latter studies have often found relatively unweathered oil in the upper intertidal zone of beaches that are armored by boulders and beneath mussel beds that were initially heavily oiled (Babcock et al. 1998; Carls et al. 2000).

The extent of oil remaining on these beaches defines the lack of recovery for these sediments. The remaining oil may also impede recovery of injured species still exposed to it. This exposure includes direct contact with water contaminated by the remaining oil, or indirect contact through ingestion of prey contaminated by the oil. The fact that the remaining oil is often so unweathered indicates the oil is still a potent source of toxic polycyclic aromatic hydrocarbons (PAH), which elicit manifold adverse effects on biota exposed to them. These species may include black oystercatchers, clams, intertidal communities, mussels, Pacific herring, pink salmon, sea otters, subtidal communities, and harlequin ducks. In addition, subsistence uses, passive uses, recreation, and tourism may also be impaired because of speculation that the area remains contaminated.

B. Rationale

The plausibility of oil-exposure linkages connecting fauna at higher trophic levels with oiled habitat, as well as the propriety of additional restoration options, depend on an assessment of the amount of oiled habitat remaining in the spill area. Conversely, without this assessment, the public will continue to wonder how much of the spill area remains contaminated, and will likely make inappropriate decisions regarding resource use based on misperceptions about the extent of remaining oil. Also, scientists evaluating biological linkages to oil exposure will be less able to assess geographic correlation, compromising those studies.

Assessment of the extent of remaining oil should be done now to maximize benefits that may derive from the expected reduction in uncertainty regarding the extent of this oil.

C. Location

This project will be undertaken in PWS during 2001. Communities directly affected by this project include Cordova, Chenega, Tatitlek, Valdez, and Whittier. Benefits of the project will

accrue especially to participants in subsistence and commercial fishing, scientists studying resource recovery in the region, and more generally to the public at large.

COMMUNITY INVOLVEMENT

Community involvement is crucial to the success of this project. Residents of the impacted area may have local knowledge of oil persisting in physical settings and locations that are not known to the investigators of this project. Communication of this knowledge will improve the accuracy of the assessment of oil remaining. Communities in the region will be canvassed, especially the Native and commercial fishing communities of Tatitlek, Chenega, Cordova, and Valdez, during winter 2001 to identify potential additional sampling compartments. This will involve presentation to these communities of a summary of where oil is presently known to persist, and an appeal for residents to identify any additional situations where oil has been recently observed. The final sampling design will address and incorporate these situations, to increase the chance that significant repositories of oil remaining in the area are not overlooked.

Local hire for field support and sampling will be used whenever possible during this project. This will likely include vessel and aircraft charters and labor during sample collection.

Results of this project will be summarized as a map depicting locations and extent of remaining oil discovered, together with a report summarizing the statistical estimate of the amount of oiled shoreline remaining. These materials will be accompanied by a press release announcing these findings to the media for general distribution. Public presentations will be given in Anchorage, Cordova, and Valdez to facilitate public review and commentary on the findings.

PROJECT DESIGN

A. Objectives

This project has three objectives:

1. Determine the amount of shoreline (length, surface area, sediment volume, and oil volume) that remains contaminated with oil in the *Exxon Valdez* oil spill area;

2. Determine the trend in the recovery of oiled shoreline in terms of oiled surface area and sediment volume;

3. Determine the trend in the recovery of subtidal sediments in terms of oil concentrations remaining at locations sampled in 1991; and

4. Verify the source of oil as the *Exxon Valdez* oil spill by "fingerprinting" and characterize the weathering state of the oil remaining in each of the strata sampled.

B. Methods

1. Phase 1

The goal of phase 1 is to produce a final sampling design to be implemented in the field the following spring. A set of design alternatives was developed by Auke Bay Laboratory staff and presented at a workshop on November 2, 2000. Attending the workshop were Trustee staff, chief scientist, and peer-reviewers for evaluation of suitability and cost-efficiency. Two geomorphologists, Drs. James Gibeaut and Dan Mann, were provided financial support to attend this workshop. Alternate designs suggested by workshop participants were considered and compared. Project objectives were discussed. Refinements to the design selected at the end of the workshop, along with a detailed study plan for phase 2 of this project, are included below.

2. Phase 2

Amount of Contaminated Shoreline in Prince William Sound

We will estimate the surface area and volume of contaminated shoreline based on a random sample of oiled shoreline identified in previous surveys from 1989 to 1993. To focus effort on areas most likely to still contain oil, we assume that oil remaining in 2001 mostly occurs in areas that had heavy or medium oil impacts. Heavy impact is defined as a band of surface oil >6 m wide or intertidal coverage >50%; medium impact is a band of surface oil 3-6 m wide or intertidal coverage 10-50%. These areas are identified in the EVOS GIS Database (ADNR 1992).

We define three sampling strata: 1) shoreline having heavy impact in 1990, 1991, or 1993 (ADNR 1992; Gibeaut and Piper 1998a); 2) shoreline with medium impact in 1990, 1991, or 1993; and 3) shoreline with heavy impact in 1989 but only light impact or less in later years. Emphasis is on shoreline showing heavy or medium impacts in surveys after 1989 because the surface contamination persisted at high levels later in those areas. Shoreline that had heavy impact in 1989 but only light-to-no impacts later are included in a separate stratum because they may contain subsurface oil even though surface oil improved over the 1989-1990 winter.

Heavy oil impact in 1990-1993 occurred in 150 shoreline subsegments (pieces of shoreline about 1 km long) having a total length of 166 km, of which 24 km was heavily impacted (Table 1). Most of these sites (134) were identified as being heavily impacted in the 1990 survey; 16 additional sites were identified in surveys in 1991 and 1993. Medium impact occurred in 270 subsegments in 1990-93, with a total length of 304 km and medium-impacted length of 46 km. Lengths of shoreline that had heavy impact in 1989 but only light-to-no impact later occurred in 238 subsegments and had a heavy-impacted length of 43 km.

Because the main purpose of this sampling design is to estimate hidden subsurface oil, the "sampling unit" must be of a size that is practical and ensures a thorough search. We define the basic sampling unit as a 100-m section of shoreline. We expect that a 100-m length of shoreline will be a workable area that can be thoroughly sampled for surface and subsurface oil in a single

day. For this study, we divided all the shoreline lengths in each impact stratum into 100-m sampling units. Because the lengths of impacted shoreline vary in length, each stratum was further stratified into two substrata: 1) sampling units shorter than 100 m and 2) sampling units equal to 100 m. "Leftover" pieces of shoreline after dividing into 100-m units were included in the first substratum. Units in the first substratum (<100 m) are sampled in proportion to their length (i.e., randomly selected with probability of inclusion equal to the proportion of their length to the total length in the substratum), whereas sampling units in the second substratum (=100 m) are sampled with equal probability.

There are 317 units with heavy impact in 1990-1993, 672 units with medium impact in 1990-1993, and 538 units with heavy impact only in 1989 later (Table 1). Sampling units will be drawn randomly without replacement from each stratum.

At each randomly selected sampling unit, we will first thoroughly search for surface oil. Any surface oil discovered will be characterized and measured according to methods of Gibeaut and Piper (19981; Appendix 1). We assume that all surface oil deposits will be discovered and accurately measured. The sampling units, therefore, constitute a simple random sample, and the Horvitz-Thompson estimator (Thompson 1992) can be used to estimate total area of surface oil and its confidence interval for the three impact strata in Prince William Sound. An estimate of the total area (T) of surface oil is given by

$$\hat{\mathrm{T}} = \frac{1}{N}\sum_{i=1}^{n}\left(\frac{y_i}{\pi_i}\right) \qquad (1)$$

where N is the total number of sampling units in the population; n is the number of units in the sample; y_i is the area of oil in the ith unit; and π_i is the probability that the ith unit is included in the sample. Thompson (1992) provides an unbiased estimator of variance.

Because subsurface oil is hidden, the amount at each sampling unit will have to be estimated by random sampling. We will use an adaptive cluster sampling design because the adaptive design is more efficient than simple random sampling when the quantity to be estimated is distributed in rare patches (Thompson and Seber 1996). We will use a systematic initial sample with primary and secondary units (Thompson and Seber 1996) to provide uniform coverage of the shoreline area within the sampling unit.

Each 100-m sampling unit will be divided into 50 blocks by placing five vertical transects spaced 20 m apart, running from 6-ft to 16-ft elevation beginning from a starting point determined by geographic coordinates from the EVOS GIS Database (ADNR 1992). Thus, each block will be 20 m long by $W/10$ wide, where W equals the slope distance between 6 ft and 16 ft elevation. Each block will then be divided into secondary units whose size is determined by dimensions of a typical pit dug for discovering subsurface oil. Pits will be 50 cm x 50 cm square and 50 cm deep or to bedrock; thus, each secondary unit is 0.25 m^2. Two random starting points will be selected in the first block, and the pattern will be repeated in the other blocks. This pattern will

provide two primary units (i.e., systematic samples) each consisting of 50 secondary units (i.e., 100 pits total). Where oil is discovered in the initial sample, additional pits will be excavated around the discovered oil to determine patch dimensions.

An estimate of the total subsurface oiled sediment area or volume is given by

$$\hat{T} = \sum_{k=1}^{K} \frac{y_k^*}{\alpha_k} \tag{2}$$

Where K is the number of patches discovered; y^*_k is the oiled sediment area or volume in the k^{th} patch; and α_k is the intersection probability of the k^{th} patch. Thompson and Seber (1996) provide an unbiased estimator of variance. Intersection probability is given by

$$\alpha_k = 1 - \left[\binom{N - x_k}{n} \Big/ \binom{N}{n} \right] \tag{3}$$

where N is the total number of primary units in the population (i.e., the total possible unique systematic samples); x_k is the number of primary units in the population that intersect the k^{th} patch; and n is the number of primary units in the sample.

Methodology for measuring subsurface oiled sediment area and volume will follow the 1993 shoreline assessment (Gibeaut and Piper 1998a; Appendix 1). In addition, approximately 150 samples of oiled sediment from the pits will be taken for gravimetric analysis to determine oil weight to calibrate visual estimates of oil weighting categories (Appendix 1). Pit dimensions will be measured to quantify mean and variance for each site. Locations of sampling units and oil patches will be determined by geographic positioning system for later mapping and entry into a geographic information system database.

To determine whether oil is present in a pit, trained personnel will look and smell for visible oil. We will attempt to develop a "wipe test" or other means that would be more reliable and objective than human eye and nose.

For analysis, data may be stratified by shoreline type if doing so increases precision of the estimates of total oil. Shoreline type is based on the Environmental Sensitivity Index (ESI) and classifies shoreline locations according to geomorphology and exposure. Heavily impacted locations in 1990 were primarily of five shoreline types: 1) exposed rocky shores; 2) exposed wavecut platforms; 3) mixed sand and gravel beaches; 4) gravel, cobble, boulder beaches; and 5) sheltered rocky shores (Table 2). The distribution of heavy impacts with respect to shore type in 1990 appeared to be random, as it was similar to overall distribution of shore types in the spill area (Table 2). In 1993, however, oil residues were principally found in areas with boulders and

bedrock and under mussel beds (Table 3). Thus, all shoreline types had equal probability of being oiled, but shoreline types with boulders and mussel beds retained oil longer.

Detailed information on shore type will be taken at each sampling unit so that relationships between oil retention and shore type can be examined. Data currently available in the EVOS GIS database (ADNR 1992) are not detailed enough to allow for stratification by shore type prior to sampling.

Power Analysis

The estimate of the total amount of oiled shoreline derived from this project will contain two components of variance: 1) variance due to variation among shoreline areas used to extrapolate to the total, and 2) variance due to sampling error at each beach where oiled area and volume are estimated. We assume that surface oil will be measured without error at the sampling sites, but subsurface oiled sediment will be estimated by an adaptive sampling design and, therefore, have an associated sampling error. For subsurface oil, both components of variance must be accounted for, through bootstrapping or other procedure, to provide a point estimate and confidence interval for total amount of subsurface oiled shoreline.

The power of the design to estimate total oiled shoreline can be evaluated based on data from the 1993 survey (Gibeaut and Piper 1998b). In this analysis, we assume that the amount of oiled sediment at each sampling unit was measured without error. In the 1993 survey, the survey appears comprehensive, and the principal investigator is confident that all significant oil deposits were discovered (Gibeaut, pers. comm.); thus, this assumption appears valid. If instead, oil patches were estimated by random sampling, additional variance due to sampling error at the beaches would decrease power of the design.

The sample size n required to estimate the population total to within proportion r of the true value, with probability $1 - \alpha$, is given by

$$n = 1/ (r^2/z^2c^2 + 1/N),$$

where n is number of samples, r is relative difference between the estimate and the true value, z is the upper α /2 of the standard normal distribution, c is the coefficient of variation s/mean, and N is the total number of sampling units in the population (Thompson 1992).

The 1993 data for surface oiled area and subsurface oiled volume in 45 sites were lognormally distributed. The data, therefore, were transformed to natural logarithms to calculate variance (Table 4). Using the coefficient of variation for subsurface oiled volume from the 1993 data, we calculated the required sample size to achieve various levels of relative precision r for an estimate of total oiled sediment volume (log scale) with error probability α of 10%.

Results for the 150 heavily impacted subsegments, for example, indicate that the confidence interval decreases rapidly as sample size increases toward about 20-30% of sampling units and decreases more slowly at greater sample sizes (Fig. 1). A sample size of about 20% of sampling units would provide an estimate within ±20% of the true value for total subsurface oiled volume

in log scale. A sample size of about 50 subsegments (30% sample) would provide an estimate within ±14% of the true value. Because precision is expressed in logarithms, actual confidence intervals after converting back to original scale will be somewhat greater and asymmetrical.

The preceding power analysis does not account for the additional variance due to sampling error at each sampling unit. No data are currently available to assess this variance. Use of the adaptive sampling procedure to discover and measure hidden subsurface oil, however, will provide an estimate of this additional variance.

For the adaptive sampling design used to estimate subsurface oil at each sampling unit, the most important consideration is that the sampling effort be sufficient to provide confidence that hidden oil, when present, will be discovered by the initial systematic sample. The probability of discovering hidden oil when present depends on the width of the beach (i.e., slope distance from 6 ft to 16 ft), number of primary units in the sample, and shape and distribution of oil patches. Width of the beach determines the area to be sampled and the density of pits within each 100-m sampling unit.

To examine likelihood of discovering oil patches under different conditions, we determined intersection probabilities α_k for several hypothetical scenarios. For example, consider a beach that is 100 m wide with a band of buried oil 2 m wide and 60 m long (Fig. 2). In this case, each block in the sampling unit is 10 m wide by 20 m long, so that there are 800 possible primary units in the population. By inspection, the oil band intersects 480 primary units. By Equation (3), therefore, the probability of discovering the oil patch with one primary unit (50 pits) equals 60%; with two primary units (100 pits), probability is 84%; and with three primary units (150 pits), probability is 94%. Although a 60% probability might be considered adequate, a minimum of two primary units is required to provide an unbiased estimate of variance (Thompson 1992). If the same beach were half as wide (50 m slope distance), intersection probability with even one primary unit would be 100%. Thus, if significant patches of oil exist in the sampling units, we anticipate a high probability of encountering them with two primary units (100 pits per 100-m sampling unit). If a beach were much wider than 100 m, we would increase the number of primary units in the sample to provide adequate coverage.

Sampling Effort and Allocation

We propose to allocate approximately two-thirds of the sampling effort to shoreline that was still heavily impacted in 1990-1993 (Stratum 1), one-quarter of effort to the shoreline that was medium impacted in 1990-1993 (Stratum 2), and about 5% of effort to shoreline with heavy impact in 1989 only (Stratum 3) (Table 5). The remaining effort will be allocated to any high-priority sites suggested by agencies or local communities as special areas of concern. This effort allocation can be adjusted as sampling progresses if, for example, it appears that greater effort in the medium-impact stratum would provide a more precise estimate of oiled shoreline. Adjustments will also be considered if it appears that geomorphologically identifiable units on the high impact beaches are consistently devoid of oil, so that effort could be more usefully concentrated in units when encountering oil is more likely.

Based on the power analysis above, a sample of about 20% of shoreline in the heavy-impact stratum should provide good precision for the estimate of total oiled shoreline area and volume in this stratum. In this stratum, we would sample 55 sampling units (18 units <100 m and 37 units = 100 m) with a total length of about 5 km. We would also sample 2 km of shoreline in Stratum 2 (medium impact), 0.5 km in Stratum 3 (heavy impact in 1989 only), and about 0.5 km of shoreline of particular concern (Table 5). The total shoreline sampled would be about 8 km, involving digging more than 8,000 pits. This effort provides a thorough coverage of the spill area.

We estimate that a crew of six (one supervisor, one assistant, one archeologist, and three diggers) could complete sampling of about 100 m per day, depending on sampling difficulty, complexity of discovered oil distribution, and travel time between sampling units. Thus, the 8 km of sampling units should be completed in eight 12-day cruises (96 charter days) accounting for travel to and from base and weather days. For comparison, the 1993 survey worked one crew for eight 1-week cruises and surveyed a total of about 19 km of shoreline but with a much lower number of pits (Gibeaut and Piper 1998a, b).

The total effort and funding requirements for this project are quite large. Additional objectives or a change in priorities would cause a shift in effort allocation but probably not an increase in total effort. For example, if more effort is desired at locations considered important by communities, less effort would be available to sample random locations, and statistical precision would decline.

Recovery Trends

The trend in recovery of oiled shoreline will be measured in two ways. First, we will resurvey at least 10 randomly selected sites from the 45 sites that were used in the 1993 shoreline assessment (Gibeaut and Piper 1998a,b). These sites have oiling and cleanup data from 1989 through 1993. At these sites, we will duplicate the sampling procedures of Gibeaut and Piper (1998a, b), as well as conduct the adaptive sampling design to compare results of the two designs.

A second means of determining recovery trend will be to resurvey some of the stations with permanent transects established in 1989 by NOAA and ADEC and resurveyed in 1993 by Gibeaut and Piper (1998a). These stations include high-energy boulder and cobble beaches; moderate-energy boulder, cobble, and pebble beaches; and sheltered set-aside stations. This type of survey entails measuring the profile along a line oriented perpendicular to the shoreline trend and visually estimating sediment and oiling conditions (Gibeaut and Piper 1998a). Resurveying 15 of these stations will provide quantitative data on erosional and depositional processes related to degradation and dispersal of oil.

The recovery trend of subtidal sediments will be evaluated by resampling 5 locations that were last monitored in 1991 (O'Clair et al. 1996). These locations include Herring Bay, Northwest Bay, Olsen Bay, Sleepy Bay, and Snug Harbor. Olsen Bay was a control location outside the spill path, and the others were heavily oiled, with oil from the spill detected in subtidal sediment at them in 1991. At each of these locations, transects were sampled at 0, 3, 6, 10, 20, 40, and 100 m below MLLW. Sediment samples will be collected from each of these transect sites at

each location for a total of 35 samples, using collection methods identical with those used in the 1991 survey in conjunction with the shoreline assessment sampling described above during summer 2001. These samples will be analyzed by GCMS in 2003, and the data will be evaluated by the hydrocarbon source recognition methods developed by Short and Heintz (1997) for these samples. Comparison of results with the 1991 data will permit assessment of oil persistence at these locations.

Oil Source -- Fingerprinting

To determine condition of remaining oil and whether it still matches *Exxon Valdez* oil, we will collect 24 sediment samples with visible subsurface oil from pits at different sampling sites. These samples will be analyzed by GC-MS to determine whether PAH composition matches weathered *Exxon Valdez* oil. A weathering index (Short and Heintz 1997) will be determined for each sample.

C. Contracts and Other Agency Assistance

Funds will be provided to the U.S. Forest Service to hire a certified archeologist for a 5-month appointment to participate in field sampling and to ensure compliance with the State Historic Inventory Program administered by the Alaska Department of Natural Resources. A contract will be provided to Dr. Jim Gibeaut of the Bureau of Economic Geology, University of Texas, to conduct training of personnel so that methodology will be comparable to previous surveys, and to analyze the recovery trend in PWS based on a resurvey of 15 transect sites established by ADEC/NOAA in 1989. A contract will be provided to conduct an Environmental Analysis if required under NEPA.

SCHEDULE

A. Measurable Project Tasks for FY01

FY01:	
Nov. 2:	Convene planning workshop in Anchorage to develop study design.
Nov. 20:	Incorporate peer-review comments into final DPD and submit for funding consideration by the Trustee Council in December. (End Phase 1).
Nov 30 – Apr 15:	Present summary of known remaining oil deposits inside PWS and canvas communities for local knowledge of persistent oil. Identify sampling locations of community concern.
Apr 15 – May 15:	Hire and train field personnel.
May 15 – Sep 30:	Collect field data and samples. (End Phase 2).

B. Project Milestones and Endpoints

FY02: Closeout.

Oct 1 – Apr 15:	Analyze phase 2 data and samples; enter data on GIS database.
Apr 15 – Sep 30:	Produce map depicting sampled locations; prepare final report and journal publications.

C. Completion Date

September 30, 2002

PUBLICATIONS AND REPORTS

No publications will be submitted in FY01. We anticipate that three research papers will be submitted to peer-reviewed scientific journals in FY02. Probable titles of these papers will be "*Amount of oil contamination in Prince William Sound 11 years after the Exxon Valdez oil spill*," "*Trend of recovery of subsurface oil after the Exxon Valdez oil spill*," and "*Identification and weathered condition of remaining Exxon Valdez oil 11 years after the spill.*"

PROFESSIONAL CONFERENCES

None Planned for FY01.

NORMAL AGENCY MANAGEMENT

If the oil spill had not occurred, neither NOAA nor the cooperating agencies would be conducting this project.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will be coordinated through participation of the cooperating agencies. Formal coordination commenced at the November workshop in Anchorage. All of the previous Trustee-funded studies on oil persistence in the spill region have been performed under the auspices of these agencies, and it is presumed that local knowledge is the only significant source of additional information relevant to this project outside these agencies.

EXPLANATION OF CHANGES IN CONTINUING PROJECTS

None

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PRINCIPAL INVESTIGATORS

Jeffrey W. Short

Education: M.S. (Physical Chemistry)

Relevant Experience:
1989- Present: Established and managed the hydrocarbon analysis facility at ABL to analyze hydrocarbon samples generated by the *Exxon Valdez* NRDA effort (about 20% of these samples were analyzed at ABL).
1989 - 1992: Principal Investigator, Exxon Valdez project Air/Water #3: Determination of petroleum hydrocarbons in seawater by direct chemical analysis and through the use of caged mussels deployed along the path of the oil spill.
1991 - 1996: Principal Investigator, Exxon Valdez project Subtidal #8: Development of computer-based statistical methods for global examination of sediment and mussel hydrocarbon data produced for the Exxon Valdez NRDA effort for systematic bias, and for identification of probable sources of hydrocarbons.
1996 - present: Principal Investigator, Restoration Project 290, Database Management.

Michael L. Murphy

Education: M.S. (Fisheries Science)

Relevant Experience:
1981 - 1995: Conducted extensive field studies on effects of logging on anadromous fish habitat

in Southeast Alaska, leading to legislative changes in forestry practices.
1995 - 1997: Principal Investigator, Exxon Valdez project 97194, Recovery of Pink Salmon Spawning Areas after the *Exxon Valdez* Oil Spill.

OTHER KEY PERSONNEL

1. Patricia Harris, Zoologist, Auke Bay Laboratory, will assist in supervising field sampling, data analysis, , and coordinate interactions with local communities.

2. Mandy Lindeberg, Fisheries Biologist, Auke Bay Laboratory, will assist in supervising field sampling, data analysis, and writing.

3. Jerome Pella, the senior biometrician at the Auke Bay Laboratory, will consult on sampling design and data analysis.

4. Marianne See, Alaska Department of Environmental Conservation, will facilitate coordination with State of Alaska agencies.

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Table 1. Number and length of shoreline subsegments with either heavy or medium oil impact in 1990-1993, or with heavy impact in fall 1989 but light-to-no impact afterwards.

	Number of Subsegments with Impact	Total Length of Impact (m)	Number of Sampling Units
Heavy impact in 1990, 1991, or 1993	150	24 km	317
Medium impact in 1990, 1991, or 1993	270	46 km	672
Heavy impact in 1989 only	238	43 km	538

Table 2. Frequency of heavily oiled locations by shoreline type in spring 1990 and overall frequency of shore types in the spill area. Locations are pieces of shoreline with consistent geomorphology and oiling history.

Shoreline type	% Frequency of heavy impacts in 1990	% Frequency of shore types in the spill area
Exposed rocky shores	18	18
Exposed wavecut platforms	9	8
Fine-grained sand beaches	0	0
Coarse-grained sand beaches	0	0
Mixed sand and gravel beaches	29	23
Gravel, cobble, boulder beaches	18	18
Exposed tidal flats	0	0
Sheltered rocky shores	25	28
Sheltered tidal flats	1	3
Marshes	0	1
Total locations (n)	332	13,025

Table 3. Surface and subsurface oiled sediment observed in the 1993 survey in relation to shore type. Data are from Gibeaut and Piper (1998b).

	Surface oiled sediment		Subsurface oiled sediment	
Shore type	Area (m^2)	% of total	Volume (m^3)	% of total
Wavecut platform	3,035	29	127	3
Sheltered rocky	2,376	22	86	2
Exposed rocky	2,166	21	714	14
Boulder/gravel beach	2,140	20	3,413	67
Sheltered tide flat	836	8	4	0
Mixed sand/gravel beach	9	0	25	0
Mussel bed	0	0	722	14
Total	10,562	100	5,091	100

Table 4. Estimates of the mean and variance of log-transformed (ln(x + 1)) surface area and subsurface volume of oiled sediment in 1993 (Gibeaut and Piper 1998b). Data are total surface area and subsurface volume per subsegment.

	Surface oil (m^2)	Subsurface oil (m^3)
Mean	4.05	3.32
Standard deviation s	2.05	2.07
Variance s^2	4.20	4.28
Coefficient of variation	0.51	0.62
Number of subsegments	45	45

Table 5. Distribution of effort among sampling strata.

Stratum	% Effort	Shoreline to be sampled (km)	Shoreline in Stratum (km)	Sample fraction (% shoreline)
Heavy impact, 1990-1993	63	5	24	21%
Medium impact, 1990-1993	25	2	46	4%
Heavy impact, 1989 only	6	0.5	43	1%
Areas of concern	6	0.5		
Total	100	8.0		

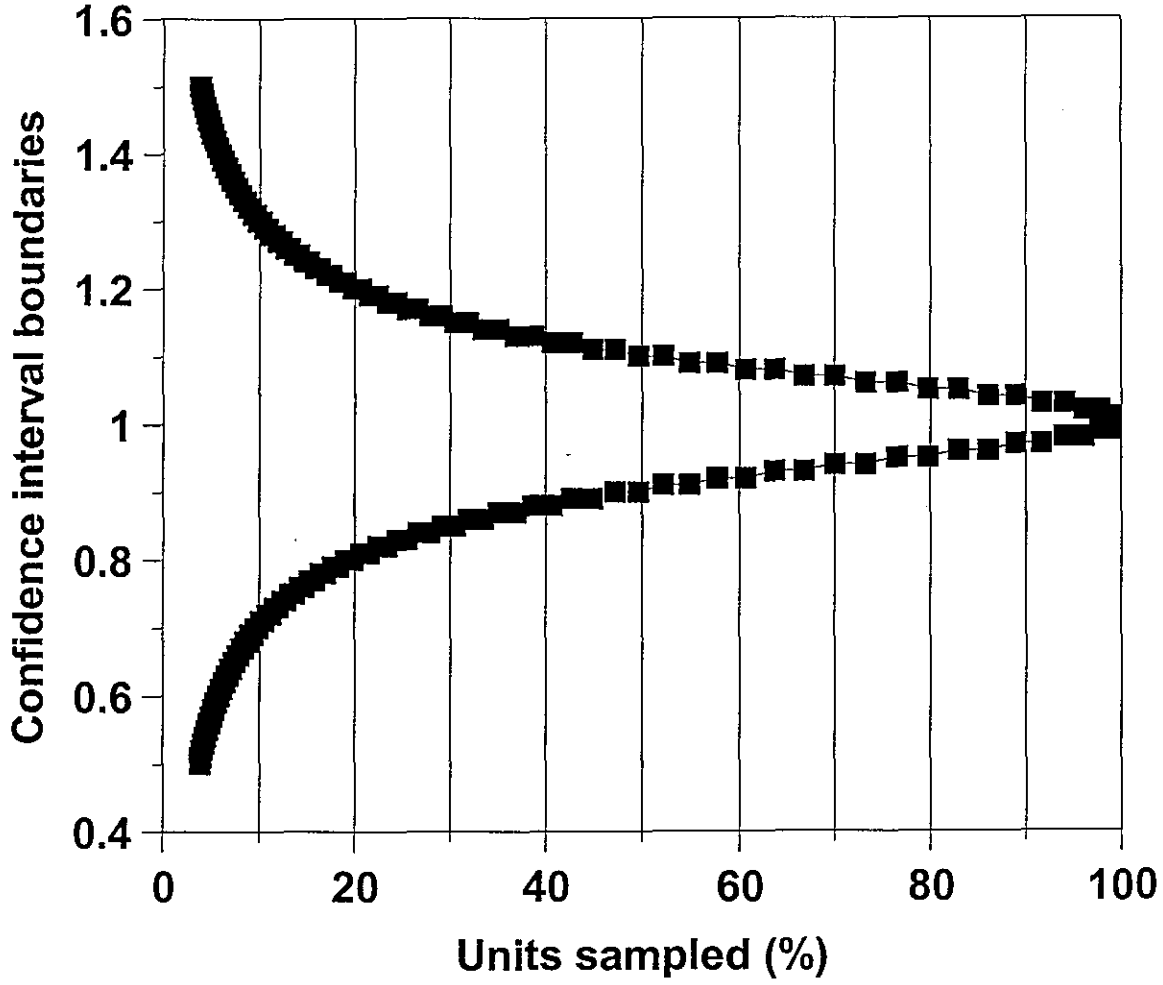

Figure 1. Upper and lower boundaries of a 90% confidence interval for an estimate of total volume of subsurface oiled sediment (log scale) in 150 sites as a function of sample size. The estimate is adjusted to 1.0 to show relative precision.

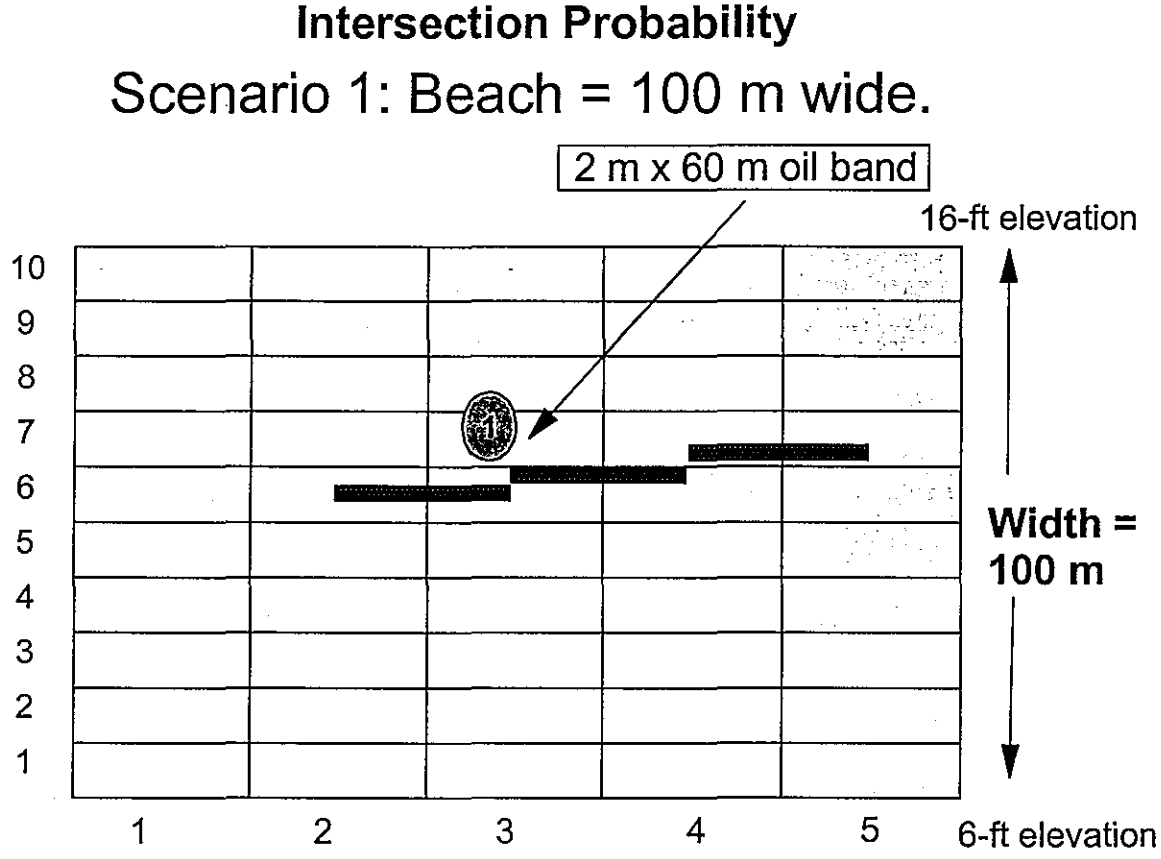

Figure 2. Analysis of the intersection probability resulting from application of an adaptive cluster sampling design with a 100-m sampling unit and an initial systematic sample. The sampling unit is divided into 50 blocks, and random starting points are selected in the first block and repeated in all other blocks. A hypothetical scenario is illustrated in which the beach is 100 m wide (slope distance from 6 ft to 16 ft elevation) and the site contains a band of subsurface oil 2 m x 60 m. There are 800 possible unique starting points for a systematic sample of 0.5 m x 0.5 m pits. The intersection probability is 60% with one primary unit (50 pits), 84% with two primary units (100 pits), and 94% with three primary units (150 pits). Although a 60% probability might be considered adequate, a minimum of two primary units is required to provide an unbiased estimate of variance (Thompson 1992).

Appendix 1. Methods used by ground surveys to estimate oil coverage in 1993 (Gibeaut and Piper 1998).

The 2001 survey will use the same techniques as previous surveys to measure the area of discovered oiled surface sediment and volume of discovered subsurface oiled sediment (Exxon Corporation 1991; Gibeaut and Piper 1998). Observed oil distribution will be recorded on field maps and forms. Observed oil will be classified according to type and distribution (Gibeaut and Piper 1998). Field classification of oil type and percent cover was designed for consistent collection of qualitative field data. The categories are broad and reflect the problems associated with making observations in areas where oil cover and beach geomorphology vary.

The size of oiled locations will be measured with a meter tape, and the percent oil cover within the area will be visually estimated. Amount of surface oil cover will be estimated by multiplying the area of oiling by the percentage value for field categories for surface oil coverage (Gibeaut and Piper 1998).

Pits will be dug to delineate subsurface oiling areas, and the pits will be plotted on field maps with a distance scale. The average oiling thickness will be calculated for each type of oil in a location, and this number will be multiplied by the area measurement of that type to yield an oiled-sediment volume. The oiled-sediment volume will be multiplied by a "weight" corresponding to the relative concentration of the oil. The weighted oiled-sediment volume (WOSV) is a way to track relative amounts of oil.

$$WOSV = 5V_{OP} + 4V_{HOR} + 3V_{MOR} + 2V_{LOR},$$

where VOP is volume of oil pore (OP) sediment; VHOR is volume of heavy oil residue (HOR); etc.

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Revision 12-14-00

Kodiak Archipelago Youth Area Watch

RECEIVED
DEC 14 2000
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Project Number:	01610
Restoration Category:	General Restoration
Proposer:	Chugach Regional Resources Commission
Lead Trustee Agency:	ADFG
Cooperating Agency:	Kodiak Island Borough School District
Alaska SeaLife Center:	Yes
Duration:	2nd year, 3-year project
Cost FY 00:	$61.8
Cost FY 01:	$61.8
Cost FY 02:	$106.1
Geographic Area:	Kodiak Archipelago
Injured Resources/Services:	Harbor seals, sub-tidal and inter-tidal communities, subsistence, and commercial fishing

ABSTRACT

In FY 99, Chugach Regional Resources Commission collaborated with the Kodiak Island Borough School District to institute an internship program within the Community Involvement Project. This internship program chose one student in the communities of Akhiok, Larsen Bay, Old Harbor, Kodiak and Ouzinkie. In FY 00 this project was expanded to include a Youth Area Watch Program. The program has collaborated with four research projects in FY 00, including EVOS-sponsored 00482, PSP Field Testing Kit; EVOS-sponsored 00245, Harbor Seal Bio-Sampling; intensive monitoring with the Fisheries Industrial Technology Center and National Oceanic and Atmospheric Administration; and an algae testing project with Dr. Gerry Plumley.

Project plans for FY 01 include the expansion of two additional communities to the program, Chiniak and Port Lions, site teacher training in collaboration with the Kodiak College, the construction of a web site for students, teachers, administrators, and project scientists to collaborate, share, and coordinate projects, as well as post data; additional equipment for monitoring activities; and participation by students, teachers and scientists in the annual Science Camp held at Afognak.

All these steps will continue the project in the direction of student oceanographic monitoring in collaboration with the Fisheries Industrial Technology Center, continued beach monitoring for PSP and algal blooms, harbor seal bio-sampling, and hands-on training for a select number of students within the Kodiak Island Borough School District with western scientific knowledge and traditional ecological ways of knowing. A project with the National Marine Fisheries Service to investigate stomach contents of halibut to determine the population and prevalence of sandlance and capelin may possibly be integrated as well.

INTRODUCTION

The Youth Area Watch program instituted in the Prince William Sound and lower Cook Inlet has been one of the most popular and supported projects that the Trustee Council has implemented. The spill area does not strictly include only those areas; it also encompasses the Kodiak Archipelago and the Alaska Peninsula.

During the spring of 1998 Kodiak Island Borough School District personnel and the Chugach Regional Resources Commission personnel began to discuss the development of the Kodiak Youth Area Watch. In September 1998 CRRC was funded through the EVOS Trustee Council to implement the KYAW project. The KIBSD and the CRRC later signed a Memorandum of Agreement.

In January 1999 KYAW applications were sent to all eight communities in the Kodiak archipelago to prompt student, teacher, and community participation. The village of Larsen Bay had one intern, the village of Karluk had one intern and one alternate, the village of Old Harbor had one intern and one alternate, and the village of Akhiok had one intern. Each of the six student interns researched, locally, the effect of the 1989 oil spill in their village by interviewing elders and other community members. Students also participated in the 10th year Symposium held in March 1999 where they reported on the status of their research activities within the KYAW Program.

During the remainder of the spring of 1999, CRRC and KIBSD personnel researched possible projects for the KYAW and sought to increase the number of students participating. CRRC later submitted a proposal to continue the KYAW for FY 00. Once the proposal was approved, CRRC and the KIBSD signed a Memorandum of Agreement.

In FY 00, the KIBSD and CRRC were successful with implementing four core research projects, two of which were funded by the Trustee Council. These projects included 1) 00482, Field-Testing of PSP Test Kits for Subsistence Use; 2) 00245, Harbor Seal Bio-sampling, will train and involve KYAW participants in the program. They were trained in how to conduct a bio-sample, where to ship the sample, and what the uses of the seal are for research: 3) Dr. Gerry Plumley, University of Alaska-Fairbanks, received funding from the Alaska Science and Technology Foundation to test algae for a possible connection to the infection of PSP to shellfish. He has involved KYAW participants in FY 00 and will continue to utilize them in FY 01; and 4) the Fisheries Industrial Technology Center and National Oceanic and Atmospheric Administration have been working closely with the program to develop and implement a long-term, consistent monitoring program that will focus on salinity, water temperature, and a host of

other oceanographic indicators. Comprehensive monitoring kits were purchased for the participants in each of the communities to use.

Increased involvement by students, teachers and community members was realized during the 1999-2000 school year to include: four students from Ouzinkie, one teacher and one community member; two students from Old Harbor, one teacher, and several community members; two students from Larsen Bay, one teacher, and one community member; two students from Kodiak, and one teacher; and two community members from Akhiok. Total involvement for 1999-2000 school year included ten students, four teachers, and over five community members.

During the 1999-2000 school year the following KYAW project activities took place:

1) On November 12, 1999 the KYAW orientation meeting took place in Kodiak. The main purpose of this meeting was to connect the District teachers with the scientists and their projects.
2) During the Kodiak Island Borough School District Rural School's Science Fair, Mitch Simeonoff and Roy Rastopsoff, the community members from Akhiok, performed seal bio sampling with seals that had been harvested for a community dinner. A number of students from throughout the region, as well as their teachers, were exposed to the data collection and purpose of this project.
3) Orders were taken to purchase equipment for the students to use. This was done through the recommendations given by the scientists, and coordinated by Brian Himelbloom and Bob Pfutzenreuter of University of Alaska-Fairbanks and the Fisheries Industrial Technology Center located in Kodiak.
4) On December 15, 1999 another meeting was held to further the development and organization of the KYAW.
5) On January 26, 2000 a student/teacher orientation meeting took place to train participations in the use of the equipment and process data collection and reporting.
6) Old Harbor School began to redesign their High School Science studies in order to integrate the KYAW into their general requirements. During 2000-2001 the teachers plan to focus more of their curriculum on marine studies school-wide.
7) Students began to collect data pertaining to ocean water temperature, presence of algae, general weather conditions, marine mammal sightings, and seal bio-sampling. Students also began research regarding PSP and its presence in the Kodiak waters.
8) In June of 2000 another training session took place that introduced participates to the collection of samples and use of the PSP testing kit created by Jellet Biotek.

In FY 01, we are proposing to continue the efforts began the first year of this program. Dr. Gerry Plumley will continue to work with the program to monitor algal blooms at the various sites around the island, assessing a connection with algal blooms and the prevalence of PSP in shellfish. The Alaska Native Harbor Seal Commission, through 01245, Harbor Seal Bio-sampling, will continue to support the program through bio-sample training in various communities throughout the region. The Fisheries Industrial Technology Center and National Oceanic and Atmospheric Administration will continue to collaborate with the project and students to collect oceanographic monitoring data. This information will be used to assist the Trustee Council with the Gulf Ecosystem Monitoring Plan. Data collected through this program will fill a hole of oceanographic information that will be necessary for the formation of a 100-

year data set. Continued work with 01482, Field-Testing of PSP Test Kits for Subsistence Use, will be achieved in FY01 regarding beach monitoring and chronic PSP site identification. Possible work with the National Marine Fisheries Service regarding the analysis of halibut stomach contents to determine the presence and abundance of sandlance and capelin is being developed as well.

In addition, students will select a local project to conduct. Connections to traditional knowledge, and integrating TEK data into a format traditionally used in western science will be developed and coordinated with the Alaska Knowledge Science Initiative, funded by the Alaska Federation of Natives. Teri Schneider, Cultural Coordinator for KIBSD, is very interested in pursuing this integration. It is an option to implement their own small-scale research. These projects would be presented at the March 2001 TEK Conference and CRRC Annual Gathering.

NEED FOR PROJECT

A. Statement of Problem

Kodiak Archipelago Youth Area Watch shares much of the same values and objectives as the original Youth Area Watch. The KYAW participants are committed to assisting in the restoration of the spill area through the collection and requisite samples and data for principal investigators of research projects. Research dollars are often scarce – the assistance of labor through this project to the four core projects is an invaluable asset to the overall restoration effort.

The public aspect of this is also invaluable to the Trustee Council. Youth involved in science, especially Alaska Natives, has been difficult to achieve in many cases. This project gives students hands-on experience and an avenue to achieve goals that may have once seemed impossible. The KYAW has received tremendous support throughout the spill area and beyond and the benefits of this project are felt in many different arenas. The Trustee Council would be supporting a win-win situation by funding this project again.

B. Rationale/Link to Restoration

The Kodiak Archipelago Youth Area Watch will work in primarily three areas. First, harbor seals disastrously affected by the oil spill are being studied under 00245. KYAW participants would assist in this recovery effort of the Alaska Native Harbor Seal Commission and Trustee Council. Secondly, the enhancement of safe shellfish to eat would benefit the use of subsistence greatly; consequently, assisting in the recovery of the subsistence service by providing a replacement subsistence resource for harvesters. The field test and algae project both will assist in making shellfish safer for everyone. Finally, the Fisheries Industrial Technology Center and the National Oceanic and Atmospheric Administration have ongoing oceanographic monitoring. The eagerness of these organizations has been confirmed through their commitment to developing the current monitoring data into a long-term KYAW project.

The public/youth involvement through this project in the restoration process will assist the Trustee Council in their mission to inform and involve the public regarding the restoration program.

C. Location

Kodiak Archipelago Youth Area Watch will take place in the Kodiak Island communities of Akhiok, Old Harbor, Larsen Bay, Port Lions, Ouzinkie, Chiniak, and Kodiak. Site teachers will be continually trained through the school district and Teri Schneider will serve as the coordinator for the program for the school district. Sarah Ward and The CRRC Office Assistant (CRRC is currently hiring a new Office Assistant) will work with the school district and provide outreach to tribal councils throughout Kodiak Island, utilizing the Community Involvement and GEM Planning Project. Additionally, traditional ecological knowledge will be integrated into the program with the assistance of TEK Specialist, Dr. Henry Huntington.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

In addition to assisting in research, community involvement and the utilization of traditional ecological knowledge are at the heart of this program. Tribal councils, schools, communities, regional organizations, and researchers will all be collaborating to ensure that this project is a success. CRRC will work closely to ensure that each of the tribal councils where there are KYAW participants will have a voice in the research and curriculum of the program. Traditional ecological knowledge will be integrated into the projects that student's design and collaborating researchers will be encouraged to utilize TEK on their particular projects.

PROJECT DESIGN

A. Objectives

Selected students in the identified communities will participate in the project to accomplish the following objectives:

1. Research project personnel interact with students, communities, and staff.
2. Identify all research and data collection activities.
3. Orient researchers on working with students.
4. Conduct research with the four projects.
5. Update MOA between CRRC and KIBSD.
6. Purchase additional monitoring equipment for expansion of area-wide monitoring.
7. Complete site teacher training and training with the Kodiak College regarding science monitoring and research.
8. Conduct school orientations for student in KYAW.
9. Set up Kodiak Archipelago Youth Area Watch web site to store data, stay informed regarding all activities, and coordinate efforts of staff, students, researchers, and community members.
10. Involve students in the annual Science Camp to be held in June of 2001. This camp will allow students to present their work to the other participants, educating and enlarging the

support and momentum of the project. The Science Camp will be an opportunity for youth to recap that activities of the year and plan for the coming year.
11. Complete student project training with tribal council and site teacher.
12. Facilitate project follow-up training with site teachers.

METHODS

CRRC will update the current sub-contract with the Kodiak Island Borough School District. Agreements will be re-issued with tribal councils throughout the island to ensure their meaningful involvement in the project. Researchers involved will sign contracts to ensure their follow-through of involving the youth in their projects.

Teri Schneider, Cultural Coordinator with the Kodiak Island Borough School District, and the new CRRC Office Assistant, will work cooperatively to plan the involvement and logistics of youth and researchers fieldwork. Additionally, training will take place with all involved parties to ensure that this project will work for everyone.

We have selected methods to choose students based on academic standing, personal interest, and potential for improvement. Approximately 49 students will be participating in the second year of the project. While distribution varies according to interest and ability of students that apply, it is expected that the distribution will be as follows: 15 from Old Harbor, 13 from Ouzinkie, 2 from Larsen Bay and Karluk, 11 from Port Lions, 2 from Chiniak, 2 from Akhiok, and 4 from Kodiak. 16 of the 49 students will be designated as interns. These students will be the ones to travel to special events and will be the 'leaders' of the projects. The rest of the students will participate to a lesser degree but will be actively involved. The communities with a large number of students participating have chosen to integrate the KYAW Project into their science curriculum, allowing all the high school and/or middle schools to participate in either all, or part of the projects.

Prior to the school year in the fall, participating KYAW teachers will congregate in Kodiak to conduct a two-day training on what the program will encompass. We will ask that researchers attend as well. Since funding will not yet be available, CRRC will front the cost of this training. Protocols from principal investigators and program details will be discussed. In addition to the site teachers, we will invite tribal council representatives.

All of the coordinating projects, field test PSP kit, algae testing, and biosampling, and oceanographic monitoring will take place geographically close to the participant's communities. It will be the responsibility of the site teacher and participants to determine field schedules. Harbor seal bio-sampling will require two training sessions and coordination with local seal harvesters. The oceanographic monitoring project will require coordinated efforts on contracted vessels and such. This will be negotiated between the Fisheries Industrial Technology Center and CRRC. Schedules will be determined when appropriate. Quarterly, students and support staff will congregate in Kodiak for a day to discuss progress and evaluate the program. Written reports describing the students' activities and the progress of the program will be submitted to EVOS quarterly. Training will be on going and project objectives will be met.

Ongoing projects will include:

1) PSP Field Testing, 01482 – Jellet Biotek – Dr. Jellet and Dr. Roberts are selecting sites throughout the spill area to field test their PSP testing kit to be used in place of the existing mouse bioassay. Students in the program will continue to do beach monitoring to determine patterns, high-risk beaches, and precautions to consider when harvesting shellfish. Also, information collected may be used to develop local aquaculture programs that would supply jobs and boost the economy in the villages.
2) Harbor Seal Bio-sampling, 01245 – Alaska Native Harbor Seal Commission – KYAW will work with local harvesters involved in the program to bio-sample harbor seals caught for subsistence purposes. Mitch Simeonoff, Akhiok, will work with CRRC and the school district to train and involve students.
3) Algal PSP Testing – Dr. Gerry Plumley – University of Alaska Fairbanks – Dr. Plumley will train students in how to test algae in their area for algal PSP infection. This project will provide data to Dr. Plumley regarding where PSP originates.
4) Fisheries Technical Center and National Oceanographic and Atmospheric Administration - This will involve utilizing the monitoring kits we have acquired in establishing and continuing a long-term oceanographic monitoring program. Indicators to be monitored will include ocean temperature, salinity, tides, and other information as it pertains to the project.

In addition to these four core projects, students will work with their tribal council or local site teacher to identify a local research project to implement that is achievable. We will encourage the tribal councils to identify an area of TEK that may be of interest and integrate that with western science methods. TEK Specialist Henry Huntington will be called upon to assist in this effort.

The participation of the students in the annual Science Camp will be an additional component of this year's program. The annual Science Camp is an opportunity for students from across the Island to learn about science basics, how traditional ways of knowing is incorporated into western science, natural science phenomena's around the island, and present information on particular projects they have been involved in the previous year. In kind funds of $75,000 will be put toward this camp from the Alaska Federation of Natives, as well as $20,000 from the Kodiak Area Native Association. We are asking for $15,000 from the Trustee Council for this portion of the project.

The development of a web site that will be integrated into the Kodiak Island Borough School District will be developed as well. The Kodiak School District's Information Technology Department will work with project staff to construct the site. The formation of this web site is seen as a necessary step to bring the program to a new level of communication, coordination, and information transfer. Intended uses will be to post oceanographic data, PSP and algae data and results, stomach content information, and harbor seal bio-sample information. A web site is necessary to keep the youth interested in the nuts and bolts of the program and is seen by all involved as a must have step.

School credit for the youth involvement in this project will be strongly encouraged. We anticipate allowing credit to those who participate for the whole length of the project. This will encourage more participation and give credibility to the project among site teachers and students

who are thinking about applying to the project. This project is popular and receives island-wide attention for the tremendous efforts it has accomplished.

COOPERATING AGENCIES

The Chugach Regional Resources Commission will serve as the administering agency for this project and work closely with the Kodiak Island Borough School District to implement the project. CRRC has a positive history with the Alaska Department of Fish and Game and expects to continue that partnership through this project. We will update our current contract with the school district to reflect the new changes to the program and work to coordinate and collaborate on the successful implementation of the project.

Additionally, CRRC has a history working with tribal councils on Kodiak Island. We implemented and completed the Subsistence Service Assessment with tribal councils on Kodiak Island, hiring many employees directly. CRRC has a strong partnership with the Community Involvement and GEM Planning Project and has demonstrated a commitment to involving all Alaska Native Tribes and organizations in the restoration process.

Partnerships with the Fisheries Industrial Technology Center and the National Oceanographic and Atmospheric Administration will continue to perpetuate the ocean monitoring component of the project.

SCHEDULE

A. Measurable Project Tasks for FY 01

July 1, 2000 – August 1, 2000	Confirm research and data collection activities
August 15-16, 2000	Site teacher, tribal, and researcher orientation
August 17-18, 2000	Site teacher training with Kodiak College
September 1 – 18, 2000	School site orientations
September 15 – 30, 2000	Students selected
October 15 – 31, 2000	Student orientation and training
October 1 – November 15, 2000	Web site development
November 1, 2000 – July 30, 2001	Students participate in research activities
March 1, 2001	Site teachers send data to project PI
March 1 – 15, 2001	Site teacher follow-up training
June 2001	Project Coordinator sends data to PI
June 2001	Students participate in Science Camp
June 2001	Students complete FY 01 projects

On-going activities

October 2000 to July 2001	Students collect shellfish samples for field test
October 2000 to July 2001	Students analyze algae
October 2000 to July 2001	Students conduct harbor seal bio-samples
October 2000 to July 2001	Students conduct their local research project

October 2000 to July 2001	PI interact and share information with students

B. Project Milestones and Endpoints

October 17, 2000	Students selected
October 30, 2000	Protocol training complete
November 1, 2000	Students conduct project activities
March 1, 2001	Data/samples to PI
June 1, 2001	Data/samples to PI and reports complete

C. Completion Date

Objective identified in the project design will serve as guidelines for community involvement within the civil settlement throughout the life of the restoration effort. It is expected that the KYAW will be completed upon termination of the restoration and monitoring effort.

PUBLICATIONS AND REPORTS

Project reports that will include a description of student activities and the progress of the program will be submitted to EVOS quarterly.

PROFESSIONAL CONFERENCES

Youth will participate in the Traditional Knowledge Conference and CRRC Annual Gathering in March 2001.

NORMAL AGENCY MANAGEMENT

Not applicable.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will work closely with the Community Involvement and GEM Planning Project (01052) and the Harbor Seal Biosampling Project (01245). If funded, this project will work closely with PSP Field Testing (01482).

PROPOSED PRINCIPAL INVESTIGATOR

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PRINCIPAL INVESTIGATOR

Patty Brown-Schwalenberg is the Executive Director of Chugach Regional Resources Commission. She maintains all management and administrative authority over CRRC programs and projects. She has extensive experience in project administration, tribal relations, and managing budgets. Ms. Schwalenberg will be responsible for all expenditures, contracts, and project management.

OTHER KEY PERSONNEL

CRRC is in the process of hiring a new Office Assistant.

Teri Schneider is the Cultural Coordinator with the Kodiak Island Borough School District.

Sarah Ward is the Community Development Director for the Chugach Regional Resources Commission.

Ms. Schneider and Ms. Ward have experience in outreach, education, and project coordination. This will be a job requirement of the new Office Assistant.

approved TC 12-5-00

Planning for Long-term Monitoring and Research Program

Project Number:	01630
Restoration Category:	Research/Monitoring
Proposer:	Restoration Office, *Exxon Valdez* Oil Spill Trustee Council
Lead Trustee Agency:	Restoration Office (ADFG)
Cooperating Agencies:	All
Alaska SeaLife Center:	No
Duration:	2nd year of a 3-year project
Cost FY 01:	$136,000 approved August 2000 Additional $127,400 requested December 2000 TOTAL $263,400
Cost FY 02:	TBD
Geographic Area:	Entire oil-spill region
Injured Resource/Service:	All injured resources and services

ABSTRACT

In March 1999 the Trustee Council earmarked a minimum of $120 million in funds from the Restoration Reserve for a long-term monitoring and research effort in the spill area and adjacent northern Gulf of Alaska. Planning for what is now called the Gulf Ecosystem Monitoring and Research program (GEM) was initiated in FY 99 and will continue through FY 02. In FY 00, a draft GEM Science Program (April 2000) was developed and submitted to the National Research Council (NRC) for review. In FY 01, follow up on the NRC recommendations on the GEM Science Program will occur. In addition, a draft Monitoring and Research Plan will be developed in consultation with spill-area stakeholders, resource managers, and the scientific community. The plan will also be coordinated with such other large-scale programs as the U.S. Global Ocean Ecosystem Dynamics (GLOBEC), the North Pacific Marine Science Organization (PICES), and the Coastal-Global Ocean Observing System (C-GOOS), and then delivered for review to the NRC. This project will also help develop the *FY 02 Invitation* which will request proposals for projects to accomplish the transition to the long-term program. This project will be accomplished through the combined efforts of the Restoration Office and the Chief Scientist.

INTRODUCTION

In March 1999 the Trustee Council earmarked a minimum of $120 million in funds from the Restoration Reserve for a long-term monitoring and research effort in the spill area and adjacent northern Gulf of Alaska. The GEM fund will be managed as an endowment, providing annual funding of $5 to $10 million depending on investment earnings. Accordingly, Restoration Office staff and representatives of Trustee agencies have begun to develop what is now called the Gulf Ecosystem Monitoring and Research program (GEM). The mission of GEM is to sustain a healthy and biologically diverse marine ecosystem in the northern Gulf of Alaska and the human use of the marine resources in that ecosystem through greater understanding of how its productivity is influenced by natural changes and human activities. The goals of GEM are to: (1) detect: serve as an early warning system by detecting annual and long-term changes in the marine ecosystem; (2) understand: identify causes of change in the marine ecosystem, including natural variation, human influences, and their interaction; (3) predict: develop the capacity to predict the status and trends of natural resources; (4) inform: provide integrated and synthesized information to the public, resource managers, industry and policy makers; and (5) solve: develop tools, technologies, and information that can help resource managers and regulators improve management of marine resources and address problems that may arise from human activities.

A first draft of the GEM Science Program was made available for public review and comment in 1999; a revised draft was submitted to the National Research Council for review in April 2000 under Project /360. During the years FY 01 and FY 02, the framework for the overall program will be finalized and a monitoring and research plan will be developed. Implementation of GEM is scheduled to begin in FY 03 (October 2002).

NEED FOR THE PROJECT

A. Statement of the Problem

Development of a successful GEM program is a complex undertaking, with a number of aspects and requirements that will go through several iterations. First, it is essential that the program be based on input from scientists and natural resource managers familiar with marine ecosystems, long-term ecological monitoring and research programs, and existing agency and university monitoring and research programs and databases. Second, it is essential that stakeholders and the general public participate in designing the program and have confidence that implementation of GEM will lead to the sustained use and conservation of the northern Gulf of Alaska marine ecosystem. Finally, the GEM program must receive independent peer review during and before implementation so it can be modified and improved in response to review comments and recommendations. In order to meet the FY 03 implementation goal, it is necessary that the progress made toward satisfying these requirements in FY 00 be continued in FY 01.

B. Rationale/Link to Restoration

In deciding to allocate a significant portion of the Restoration Reserve for long-term monitoring and research, the Trustee Council explicitly recognized that complete recovery from the oil spill will not occur for decades and that long-term observation and, possibly, restoration actions are needed if injured resources and services are to be fully restored. The Council further recognized that conservation and improved management of these resources and services will require a substantial ongoing investment to improve understanding of the biology and marine and coastal ecosystems that support the services as well as the people of the spill region. Hence, the Council made a commitment to development of a long-term monitoring and research program for the spill region that will inform and promote the full recovery and restoration, conservation, and improved management of spill-area resources.

C. Location

Monitoring and research carried out under GEM will take place mostly in the coastal and marine environment within the oil-spill area and, to the extent necessary, in adjacent parts of the northern Gulf of Alaska. Most of the planning activities described in this proposal will take place in Anchorage and in spill-area communities.

COMMUNITY INVOLVEMENT AND TRADITIONAL ECOLOGICAL KNOWLEDGE

The decision by the Trustee Council to use a significant portion of funds in the Restoration Reserve for long-term monitoring and research was made after extensive public review and comment, including meetings in most spill-area communities, in FY 98 and FY 99. The Council's Community Involvement Coordinator and an expert in traditional ecological knowledge (Project \052) have participated in the discussions that led to the first draft of the GEM program. In FY 00, a series of visits to spill-area communities, public meetings, and presentations to stakeholder groups further involved the public in development of GEM. In addition, one of the explicit goals of GEM is to involve communities in gathering data and other information, including local and traditional knowledge, that contribute to understanding of the spill-area ecosystem.

PROJECT DESIGN

A. Objectives

The mission of the GEM program is to sustain a healthy and biologically diverse marine ecosystem in the northern Gulf of Alaska and the human use of the marine resources in that ecosystem through greater understanding of how its productivity is influenced by natural changes and human activities. The goal of this project is to design the GEM program and monitoring and research plan.

Specific objectives are to:

(1) Develop a draft GEM Science Program (accomplished in April 2000) and draft GEM Monitoring and Research Plan. Incorporate feedback from the public, stakeholders, and the scientific community in their development and revision.

(2) Consult and coordinate with biologists, oceanographers, and other scientists working on other state, national, and international programs. These consultations will focus upon those working with prior or ongoing agency and university monitoring and research programs, plans, projects, and databases in the Gulf of Alaska and north Pacific Ocean. Another key group will be those involved in establishing other large scale marine ecological monitoring programs (i.e., GOOS, GLOBEC, PICES, PISCO, FOCI), including efforts in the Gulf of Mexico and the Gulf of Maine.

(3) Assist with independent peer review by the National Research Council of the GEM Science Program (April 2000) and draft GEM Monitoring and Research Plan.

(4) Prepare a final GEM Science Program and final GEM Monitoring and Research Plan, reflecting the comments of the National Research Council. Contribute to development of the FY 02 and FY 03 *Invitations to Submit Proposals* regarding proposals to transition to GEM in FY 02 with implementation starting in FY 03. Plan for projects to obtain information and advice needed to plan for and accomplish the transition to the long-term program.

(5) Develop the infrastructure in Alaska to develop and implement GEM, including data management and web-based communications (see Project 01455).

B. Methods

The methods described below are organized by project objective (in parentheses) and only pertain to activities proposed to be carried out in FY 01:

(1) Develop draft Monitoring and Research Plan. A conceptual draft ("straw dog") of the GEM Monitoring and Research Plan was developed at the end of FY 00 and presented for review at the Trustee Council's Annual Workshop, October 12-13, 2000. Development of the "straw dog" presented in October had the benefit of earlier input by numerous stakeholders at small workshops ("focus groups") conducted under Project 00630. The October workshop was organized as an intensive work session and involved the general public, stakeholders, resource agency managers, scientists, and peer reviewers. Input and feedback received from the workshop were analyzed and used for the next revision of the draft plan. A draft conceptual outline of the draft Monitoring and Research Plan is being developed and will be submitted to the Trustee Council and the NRC in early December 2000 for review and discussion. A revised draft, incorporating comments from the Trustee Council and the NRC, will be presented to the Trustee Council by mid-January 2001. From mid-January through March 2001, using a combination of small writing teams, peer reviewers, and experts as needed, the Restoration Office will develop the draft Monitoring and Research Plan based on the conceptual outline. In April 2001 the draft

Monitoring and Research Plan will be presented to the Trustee Council for adoption. From April through May 2001 the final editing of the draft plan will be completed. The final draft will be sent to the NRC for review by early June 2001.

(2) Consult and coordinate with other state, national and international programs. Additional comments will be obtained from scientists working with other large-scale monitoring and research programs and projects in the northern Gulf of Alaska or the north Pacific Ocean (e.g., GLOBEC, PICES, FOCI, GOOS, PISCO), and with others working on large scale programs in the Gulf of Mexico and Gulf of Maine. The Science Coordinator presented the monitoring plan to PICES scientists at the PICES annual meeting in Hakodate, Japan, in October 2000. Obtaining detailed information about other ongoing data gathering efforts, including ongoing agency and university programs, will allow GEM to be refined to complement and take advantage of ongoing work, thus achieving greater scientific integration, applicability to management needs, cost savings, and efficiency.

(3) Assist with NRC review. The "straw dog" draft Monitoring and Research Plan was presented to the NRC in October 2000. An outline of a revised draft GEM Monitoring and Research Plan will be presented to the NRC in early December 2000, with a fully developed plan to be finalized by June 2001. Interim recommendations on the draft GEM Science Program (April 2000) are scheduled to be received from the NRC in February 2001, and will be incorporated in a revised Science Program document and revised Monitoring and Research plan. The NRC will be briefed on the draft GEM Monitoring and Research Plan at two meetings in summer 2001.

(4) Transition Projects. The *FY 02 Invitation to Submit Proposals,* scheduled to be issued in February 2001, will invite proposals to assist in the transition to a long-term monitoring and research program. Development of the appropriate request will require considerable effort, including additional consultation by Restoration Office staff with the Chief Scientist and core peer-reviewers.

(5) GEM Infrastructure, Data Management, and Web-Based Communication. In order to implement a fully-developed long-term monitoring program, the necessary infrastructure must be in place. A number of issues related to this were identified in the GEM Science Program (April 2000) document: administration, scientific advice, peer review and management, data and information management and transfer, and public advice and involvement. An interim report from the National Research Council is expected in February 2001 to provide some guidance on these issues. Those recommendations, plus others from the Public Advisory Group and the Trustee agencies, will be used to develop a recommended approach for the Trustee Council to take.

C. Cooperating Agencies, Contracts, and Other Agency Assistance

Representatives of all Trustee agencies are involved in developing the GEM program and Monitoring and Research Plan. In addition to a direct role in developing GEM, agency representatives will be involved in the continuing process of identifying and describing prior and existing monitoring and research programs, plans, projects, and databases relevant to the northern

Gulf of Alaska. There may be need for one or more small personal services contracts to obtain timely information needed in the further development of GEM (e.g., with a statistician in regard to the overall sampling design of the GEM Monitoring and Research Plan).

Beyond the participation of Trustee agencies, there will be consultations with other institutions and programs involved in monitoring and research in the north Pacific Ocean. These include, for example, the North Pacific Marine Science Organization (PICES) and the Global Oceans Ecosystems Dynamics (GLOBEC) Northeast Pacific Project, which is sponsored jointly by the National Science Foundation and National Oceanic and Atmospheric Administration.

SCHEDULE

A. Measurable Project Tasks

FY 01

October 2000:	Present draft GEM Monitoring and Research Plan at EVOS Annual Workshop and at PICES annual meeting
October – December 2000:	Analyze input and feedback received from EVOS Annual Workshop; develop conceptual outline of a revised Draft GEM Monitoring and Research Plan
December 2000:	Outline of Draft GEM Monitoring and research Plan presented to Trustee Council and National Research Council review committee for discussion
December 2000 - January 2001:	Revise outline of draft to incorporate feedback from Trustee Council and National Research Council
January 2001:	Present outline of draft GEM Monitoring and Research Plan to Trustee Council for approval; public comment accepted
January-March 2001:	Small writing groups, reviewers, and experts (as needed) assist in further developing draft GEM Monitoring and Research Plan
February 2001:	Receive interim report from NRC on draft GEM Science Program (April 2000); respond to recommendations as needed
April 2001:	Present draft GEM Monitoring and Research Plan to Trustee Council for adoption; additional public comment
April - May 2001:	Final revision and editing of draft GEM Monitoring and Research Plan
June 2001:	Submit draft GEM Monitoring and Research Plan to NRC
June – September 2001:	Brief NRC review committee as needed. Continue work on developing other aspects of GEM (community involvement, data management, etc.)

FY 02

November 2001:	Receive final report from NRC on draft GEM Science Program and Monitoring and Research Plan (Extension of draft plan schedule could delay this)

Dec 2001/Jan 2002: Revise GEM Science Program and Monitoring and Research Plan based on NRC review; circulate for public comment; adopt final documents (Extension of draft plan schedule could delay this)

B. Project Milestones and Endpoints

Progress toward project objectives in FY 01 will be completed according to the schedule above. The following overall milestones are key:

1. Assist in developing draft Monitoring and Research Plan; coordinate review and revision with EVOS annual meeting in October 2000, public meetings, the Trustee Council, and the NRC.
2. Revise GEM Science Program incorporating NRC comments.
3. Contribute to *FY 02 Invitation.*

A. Completion Date

The GEM Science Program and Monitoring and Research Plan are scheduled to be approved by the Trustee Council in January 2002. Implementation of GEM will begin with the FY 03 work plan cycle and will be ongoing. These dates are dependent on all the writing and review deadlines and may be adjusted based on actual completion dates.

PUBLICATIONS AND REPORTS

The products of this project will be the GEM Science Program and the GEM Monitoring and Research Plan. No reports will be required and no additional publications are expected.

PROFESSIONAL CONFERENCES

The Science Coordinator presented the draft GEM Monitoring Plan to the PICES Annual Meeting in Hakodate, Japan, October 2000. The Science Coordinator will present the draft GEM monitoring plan at the annual meeting of the American Fisheries Society in Phoenix, AZ in August 2001.

NORMAL AGENCY MANAGEMENT

The Trustee Council directed the executive director and chief scientist to develop a plan for long-term monitoring and research (i.e., GEM) in a resolution adopted on March 1, 1999, in regard to the expenditure of Restoration Reserve funds. Thus, this project is something that is appropriately carried out by the Restoration Office.

COORDINATION AND INTEGRATION OF RESTORATION EFFORT

This project will be fully coordinated with and among Trustee agencies, scientific peer reviewers, the Public Advisory Group, and others.

PROPOSED PRINCIPAL INVESTIGATOR

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PRINCIPAL INVESTIGATOR

Ms. McCammon has 25 years of experience in Alaska in recreation and tourism, journalism, communications, and public policy, emphasizing natural resource issues. She has been Executive Director of the Trustee Council since 1994.

Dr. Spies has 35 years of experience as a scientist in marine pollution and toxicology, the effects of petroleum on marine organisms, and benthic ecology. He is president of Applied Marine Sciences, Inc. and has been the Trustee Council's Chief Scientist since 1991.

Dr. Mundy has 27 years of experience as a fisheries scientist, including 24 years in Alaskan fisheries research and management. As Science Coordinator since 1999, Phil has been key to development of the Gulf Ecosystem Monitoring (GEM) program. He has worked as a review of research on the oil spill since 1989.

Revised 12-5-00
Approved TC 12-5-00

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$5.3
Travel		$0.0
Contractual		$15.4
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$20.7
General Administration		$1.9
Project Total	$0.0	$22.6
Full-time Equivalents (FTE)		0.1
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
			Estimated FY 2002		
			$0.0		

Dollar amounts are shown in thousands of dollars.

Comments:

This proposal is to conduct final analysis and manuscript preparation for aerial surveys conducted in August 2000, and satellite tags attached in .

None of the costs identified in this budget are for NEPA compliance. Costs for meeting attendance are included under travel, and total $0.7 K. This includes attandance at the annual EVOS workshop.

FY01

Prepared: 3 April 2000

Project Number: 01064
Project Title: Manuscript Preparation - PWS Harbor Seal Studies
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FY 2001
Name	Position Description					
G. Sheffield	WBII - data analysis	16	0.5	4.2		2.1
J. Ver Hoef	Biometrician II - survey statistical anal	19F	0.5	6.4		3.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal	[redacted]	1.0	10.6	0.0	[redacted]
					Personnel Total	$5.3

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 2001
Description					
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.0

FY01

Prepared:3 April 2000

Project Number: 01064
Project Title: Manuscript Preparation - PWS Harbor Seal Studies
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed FY 2001
Description	
Page charges (Marine Mammal Science, 2 manuscripts @ 14 pp each at $15/page	0.4
K. Frost as named recipient (2.5 months)	15.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$15.4

Commodities Costs:	Proposed FY 2001
Description	
Commodities Total	$0.0

FY01

Prepared:3 April 2000

Project Number: 01064
Project Title: Manuscript Preparation - PWS Harbor Seal Studies
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2001
none			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency

FY01

Prepared:3 April 2000

Project Number: 01064
Project Title: Manuscript Preparation - PWS Harbor Seal Studies
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

Re[illegible]ion 8-28-
Approved TC 12-5-

2001 EXXON VALDEZ TRU[illegible]E COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Budget Category:	Authorized FFY 2000	Proposed FFY 2001	PROPOSED FFY 2001 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NOAA
			$0.0	$0.0	$0.0	$0.0	$76.0	$123.6
Personnel	$626.2	$48.6						
Travel	$7.0	$0.0						
Contractual	$470.2	$134.3						
Commodities	$0.0	$0.0						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$1,103.4	$182.9	Estimated FFY 2002	Estimated FFY 2003	Estimated FFY 2004	Estimated FFY 2005	Estimated FFY 2006	Estimated FFY 2006
General Administration	$126.7	$16.7						
Project Total	$1,230.1	$199.6	$100.0	$20.0	$0.0	$0.0	$0.0	$0.0
Full-time Equivalents (FTE)	12.8	0.7						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

[illegible] sampling sample and data analysis, and write up of final report and manuscripts for publication. FY01 and FY02 is dedicated to write up of syntheses papers.

2001	Project Number: 01163 Project Title: APEX Synthesis Lead Agency: NOAA	FORM 2A PROJECT DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FFY 2000	Proposed FFY 2001	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$15.1						
Travel		$0.0						
Contractual		$99.3						
Commodities		$0.0						
Equipment		$0.0						
Subtotal		$114.4	Estimated FFY 2002	Estimated FFY 2003				
General Administration		$9.2						
Project Total		$123.6	$80.0	$20.0				
Full-time Equivalents (FTE)		0.2						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments: This project was first funded as the Forage Fish/Seabird Study (94163) then as the Apex Predator Ecosystem Experiment (APE

2001

Project Number: 01163
Project Title: APEX Synthesis
Agency: NOAA

FORM 3A
AGENCY
PROJECT
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 2001
	Name	Position Description					
	J. Thedinga	PI for 00163A	GS12	1.0	7,000		7.0
	P. Anderson	PI for 00163	GS12	1.1	7,400		8.1
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
		Subtotal		2.1	14,400	0	
						Personnel Total	$15.1

Travel Costs:		Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 2001
	Description					
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$0.0

2001

Project Number: 01163
Project Title: APEX Synthesis
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed
Description	FFY 2001
Oregon State University contract (00163 G Energetics/Roby/Jodice)	18.7
Paumanok contract (00163 I/Duffy) subcontract to UAF/00163T/Brown for $9.3K	28.0
University of Maryland contract (00163 S Jellyfish/Purcell)	19.0
H.T. Harvey and Associates contract (00163 Q Modeling/Ainley/Ford)	24.3
University of Alaska contract (00163T/Brown)	9.3
Contractual Total	$99.3

Commodities Costs:	Proposed
Description	FFY 2000
Commodities Total	$0.0

2001

Project Number: 01163
Project Title: APEX Synthesis
Agency: NOAA

FORM 3B
Contractual
&
Commoditie

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 2001
			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

2001

Project Number: 01163
Project Title: APEX Synthesis
Agency: NOAA

FORM 3B
Equipment
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FFY 2000	Proposed FFY 2001	LONG RANGE FUNDING REQUIREMENTS					
			Estimated FFY 2002	Estimated FFY 2003	Estimated FFY 2004	Estimated FFY 2005	Estimated FFY 2006	
Personnel		$33.5						
Travel		$0.0						
Contractual		$35.0						
Commodities		$0.0						
Equipment		$0.0						
Subtotal		$68.5						
General Administration		$7.5						
Project Total		$76.0	$20.0	$0.0				
Full-time Equivalents (FTE)		0.5						
Dollar amounts are shown in thousands of dollars.								
Other Resources								

Comments: FY 00 is dedicated to sample and data analysis, and write up of the final report and manuscripts for publication. FY01 and FY02 is dedicated to write up of syntheses papers.

2001

Project Number: 01163
Project Title: APEX Synthesis
Agency: DOI

FORM 3A
AGENCY
PROJECT
DETAIL

8/28/00

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 2001
	Name	Position Description					
	B. Ostrand	PI for 00163 B	GS11-4	3.0	5,367		16.1
	R. Suryan	PI for 00163 E	GS11-4	3.0	5,800		17.4
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
		Subtotal		6.0	11,167	0	
						Personnel Total	$33.5

Travel Costs:		Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 2001
	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

2001

Project Number: 01163
Project Title: APEX Synthesis
Agency: DOI

FORM 3B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed
Description	FFY 2001
S. Speckman (00163 M/Piatt)	17.5
M. Robards (00163 M/Piatt)	17.5
Contractual Total	$35.0

Commodities Costs:	Proposed
Description	FFY 2001
Commodities Total	$0.0

2001

Project Number: 01163
Project Title: APEX Synthesis
Agency: DOI

FORM 3B
Contractual
&
Commoditie

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 2001
			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

2001

Project Number: 01163
Project Title: APEX Synthesis
Agency: DOI

FORM 3B
Equipment
DETAIL

Revision 11/27/01
Approved 12/5/00

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized *FY 2000	Proposed FY 2001
Personnel		$0.0
Travel		$0.0
Contractual	$145.5	$111,216.9
Commodities		$0.0
Equipment		$0.0
Subtotal	$145.5	$111,216.9
General Administration	$2.9	$7,785.2
Project Total	$148.4	$119,002.1
Full-time Equivalents (FTE)	1.2	0.8
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
Estimated FY 2002					

*Dollar amounts are shown in thousands of dollars.

FY01

Prepared:

Project Number: 01393
Project Title: Prince William Sound Food Webs: Structure and Change, Submiited Under the BAA
Name: Prince William Sound Science Center
Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized *'FY 2000	Proposed FY 2001						
Personnel	$86.4	$67,792.8						
Travel	$3.7	$5,180.0						
Contractual	$25.1	$9,560.0						
Commodities	$2.5	$3,950.0						
Equipment	$3.5	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$121.2	$86,482.8	Estimated FY 2002					
Indirect	$24.2	$24,734.1						
Project Total	$145.5	$111,216.9	$127.7					
Full-time Equivalents (FTE)	1.2	0.8						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY01

Prepared:

Project Number: 01393
Project Title: Prince William Sound Food Webs: Structure and Change, Submiited Under the BAA
Name: Prince William Sound Science Center

FORM 4A
Non-Trustee
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 2000
T. Kline	Principal Investigator		6.0	8734.6		52,407.6
TBN	Technician		4.0	3846.3		15,385.2
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		10.0	12580.9	0.0	
					Personnel Total	$67,792.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
IABO/IAPSO meeting*	1400.0	1	8	110.0	2,280.0
registration and car rental	300.0	1	8	55.0	740.0
EVOS and collaborative workshops	300.0	2	8	145.0	1,760.0
car rental	0.0	0	8	50.0	400.0
*The Joint Assembly of the International Association for the					0.0
Physical Sciences of the Oceans (IAPSO) and the International					0.0
Association for Biological Oceanography (IABO), to be held in Mar					0.0
del Plata, Argentina					0.0
					0.0
					0.0
					0.0
				Travel Total	$5,180.0

FY01

Prepared:

Project Number: 01393
Project Title: Prince William Sound Food Webs: Structure and Change, Submiited Under the BAA
Name: Prince William Sound Science Center

FORM 4B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Contractual Costs:				Proposed
Description		cost per unit		FY 2000
PWSSC network charge by computer-months	computer months	10	100	1,000.0
Stable Isotope Analysis	number:	200	27	5,400.0
Freeze drier charge	number:	200	3	600.0
photocopying				400.0
shipping				500.0
communications (fax and phone)				660.0
page charges				1,000.0
			Contractual Total	$9,560.0

Commodities Costs:	Proposed
Description	FY 2000
Lab supplies miscl	1,000.0
Lab supplies: chemicals, vials, knives	750.0
Office supplies miscl	600.0
Computer supplies and upgrades	1,000.0
Dyesub, photog. (presentation materials)	600.0
Commodities Total	$3,950.0

FY01

Prepared:

Project Number: 01393
Project Title: Prince William Sound Food Webs: Structure and Change, Submiited Under the BAA
Name: Prince William Sound Science Center

FORM 4B
Contractual & Commodities DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

New Equipment Purchases:	Number of Units	Unit Price	Proposed FY 2000
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		
		[redacted]

FY01

Prepared:

Project Number: 01393
Project Title: Prince William Sound Food Webs: Structure and Change, Submiited Under the BAA
Name: Prince William Sound Science Center

FORM 4B
Equipment
DETAIL

Revision 1-9-01
Approved 12-5-00

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Budget Category:	Authorized FFY 1999	Proposed FFY 2000
Personnel	$0.0	$28.2
Travel	$0.0	$2.2
Contractual	$0.0	$22.2
Commodities	$0.0	$26.6
Equipment	$0.0	$0.0
Subtotal	$0.0	$79.2
General Administration	$0.0	$5.8
Project Total	$0.0	$85.0
Full-time Equivalents (FTE)	0.0	0.5
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FFY 2002	Estimated FFY 2003
$50.0	$0.0

Dollar amounts are shown in thousands of dollars.

Comments: This project investigates salmon shark seasonal residency, movements, and trophic interactions in the eastern Gulf of Alaska (GOA) and Prince William Sound (PWS). State-of-the-art satellite tags will be employed to describe salmon shark movements and migrations, and critical feeding areas and depths.

National Marine Fisheries Service will donate 3 PAT tags and salary (Jeep Rice, approx. 1 month @ $12.1K/mo). NMFS is pursuing investigations of Pacific sleeper shark predation on marine mammals with seperate agency funds.

2001

Project Number: 01396
Project Title: Alaska Salmon Shark Assessment Project
Agency: NOAA

FORM 3A
AGENCY
PROJECT
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:			GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FFY 2000
	Name	Position Description					
	L. Hulbert		GS9	6.0	4,700		28.2
	J. Rice		GS14	0.0	12,100		0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
							0.0
		Subtotal		6.0	16,800	0	
						Personnel Total	$28.2

Travel Costs:		Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FFY 2000
	Description					
	Juneau to Cordova (Lee Hulbert)	374	1	2	225	0.9
	Juneau to Cordova (Scott Johnson)	374	1	2	225	0.9
	Homer to Cordova (Scott Myers, ADFG invitational travel)	100	1	2	150	0.4
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$2.2

2001

Project Number: 01396
Project Title: Alaska Salmon Shark Assessment Project
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed
Description	FFY 2000
vessel charter (10 days at $1,650/day, 7/10-7/19)	16.5
fuel charges for vessel	1.5
shipping	1.2
ARGOS platform satellite rental time ($350/tagx3 PAT tags plus 3 SPOT tag charges= $1.5K-5.0K)	2.0
seine net repair	1.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$22.2

Commodities Costs:	Proposed
Description	FFY 2000
Wildlife Computers PAT tag ($3,500 per tag x 6 tags)	21.0
Wildlife Computers SPOT tag ($1,860 per tag x 3 tags)	5.6
Commodities Total	$26.6

2001

Project Number: 01396
Project Title: Alaska Salmon Shark Assessment Project
Agency: NOAA

FORM 3B
Contractual
&
Commoditie

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 2000
			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
purse seine	1	ADFG
scale	1	NOAA
PAT tags	3	NOAA

.2001

Project Number: 01396
Project Title: Alaska Salmon Shark Assessment Project
Agency: NOAA

FORM 3B
Equipment
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FFY 2000
			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
purse seine	1	ADFG
scale	1	NOAA
PAT tags	3	NOAA

2001

Project Number: 01396
Project Title: Alaska Salmon Shark Assessment Project
Agency: NOAA

FORM 3B
Equipment
DETAIL

Revision 12-20-00
Approved 12-5-00

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Actual FY 2000	Proposed FY 2001
Personnel		$15.4
Travel		$0.6
Contractual		$1.3
Commodities		$0.9
Equipment		$54.4
Subtotal		$72.6
General Administration		$2.4
Project Total		$75.0
Full-time Equivalents (FTE)		0.4
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2002	Estimated FY 2003
$106.5	$0.0

Dollar amounts are shown in thousands of dollars.

USGS/BRD will provide salary for PI, staff veterinarian, and systems scientist throughout the study and support all activities including most travel. costs. BRD will purchase buoy array tags estimated at $7,800 needed for completion of project in FY03.
Data analysis and reporting writing will be done with BRD funds.

Revision December 2000: The budget originally proposed for this project ($100K) is being revised downward to $75K as requested by the Trustee Council. The $25K reduction being taken from salary will now be funded by the USGS instead.

FY01

Revised 12/20/00

Project Number: 01404
Project Title: Archive tags for tracking king salmon at sea
Agency: DOI-USGS--BRD

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Personnel Costs*:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2001
J. Nielsen*	Fisheries Supervisor	GS14/01	3.0	7.2		0.0
TBA**	Fisheries Project Leader	GS9/01	5.0	3.1		15.4
D. Mulcahy*	Fish/Wild. Veterinarian	GS13/05	0.5	6.8		0.0
D.Douglas*	Fish/Wild Scientists	GS12/05	0.5	6.0		0.0
						0.0
						0.0
						0.0
						0.0
*all personnel costs will be covered by USGS/BRD						0.0
**7 months salary will be funded by USGS/BRD						0.0
						0.0
	Subtotal		9.0	23.1	0.0	
					Personnel Total	$15.4

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2001
Anchorage to hatchery, Anchorage to Whittier, etc. to check potential release sites					0.60
PI & veterinarian travel at USGS/BRD costs					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
				Travel Total	0.60

FY01

Revised 12/20/00

Project Number: 01404
Project Title: Archive tags for tracking king salmon at sea
Agency: DOI-USGS-BRD

FORM 3B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed FY 2000
Description	
Tag data consultation and data recovery fees	0.3
Research vessel lease (private) - 1 day	1.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$1.3

Commodities Costs:	Proposed FY 2000
Description	
Materials and supplies - misc.	0.9
Commodities Total	$0.9

FY01

Revised 12/20/00

Project Number: 01404
Project Title: Archive tags for tracking king salmon at sea
Agency: DOI-USGS--BRD

FORM 3B
Contractual & Commodities DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2000
Archive tags (light/temp) (40 @ 1300 ea.)	40	1.3	52.0
Dummy tags (20 @ 120 ea.)	20	0.1	2.4
Archive tags (light/temp) for buoy array (6@ 1300 ea.)			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**		$54.4

Existing Equipment Usage:	Number	Inventory
Description	of Units	Agency

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Revision 10-30-00
approved TC 12-5-00

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel	$34.8	$38.5
Travel	$2.8	$0.2
Contractual	$18.1	$19.8
Commodities	$1.6	$1.9
Equipment	$0.0	$0.0
Subtotal	$57.3	$60.4
General Administration	$6.5	$7.2
Project Total	$63.8	$67.6
Full-time Equivalents (FTE)	0.6	0.6
Other Resources		

LONG RANGE FUNDING REQUIREMENTS	
Estimated FY 2002	Estimated FY 2003
$70.0	$43.0

Dollar amounts are shown in thousands of dollars.

Comments:

FY01

Prepared:10/30/00

Project Number: 01407
Project Title: Harlequin Duck Population Dynamics
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2001
D. Rosenberg	WBIII, Principal Investigator	18J	3.0	6.5		19.5
Mike Petrula	WBII, survey and data analysis	16B	2.5	4.5		11.3
2 F&G Tech.	F&G Tech. III, Field Technician	11F	1.8	3.7	1.0	7.7
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		7.3	14.7	1.0	
					Personnel Total	$38.5

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2001
Whittier parking, 2 vehicles- 12 days					0.2
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$0.2

FY01

Prepared:10/30/00

Project Number: 01407
Project Title: Harlequin Duck Population Dynamics
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed
Description	FY 2001
Boat and outboard motor repair and maintenance	2.2
Photo processing, presentation productions	0.4
Air charter for field support 4 hrs @ $270/hr	1.0
Trailer and boat moorage Whittier	0.1
Vessel support for March surveys 12 days @1300/day	15.6
Truck Leasing Costs	0.5
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$19.8

Commodities Costs:	Proposed
Description	FY 2001
Boat fuel 350 gallons @ $2.00/gal	0.7
Boat supplies- replacement parts, props, fuel lines, fuel filters, water filters, battery, absorbent rags, oil, emergency provisions	0.9
Field survey supplies- rite-in-rain notebooks/paper, nautical charts, batteries,	0.3
Commodities Total	$1.9

FY01

Prepared:10/30/00

Project Number: 01407
Project Title: Harlequin Duck Population Dynamics
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2001
NONE			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
20 ft. Caribe rigid hull inflatable	1	ADFG
17 ft. Boston Whaler	1	ADFG
10x40 binoculars	4	ADFG
Spotting Scopes	2	ADFG
Survival Suits	2	ADFG
Outboard Motors/various hp	6	ADFG
Magellan GPS	3	ADFG
Marine VHF radios	4	ADFG

FY01

Prepared:10/30/00

Project Number: 01407
Project Title: Harlequin Duck Population Dynamics
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

Revision 1-17-00
approved 2-5-00

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$0.0
Travel		$0.0
Contractual		$53.8
Commodities		$0.0
Equipment		$0.0
Subtotal		$53.8
General Administration		$3.8
Project Total	$0.0	$57.6
Full-time Equivalents (FTE)		4.0
Other Resources		$160.0

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2002	Estimated FY 2003	Estimated FY 2004
$89.5	$0.0	$0.0

Dollar amounts are shown in thousands of dollars.

Comments:

FY 01

Prepared:

Project Number: 01452
Project Title: Assessing prey and competitor/predators of pink salmon fry, Submitted Under the BAA
Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Authorized | Proposed

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	FY 2000	FY 2001
Personnel		$29.4
Travel		$1.9
Contractual		$10.5
Commodities		$1.2
Equipment		$0.0
Subtotal	$0.0	$43.0
Indirect		$10.8
Project Total	$0.0	$53.8
Full-time Equivalents (FTE)		4.0
Other Resources		$160.0

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2002	Estimated FY 2003	Estimated FY 2004
$83.6		

Dollar amounts are shown in thousands of dollars.

Comments:

The total EVOS TC share of the requested project is approximately 25%

*Salary rate for G.L. Thomas reflects research time at 20% reduction from administrative costs
**OSRI, is contributing $75,000 per year to this project
***SERVS is providing 15 days of vessel charter, valued at $5,000 per day, for $75,000 of in-kind support
****ADF&G is contributing personnel time, equipment and supplies valued at $10,000 of in-kind support
*****PWSAC, CDFU and fishermen are also expected to contribute in-kind services to this program

FY 01

Prepared:

Project Number:
Project Title: Assessing prey and competitor/predators of pink salmon fry, Submitted Under the BAA
Name: Prince William Sound Science Center
Agency: NOAA

FORM 4A
Non-Trustee
SUMMARY

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 2001

G.L. Thomas	co-Principal Investigator		1.0	10.9		10.9
R.E. Thorne	co-Principal Investigator		1.0	10.5		10.5
TBN	Technician		2.0	4.0		8.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		4.0	25.4	0.0	
					Personnel Total	$29.4

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 2001
EVOS and collaborative workshops	0.5	1	7	0.2	1.9
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.9

FY 01

Prepared:

Project Number:
Project Title: Assessing prey and competitor/predators of pink salmon fry, Submitted Under the BAA
Name: Prince William Sound Science Center
Agency: NOAA

FORM 4B
Personnel
& Travel
DETAIL

Contractual Costs: Description	Proposed FY 2001
tele, communications, fax, etc.	0.4

maintenance	0.1
Upgrades and calibration of 420 kHz digital transducer	6.0
Vessel Charters	4.0
Contractual Total	$10.5
Commodities Costs:	Proposed
Description	FY 2001
supplies	1.2
Commodities Total	$1.2

FY 01

Project Number:
Project Title: Assessing prey and competitor/predators of pink salmon fry, Submitted Under the BAA
Name: Prince William Sound Science Center
Agency: NOAA

FORM 4B
Contractual & Commodities DETAIL

Prepared:

New Equipment Purchases:	Number of Units	Unit Price	Proposed FY 2001
Description			
			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		
420, 120 and 38 kHz echosounding systems		
Towfin and harnesses		
Plankton nets		
CTD		
Processing hardware and software		

FY 01

Prepared:

Project Number:
Project Title: Assessing prey and competitor/predators of pink salmon fry, Submitted Under the BAA
Name: Prince William Sound Science Center
Agency: NOAA

FORM 4B
Equipment
DETAIL

Approved TC 12-5-00

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 00	Proposed FY 01
Personnel		$30.0
Travel		$1.2
Contractual		$0.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$31.2
General Administration		$4.5
Project Total	$0.0	$35.7
Full-time Equivalents (FTE)		0.3
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
			Estimated FY 2002		
			TBD		

Dollar amounts are shown in thousands of dollars.

Comments:
Personnel Costs are for 4 months (June - September 2001)

FY01

11/17/00

Project Number: 01455
Project Title: Gulf Ecosystem Monitoring and Research Program Data System
Agency: ADFG & Restoration Office

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 01
						0.0
Yet to be determined	Data System Manager		4.0	7.5		30.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		4.0	7.5	0.0	
					Personnel Total	$30.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 01
In-State Travel					
Anchorage to Juneau (2 trips)	0.4	2	2	0.2	1.2
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$1.2

FY01

Project Number: 01455
Project Title: Gulf Ecosystem Monitoring and Research Program Data System
Agency: ADFG & Restoration Office

FORM 3B
Personnel
& Travel
DETAIL

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed FY 01
Description	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed FY 01
Description	
Commodities Total	$0.0

FY01

Project Number:01455
Project Title: Gulf Ecosystem Monitoring and Research Program Data System
Agency: ADFG & Restoration Office

FORM 3B
Contractual & Commodities DETAIL

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 01
			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

FY01

Project Number: 01455
Project Title: Gulf Ecosystem Monitoring and Research Program Data System
Agency: ADFG & Restoration Office

FORM 3B
Equipment
DETAIL

Revised 11/24/00
Approved 12-5-00

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$0.0
Travel		$0.0
Contractual		$5.4
Commodities		$0.0
Equipment		$0.0
Subtotal		$5.4
General Administration		$0.4
Project Total		$5.8
Full-time Equivalents (FTE)		
Other Resources		

LONG RANGE FUNDING REQUIREMENTS

Estimated FY 2002	Estimated FY 2003	Estimated FY 2004
$0.0	$0.0	$0.0

Dollar amounts are shown in thousands of dollars.

Comments:

FY 01

Prepared:

Project Number: 01468
Project Title: TS report revision
Name: Prince William Sound Science Center
Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

	Authorized	Proposed

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	FY 2000	FY 2001
Personnel		$4.3
Travel		$0.0
Contractual		$0.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$4.3
Indirect		$1.1
Project Total	$0.0	$5.4
Full-time Equivalents (FTE)		
Other Resources		

LONG RANGE FUNDING REQUIREMENTS			
	Estimated FY 2002	Estimated FY 2003	Estimated FY 2004
	$0.0	$0.0	$0.0

Dollar amounts are shown in thousands of dollars.

FY 01

Prepared:

Project Number:
Project Title: TS report revision
Name: Prince William Sound Science Center
Agency: NOAA

FORM 4A
Non-Trustee
SUMMARY

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 2001

[redacted]	G.L. Thomas	co-Principal Investigator	[redacted]	0.2	10.9	2.2
	R.E. Thorne	co-Principal Investigator		0.2	10.5	2.1
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	[redacted]	0.4	21.4	0.0 [redacted]
						Personnel Total $4.3

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 2001
[redacted]						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$0.0

FY 01

Prepared:

Project Number:
Project Title: TS report revision
Name: Prince William Sound Science Center
Agency: NOAA

FORM 4B
Personnel
& Travel
DETAIL

Contractual Costs:	Proposed
Description	FY 2001

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Contractual Total	$0.0
Commodities Costs:	Proposed
Description	FY 2001
Commodities Total	$0.0

FY 01

Project Number:
Project Title: TS report revision
Name: Prince William Sound Science Center
Agency: NOAA

FORM 4B
Contractual & Commodities DETAIL

Prepared:

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2001
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.		**New Equipment Total**	$0.0

Existing Equipment Usage: Description	Number of Units	

FY 01

Prepared:

Project Number:
Project Title: TS report revision
Name: Prince William Sound Science Center
Agency: NOAA

FORM 4B
Equipment
DETAIL

Revision 1-8-01
Approved 1-16-01

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001	PROPOSED FY 2001 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NOAA
				$4.0				$6.1
Personnel	$0.0	$5.3						
Travel	$0.0	$0.0						
Contractual	$0.0	$0.0						
Commodities	$0.0	$4.0						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$9.3				Estimated FY 2002		
General Administration	$0.0	$0.8						
Project Total	$0.0	$10.1				$47.1		
Full-time Equivalents (FTE)	0.0	0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$0.0	$0.0				$0.0		

Comments:
Heart tissue samples for fatty acid analysis will be collected in FY01 by normal ADFG catch sampling in each area. Thus, costs associated with vessel charters and field sampling crews will not be incurred by EVOS.

FY01

Prepared:

Project Number: 01538
Project Title: Northwest Gulf of Alaska Herring Stock Identification
Lead Agency: ADFG

FORM 2A
MULTI-TRUSTEE
AGENCY
SUMMARY

Budget Category:	Authorized FY 2000	Proposed FY 2001

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel		$0.0						
Travel		$0.0						
Contractual		$0.0						
Commodities		$4.0						
Equipment		$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$4.0				Estimated FY 2002		
General Administration		$0.0						
Project Total	$0.0	$4.0				$47.1		
Full-time Equivalents (FTE)		0.0						
			Dollar amounts are shown in thousands of dollars.					
Other Resources								

Comments:

FY01

Prepared:

Project Number: 01538
Project Title: Northwest Gulf of Alaska Herring Stock Identification
Agency: ADFG

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FY 2001
Name	Position Description					
						0.0
						.0

						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		0.0	0.0	0.0	
					Personnel Total	$0.0

Travel Costs:					
Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 2001
					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

FY01

Prepared:

Project Number: 01538
Project Title: Northwest Gulf of Alaska Herring Stock Identification
Agency: ADFG

FORM 3B
Personnel
& Travel
DETAIL

Contractual Costs:	
Description	Proposed FY 2001
	0.0
	0.0

When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed
Description	FY 2001
Liquid Nitrogen to fill four 35VHC containers (Including cool down and haz. mat. charges)	2.0
Freight charges for four containers of liquid Nitrogen (Anchorage to field; field to contract lab)	1.5
15 ml nalgene cryotubes (200 ct), labels	0.3
Misc sampling gear,	0.2
Commodities Total	$4.0

FY01

Prepared:

Project Number: 01538
Project Title: Northwest Gulf of Alaska Herring Stock Identification
Agency: ADFG

FORM 3B
Contractual & Commodities
DETAIL

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2001
			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
Vessel charters for sample collection	4	ADFG
35VHC liquid nitrogen containers	4	ADFG
Personal computers	2	ADFG

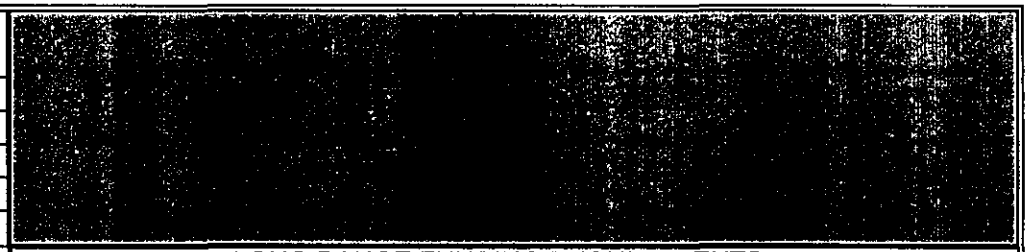
FY01

Project Number: 01538
Project Title: Northwest Gulf of Alaska Herring Stock Identification
Agency: NMFS

FORM 3B
Equipment
DETAIL

Prepared:

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$5.3
Travel		$0.0
Contractual		$0.0
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$5.3
General Administration		$0.8



2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Project Total	$0.0	$6.1				$47.1		
Full-time Equivalents (FTE)		0.1						
			Dollar amounts are shown in thousands of dollars.					
Other Resources								

Comments:
To limit FY01 costs, fatty acid analysis will be delayed until FY02. Only lipid extraction and sample preservation will occur in FY01.

FY01

Prepared:

Project Number: 01538
Project Title: Northwest Gulf of Alaska Herring Stock Identification
Agency: NMFS

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2001
						0.0
						0.0
Larry Holland	Chemist (lipid extraction and preservation)	GS/12	0.8	7030.0		5.3
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0

						0.0
						0.0
	Subtotal	[redacted]	0.8	7030.0	0.0	[redacted]
					Personnel Total	$5.3

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2001
					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

FY01

Prepared:

Project Number: 01538
Project Title: Northwest Gulf of Alaska Herring Stock Identification
Agency: NMFS

FORM 3B
Personnel
& Travel
DETAIL

Contractual Costs:	Proposed
Description	FY 2001

When a non-trustee organization is used, the form 4A is required.	**Contractual Total**	$0.0

Commodities Costs:	Proposed
Description	FY 2001
Commodities Total	$0.0

FY01

Prepared:

Project Number: 01538
Project Title: Northwest Gulf of Alaska Herring Stock Identification
Agency: NMFS

FORM 3B
Contractual & Commodities DETAIL

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2001
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Th[illegible]e purchases associated with replacement equipment should be i[illegible]ated by placement of an R.	**New Equipment Total**		[illegible].0

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Existing Equipment Usage:		
Description	Number of Units	Inventory Agency
GC/MS	1	NMFS
HPLC	1	NMFS
computers, analytical software	2	NMFS

FY01

Prepared:

Project Number: 01538
Project Title: Northwest Gulf of Alaska Herring Stock Identification
Agency: NMFS

FORM 3B
Equipment
DETAIL

Revision 1-18-01
Approved TC 10-5-00

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001	PROPOSED FY 2001 TRUSTEE AGENCIES TOTALS ADEC	ADF&G	ADNR	USFS	DOI	NOAA
						$23.0		
Personnel	$0.0	$89.1						
Travel	$0.0	$30.0						
Contractual	$0.0	$284.9						
Commodities	$0.0	$9.0						
Equipment	$0.0	$10.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$0.0	$423.0				Estimated FY 2002		
General Administration	$0.0	$31.6						
Project Total	$0.0	$454.6				$100.0		
Full-time Equivalents (FTE)	0.0	1.0						
	Dollar amounts are shown in thousands of dollars.							
Other Resources	$0.0	$0.0				$0.0		

Comments:
Phase 1 of this project (planning workshop) was completed in Nov. Phase 2 is the detailed costs of field sampling and analyses. This is the budget for phase 2 ONLY.

NOAA Contributions: Jeff Short 1 mo. @ 10.1K, Jeep Rice .5 mo 6K, Robert Bradshaw 1 mo @ 5.9K, Pat Harris, 2 mo @ 12K, and Marie Larsen (chemist) 2 mo @ 14K for a total of 48K

NOTE: TC approved Phase I 8/3/00 $ 22.6
Phase II 454.6
$ 477.2 TOTAL PROJECT COST

FY01

Prepared: 1/16/01

Project Number: 01543 Phase 2
Project Title: Oil Remaining on the Intertidal
Lead Agency: NOAA

FORM
MULTI-TRUSTEE &
Non-Trustee
AGENCY SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$69.1
Travel		$27.2
Contractual		$284.9
Commodities		$9.0
Equipment		$10.0
Subtotal	$0.0	$400.2
General Administration		$28.6
Project Total	$0.0	$428.8
Full-time Equivalents (FTE)		0.6
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
			Estimated FY 2002		
			$60.0		

Dollar amounts are shown in thousands of dollars.

Comments:

FY01

Project Number: 01543 Phase 2
Project Title: Oil Remaining on the Intertidal
Lead Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared: 1/16/01

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2001
Mike Murphy	Fisheries Biologist	GS/12/06	4.0	8.1		32.4
Pat Harris	Zoologist	GS/11/03	3.0	6.4		19.2
						0.0
OT for field crew					17.5	17.5
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		7.0	14.5	17.5	
					Personnel Total	$69.1

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2001
					0.0
Travel JNU to CDV for Murphy, Harris, Bradshaw, Short, Carls	0.4	16	16	0.1	8.0
Plane charter s to get from CDV to sampling sites	1.2	12			14.4
JNU-CDV-Chenega for outreach Rice, Short	0.4	2			0.8
Charter to Chenega, Valdez, Titilik for outreach	2.0	2			4.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$27.2

FY01

Project Number: 01543 Phase 2
Project Title: Oil Remaining on the Intertidal
Lead Agency: NOAA:

FORM 3B
Personnel
& Travel
DETAIL

Prepared: 1/16/01

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:		Proposed
Description		FY 2001
Temporary labor for digging 3 diggers, 96 days @ 200$/day/digger		57.6
Boat Charter for Gibeau 15 days@1.2K/day		18.0
Boat charter for beach sampling/survey	96 days@1.5K/day	144.0
Contract temp labor for field and logistical support		12.0
NEPA environmental analysis		3.3
Jim Gibeaut trend analysis, training and sampling		50.0
When a non-trustee organization is used, the form 4A is required.	**Contractual Total**	$284.9

Commodities Costs:		Proposed
Description		FY 2001
Field gear (shovels, jars, bags) lab supplies, shipping gear		6.0
Aerial photography, field photography supplies		1.0
Raingear for field crew 10 people@200/each		2.0
	Commodities Total	$9.0

FY01

Project Number: 001543 Part B
Project Title: Oil Remaining on the Intertidal
Lead Agency: NOAA

FORM 3B
Contractual & Commodities DETAIL

Prepared: 1/16/01

New Equipment Purchases:		Number	Unit	Proposed
Description		of Units	Price	FY 2001
1	Differntial GPs for site mapping	1	5.0	5.0
				0.0
1	portable computer for field data entry, alaysis of site location- GPS and photography and associated software	1	5.0	5.0
				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**	$10.0

Existing Equipment Usage:		Number	Inventory
Description		of Units	Agency
GC-MS	NOAA		

FY01

Project Number: 01543 Phase 2
Project Title: Oil Remaining on the Intertidal
Lead Agency: NOAA

FORM 3B
Equipment
DETAIL

Prepared: 1/16/01

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$20.0						
Travel		$2.8						
Contractual		$0.0						
Commodities		$0.0						
Equipment		$0.0						
Subtotal	$0.0	$22.8				Estimated FY 2002		
General Administration		$3.0						
Project Total	$0.0	$25.8						
Full-time Equivalents (FTE)		0.4						
			Dollar amounts are shown in thousands of dollars.					
Other Resources								

Comments:

FY01

Project Number: 01543 Phase 2
Project Title: Oil Remaining on the Intertidal
Agency: USFS

FORM 3A
TRUSTEE
AGENCY
SUMMARY

Prepared: 1/16/01

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FY 2001
Name	Position Description					
Unknown	Archelogist	GS/7	5.0	4.0		20.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		5.0	4.0	0.0	
					Personnel Total	$20.0

Travel Costs:		Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 2001
Description						
						0.0
Anc to PWS	and to sampling site	0.7	4			2.8
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
					Travel Total	$2.8

FY01

Project Number: 01543 Phase 2
Project Title: Oil Remaining on the Intertidal
Agency: USFS

FORM 3B
Personnel
& Travel
DETAIL

Prepared: 1/16/01

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed FY 2001
Description	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed FY 2001
Description	
Commodities Total	$0.0

FY01

Project Number: 001543
Project Title: Oil Remaining on the Intertidal
Agency: USFS

FORM 3B
Contractual & Commodities DETAIL

Prepared: 1/16/01

New Equipment Purchases:			
Description	Number of Units	Unit Price	Proposed FY 2001
			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

FY01

Project Number: 001543 Part B
Project Title: Oil Remaining on the Intertidal
Agency: USFS

FORM 3B
Equipment
DETAIL

Prepared: 1/16/01

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2001
			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

FY01

Project Number: 001543 Part B
Project Title: Oil Remaining on the Intertidal
Lead Agency: NOAA

FORM 3B
Equipment
DETAIL

Prepared: 1/16/01

Revision 12-14-00
Approved TC 8- -00

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000- September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$0.0
Travel		$0.0
Contractual		$57.8
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$57.8
General Administration		$4.0
Project Total	$0.0	$61.8
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
			Estimated FY 2002		
			$106.1		

Dollar amounts are shown in thousands of dollars.

Comments:

Please see attached sheet for in-kind contributions to the Kodiak Youth Area Watch Project (01610).

RECEIVED
DEC 14 2000
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

FY01

Prepared: 10-27-00

Project Number: 01610
Project Title: Kodiak Archipelago Youth Area Watch
Agency: Alaska Department of Fish and Game

FORM 3A
TRUSTEE
AGENCY
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000- September 30, 2001

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 2000
						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	
					Personnel Total	$0.0

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2000
					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

FY01

Prepared: 10-27-00

Project Number: 01610
Project Title: Kodiak Archipelago Youth Area Watch
Agency: Alaska Department of Fish and Game

FORM 3B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000- September 30, 2001

Contractual Costs:	Proposed
Description	FY 2000
Contract with Chugach Regional Resources Commission	57.8
	0.0
	0.0
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$57.8

Commodities Costs:	Proposed
Description	FY 2000
Commodities Total	$0.0

FY01

Prepared: 10-27-00

Project Number: 01610
Project Title: Kodiak Archipelago Youth Area Watch
Agency: Alaska Department of Fish and Game

FORM 3B
Contractual & Commodities DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000- September 30, 2001

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2000
			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

FY01

Prepared: 10-27-00

Project Number: 01610
Project Title: Kodiak Archipelago Youth Area Watch
Agency: Alaska Department of Fish and Game

FORM 3B
Equipment
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000- September 30, 2001

Budget Category:	Authorized FY 2000	Proposed FY 2001
Personnel		$0.0
Travel		$13.3
Contractual		$38.7
Commodities		$0.0
Equipment		$0.0
Subtotal	$0.0	$52.0
Indirect		$5.8
Project Total	$0.0	$57.8
Full-time Equivalents (FTE)		0.0
Other Resources		

LONG RANGE FUNDING REQUIREMENTS					
			Estimated FY 2002		
			$106.1		

Dollar amounts are shown in thousands of dollars.

Comments:

FY01

Prepared: 10-27-00

Project Number: 01610
Project Title: Kodiak Archipelago Youth Area Watch
Name: Chugach Regional Resources Commission

FORM 4A
Non-Trustee
SUMMARY

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000- September 30, 2001

Personnel Costs:			Months	Monthly		Proposed
	Name	Position Description	Budgeted	Costs	Overtime	FY 2000
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
		Subtotal	0.0	0.0	0.0	
					Personnel Total	$0.0

Travel Costs:		Ticket	Round	Total	Daily	Proposed
	Description	Price	Trips	Days	Per Diem	FY 2000
	Village - Kodiak - Anchorage (TEK Conference) 6 communities	0.5	16	45	0.0	8.0
	Kodiak - Akhiok	0.1	3	3	0.1	0.6
	Kodiak - Old Harbor	0.1	3	3	0.1	0.6
	Kodiak - Ouzinkie	0.1	3	3	0.1	0.6
	Kodiak - Larsen Bay	0.1	3	3	0.1	0.6
	Kodiak - Port Lions	0.1	3	3	0.1	0.6
	Kodiak - Karluk	0.1	3	3	0.1	0.6
	Science Camp Trip	0.3	3	8	0.1	1.7
						0.0
						0.0
						0.0
						0.0
					Travel Total	$13.3

FY01

Prepared: 10-27-00

Project Number: 01610
Project Title: Kodiak Archipelago Youth Area Watch
Name: Chugach Regional Resources Commission

FORM 4B
Personnel
& Travel
DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000- September 30, 2001

Contractual Costs:	Proposed FY 2000
Description	
Contract with Kodiak Island Borough School District to provide services below 1 coordinator staff - Teri Schneider at $23.0 equipment at $4.6 (the KIBSD is contributing $0.4 on top of the $4.6) * Portable computer equipment $3.0 Biosampling kit for each site ($.15 X 7) $1.1 Misc. (replacing consumable supplies, i.e. ph strips, etc.) $0.4 school district technology support (web site) at $4.6 (the KIBSD is contributing $5.4 on top of the $4.6) ** contract with vessel or project participation costs (i.e. training or equipment) at $3.5 teacher training at Kodiak College at $3.0 (10 X $0.4 with the KIBSD contributing $1.0 to this cost)	38.7
* To purchase an IBM compatible computer, which will be used by the KYAW Coordinator, teachers, and students for presentations, etc. ** To allow for fuel/time compensation, and/or chartering for community members who take students in their own boats.	
Contractual Total	$38.7

Commodities Costs:	Proposed FY 2000
Description	
Commodities Total	$0.0

FY01

Prepared: 10-27-00

Project Number: 01610
Project Title: Kodiak Archipelago Youth Area Watch
Name: Chugach Regional Resources Commission

FORM 4B
Contractual & Commodities DETAIL

2001 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000- September 30, 2001

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 2000
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
Those purchases associated with replacement equipment should be indicated by placement of an R.	**New Equipment Total**		$0.0

Existing Equipment Usage:	Number	
Description	of Units	

FY01

Prepared: 10-27-00

Project Number: 01610
Project Title: Kodiak Archipelago Youth Area Watch
Name: Chugach Regional Resources Commission

FORM 4B
Equipment
DETAIL

In-kind Contributions to the Kodiak Youth Area Watch Project (01610)

In-kind contributions to the Project by the Kodiak Island Borough School District totals approximately $64.2 and includes the following[1]:

- 2 KYAW coordinators on staff at $32.0
  - Alutiiq Studies Coordinator at $16.0
  - Environmental Education Coordinator at $16.0
- equipment at $0.4
- school district technology support (web site) at $5.4
- teacher training at Kodiak College at $1.0
- office space at $0.3
- utilities at $0.1
- administrative support and general office support (secretarial, etc.) at $3.6
- Science Camp at $15.0[2]
- Science Fair at $10.0

In-kind contributions to the Project by the Chugach Regional Resources Commission totals approximately $21.4 and includes the following:

- 2 KYAW coordinators on staff at $14.0
  - Community Development Director at 8.8
  - Office Assistant at $5.2
- fringe benefits for 2 KYAW coordinators (at 28.6%) at $3.9
- supplies $0.5
- contractual for Traditional Ecological Knowledge Specialist to provide TEK training at $2.0
- audit $1.0

Total in-kind contributions: $85.6

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[1] Other in-kind contributions from the KIBSD that are not figured in here come in the form of time from site coordinators, scientists, elders, community people, and agency representatives at local and state levels. Teachers are not given an extra duty contract and none of the others are paid either.

[2] while at camp students explore place based culturally relevant topics and learn the science of subsistence, integrating western science with Native ways of knowing.

Approved TC 12-5-00

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 00	Proposed FY 01	PROPOSED FY 01 TRUSTEE AGENCIES TOTALS					
			ADEC	ADF&G	ADNR	USFS	DOI	NOAA
			$9.5	$33.3	$181.3	$8.5	$21.0	$9.8
Personnel	$0.0	$56.7	[redacted]					
Travel	$15.0	$20.0						
Contractual	$60.0	$161.5						
Commodities	$5.5	$5.5						
Equipment	$0.0	$0.0	LONG RANGE FUNDING REQUIREMENTS					
Subtotal	$80.5	$243.7				Estimated FY 2002		
General Administration	$4.2	$19.7						
Project Total	$84.7	$263.4						
			[redacted]					
Full-time Equivalents (FTE)								
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

In August 2000, the Trustee Council approved $136,000 for this project. The additional request, to be considered by the Council in December 2000, is $127,400.

PREPARED 11/24/00

FY01

Project Number: 01630
Project Title: Planning for Long-Term Research & Monitoring Program
Lead Agency: ADFG/Restoration Office

FORM 2A
MULTI-TRUSTEE
AGENCY
SUMMARY

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 00	Proposed FY 01	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$6.8						
Travel		$20.0						
Contractual		$0.0						
Commodities		$5.5						
Equipment		$0.0						
Subtotal	$0.0	$32.3				Estimated FY 2002		
General Administration		$1.0						
Project Total	$0.0	$33.3						
Full-time Equivalents (FTE)		0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

FY01

Project Number: 01630
Project Title: Planning for Long-Term Research & Monitoring Program
Agency: ADF&G & Restoration Office

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 01
						0.0
Claudia Slater	Agency Liaison		1.0	6.8		6.8
						0.0
						0.0
NOTE: This $6.8 was approved by the Trustee Council in August 2000.						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.0	6.8	0.0	
					Personnel Total	$6.8

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 01
Travel for Restoration Office staff and other personnel as needed					20.0
for National Research Council review sessions and public/					0.0
stakeholder presentation meetings.					0.0
					0.0
					0.0
NOTE: $15.0 of the $20.0 was approved by the Trustee Council in August 2000.					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$20.0

FY01

Project Number: 01630
Project Title: Planning for Long-Term Research & Monitoring Program
Agency: ADFG & Restoration Office

FORM 3B
Personnel
& Travel
DETAIL

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed FY 01
Description	
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$0.0

Commodities Costs:	Proposed FY 01
Description	
Presentation/public education materials for Restoration Office	5.5
NOTE: This $5.5 was approved by the Trustee Council in August 2000.	
Commodities Total	$5.5

FY01

Project Number:01630
Project Title: Planning for Long-Term Research & Monitoring Program
Agency: ADFG & Restoration Office

FORM 3B
Contractual & Commodities DETAIL

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 01
			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

FY01

Project Number: 01630
Project Title: Planning for Long-Term Research & Monitoring Program
Agency: ADFG & Restoration Office

FORM 3B
Equipment
DETAIL

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Budget Category:	Authorized FY 00	Proposed FY 01	LONG RANGE FUNDING REQUIREMENTS					
Personnel		$7.4						
Travel		$0.0						
Contractual	$60.0	$161.5						
Commodities		$0.0						
Equipment		$0.0						
Subtotal	$60.0	$168.9				Estimated FY 2002		
General Administration	$4.2	$12.4						
Project Total	$64.2	$181.3						
Full-time Equivalents (FTE)		0.1						
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:

NOTE: $5.3 of the $12.4 General Administration was approved by the Trustee Council in August 2000.

FY01

Project Number: 01630
Project Title: Planning for Long-Term Research & Monitoring
Program
Agency: ADNR

FORM 3A
TRUSTEE
AGENCY
SUMMARY

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Proposed FY 01
Name	Position Description					
Carol Fries	Agency Liaison		1.0	7.4		7.4
						0.0
						0.0
						0.0
NOTE: This $7.4 was approved by the Trustee Council in August 2000.						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.0	7.4	0.0	
					Personnel Total	$7.4

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 01
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

FY01

Project Number: 01630
Project Title: Planning for Long-Term Research & Monitoring Program
Agency: ADNR

FORM 3B
Personnel & Travel DETAIL

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Contractual Costs:	Proposed
Description	FY 01
Applied Marine Sciences (Chief Scientist Bob Spies): Time and travel for Spies to participate in development, presentation, and review of GEM Services of G. Oosterhout on modeling component of GEM Time and travel for lead writers Time for core peer reviewers NOTE: $60.0 of the $161.5 was approved by the Trustee Council in August 2000.	161.5
When a non-trustee organization is used, the form 4A is required. **Contractual Total**	$161.5

Commodities Costs:	Proposed
Description	FY 01
Commodities Total	$0.0

FY01

Project Number: 01630
Project Title: Planning for Long-Term Research & Monitoring Program
Agency: ADNR

FORM 3B
Contractual & Commodities DETAIL

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2000 - September 30, 2001

New Equipment Purchases:	Number	Unit	Proposed
Description	of Units	Price	FY 01
			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

FY01

Project Number: 01630
Project Title: Planning for Long-Term Research & Monitoring Program
Agency: ADNR

FORM 3B
Equipment
DETAIL

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 01
Ken Holbrook	Agency Liaison		1.0	7.4		7.4
						0.0
						0.0
Plus $1.1 GA						0.0
						0.0
						0.0
NOTE: This $8.5 was approved by the Trustee Council in August 2000.						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.0	7.4	0.0	
					Personnel Total	$7.4

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 01
					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

FY01

Project Number: 01630
Project Title: Planning for Long-Term Research & Monitoring Program
Agency: USFS

FORM 3B
Personnel
& Travel
DETAIL

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 01
Catherine Berg	Agency Liaison		1.0	6.3		6.3
Plus $0.9 GA						0.0
						0.0
Dede Bohn	USGS Liaison		2.0	6.0		12.0
For work on GEM "gap analysis"						0.0
Plus $1.8 GA						0.0
						0.0
NOTE: The $7.2 for C. Berg was approved by the Trustee Council in August 2000.						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.0	12.3	0.0	
					Personnel Total	$18.3

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 01
					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

FY01

Project Number: 01630
Project Title: Planning for Long-Term Research & Monitoring Program
Agency: DOI

FORM 3B
Personnel
& Travel
DETAIL

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 01
Bruce Wright	Agency Liaison		1.0	8.5		8.5
						0.0
Plus $1.3 GA						0.0
						0.0
						0.0
NOTE: This $9.8 was approved by the Trustee Council in August 2000.						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.0	8.5	0.0	
					Personnel Total	$8.5

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 01
					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

FY01

Project Number: 01630
Project Title: Planning for Long-Term Research & Monitoring Program
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

FY 01 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET

October 1, 2000 - September 30, 2001

Personnel Costs:		GS/Range/	Months	Monthly		Proposed
Name	Position Description	Step	Budgeted	Costs	Overtime	FY 01
Marianne See	Agency Liaison		1.0	8.3		8.3
						0.0
Plus $1.2 GA						0.0
						0.0
						0.0
NOTE: This $9.5 was approved by the Trustee Council in August 2000.						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal	[redacted]	1.0	8.3	0.0	[redacted]
					Personnel Total	$8.3

Travel Costs:		Ticket	Round	Total	Daily	Proposed
Description		Price	Trips	Days	Per Diem	FY 01
						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

FY01

Project Number: 01630
Project Title: Planning for Long-Term Research & Monitoring Program
Agency: ADEC

FORM 3B
Personnel
& Travel
DETAIL